University of Reading

Future policy options to ensure food security: Developing a sustainability narrative for United Kingdom health professionals

Professional Doctorate in Sustainable Food Quality for Health (DAgriFood)

Department of Food and Nutritional Sciences

Andrew P. Hollingsworth

May 2021

Declaration

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Preamble

"The challenge of how to balance seemingly contrary policy imperatives - health, environment, consumer aspirations, commerce - and how to bridge tensions within the food system - land, industry, retailers, catering, domestic life - is formidable. To accord priority to the protection of the environment, health, consumers, and social justice will require considerable adjustment in policy and food practices, but can society and the environment afford not to do this?"

Lang, T. (1999). The complexities of globalization: the UK as a case study of tensions within the food system and the challenge of food policy, *Agriculture and Human Values*, Vol. 16, No. 2, p.182.

Future policy options to ensure food security:

Developing a sustainability narrative for United Kingdom health professionals

List of figures

List of tables

Abbreviations and common terms used throughout this thesis

BECCS	Bioenergy with Carbon Capture and Storage
Brexit	The pending (at the time of writing) withdrawal of the UK from the European Union
CAP	Common Agricultural Policy of the European Union
CCC	Committee on Climate Change - an independent, UK statutory body established under the Climate Change Act 2008
CFO	Common Fisheries Policy of the European Union
CSO	Civil Society Organisations
CVD	Cardiovascular disease - diseases of the heart or blood vessels such as angina and myocardial infarction (heart attack)
DEFRA	Department for Environment, Food and Rural Affairs (UK Government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the UK and Northern Ireland)
EAC	Environmental Audit Select Committee - select committee of the UK House of Commons that examines government department's policies and programmes which affect both the environment and sustainable development
EU	European Union - a political and economic union between 28 European member states
FAO	Food and Agriculture Organization of the United Nations (leads international efforts to improve nutrition and food security)
FSA	Food Standards Agency - non-ministerial UK government department currently responsible for protecting public health in relation to food
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GHGe	Greenhouse Gas emissions
IEA	International Energy Agency, Paris
IFPRI	International Food Policy Research Institute, Washington, USA
IFST	Institute of Food Science & Technology - professional body for food
IPCC	Intergovernmental Panel on Climate Change - an intergovernmental body of the United Nations
IPES-Food	International Panel of Experts on Sustainable Food Systems
LCA	Life cycle analysis
LUC	Land-use change
MDGs	Millennium Development Goals - eight goals launched in 2000 by the United Nations General Assembly to be achieved by the year 2015
mt	Million tonnes
NASA	National Aeronautics and Space Administration, an independent agency of the United States Government
NCDs	Non-Communicable Diseases
NDCs	Nationally Determined Contributions - efforts by a country to reduce national emissions and adapt to the impacts of climate change
NGO	Non-Governmental Organisations - operate independent government, usually non-profit but can also be lobby groups for corporations, and often active in humanitarian or social areas;
ppm	Parts per million
RSA FFCC	Royal Society for the Encouragement of Arts, Manufactures and Commerce Food, Farming and Countryside Commission

SDGs	Sustainable Development Goals - 17 global goals designed to be a blueprint to achieve a better and more sustainable future for all set in 2015 by the United Nations General Assembly and intended to be achieved by the year 2030
UK	United Kingdom - England, Scotland, Wales, and Northern Ireland
UKHACC	UK Health Alliance on Climate Change
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change - an international environmental treaty adopted in 1992
WHO	World Health Organization of the United Nations (concerned with international public health)
WMO	World Meteorological Organization
WTO	World Trade Organization

Acknowledgements

I would like to thank all the AgriFood Training Partnership staff at the University of Reading and collaborating academic institutions that I have met throughout the duration of the Sustainable Food Quality for Health (DAgriFood) programme. In particular, my thanks go to Professor Carol Wagstaff for her continued support throughout the programme and, in particular, for her comments on this thesis; and to the examiners Dr. Giuseppe Nocella, Associate Professor of Consumer Research and Policy at the University of Reading, and Professor Tim Lang, Emeritus Professor of Food Policy at City, University of London. Finally, to Cristina Ayala Espin for her constructive comments on some of the ideas behind this thesis.

Dedication

To
Peter, Joyce,
Sue and Tim

All of whom have had to endure my deliberations
on food sustainability
for far too long

Image source: morewell/needpix.com

Abstract

The free market in food has long been thought to have served the United Kingdom market well, producing an endless array of choice, year-round availability through a highly developed retail network, and some of the lowest consumer prices in Western Europe. Successive government administrations have laid the foundations for this laissez-faire approach, thereby enabling the market in food to thrive uninhibited. Where regulation has been necessary, much of this has been effectively devolved to the European Union (EU) through membership of the Single European Market.

The scientific literature, however, is progressively developing a future prognosis for the planet which will invariably involve rapid change and new risks. Food security is especially a concern, even in the 'developed' world economies, where it has been off political radars for many decades. The threats to existing food security are complex but include: population growth and changing dietary preferences driving growth in demand; food supplies increasingly restricted by water scarcity and energy demand; a growing international scientific consensus on the potentially catastrophic impact and gigantean scale of climate change; and rapidly changing international political environments, some of which are witnessing a resurgence in economic nationalism which has the potential to usurp multilateralism on a number of common goals, such as health and the environment. This is particularly critical for the UK at a time when it is seeking to re-establish trading relationships with its largest food supplier, the EU. Furthermore, many of the economic and social benefits that the free market in food has generated have been achieved through the unsustainable use of resources. Many papers make urgent calls for governance across both sectors and institutions alike: without such infrastructures, the probability of the UK being able to meet its commitments on carbon emissions to the UN on either the Sustainable Development Goals or the Framework Convention on Climate Change will be significantly reduced. Some studies go as far as suggesting that the free market for food has failed, citing the current obesity epidemic, as an example.

There is an urgent need in the UK to develop a food policy to tackle the imminent threats to food security whilst, at the same time, addressing the health concerns associated with diets. This research makes three original contributions to the research field. Firstly, the research provides an umbrella review of the latest evidence on how climate change will impact the UK's ability to both produce and import healthy food and develops recommendations for a new policy framework to ensure the sustainability and security of UK food. Secondly, it uses climate modelling to quantify the impacts of climate change on food production in one area of the UK. Finally, it synthesises the latest findings on what constitutes a healthy diet and provides a framework for UK health professionals that will enable them to deliver evidence-based information to inform and bring about the behavioural change needed in the transition to more sustainable and healthy diets.

1. Introduction

1.1 Background to the problems within existing food production systems

Food production and consumption are fundamental to both human health and the health of the planet on which humanity depends. The way food is produced increasingly impacts many of the fundamental issues society faces today – our health, the health of the environment in which we live, our water, and our climate. The interdisciplinarity between these factors, often simply referred to as the food–environment–health nexus, has become a mainstream area of study within the literature (Gowdy, 2020). Three emergent threats are particularly concerning – ecosystem collapse, global pandemics, and climate change; food is the primary driver in the nexus between all three. As food production systems replace natural ecosystems, they cause habitat loss and further accelerate biodiversity loss (Benton *et al*., 2021). The drive towards cheaper food has become a vicious circle, whereby greater levels of intensification are required to meet falling yields which, in turn, results in further soil and ecosystem degradation. It also drives down the productive capacity of land and necessitates ever more intensive production to keep pace with consumer demand, cheaper calories, and resource-intensive foods. Also, by contributing to climate change, food production both degrades habitats and causes species dispersal, which can create opportunities for infectious diseases. Looking to the immediate future, the rapidly growing world population means securing food supplies will increasingly become a monumental challenge, especially given that it is already showing signs of strain (Gralak *et al*., 2020). Estimates that an additional 50 per cent more food will be required by 2050 will place the world's resources under unprecedented pressure, at a time when serious concerns about the sustainability of current food systems are already gathering pace. With the very future of food supply at risk, humanity urgently needs to find a new food system to meet our health needs and those of the environment, both of which are also seen as critical in ensuring peace on the planet (Cribb, 2019; Reynolds *et al*., 2019; Lang, 2020). The risks to UK food security are exacerbated by its high dependency (around 50 per cent) on imported food, despite being rich in the resources needed for food production (Hasnain *et al*., 2020).

This growing body of evidence also calls for the environmental and human health risks associated with producing food to be urgently addressed. At the same time, the United Nations' Intergovernmental Panel on Climate Change declared a climate emergency in 2019 and called for an immediate transformation of food systems to avoid passing an imminent tipping point, beyond which they predict escalating catastrophe with the ultimate risk being human extinction (IPCC, 2019). The scientific literature abounds with calls for food system transformation, before food bankrupts health systems, destroys vital ecosystems on which health depends, and tips greenhouse gas emissions beyond the point at which anthropogenic climate change can be reversed (Steffen *et al*., 2018; Schneider *et al*., 2019; Harwatt *et al*., 2020; Richards *et al*., 2021). Latest estimates confirm that food systems are already responsible for 34 per cent of these emissions (Crippa *et al*., 2021). Unless nations transition to more sustainable food systems, it is unlikely they will be able to meet international commitments, such as the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement on limiting global temperatures. Food system transformation, therefore, must conserve and sustain the natural environment, as well as bring about the adoption of healthier diets to limit the demand for increased food production. The scale of the challenge is such that failure to achieve food system transformation ultimately puts humanity at a much greater risk from various existential threats.

When the threats of ecosystem collapse, global pandemics, and climate change occur simultaneously, combining and acting in synergy, they pose huge potential existential risks to humanity (Kunreuther *et al*., 2013; Shepherd *et al*., 2018; Anthony, 2020; Marques, 2020; WHO, 2020) including extinction (Cribb, 2019; Ord, 2020; Richards *et al*., 2021). The ongoing coronavirus pandemic (COVID-19) has brought the enormity of such threats and crises into sharp focus (Gralak *et al*., 2020; Hasnain *et al*., 2020; Shanks *et al*., 2020; Zimberg, 2020; Laybourn-Langton and Stott, 2021). Several international agencies are now warning about the threats of such crises to humanity in general and, in particular, to food security and public health (FAO, IFAD, UNICEF, 2020; WHO, 2020). Writing in the British Medical Journal, Laybourn-Langton and Stott (2021) argue it is the greatest health emergency humanity has ever faced, and call for health professionals to take urgent action, advocacy and awareness raising. The Lancet's Planetary Health Manifesto was the first to establish a clear scientific platform between health and the strong interdependencies with food and the natural environment (Horton *et al*., 2014). Their Manifesto not only makes the connection between increasingly limited resources and declining health, but also how climate change acts as a multiplier to the level of threat (Butler, 2018).

The inherent interdisciplinarity between food, environment and health, whereby multiple branches of science need to come together, adds further challenges in terms of developing and communicating knowledge and policies to bring about societal transformation. The topics can often seem disparate: food insecurity can lead to migration, declining mental health, and conflict; climate change similarly influences sea-level rise, food production, nutrition, and multiple health outcomes, to such an extent it has the potential to undermine many decades of progress in global health. At present, current UK diets are unsustainable. They not only appear to be contributing to obesity and health-related problems, they are driving biodiversity loss, soil degradation, pollution, water scarcity and climate change in both the UK and overseas (Mendenhall and Singer, 2019; New Food, 2019a; Silva, 2019; Swinburn *et al*., 2019; Hasnain *et al*., 2020). Many diets are too rich in fat, sugar, and meat but too low in fruit and vegetables. This causes unsustainable health costs; furthermore, the UK's current dietary recommendations appear to do little to reduce greenhouse gas emissions (Springmann *et al*., 2018). Greater coherency is urgently needed for all stakeholders if transformational change is to be achieved (Campbell *et al*., 2018; Hasnain *et al*., 2020). Certainly, a better understanding of the relationship between food production, diets and the environmental impacts is urgently needed for more sustainable diets to be developed. It also requires greater cooperation, between policymakers, governments, civil society and health professionals; in the first instance to recognise the scientific consensus regarding the unsustainability of current food systems; and then to resolve the multiple future challenges for food security that also must be addressed as a matter of urgency. Stronger cooperation and collective action are also seen as quintessential, especially when societies need to collectively pursue the greater good of sustainable systems (Muhumuza, 2020). For consumers, this transformational change includes transitioning to healthier, more plant-based diets. This understanding will further the development of dietary recommendations, policies, and the behavioural changes needed.

1.2 The challenges for health professionals

Transitioning from the UK's current food system, driven by economic growth, urbanisation, imports, and unsustainable diets, to one fit for the enormous challenges ahead raises many questions for policymakers and health professionals alike. Clear policy direction is urgently required to ensure food security, sustainability, and health. Some health professional bodies, such as the *UK Health Alliance on Climate Change* (UKHACC) and *The Lancet Countdown* project, are already involved. Some are warning the world is clearly on course for catastrophe (Laybourn-Langton and Stott, 2021). Health professionals will continue to have a pivotal role in the transition needed. They have long been respected and trusted; this position continues to galvanise through the ongoing COVID-19 pandemic. Laybourn-Langton and Stott (2021) argue this unique position should be used to stiffen the resolve of governments to ensure a smooth and timely transition. This transition to a healthier planet and population will, however, require knowledge of the latest science, the latest thinking, and innovative approaches to the interdisciplinarity of problems. The voice of health professionals is needed to provide both the moral imperative and the practical solutions to ensure a shared survival.

1.3 Gaps in the literature

The challenges of sustainability in general, and food sustainability in particular, have garnered increasing numbers of published articles in recent years. Climate change, for example, has arguably become one of the most intensively researched areas of science, progressing rapidly since the 1990s. The very nature of the interdisciplinarity of sustainability invariably means, however, that the scientific evidence is spread across an extremely wide range of publications. In addition, most health professionals receive no formal training on food sustainability. Furthermore, their professional journals have only started to cover the wide variety of subjects associated with the interdisciplinarity of the various knowledge branches much more recently. The challenge for them, therefore, is more likely to be concerned with appreciating the very wide scope of food systems impact and finding easy access to the essential scientific evidence. At present, the literature is devoid of articles that distil the multiple complexities that would enable health professionals to determine what constitutes healthy diets, for example; similarly, there are no recommendations on what constitutes a sustainable diet at present in the UK.

1.4 Problem statement and overview of this thesis

This thesis explores the problems associated with the policy options available to ensure future UK food security. By providing a narrative for UK health professionals, it will help train and enable them to bring about the changes necessary in the move towards more sustainable diets. The thesis problem statement therefore is to provide a detailed synthesis of the challenges to the food– environment–health nexus, the anticipated impacts of climate change on this nexus, and identify the dietary behaviours that need to be adopted to reduce the impacts on human health. Chapter 2 provides the research objectives and an initial review of the sustainability literature. Chapter 3 then establish is the research questions and designs the methodological approach. Chapters 4, 5 and 6 respectively deal with results, discussion, and conclusion. Figure 1 provides a more detailed structure employed throughout this thesis.

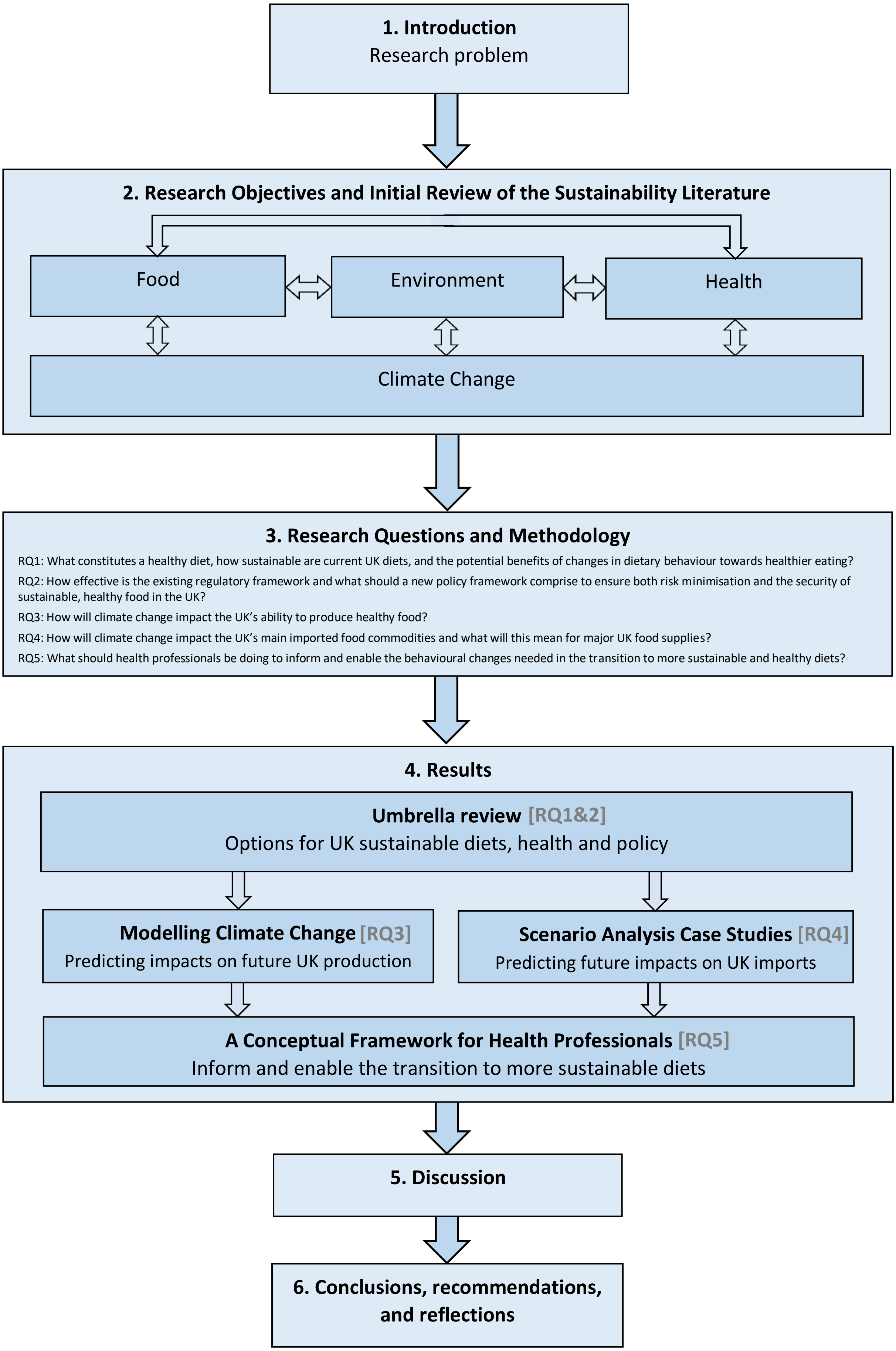


Figure 1: Overview of the thesis structure

2. Research objectives and initial review of the sustainability literature

2.1 Research objectives

The overall objective and main purpose of the research was to synthesise the challenges from the food–environment–health nexus, the anticipated impacts of climate change on this nexus, and identify the dietary behaviours that need to be adopted to reduce the impacts on human health. This chapter investigates the existing scientific and grey literature to understand the impact of the identified risks to UK food security in the immediate future. To achieve this, this thesis uses several, more narrowly defined objectives. It uses existing meteorological predictive models to systematically map the latest evidence on how climate change will impact domestic production factors, such as the area of land available for food production, the consequences of further environmental degradation (e.g. continued declines in soil health), and the available range and yield of plant and animal raw materials sources. It also attempts to quantify the impact of climate change on the UK's overseas food supply chains and assess the future risks to imported food security. It synthesises the latest findings on what constitutes a healthy diet, establish how the existing policy instruments can be adapted and coordinated to ensure future food sustainability and security, thereby enabling resilience to future food system challenges and reversing the growing trends in diet-related diseases that are placing a burden on the UK economy. Finally, recommendations for how food policy should be developed to ensure UK food security and specific proposals for UK health professionals that will enable them to deliver evidence-based information to inform and bring about the behavioural change needed in the transition to more sustainable and healthy diets.

2.2 The genesis and theoretical foundations of sustainability science

Over the past forty years, there has also been a growing scientific consensus on a future prognosis for the planet which is centred around unsustainability; involving both rapid change and existential threats caused by ecosystems collapse, global pandemics, and climate change. Alongside the prognoses are calls for food system transformation, before food bankrupts health systems, destroys vital ecosystems on which health depends, and tips greenhouse gas emissions beyond the point at which anthropogenic climate change can be reversed (Audsley *et al.*, 2010; Dimova *et al*., 2014; Steffen *et al*., 2018; Schneider *et al*., 2019; Harwatt *et al*., 2020; Richards *et al*., 2021). Calls for the increasingly urgent need for transformational change to food systems continue to be held back by political and social constraints that are more used to gradual and incremental change (Bunyavanich *et al.*, 2003; de Schutter, 2009; Beniston, 2010; Drexhage and Murphy, 2010; FCRN, 2014a; Bailey *et al.*, 2018; Alexander *et al*., 2019; Benton *et al.*, 2019). Writing in *The Lancet*, Lucas and Horton (2019) warn that civilisation is facing an accelerating crisis whereby food security cannot be balanced with existing planetary resources.

Science enables the systematic study of the natural world, through measurement, experimentation, observation, and formulation of theories (Kyle, 1958). Although there is neither a correct or intrinsically better organisation of classification of science, traditional approaches are evolving into more unified systems i.e. cognitive and social dimensions (Popper, 1952) and the need to accommodate interdisciplinarity (convergence) of disciplines, divergence, or changes in impact over time (Dias *et al.*, 2018). The same authors also argue there is neither a correct nor intrinsically better organisation of classification. Sustainability science is much more recent: opinions vary as to whether it was an article in the Ecologist entitled '*Blueprint for Survival'* published in 1972 (Manning, 1972; Kidd, 1992) or the 1987 Brundtland report, which stated that sustainable development could only be achieved where there was a coexistence between the economy and the environment (Komiyama and Takeuchi, 2006). Lang *et al.* (2012) refer to an emerging agreement that sustainability requires new, transdisciplinary research to integrate the best available knowledge; Brandt *et al.* (2013) recommends this must be clearly framed with a common terminology and appropriate methods. Sustainability is typically represented by the ubiquitous three-pillar model of intersecting circles of social, economic, and environmental sustainability. Although its origins may lay in the triple bottom line principle of '*people, planet and profit*' from the business literature (Purvis *et al.*, 2019), it has spread to the social, economic, and ecological literature. It is frequently adapted to include institutional, cultural, technical, and health pillars, as shown in Figure 3. Hancock (1993, p.43) shifts the focus of the model away from economic development to a '*system of economic activity that enhances human development while being environmentally and socially sustainable*', in which the community is convivial, the environment viable, and the economy adequately prosperous, equitable, and sustainable. Purvis *et al.* (2019) argue this latter point makes the economy subservient to both its community and environment; as society and the economy could not exist without the environment, it should always take conceptual priority in any model.

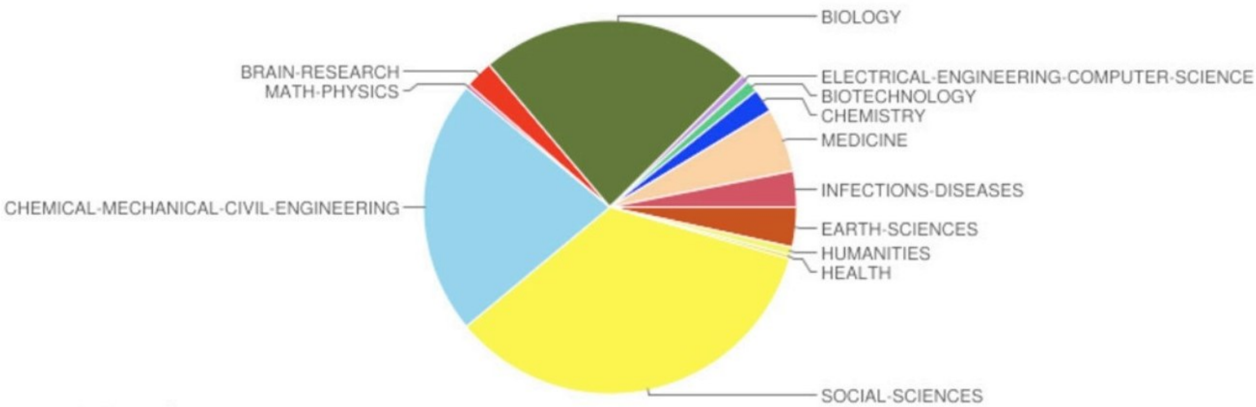


Figure 2: The footprint of sustainability science in terms of traditional scientific disciplines

Source: Bettencourt and Kaur (2011).

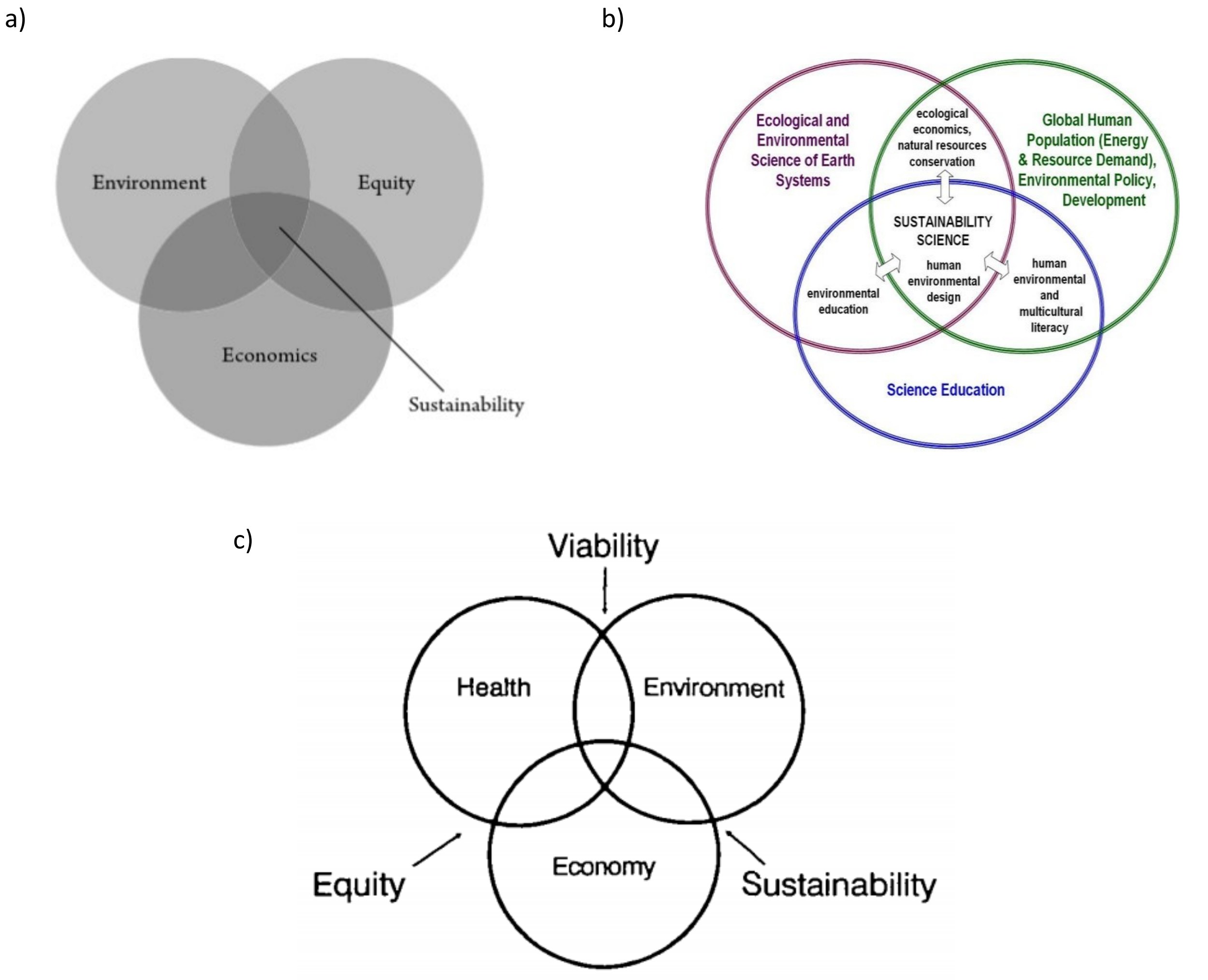


Figure 3: Three examples of the tripartite Venn diagram commonly used to illustrate the interconnectedness of the environment, economy, and social equality/equity: a) for sustainability; b) for sustainability science; and c) human development for sustainable health

Sources: a) Caradonna (2014); b) adapted from Bettencourt and Kaur (2011); c) Hancock (1993).

The extent to which sustainability has become a scientific discipline, however, has yet to be clearly established. It is deeply embedded in fundamentally different discourses, namely: ecological carrying capacity; environmental resources; biosphere; technology; rate of growth; and, eco-development (Kidd, 1992; Smetana *et al.*, 2019). Schoolman *et al.* (2012) argue that although sustainability science is more interdisciplinary than other scientific fields, sustainability research was centred on a smaller number of economics and social science journals. Figure 2 shows the relative breakdown of the sustainability science literature by the traditional scientific disciplines used by the Institute for Scientific Information. The largest contribution (34 per cent) was found in the social science journals, with significant contributions from biology, engineering, medicine, earth sciences and infectious diseases. Despite the exponential growth in sustainability science, there appears to be little change in the disciplinary mixture over the fourteen years observed in the original study. Bettencourt and Kaur (2011) argue that sustainability has both become established as a science since the 1990s and predict it will continue to generate impact and have permanency as an unusual, inclusive, and ubiquitous scientific practice. Some political studies suggest two competing philosophies of sustainability have emerged, with '*weak*' sustainability meaning humanity will replace the natural capital used, and '*strong*' sustainability meaning that the planetary limits for the environment and ecology must be adhered to (Bettencourt and Kaur, 2011; UNEP, 2012; FAO, 2015d; Science for Environment Policy, 2017; Food Service Footprint, 2018e; UNEP, 2019). Where policies or politics put short-term goals ahead of the health of humans or the planet, these cannot in principle be regarded as sustainable (Acunzo *et al.*, 2018). Sustainability has certainly become an integral part of governmental policy agendas, being recognised as a key issue facing twenty-first century civilisations.

While most branches of science are firmly established, nutrition science is a notable exception (Fears *et al*., 2019). A recent critique in the *New Scientist* (2019a) explores why many of the dietary recommendations turn out to be fundamentally flawed and recommends a degree of scepticism for all dietary advice. Lawrence (2019) similarly questions nutritional epidemiology, particularly with previous dietary recommendations regarding eggs and cholesterol. This lack of confidence even applies to the respected science journals; to such an extent that it risks consumers losing faith in the science altogether. The main problem is the vast majority of research are observational studies, where other behavioural factors known as confounders easily distort the findings; publication bias can then apply throughout the research process, ensuring the most interesting stories appear in the consumer press (Rowe, 2018). Apart from early successes with addressing deficiencies such as folic acid in pregnancy, and reducing salt intake for blood pressure, many of the later studies were more about ideological diets. The *New Scientist* recommends the urgent need for nutrition science to adopt the good research practices used in the other science disciplines, such as preregistering all research including which confounders will be used; also the need for a moratorium on all observational studies until these problems are fixed. Writing in the *British Medical Journal*, Winkler (2013) advises nutritionists to recognise the brutal pragmatism that many consumers are either uninterested in healthy eating or repelled by well-meaning advice. The key historical events associated with nutrition science, with implications for current science and policy, can be found in appendix 8.8.

The scientific and health professions communities have called for a new branch of science to address the future challenges, especially integrating different approaches from natural, social and cultural science perspectives (Wellcome Trust, 2015b; Panorama Perspectives, 2017a; 2017b; 2017c; Görg *et al*., 2019). Leach *et al.* (2013), for example, advocate a new scientific discipline which brings together interdisciplinarity from both the social and natural sciences; Horton and Lo (2015) recommend a new planetary health science to help place human health within the human system and ensure that humans live within the safe operating space of natural systems. Some scientists now believe humanity is entering a third geological period, the Anthropocene, where human activity is the primary cause of environmental pollution (Barnett, 2001; Arias-Maldonado, 2013; Kahn, 2013; Caradonna, 2014; Richter *et al.*, 2016; Waters *et al.*, 2016; Hausfather, 2017a; Guiry *et al*., 2018; Schmidt and Frank, 2018; Turney *et al.*, 2018; *The Lancet*, *2019c*; Görg *et al*., 2020).

Food is at the heart of the sustainability challenge. When the then chief scientific adviser to the UK Government made his '*perfect storm'* warnings, the intrinsic link between ensuring food security at the same time as uncertainty from the unknown impacts of climate change became firmly established (Beddington, 2010). Shown in figure 4, it incorporates predicted shortfalls from the leading global agencies (IEA, FAO and IFPRI) to calculate increases of 50 per cent more food, 50 per cent more energy, and 30 per cent more fresh water will be required by 2030. This will directly impact UK food security with import costs becoming more expensive and parts of the country becoming less able to grow crops; indirect impacts may include growing public unrest, cross-border conflicts, and increased migration. At the same time, McKinsey's commodity price index has started to increase from 2000 onwards (Cranfield *et al*., 1998; Dobbs *et al*., 2011; Gao, 2012), with this trajectory expected to continue indefinitely, raising equity and environmental concerns (Mearns and Norton, 2010; Steffen *et al*., 2015a; Shultz *et al*., 2018). To mitigate against these risks, Beddington stresses the need to make scientists more directly involved in policy making, as well as specifically calling for a new 'greener revolution'.

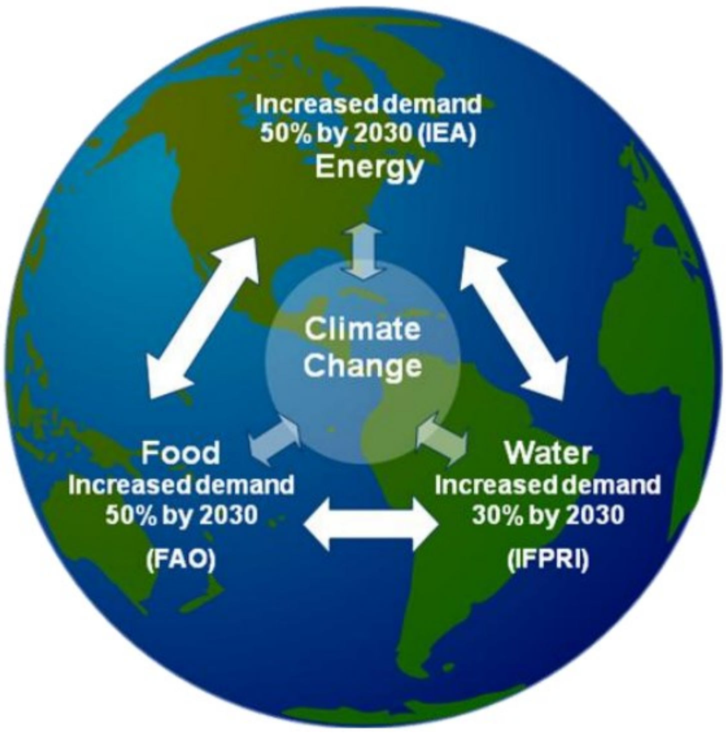


Figure 4: Beddington's Perfect Storm Scenario

Source: Beddington (2010).

Beddington's analysis was grounded on a growing body of scientific evidence. Estimates of the size of future populations vary between 8-10 billion, due to uncertainty over fertility and mortality trends (Lutz and Samir, 2010; Conway, 2012; Samir and Lutz, 2015; Hwang, 2018); this uncertainty invariably leads to concerns regarding overpopulation (Pimentel and Pimentel, 1993; Dyson, 1996; Gerland *et al*., 2014; Connell, 2015; UN, 2015g; UNDSA, 2015; UNDESA, 2017; Bongaarts and O'Neill, 2018; The World Bank, 2019). Others expect access to food imports will be reduced and the possibility of global food shortages (Fischer *et al*., 1994; Bruinsma, 2009; Eccleston, 2009; Population Institute, 2010; Jones, 2015; Goldie and Betts, 2015; Gladek *et al*., 2016; Natalini *et al.*, 2019) and supplies become increasingly scarce (the FAO 'food system wheel' can be found in appendix 8.4). Further predictions from both the International Monetary Fund (IMF) about economic certainty and the Intergovernmental Panel on Climate Change (IPCC) predict there are less than ten years left to avert a global climate catastrophe (Watson *et al*., 1996; Schiermeier, 2010). More recently, the term *'perfect storm'* has been used to raise awareness about the limited resources, expanding human population, and the climate change emergency (Carrington, 2019; IPCC, 2019a), with the perfect storm for extinction being characterised by the exceptionally rapid loss of biodiversity (i.e. biological diversity) (Thuiller, 2007; Kolbert, 2014; Odegard and van der Voet, 2014; Mason, 2015; Payne *et al*., 2016; Guo *et al*., 2018; Pritchard, 2018; Greenpeace, 2019a; Longrich, 2019; McWilliams *et al*., 2019; Saltré and Bradshaw, 2019; Watts, 2019).

2.3 Food sustainability challenges

Although the academic study of sustainability may be relatively new, the challenges associated with securing sustainable food supplies seems to have been a constant throughout human history. Exploring such historical practices allows a better understanding of the successes and failures of societies and their interactions with the environment (Reed and Ryan, 2019). Historical examples include: the spread of domesticated bananas from 4000 B.C. (Hunt and Premathilake, 2018); the Akkadian Empire in Mesopotamia around in 2300 B.C. where food shortages caused by an abrupt onset of drought severely affected the empire (Ersek, 2019); in 200, the early Christian writer Tertullian stating *'we are burdensome to the world, the resources are scarcely adequate for us . . . truly, pestilence and hunger and war and flood must be considered as a remedy for nations, like a pruning of the human race becoming excessive in numbers'* (Cohen, 1995); the Maya civilisation collapsing during the 800s due to cataclysmic environmental change and hostility with neighbours; the Anasazi people during the 1200s suffering from environmental damage and climate change (Diamond, 2005); the French King Philip IV raising concern in 1289 about the impact of overfishing on resource destruction (Hoffmann, 1996); the Polynesian Pitcairn Island collapsed before the 1600s following both environmental damage and the loss of trade (Diamond, 2005); the Easter Island civilisation failure in the 1800s attributable to a long struggle with decreasing land-use intensity (Stevenson *et al.*, 2015); and, concerns over dwindling forest resources throughout Europe in the 1600 and 1700s (Caradonna, 2014).

Similar challenges with securing sustainable food supplies are also a feature throughout the history of the United Kingdom. During the late medieval period (1250-1500), rapid population growth and urbanisation was coupled with the better farming methods promoted by monasteries and warmer weather. King John's Magna Carta in 1215 had been designed, in part, to enshrine into English law the right of the common man to access 'common resources' such as fish. This relative prosperity was also associated with forest clearance and river diversions, primarily to meet growing demands for food (Thirsk, 2002). The rapid expansion in grain mills along rivers throughout the country brought about declines in spawning fish species such as salmon and sturgeon. As early as 1214, a Scottish statute required all river dams to include an opening for spawning fish, and barrier nets had to be lifted every Saturday (Boissoneault, 2019). Other interactions such as eutrophication, pollution, erosion, and habitat loss also contributed to declining freshwater fish availability (Scearce, 2009).

The early literature also records British political economists questioning the limits of both economic and demographic growth, as well as acknowledging the conflicts between equity and social justice. For example, a poor UK harvest in the late 1640s led to extreme food shortages, but the maltsters continued to purchase barley which further inflated the price of bread for the poor, which Hindle and Humphries (2008, p.2) argue was a *'conspicuously wasteful use of grain that should have been employed as a basic foodstuff'*. The economist and philosopher Adam Smith's (1776) publication *'an inquiry into the nature and causes of the Wealth of Nations'* promoted the theory that merchant power, colonialism and the slave economy had brought about growth in production and progress; he also believed the free market had been ordained by God (Barnett, 2008). Thomas Malthus's (1798) *'essay on the principle of population'* gave rise to the theory that any improvement brought about by increases in food production was only temporary because it would, in turn, lead to population growth. Malthus initially supported the protectionist Corn Laws and advocated duties on imported grain, in the expectation that both would guarantee self-sufficiency in British food. Smith's publication later inspired the work of British economist David Ricardo, who went onto develop the argument in favour of comparative advantage in 1817, and against the protectionism of sectors such as agriculture (Case and Fair, 1999). Ricardo failed to relate to real world events (especially those outside human control), however, whereby natural disasters in agrarian nations could lead to starvation in industrially based, trading-partner nations. Similarly, William Forster Lloyd's (1833) lectures on population control influenced economic theory, later becoming known as the tragedy of the commons, warned against individuals using natural resources to their advantage without considering the greater good of society. The economist and political theorist James Mill (1848) advocated population limits and slower growth to benefit the environment and increase the availability of public goods. During the late 1800s, a schism emerged within conservation science philosophy: that is, between conserving national resources for sustainable consumption and the opposing view of preserving nature for its inherent worth (Callicott and Mumford, 1997).

Throughout the early 1900s, the British economy continued to change from being largely agricultural to an industrial one. Expansion in trade enabled increases in wealth, as goods became cheaper and increasing buyer power boosted consumption. Throughout Europe, calls for international efforts to promote equitable economic development marked a significant departure away from the former exploitation of national resources associated with colonialism, to an increase in the flow of goods that would generate growth in per capita income and thereby increase material well-being. This latter point invariably led to economic development becoming synonymous with economic growth, as far as developed world policy was concerned (Purvis *et al.*, 2019). Carson's (1962) book *'Silent Spring'* about the negative effects of chemical pesticides is considered, albeit in retrospect, as initiating the shift in environmental consciousness throughout the world. The 1972 publication of the *'Limits to Growth'* report by the Club of Rome also highlighted the increasing concerns associated with continued growth in the human ecological footprint (Meadows, 1972). The 1972 UN Conference on the Human–Environment in Stockholm and the 1973 oil crisis and the global recession that followed further galvanised calls for structural reform to address the incompatibility between capitalist economic growth and social sustainability of economic, social and health systems (Landires *et al*., 2018; Purvis *et al.*, 2019). By the time of the first UN World Climate Conference (the Geneva Convention) in 1979, primarily to reduce and prevent pollution including trans-boundary air pollution, interdisciplinary scientists were already talking of their moral obligation to warn humanity of the pending, catastrophic threat.

The UN World Commission on Environment and Development's 1987 Brundtland Report called for *'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.* It also laid the intellectual foundations for the Rio Earth Summit in 1992, when UN leaders pledged their support for sustainable development, and the SDGs that followed in 2015. The report led to sustainable development becoming the dominant paradigm within the environmental science literature and publications in this area have grown exponentially since (Purvis *et al.*, 2019). Criticisms of the consensus building through compromise approach recommended by the Brundtland Report and the Rio Summit Declaration abound: Castro (2004) argues that if poverty causes environmental degradation which can be reduced by lessening poverty, then developing nations require economic growth which in turn requires freer markets. Other similar arguments also refer to this over-simplification, and suggest it may lead to inadequacies and contradictions in policy making, especially in international trade sectors such as agriculture and forestry (Adams, 1989; Lélé, 1991; Anderson, 2010;

Moon and Stanton, 2014; Rainforest Alliance, 2014; Rainforest Alliance, 2015). Tulloch (2013) has also argued this compromise approach legitimises and obscures neoliberal policy.

Food systems enable food to be derived from the Earth's resources and, in doing so, have the potential to impact both socioeconomic and geopolitical systems (De Vries *et al*., 2014; Knight, 2015; Blay-Palmer *et al*., 2016; Bonanno, 2017; Challinor *et al.*, 2017; Acunzo *et al.*, 2018; Burke *et al*., 2018; Cottrell *et al*., 2019). Food systems are hugely resource intensive: responsible for 34 per cent of global emissions (Vermeulen *et al*., 2012c; Smith and Gregory, 2013; Aleksandrowicz *et al.*, 2016; EAC, 2019; Crippa *et al*., 2021); the single largest consumer of freshwater; they undermine the resilience of land-based ecosystems, especially diversity and natural carbon sinks; and they are the largest consumer of the chemicals responsible for eutrophication of water resources systems and emissions of nitrous oxide. With current predictions of an extra 70 per cent of food being required by 2050 to meet expected population growth, this can only exacerbate the impacts on resources (IPCC, 2006; FAO, 2009a; Hofmann, 2009; Beniston, 2010; Hanjra and Qureshi, 2010; Jaggard *et al.*, 2010; Godfray *et al.*, 2011; Godfray, 2013; Misra, 2014; Global Panel, 2015; McMichael *et al.*, 2015; Alders, 2016; Thyberg and Tonjes, 2016; FCRN, 2018e; FCRN, 2018g; FCRN, 2019m). Although current legislation requires countries to report their respective GHG emissions to the UNFCCC, considerable differences can be found depending on how the inventories are calculated. Bell *et al.* (2014), for example, estimated that Scottish emissions from agriculture were 10.63mt carbon dioxide equivalent (CO_2e) in 2009 when land-use change was included, compared to the 7.06mt CO_2e actually reported, as the UNFCCC doesn't count land-use change within the inventory. The number of food production shocks over the past fifty years driven by climate change and mismanagement have continued to increase in frequency (Lloyds, 2015; Puma *et al.,* 2015; Cottrell *et al*., 2019). Although current food production systems are both increasingly unsustainable and threatening to future survival, they are also seen as being part of the potential solution. Beddington *et al.* (2012) argues that more efficient food production systems can provide healthier and more sustainable food. New governance initiatives have been launched, such as the UN's MDG's, SDGs (Barth *et al.*, 2017; Lang, 2017b; Stephens *et al.*, 2018), the Rockefeller Foundation-Lancet Commission on planetary health (Whitmee *et al.*, 2015), the Paris Agreement at the 21st Conference of the Parties (COP21) of the UNFCCC in 2015 (although Robbins (2017) notes that the unintended health consequences of climate change was not covered by the Paris Summit). Finally, the IPCC published an assessment of the scientific, technical, and socio-economic literature comparing the effects between global warming of 1.5°C and 2°C above pre-industrial levels on various Earth systems (Schleussner *et al*., 2016; IPCC, 2018b). However, as Petersen (2018) highlights, the feasibility and sustainability constraints that the IPCC acknowledge with their own scenarios means that a global temperature reduction of 1.5°C is unlikely due to political and economic reasons.

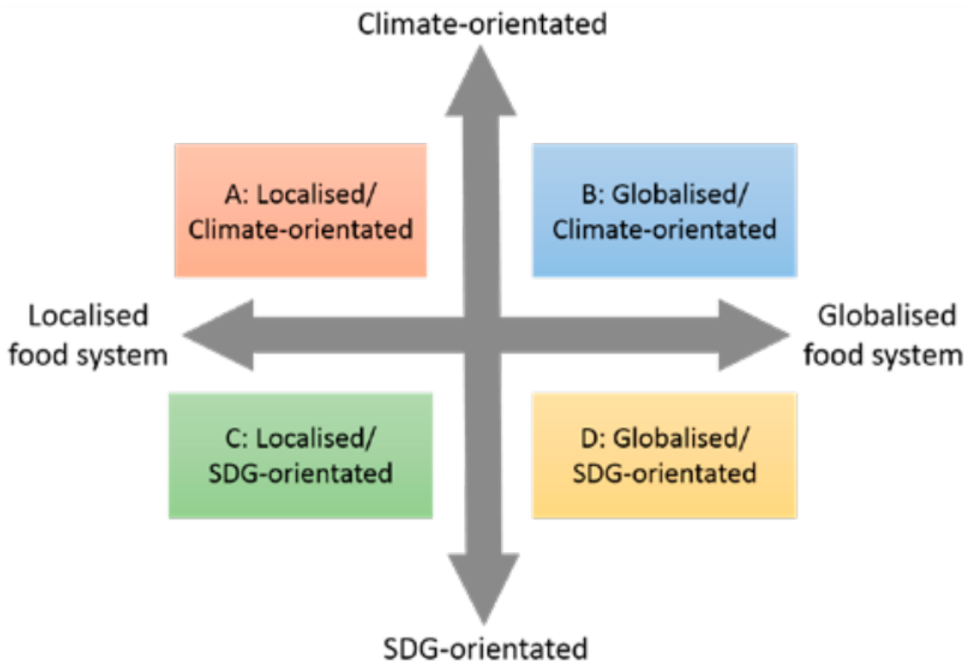


Figure 5: Scenario planning matrix for 2050 food system scenarios

Source: GFS (2017).

Several Civil Society Organisations (CSOs) are also involved in helping determine food sustainability (Foresight4food, 2019); the four scenarios identified by Global Food Security (2017) are shown in figure 5 and the possible scenarios for future global food supply by the Chatham House Royal Institute of International Affairs (Ambler-Edwards *et al*., 2009) in figure 6. A decade later, the same Chatham House is calling for a better food policy and better government to effectively manage the competing interests between food production, trade, regulatory policy, and economic performance (Benton, 2019a). They also warn that overseas trade tends to place many of these competing interests out of sight, where their consequences are not transparent or necessarily articulated to consumers. To make future food policies more effective, equitable and efficient, many recent studies call for a food systems approach to embed and align food into the many, different food policy areas (Grant, 2015; EEA, 2017; GFS, 2018; *The Lancet*, 2018e; van Berkum *et al*., 2018; Bhunnoo, 2019; Centre for Food Policy, 2019a; Parsons and Hawkes, 2019c). The Global Food Security interdisciplinary research programme has also made an extensive contribution to research into the environmental, biological, economic, social and geopolitical shocks that are threatening the resilience of the UK food system (GFS, 2010; GFS, 2012; GFS, 2012a; GFS, 2012b; GFS, 2013a; GFS, 2013b; Bailey *et al*., 2015b; GFS, 2015a; GFS, 2015b; GFS, 2015c; UK-US Taskforce, 2015; GFS, 2016; Kougioumoutzi, 2016; GFS, 2017a; GFS, 2017b; GFS, 2017e; GFS, 2018; GFS, 2019a; GFS, 2019b; GFS, 2019c; GFS, 2019d; Franco *et al*., 2020).

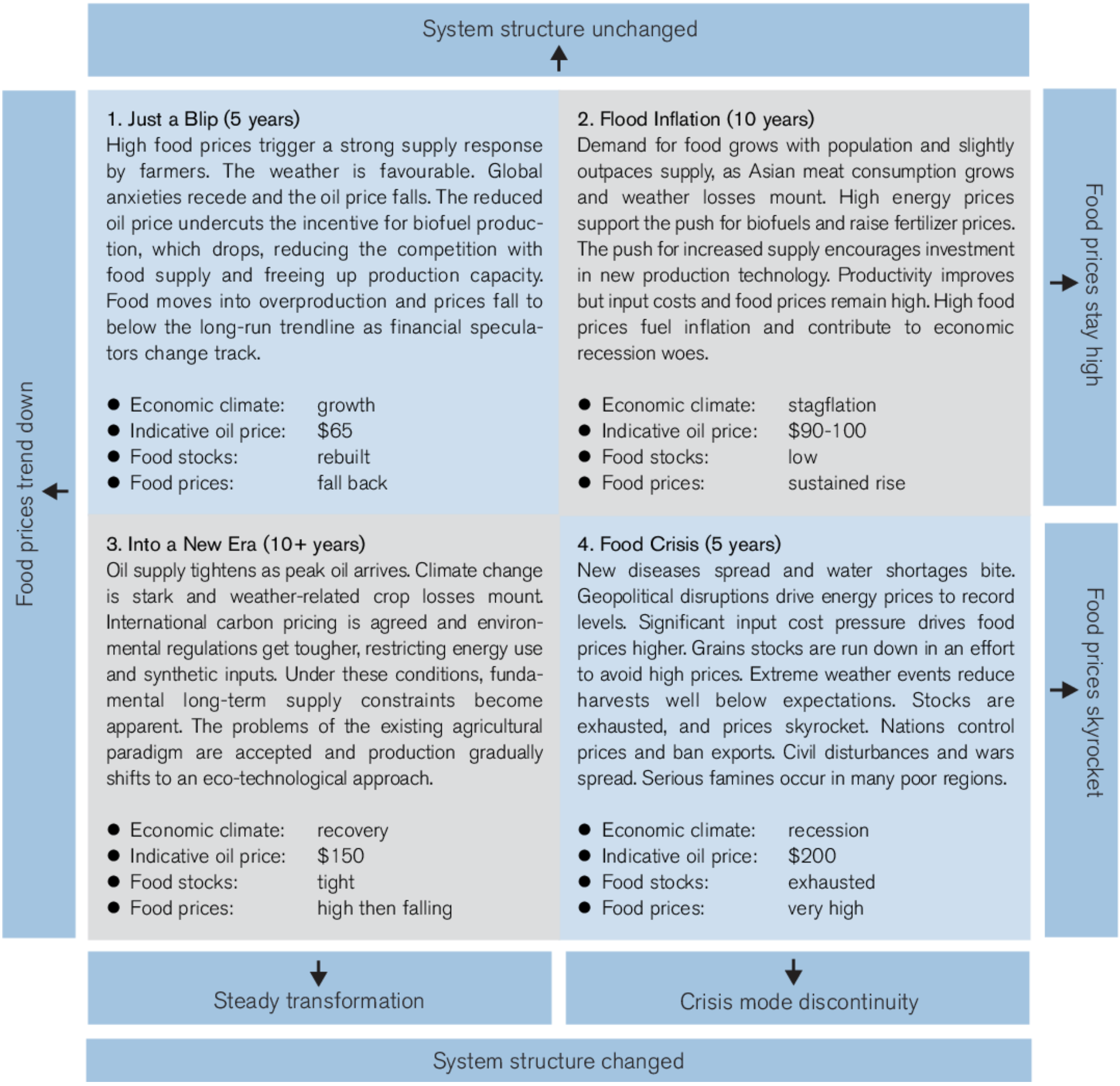


Figure 6: Four global food supply scenarios that consider the challenges and impacts on the EU / UK

Source: Ambler-Edwards *et al*. (2009).

2.3.1 Food production

The UK food system comprises a mix of domestically grown and imported food which are impacted by a wide range of policies and mediations. Figure 7 shows how Benton *et al.* (2019) see the UK food system structure, by way of example. Three further figures show the origins of food consumed in the UK (figure 8), the latest data available from DEFRA (figure 9) and HMRC (figure 10). King *et al*. (2015) define systemic risks as those '*that can trigger unexpected large-scale changes of a system or imply uncontrollable large-scale threats to it*' (King *et al*., 2015, p.110). These risks are further analysed by Jones and Hiller (2015), Benton (2017), and CCC (2019). Despite the small variations in data, the overall picture is one whereby just under 50 per cent of UK food is domestically grown; the remainder (mostly fruit, vegetables, meat, and beverages) is imported mainly from the EU, with Africa, Asia, North and South America each providing around a 4 per cent share of the remaining imports. For the past decade, the government had argued that '*sourcing nutritious food from a diverse range of stable countries including domestically enhances security by spreading risks and keeping prices competitive* (DEFRA, 2010b, p.3). The publication of the Environmental Audit Committee's '*Our Planet, Our Health'* (EAC, 2019), however, marks a fundamental shift in government thinking on food production systems. The report argues that, as 20 per cent of the UK's fruit and vegetable imports come from countries at risk from climate change, the UK is facing a food security crisis that is further exacerbated by the UK's future trading position after Brexit. In recognising the critical connection between the increasingly degraded natural environmental systems and human health, the report details the urgent steps needed to normalise healthy diets from sustainable food systems. The report's proscriptions including the EAT-Lancet Commission's recommendation for a '*Great Food Transformation'*, the future role of the Eatwell Guide, a National Food Strategy and a National Council for Food Policy to advise on transforming our food system, and ministerial and civil service accountability for planetary health will be addressed in section 2.4. There is a need, however, to understand where the UK food system is now, both in terms of the sustainability of domestic production as well as the sustainability of imports, before considering how these factors can be incorporated into a new, transformational food system (FCRN, 2018a; FCRN, 2018d; FCRN, 2018h; FCRN, 2019c). Further detail on the impacts of climate change on the food system can be found in appendix 8.1.

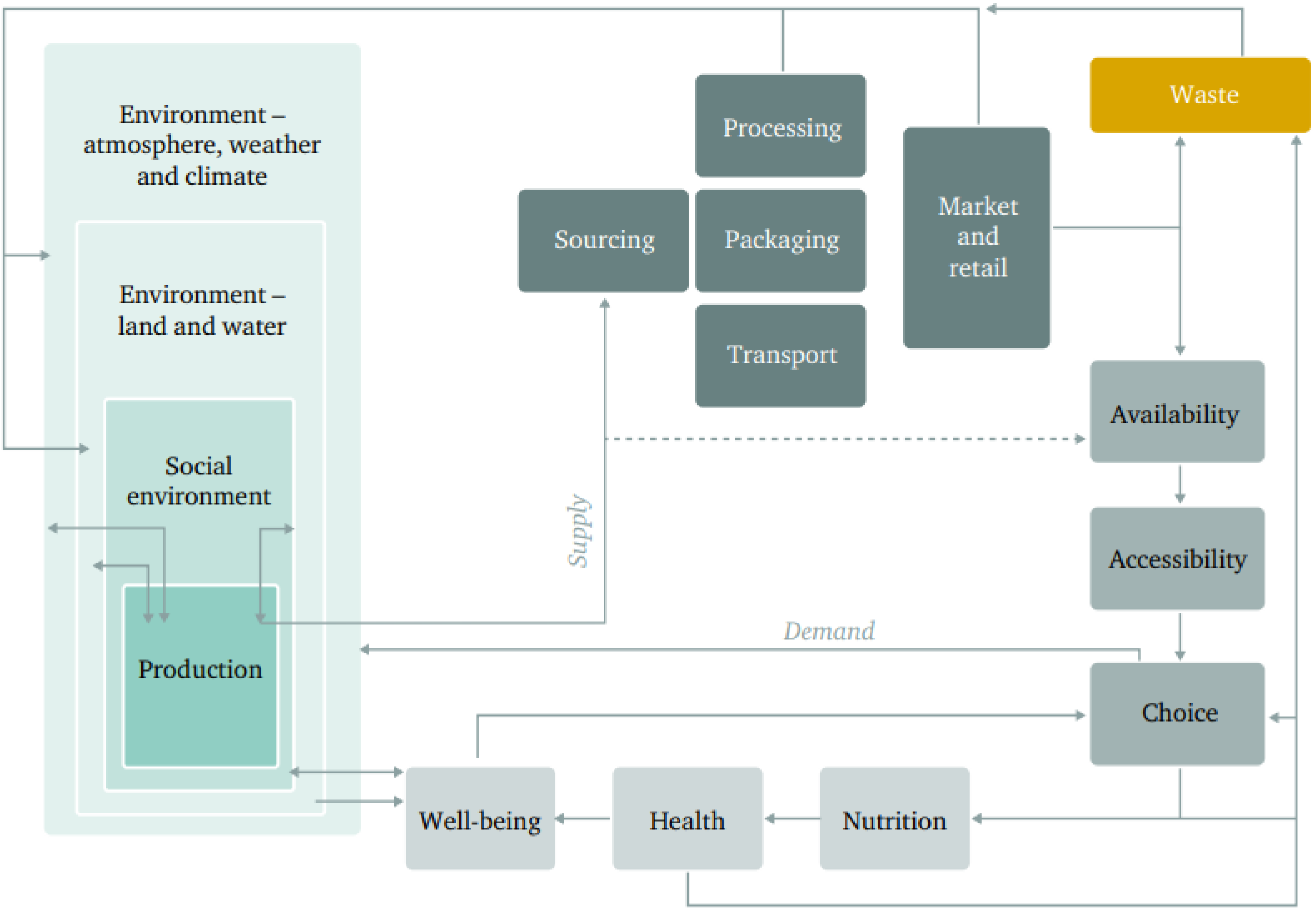


Figure 7: How the UK food system is structured

Source: Benton *et al*. (2019).

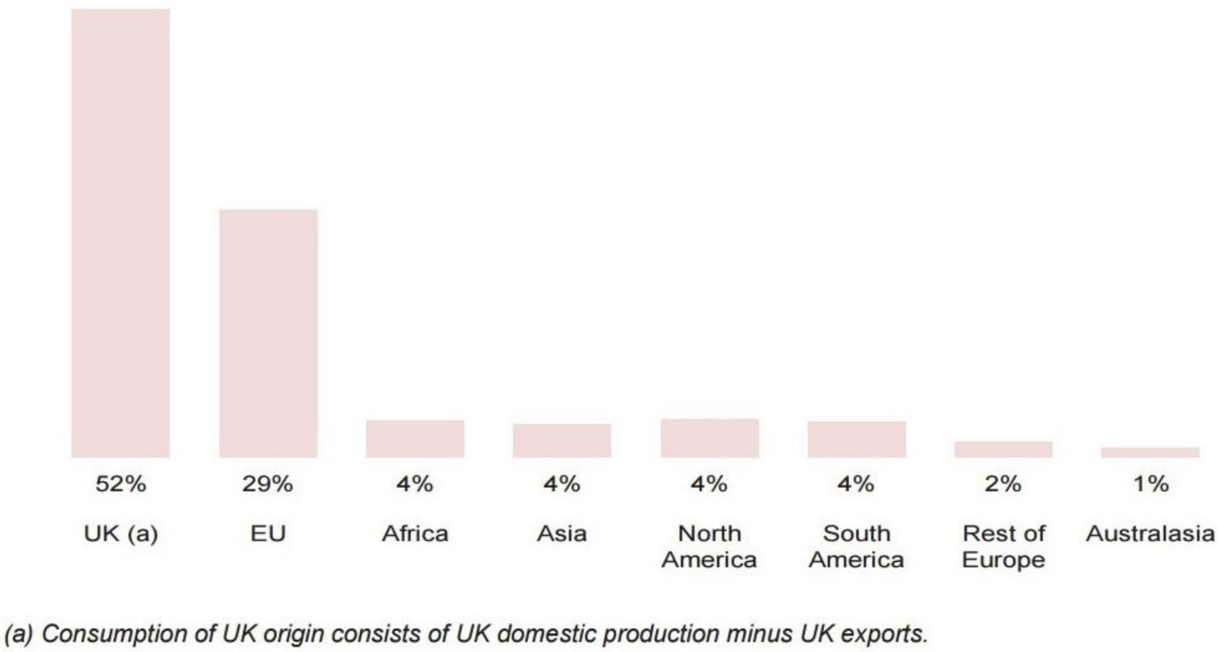
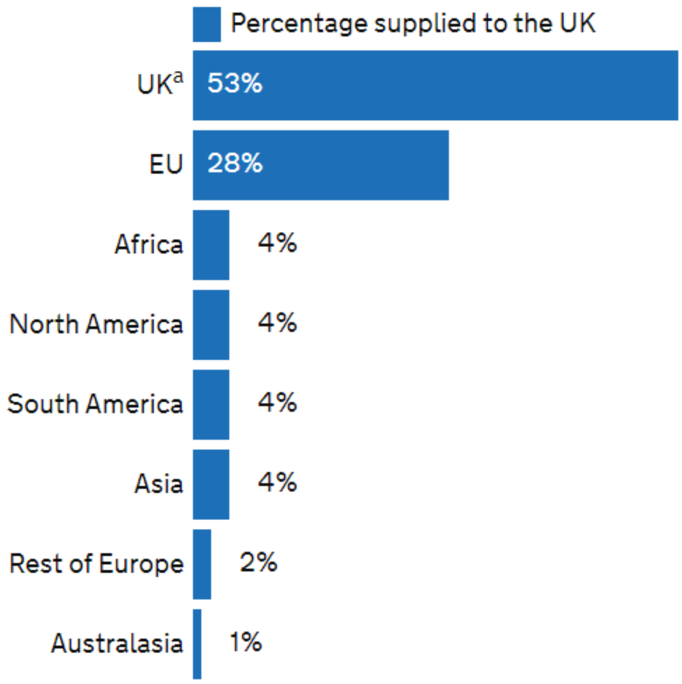


Figure 8: Origins of food consumed in the UK, 2015

Source: GFS (2018).



[a] UK origin consists of UK domestic production minus UK exports

Figure 9: Origins of food consumed in the UK, 2018

Source: DEFRA (2020).

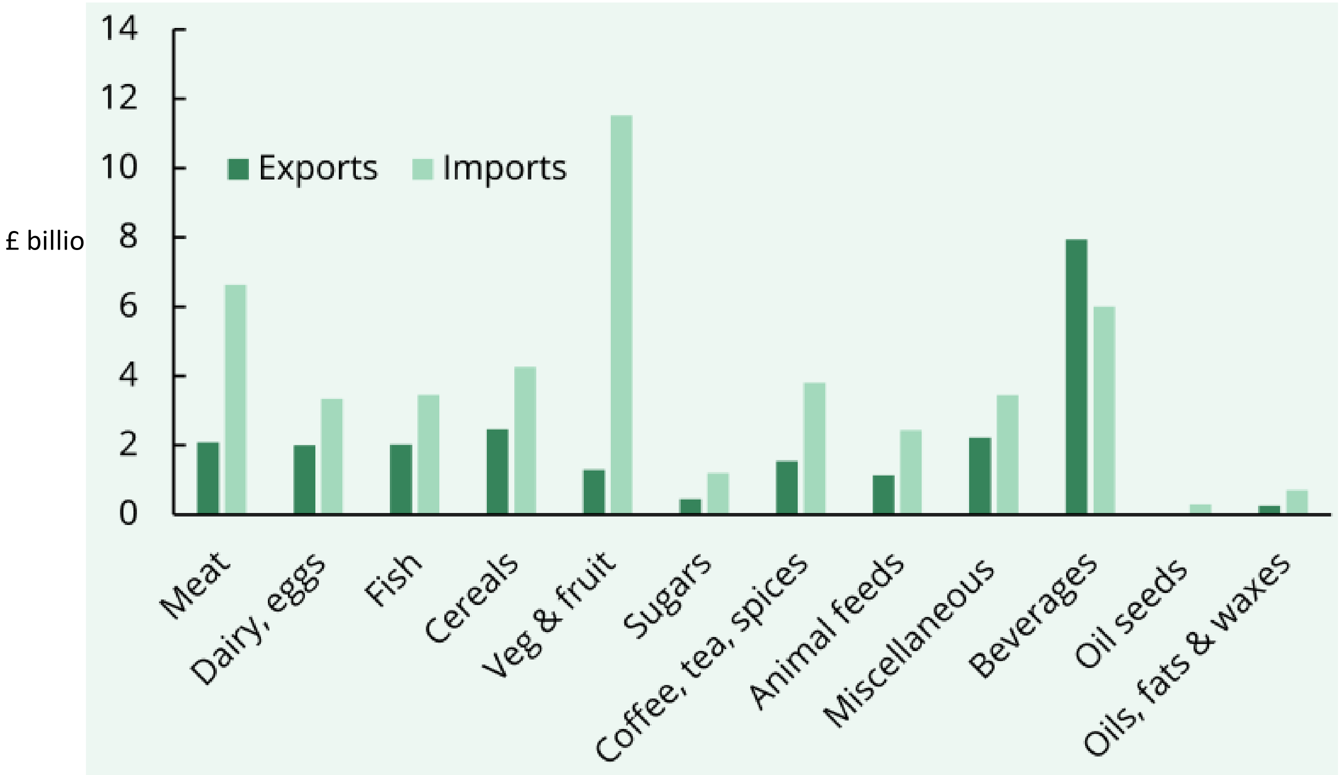


Figure 10: UK food trade 2019 (£ billions)

Source: HMRC (2020).

Critics of current UK food systems argue that, although they may have provided cheap food, they have also resulted in environmental destruction and a spiralling public health crisis (Patel, 2017; Benton, 2019; Carrington, 2019). Some researchers see the need to move away from yields per unit input as a measure of the food system's overall productivity and efficiency, to the number of consumers fed healthily and sustainably per unit of input (Cassidy *et al*., 2013; Benton and Bailey, 2019). What we eat not only determines our health, but also the health of the planet's natural systems. The extent and trajectory of population health is entirely dependent on the vitality of nature's life-support processes (McMichael *et al.*, 2009; Beniston, 2010; McMichael, 2017; Lindgren *et al*., 2018). It is becoming increasingly recognised that these life-supporting, natural systems are being degraded at an unprecedented rate (McMichael *et al.*, 2015; EAC, 2019; Swinburn, 2019). Rather conversely perhaps, Prescott and Logan (2019) argue that the concept is not new; rather, an extension of a concept previously understood by our ancestors but, given the historical timeline plotting the availability of fish discussed in section 4.3.3, this may only have been the case with hunter-gatherers and before settled agriculture. These consequences are, however, over and above anticipated reductions in the availability of food, which Woodward and Porter (2016) estimate could be as much as one third. The recently established RSA Food Farming and Countryside Commission are now pressing government and policymakers to ensure that food systems become sustainable before 2030. Although traditionally, public health has not addressed the wider food system and its impact on the environment (Costello *et al.*, 2011; Butler, 2016a; Springmann *et al.*, 2016a), more recent publications argue this now has to change (Bash and Donnelly, 2019; Boyer *et al.*, 2019), as food systems, environmental sustainability and population health overlap in three key areas, namely climate change, environmental damage, and antimicrobial resistance (AMR). Tijhuis *et al*. (2012), for example, see the need for benefit-risk assessment to systematically provide science-based information for public health. Lindgren *et al*. (2018) see an urgent need for policies that enable universal access to healthy food, whilst reducing the environmental impacts. Their interactions between health, food systems, environment, and society are shown in figure 11 is based on earlier work by Tuomisto *et al*. (2017).

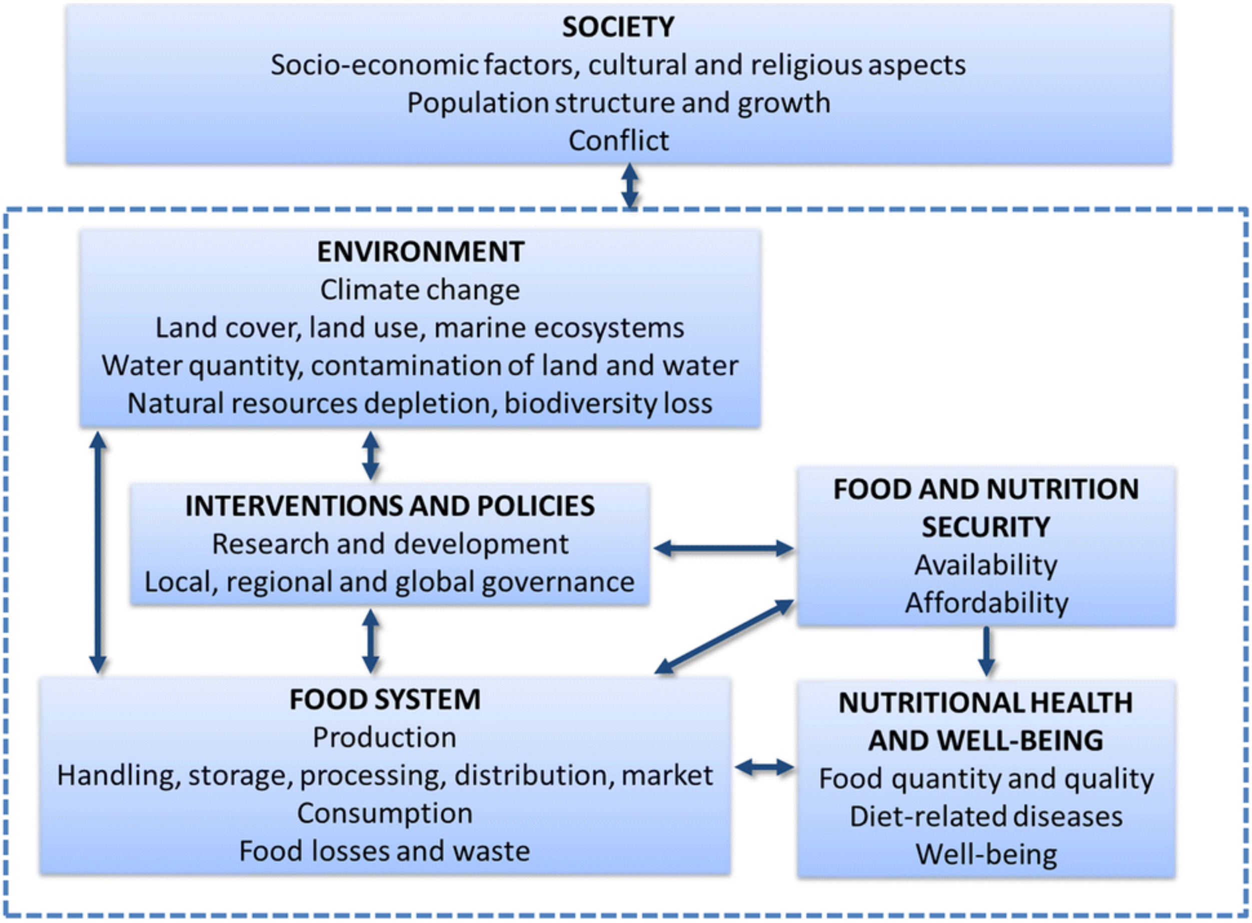


Figure 11: Interactions between health, food systems, environment, and society

Source: Lindgren *et al*. (2018), modified from Tuomisto *et al*. (2017).

2.3.2 The impacts of climate change on food systems

The impacts of climate change on food systems have far-reaching, global potential. Although several analytical frameworks are available for assessing the impacts of climate change on food, however, none have yet emerged as either generally accepted or comprehensive. Figure 14 shows the framework developed by the CGIAR (Consultative Group on International Agricultural Research) work, Brown (2013) argues, are one of the most effective organisations during food crises. It details how climate impacts food system activities all along the food chain. These can be mediated by resources and policies that can potentially boost adaptive capacity, protect, or even maintain inequality (Motesharrei *et al*., 2014; MSF, 2014; Whitmee *et al*., 2015; Bijl *et al*., 2017; Byrd and Byrd, 2017; Scheidel, 2017; Bathiany *et al*., 2018; King and Harrington, 2018; Oxfam, 2019; Stiglitz, 2019). Shocks, trends and seasonality also affect nutrition (Macdiarmid *et al*., 2014; IFPRI, 2015; Cosstick, 2017; IFPRI, 2018; Santeramo *et al*., 2018; Macdiarmid and Whybrow, 2019), especially as temperatures rise, precipitation changes, and more frequent climatic events such as flooding occur. All these factors risk being further compounded by the associated changes in pests and diseases that affect plants and animals (Gregory *et al*., 2009; Flood, 2010).

Deutsch *et al*. (2018), for example, estimate that crop pests already consume 5 to 20 per cent of the three most important grain crops (wheat, rice, and maize) and predicts this will increase by 10 to 20 per cent for every degree Celsius of warming. A further framework is provided by Schnitter *et al.* (2018), who analyse the pathways by which climate change influences human health outcomes to enable health professionals to investigate, understand and protect against current and future health risks (see figure 12). The pathways framework provided by Myers *et al*. (2017), sees anthropogenic greenhouse gas emissions impacting human nutritional status through a cascading set of biophysical and socioeconomic changes (figure 13).

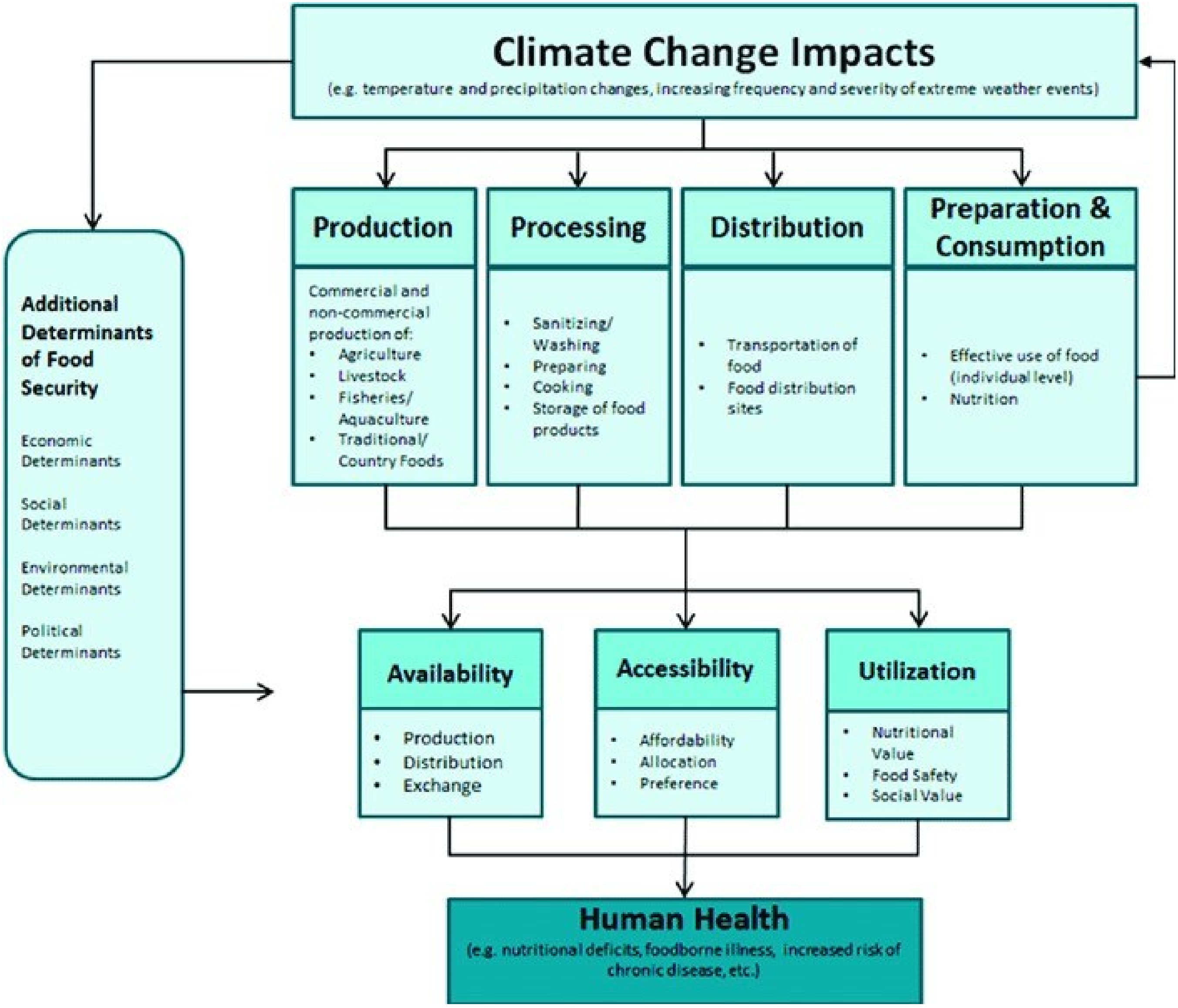


Figure 12: Food security, climate change, and human health nexus framework

Source: Schnitter *et al.* (2018).

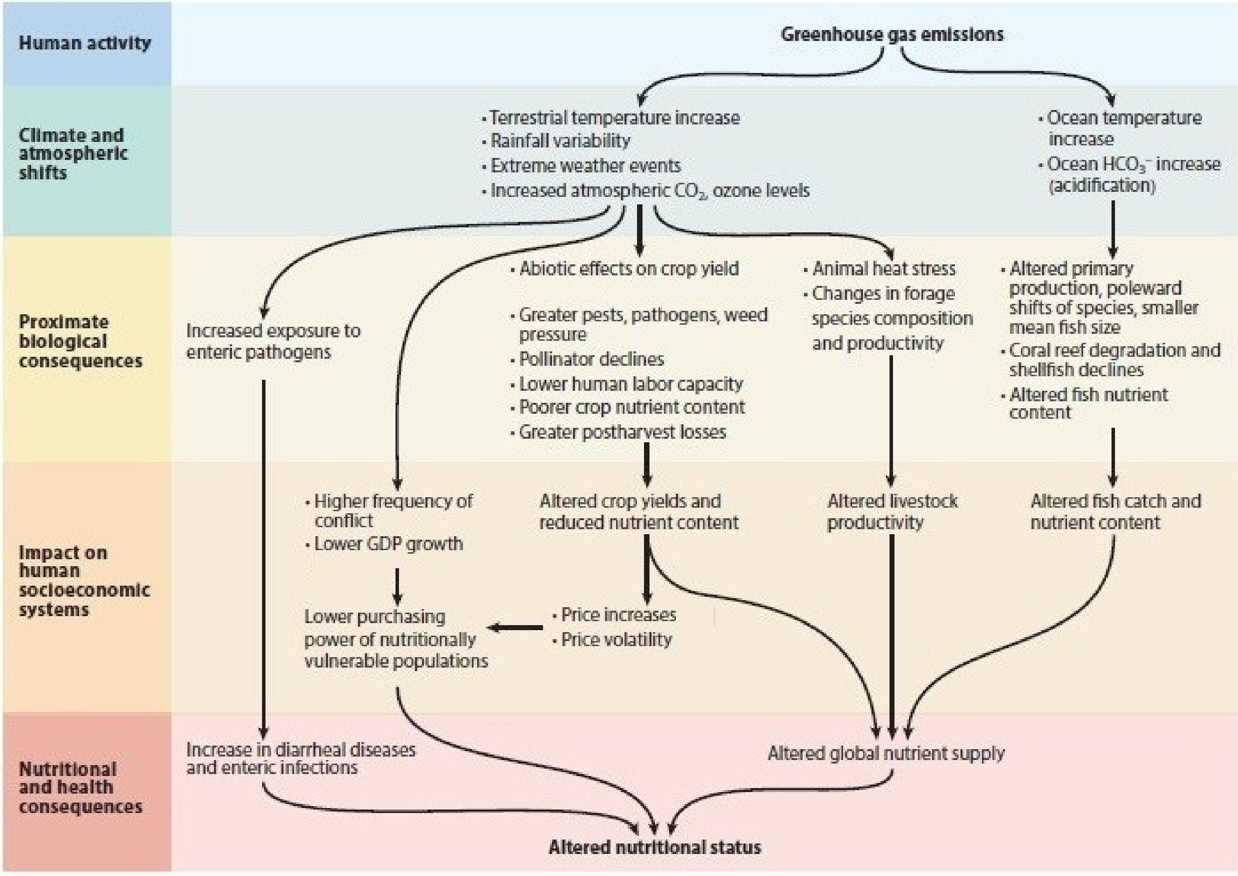


Figure 13: Pathways for impacts of climate change on food systems, food security, and nutrition

Source: adapted from Myers *et al*. (2017).

The UK government's review into the economics of climate change was published by Stern (2006). Its main observations included the scientific evidence on climate change was already overwhelming and it was a serious, global threat, that demanded an urgent, global response. Similarly, it recommended there was still time to avoid the worst impacts of climate change, provided that strong action was taken, with immediate effect. From an economic perspective, it concluded '*the benefits of strong and early action far outweigh the economic costs of not acting*'. The cost of inaction would equate to at least a 5 per cent reduction in global Gross Domestic Product (GDP) per annum, forever, and may ultimately rise to an annual 20 per cent reduction in GDP. The cost of action, however, was initially estimated at 1 per cent of global GDP each year. Two years after the initial report was published, Stern revised the cost of action from 1 per cent of global GDP to 2 per cent, to be able to achieve the stabilisation of atmospheric carbon levels at between 500-550ppm CO_2e. In a newspaper interview at the 2013 World Economic Forum (WEF), however, Stern stated that he had under-estimated climate change. It was far worse and happening much quicker than he had originally estimated, and he now thought that the world was on track for a 4°C increase (Stewart and Elliott, 2013). A similar study in the USA (Deschenes and Greenstone, 2006) suggested large negative or positive effects on food production were unlikely, contrary to the majority scientific consensus, although the authors acknowledged their approach might have been unreliable. More recently, Estrada *et al*. (2017) found that anthropogenic influences replaced natural influences as the major global economic impacts of climate change from 1950 onwards.

The climate impacts on food security and nutrition are listed in table 1 and on the food system and nutrition shown diagrammatically in Figure 14. These impacts include the loss of suitable land for crop production, lower yields, higher food prices, and instability of food supplies, due to an increase in extreme events. Although some positive impacts are also expected, such as longer growing seasons, reduced frost damage, and increased yields in temperate regions (Maracchi *et al*., 2005; Smith *et al*., 2007a; Benton, 2012; Met Office, 2014; Betts and McNeall, 2018; Food Source, 2018), any potential benefit may not be realised due to extreme weather such as droughts and heavy precipitation (Torquebiau, 2016; Easterling and Aggarwal, 2018; Kendon *et al*., 2018). Numerous country studies predict shifting production locations as a result of climate change (Carlsson-Kanyama and González, 2009; Edame *et al*., 2011; Kotir, 2011; Alston and Whittenbury, 2013; Dube *et al*., 2013; Baldos and Hertel, 2014; Bandara and Cai, 2014; Fezzi *et al*., 2014; Furman *et al*., 2014; Thomas and Rosegrant, 2015; Cai *et al.,* 2016; Fukase and Martin, 2016; Hallegatte *et al*., 2016; Jat *et al*., 2016; Van Passel, 2016; Berardy and Chester, 2017; Khanal and Mishra, 2017; Kantor *et al*., 2017; Herold *et al*., 2018; Lopez-Ridaura *et al*., 2018; Ogallo *et al*., 2018; Springmann *et al*., 2018d; Tom *et al*., 2016; Blackstone *et al*., 2018; Turner *et al*., 2018; Xie *et al*., 2018).

Food security dimension	***Consequences of climate change***
AVAILABILITY *(sufficient quantity of food for consumption)*	• Reduced agricultural production in some areas locally • Changes in the suitability of land for crop production • Changes in precipitation patterns could affect the sustainability of rain-fed agriculture in some areas • Increases in temperature could lead to longer growing seasons in temperate regions and reduced frost damage • CO_2 fertilisation could increase yields for those crops with the physiology to benefit from CO_2 enrichment
ACCESS *(ability to obtain food regularly through own production or purchase)*	• Lower yields in some areas could result in higher food prices • Loss of income due to potential increase in damage to agricultural production
STABILITY *(risk of losing access to resources required to consume food)*	• Instability of food supplies due to an increase in extreme events • Instability of incomes from agriculture
UTILISATION *(quality and safety of food, including nutrition aspects)*	• Food security and health impacts include increased malnutrition • Ability to utilise food might decrease where changes in climate increase disease • Impact on food safety due to changes in pests and water pollution

Table 1: Climate impacts on food security and nutrition

Source: Met Office (2014).

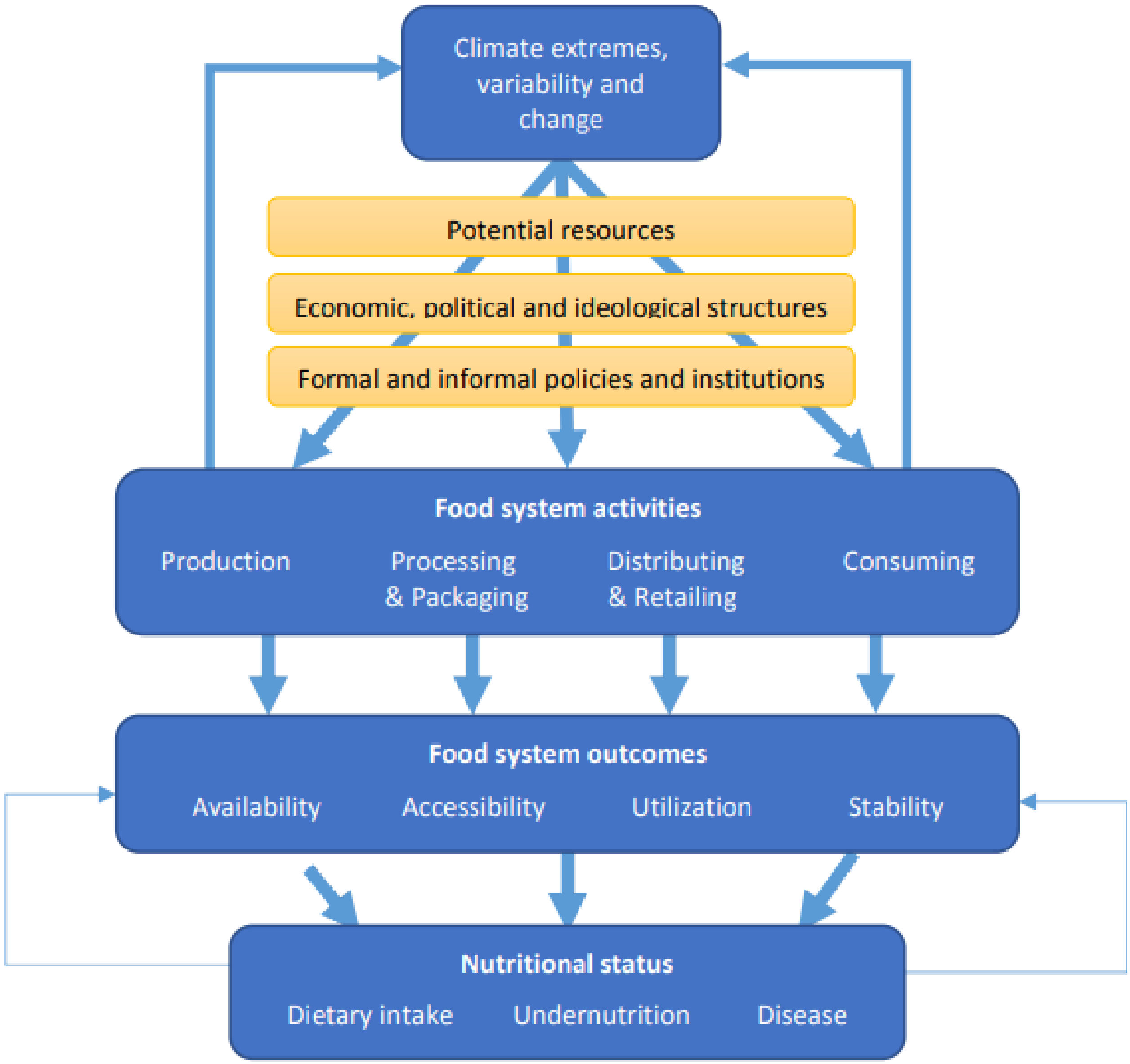


Figure 14: Climate change impacts on the food system and nutrition

Source: Cramer *et al*. (2017).

2.3.3 Food manufacturing and retailing

The literature relating to sustainability within food businesses is mostly restricted to environmental issues (Pullman *et al*., 2009; Fremeth and Richter, 2011; Dittrich *et al*., 2012; SAC, 2012; Darkow *et al*., 2015; Graham and Potter, 2015; *The Economist*, 2017b; FDF, 2017; Kopnina, 2017) or used synonymously with corporate social responsibility (CSR) (Gold *et al*., 2000; Piacentini *et al*., 2000; Jones *et al*., 2005; Maloni and Brown, 2006; Manning *et al*., 2006; Rimmington *et al*., 2006; Fritz and Matopoulos, 2008; Pivato *et al*., 2008; Grant Thompson, 2011; Grayson, 2011; Gold and Heikkurinen, 2013; Manning, 2013; Mueller Loose and Remaud, 2013; Bansal and DesJardine, 2014; Dyllick and Muff, 2015; Marland *et al*., 2015;

Nagyová *et al*., 2016; Eastham *et al*., 2017; Bhardwaj *et al*., 2018; Morgan *et al.,* 2018; Arratia, 2019). Tollina and Vej (2012) suggest this is due, in part, to differing management competencies. The role of food retailers in enabling sustainable consumption is also seen as critical (Evans, 2012; IGD, 2014; Chkanikova and Lehner, 2015; Engel *et al*., 2015; IGD, 2015; Bradley, 2016; Kougioumoutzi, 2016; IGD, 2018; Reisfield, 2018; IGD, 2019a). Although Iceland's disruptive campaigns on plastics and palm oil, Sainsbury's encouraging consumers to switch to plant-based diets (Arratia, 2019), and Marks & Spencer's support for Oxfam (Kuehn and Mclntire, 2014) were all seen as positive examples, the majority of the literature suggest little progress has been made on sustainability from a food retail perspective. Some retailer sustainability initiatives are political rather than economic, whereas a combination of soft regulation and state regulation would be more effective for sustainability governance (Anstey, 2009; Sodano and Hingley, 2013; Li, 2014; Bush *et al*., 2015; Chkanikova and Lehner, 2015; Higgins *et al*., 2015; Malecki, 2018). Also of concern is the need for retailers to address the recent resurgence in slavery (Bradley, 2014; Lake *et al*., 2015). Jones *et al*. (2014) raise concerns over the nature and scope of assurance processes, having found considerable variations and a lack of independence was reducing the reliability and credibility of the assurance process. A more recent comparison of retailer strategies by Souza-Monteiro and Hooker (2017) warns policymakers to be wary of retailer commitments to voluntary agreements, especially when the competitive environment and economic conditions are more challenging.

2.4 Environmental sustainability challenges

The increasing globalisation of food systems that has taken place over the past 4-5 decades has bridged the gap between production and consumption, with little or no consideration for environmental impacts, such as biodiversity loss, water scarcity and pollution (Phillips, 2006; Chakraborty and Newton, 2011; Foti *et al.*, 2013; SDSN, 2013; Centeno *et al*., 2015; Khanna, 2016; Accorsi and Manzini, 2019). Policymakers must address these concerns at the same time as ensuring that there is enough food to meet population demand. Environmental changes are occurring concurrently with the additional pressures of land-use change, pollution, loss of natural ecosystems to other land uses, exploitation of natural resources and ingress by non-native species (Cornell *et al*., 2013; Nolan *et al*., 2018; NAP, 2019a). The primary challenge is how feed more people with less environmental impact (Nemecek *et al*., 2016; Sala *et al*., 2017), with the United Nations Environment Programme (UNEP) arguing that environmental breakdown may cause up to 25 per cent of the world's food production to be lost by 2050 (Nelleman *et al*., 2009; Laybourn-Langton *et al*., 2019; People & Planet, 2019). The next section explores sustainability challenges within the natural environment.

2.4.1 The impacts of climate change on the environment

Anthropogenic emissions of carbon dioxide and other greenhouse gases are a primary driver of climate change, with a direct correlation between greenhouse gas concentrations and global temperature increases. All stages within the global food system make significant contributions to climate changing GHG emissions. The impacts of climate change can be broadly categorised into climate and atmospheric, biological, socio-economic, and those affecting health and nutrition. The latest available data (May 2021) records 418.48ppm of CO_2e, higher than at any time in the past 800,000 years (Zeebe *et al*., 2016; NOAA, 2019). These gases absorb thermal infra-red radiation that would otherwise be emitted by the earth into space, and have caused the Earth's surface to warm by about 1°C since the 1850s (Manabe and Wetherald, 1967; Broecker, 1975; IPCC, 2007a; IPCC, 2007b; IPCC, 2013a; Pachauri *et al*., 2014; Ackerman and Munitz, 2016; Tol, 2016b; Met Office, 2019).

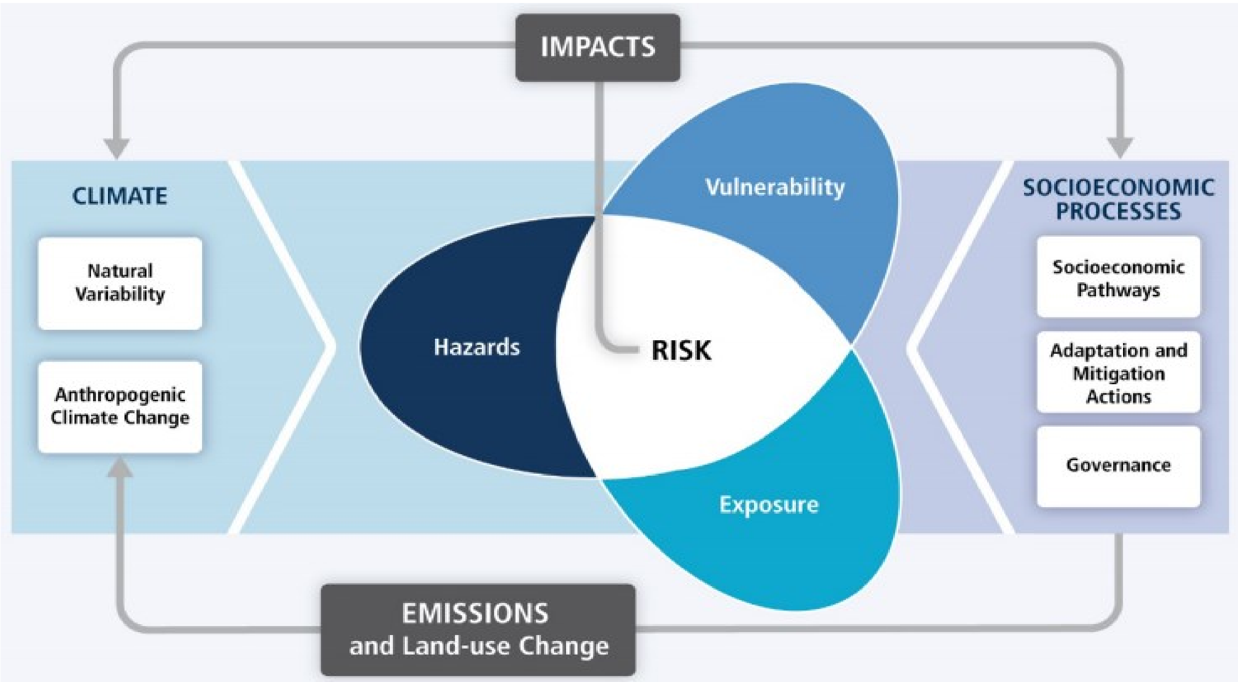


Figure 15: Risk of climate-related impacts results from the interaction of climate-related hazards with the vulnerability and exposure of human and natural systems

Source: IPCC, 2014 cited in Met Office (2018).

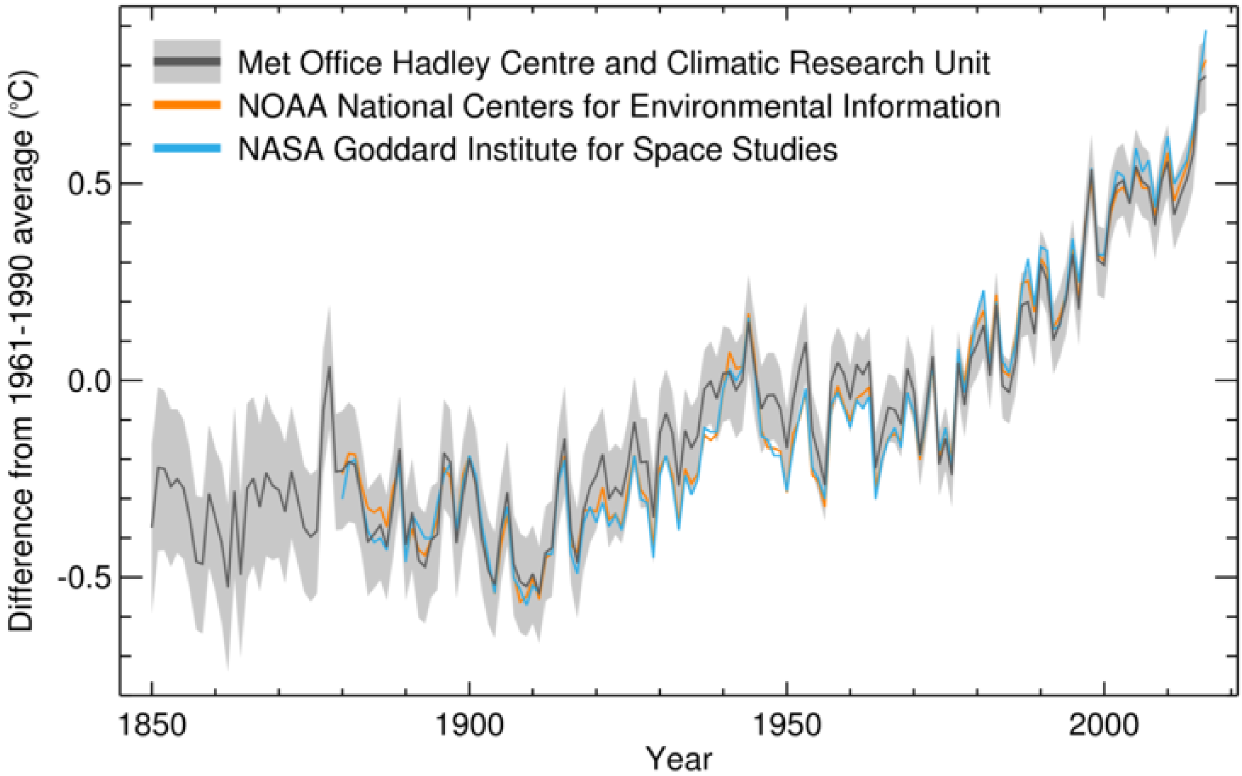


Figure 16: Global average temperature changes 1850-2018

Source: Met Office (2019).

Figure 15 shows this global temperature change from 1850 to 2018, compared to the 1961-1990 average temperature. Although minor variations can be seen from year to year, the temperature records display similar characteristics with each other. The past five years have been the warmest of the last 140 years, with every decade since the 1960s being warmer than the previous one, and 2019 was 0.98°C warmer than the 1951 to 1980 mean (NASA, 2020). Arnell *et al*. (2002) had previously suggested that stabilisation at 550 ppm would be required to avoid or mitigate against the worst effects of climate change. This data shows the last 5 years as the highest on record; 19 of the 20 warmest years have occurred since 2000; and, current average temperatures are already around 1°C warmer than the pre-industrial period before 1850. In the future, however, King *et al*. (2015) warn that further temperature increases could be more than 10°C over the next few centuries.

Anthropogenic climate change has been driven since the industrial revolution by greenhouse gases, aerosol emissions, and land-use change (Met Office, 2019). As a result, higher concentrations of GHG in the atmosphere (mostly carbon dioxide, methane, and nitrous oxides) have resulted in several climate and atmospheric consequences. Firstly, is the increasing frequency of the extreme weather events and anomalies (Hansen *et al*., 2012; Schellnhuber *et al*., 2013; Herring *et al*., 2014; Royal Society, 2014; Diffenbaugh *et al*., 2017; AMS, 2018; Diffenbaugh *et al*., 2018; Piecuch *et al*., 2018; Ruthrof *et al*., 2018;

Storlazzi *et al*., 2018; Cogato *et al*., 2019; Harvey, 2019; Met Office, 2019). The WMO (2019b) estimate that more than 90 per cent of natural disasters are related to weather. Warmer air holds more water which changes hydrological cycles, with warmer surface temperatures causing faster evaporation and ultimately rainfall amounts, ranging from more rainfall to more droughts, depending on the region (Met Office, 2017; NASA, 2019). Also, global greening, whereby higher levels of carbon dioxide and warmer temperatures promote vegetation growth where water and nutrients are available (Met Office, 2019). Zhu *et al*. (2016) estimate that 70 per cent of the observed greening effect is attributable to increased atmospheric CO_2 concentrations. Figure 17 provides further detail on the observed global temperature change and modelled responses to stylised anthropogenic emission and forcing pathways from the latest IPCC report. Importantly, it also illustrates the differing probabilities associated with limiting temperature increases to the desired 1.5°C. The USA National Oceanic and Atmospheric Administration (NOAA, 2020) scientific agency record data on weather anomalies throughout the year (see figure 16). In addition to recording the second highest temperatures since 1880, (0.95°C above the 20th century average), they also recorded the smallest sea ice extent in 41 years and lower levels of snow cover throughout 2019.

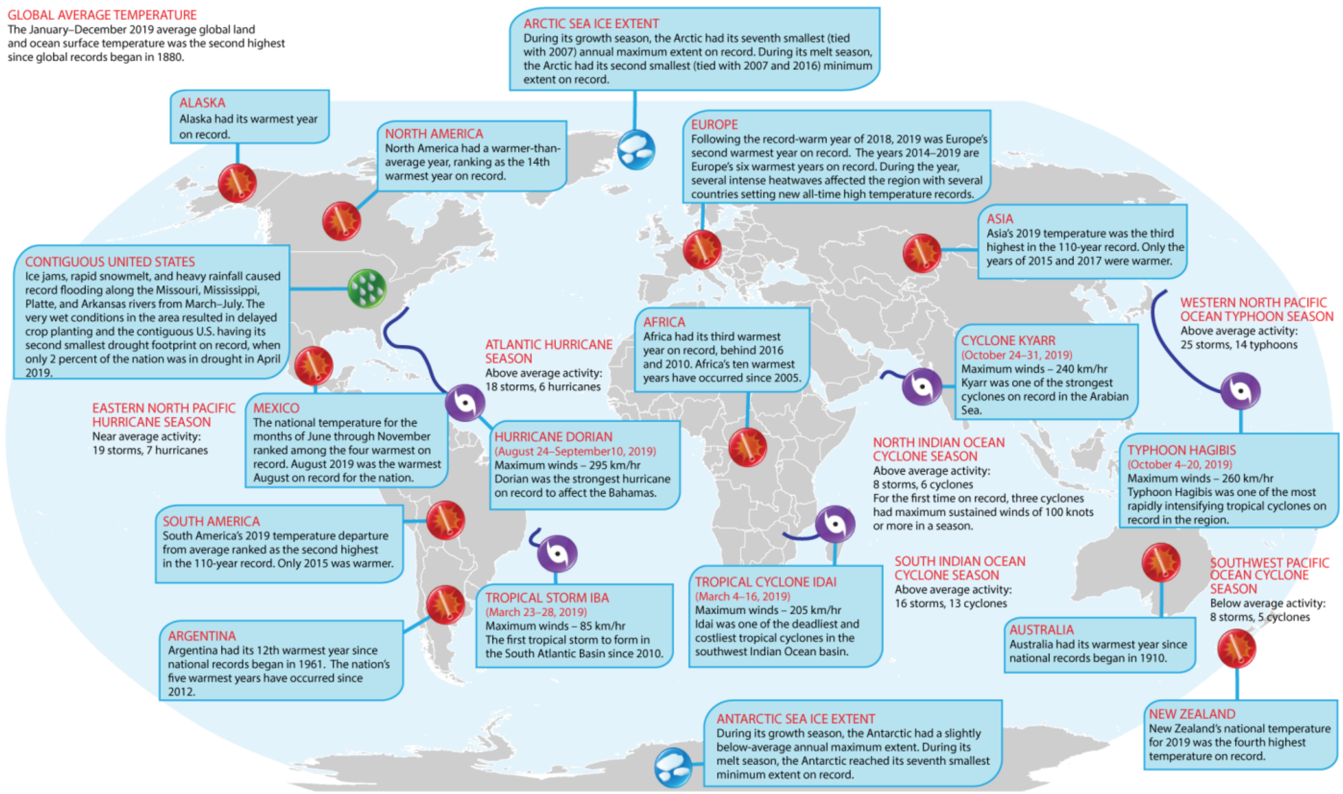


Figure 17: Selected climate anomalies and events map for 2019

Source: NOAA (2020).

Paleoclimatic evidence suggests that the current temperature increases are occurring around ten times faster than the average rate since the last ice age (NASA, 2018a and 2018b; WMO, 2019b). These increasing temperatures have numerous effects on the earth systems. They warm the lower 20km of the earth's atmosphere (Santer *et al*., 2018) which in turn warms the land and oceans down to depths of 2km. Following a recent correction to satellite data it is now thought that the lower tropospheric atmosphere has warmed 140 per cent faster (i.e. 2.4 times larger) since 1998 than previously thought (Hausfather, 2017b; Mears and Wentz, 2017). Rising ocean temperatures, acidification, and anoxia threaten both marine life and the marine food chain (Barange and Perry, 2009; Beaudoin and Pendleton, 2012; Rossoll *et al*., 2012; Bijma *et al.*, 2013; Lewandowska *et al*., 2014; Malone *et al*., 2014; Boyd *et al*., 2015; Dutkiewicz *et al*., 2015; Gattuso *et al*., 2015; Molinos *et al.*, 2015; Hixson and Arts, 2016; Cheng *et al*., 2017; Clarkson *et al*., 2018; Schneider *et al*., 2019). Oceans have absorbed more than 90 per cent of the energy produced by the excess GHGs (Met Office, 2019); but this carbon absorption causes ocean acidification which has reduced surface ocean pH by 0.1, increasing acidity by 26 per cent (Met Office, 2017). Warmer temperatures also impact both ice cover and glaciers, which Llovel *et al*. (2014) estimate have reduced by 13 per cent each decade between 1979 and 2016. The high albedo nature of ice means that less solar radiation is reflected once ice cover is reduced, and black carbon (from aerosols) can also further reduce the albedo effect by changing its surface colour (Hansen *et al*., 1981; Bollmann *et al*., 2019). Duveiller *et al.* (2018) note similar effects in the tropics, where land-use change has caused surface brightening and the consequential reduction of net radiation.

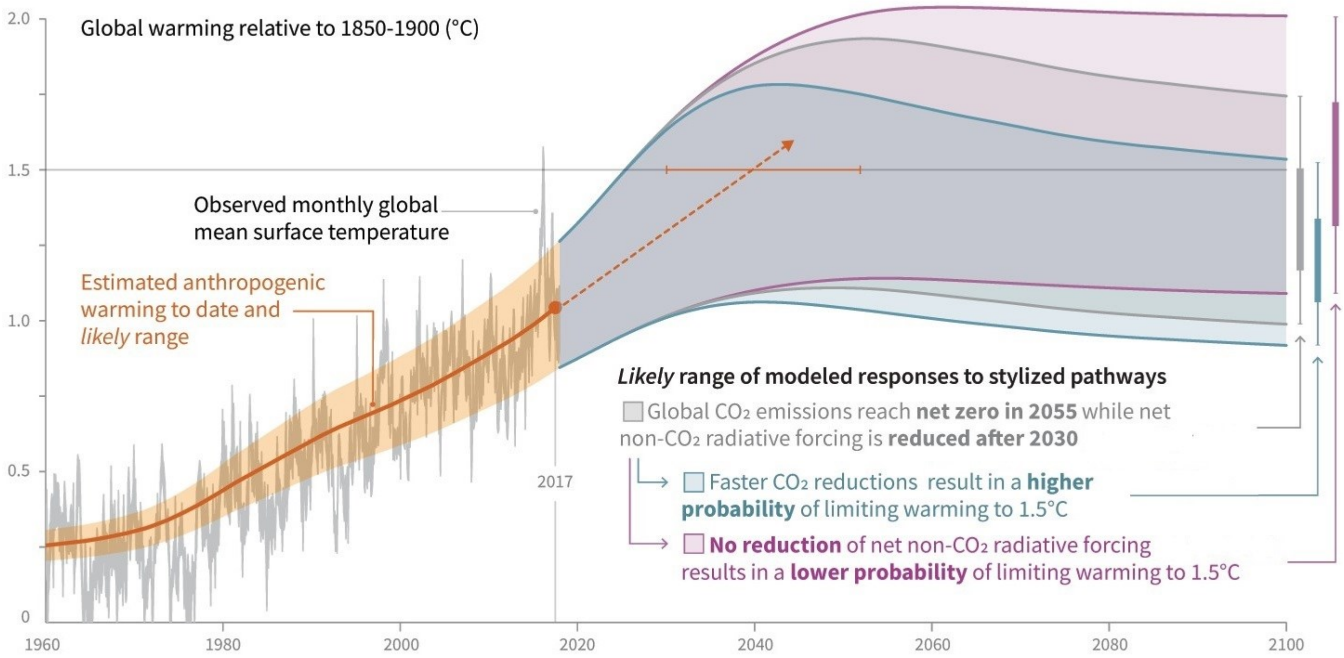


Figure 18: Observed global temperature change and modelled responses to stylised anthropogenic emission and forcing pathways

Observed monthly global mean surface temperature change (grey line up to 2017) and estimated anthropogenic global warming (solid orange line up to 2017, with orange shading indicating assessed likely range). Orange dashed arrow and horizontal orange error bar show respectively the central estimate and likely range of the time at which 1.5°C is reached if the current rate of warming continues. The grey plume on the right shows the likely range of warming responses, computed with a simple climate model, to a stylised pathway (hypothetical future) in which net CO_2 emissions decline in a straight line from 2020 to reach net zero in 2055 and net non-CO_2 radiative forcing increases to 2030 and then declines. The blue plume in shows the response to faster CO_2 emissions reductions. The purple plume shows the response to net CO_2 emissions declining to zero in 2055, with net non-CO_2 forcing remaining constant after 2030. The vertical error bars on right show the likely ranges (thin lines) and central terciles (33rd – 66th percentiles, thick lines) of the estimated distribution of warming in 2100 under these three stylised pathways.

Source: adapted from IPCC (2018b, p.6).

Melting ice and the thermal expansion of seawater are also causing sea levels to rise at an increasing rate (Kopp *et al*., 2017; WMO, 2019b): from 1.7mm per annum through the 1800s to 3.3 mm per annum since the early 1990s (Met Office, 2017) and 3.7mm in 2017, the highest on record (WMO, 2019a). From 2014-2019, the rate of global mean sea-level rise averaged 5mm per year, compared to 4mm per year during 2007-2016 (WMO, 2019b). The resultant flooding has already affected more than 35 million people, with over two million people displaced by disasters linked to weather and climate events (WMO, 2019a). The latest UK sea-level rise projections have been revised upwards meaning low-lying areas are at an increasing risk from flooding (IPCC, 2015; Tollefson, 2016; Taniguchi *et al*., 2018; MCCIP, 2020), especially in areas such as the Fens, where highly productive farmland is either at, or even below current sea level (BBC, 2019c). Adaptation strategies will be required as sea levels are projected to carry on rising beyond 2100 (IPCC, 2015; Rippke *et al*., 2016). Melting ice also weakens and disrupts the system of ocean currents in the Atlantic (the Atlantic Meridional Overturning Circulation), which may also lead to a cooling of the northern hemisphere, an increased frequency of storms throughout Europe, and changes in summer rainfall (Pörtner *et al*., 2014; Caesar *et al*., 2018; NERC, 2018; Golledge *et al.*, 2019), although cold meltwater running off Antarctica's ice sheets may, however, dampen the rate of temperature rise (Bronselaer *et al*., 2018). Ritchie *et al*. (2020) estimate the impacts of a potential collapse in the Atlantic Meridional Overturning Circulation on UK food production and conclude it would create a tipping point where arable production would cease. Finally, ensuring global temperatures stay below 1.5°C above pre-industrial levels will require reduced emissions from deforestation, food loss and waste, and changing human diets (Hansen *et al*., 2010; Loboguerrero *et al*., 2019).

Climate change also causes a wide array of biological impacts which reduce the availability of food, leading to higher food prices, lower quality, changing supply chain processes and, ultimately, impact human nutrition and health. As the climate is changing faster than many species can adapt, these become increasingly at risk of extinction, so loss of biodiversity is seen as a major risk. Many species are struggling to stay within their preferred biological space (Quinn and Collie, 2005; Kirkaldy, 2019; Morris, 2019). This is further exacerbated by phenology (i.e. changes in seasonality) which has huge potential consequences for both species and entire ecosystems (Memmott *et al*., 2007; Hannah, 2015; FAO, 2016m; Newbold, 2018; Hayhow *et al*., 2019). Climate change is also responsible for the introduction of non-native species into ecosystems, which Hayhow *et al*. (2019) claim has been a contributory factor in 58 per cent of known extinctions. Animals may be able to use their sensory and locomotor capacities to better adapt to additional stresses such as those posed by climate change, whereas plants will need longer to adapt their physiological tolerance i.e. behaviour, morphology and physiology (known as phenotypic plasticity) in response to the changing environment (Bradshaw, 1972; Huey *et al*., 2002; Menzel *et al.*, 2006; Gregory *et al*., 2009; Hegland *et al*., 2009; Bebber *et al*., 2013; Chmielewski, 2013; Bebber, 2015; Cang *et al*., 2016; Gray and Brady, 2016; Barnard *et al*., 2018; Fattorini *et al*., 2018). Estrella *et al*. (2007) studied 78 crops in Germany over a 50-year period, observing that all the main events were increasing by 1.1–1.3 days per decade. By keeping the temperature increase to 1.5°C rather than 2°C, Smith *et al*. (2018) calculated that this would reduce the number of species facing a loss of their climatic range.

The transition of landscapes from natural to intensive agriculture is especially detrimental to pollinators (Ziska and George, 2004; Memmott *et al*., 2007; Smith *et al*., 2015; Ziska *et al.*, 2016; Kremen and Merenlender, 2018; Kunin, 2019; Soroye *et al*., 2020). Darwin (1859) first proposed that some important species would face extinction if bees disappeared; the current '*pollination crisis*' is now understood to include a wide range of bird, bee, butterfly, moth, fly, wasp, beetle, bat and mosquito species around the globe. Bees are not only responsible for the pollination of 35 per cent of the world's crops and 90 per cent of all wild flowering plants (Klein *et al*., 2007; Abrol, 2012; IPBES, 2016b; IPBES, 2017; IPBES, 2018c), they are also regarded as mobile biomonitors of ecosystem health (Abrol, 2012; Solazzo *et al*., 2015; Schroter *et al*., 2017; Soroye *et al*., 2020). Yet the speed of this transition effectively bypasses the millions of years of pollinator evolution that bees would need to transition into a new environment (Grab *et al*., 2019). One study found 35 per cent of bees died in the first year and 70 per cent died in the second year following changes in temperature, suggesting an urgent need to address (CaraDonna *et al*., 2018). Such rapid change in environments also affects the waggle dance language that is critical to foraging behaviour (I'Anson Price *et al*., 2019). Pollinators contribute around 10 per cent of the economic value of crop production globally and their contribution to human nutrition is potentially much higher. Many of the most pollinator-dependent crops are also among the richest in the micronutrients essential to human health, such as vitamin C, Lycopene, the antioxidants β-cryptoxanthin and β-tocopherol, carotenoids, calcium, fluoride, and folic acid essential to human health (Eilers *et al*., 2011; Chaplin-Kramer *et al*., 2014; Myers *et al.*, 2015). For this reason, Abrol (2012) suggests, the cost of conserving biodiversity far outweighs the cost of letting it degrade, with DEFRA (2018a) recently acknowledging the government's responsibility in protecting human health by nurturing the environment on which all human life depends.

The increasing use of synthetic pesticides in many food systems continue to have negative impacts on pollinator health (Miller, 2016). The neonicotinoid group of pesticides, for example, has come under intense scrutiny with the increasing use of the chemical in oilseed rape production systems (Budge *et al*., 2015; Rundlof *et al*., 2015; Woodcock *et al*., 2016; Woodcock, 2017; Siviter *et al.,* 2018; Eng *et al*., 2019). Here studies have found it reduces feeding activity and affects ovary development (Baron *et al*., 2017), disrupts nesting behaviour, social networks, and thermoregulation (Crall *et al*., 2018), results in the ingestion of pesticide contaminated pollen (Sánchez-Bayo and Goka, 2014), causes acquired preferences (Arce *et al*., 2018), reduces pollination services to apples (Stanley *et al*., 2015), and poses risks to invertebrates through waterborne exposure (Englert *et al*., 2017). Most global honeys now contain neonicotinoids at levels known to be neuroactive (i.e. affecting or interacting directly with the nervous system) in bees (Connolly, 2017), with trace amounts also detectable in the royal jelly that queen bees produce for their off-spring (Bohme *et al*., 2018). Précis of neonicotinoid insecticides are usefully provided by Godfray (2015), Godfray *et al*. (2015) and Koricheva (2018), providing robust statistical meta-analysis. They also raise concerns on the role of corporate chemical manufacturers and their tendency not to publish in the peer-reviewed literature evidence that is subsequently used by the regulators. Henry *et al*. (2015) similarly recommend how differing results from laboratory and field assessments can be reconciled. Farina *et al*. (2019) recently claimed that glyphosate, the most widely used systemic herbicide in the world, causes a similar cascade of neuro-endocrine disruptions to pollinators, therefore adding to the effects from neonicotinoids. Christmann (2019) advocates the need for a Multilateral Environmental Agreement to protect pollinators, perhaps by utilising the recently established '*Coalition of the Willing on Pollinators*' group of countries. At the same time, a wide range of policy initiatives have emerged, ranging from the EU ban on a number of the neonicotinoid insecticides (EC, 2018a; Greenpeace, 2018a) to local biodiversity action plans such as the one covering the Lincolnshire Fens (LBP, 2011).

Not only are social and economic activities the main driver of climate change, climate change will in turn have serious impacts on these activities (WMO, 2019a). Assessing the monetary cost of these climate impacts at different levels of warming is both complex and methodologies still seemingly controversial (Tol, 2002a; Tol, 2002b; Webster *et al*., 2008; Watkiss *et al*., 2016; Pidcock, 2017) although cutting the costs now would save money in the longer term (Wynn, 2014). Perhaps the greater impact, judging by the volume of publications, is the threat to food security. Evidence on the economic costs associated with increasingly volatile food prices is also abundant within the literature (Horton *et al*., 2009; Richards and Pofahl, 2009; Gilbert and Morgan, 2010; ISU, 2011; IMF, 2012; Korale-Gedara *et al.*, 2012; Bradbear and Friel, 2013; IMF, 2014; Lloyd *et al*., 2015; Future of Food, 2017; Global Witness, 2018). Market analysts PricewaterhouseCoopers see climate change as multiplying the existing threats to the UK, including increasingly volatile food prices that may be further amplified by protectionist reactions which will impact health, security, and global governance. They argue that existing and mature trade links (e.g. EU and USA) will be insufficient to fully insulate the UK from the impacts of climate change on food imports (PwC, 2013b). Technological fixes are also seen as being insufficient to offset the impacts of climate change; rather they need to be integrated into food system approaches to food security (Ericksen *et al.,* 2009; Becken and Mackey, 2017; JPI, 2017; Kamali *et al.*, 2017; Allwood *et al.*, 2019) and that effective governance arrangements are increasingly needed (Ericksen *et al.,* 2009; Hoffmann, 2011; McKeon, 2011; Lal, 2013; Margulis, 2013; Grafton *et al.,* 2015; McKeon, 2015a; McKeon, 2015b; Metzger, 2015; Hess *et al.,* 2017).

There have been several attempts by scientific communities to issue collective warnings. The first was signed by 1,700 global scientists (Kendall, 1992): the second 25 years later was initially countersigned by 15,364 scientists (Ripple *et al*., 2017). Despite this scientific support, a very small number of subsequent publications have questioned both the effectiveness of this kind of message (Oreskes, 2004; Bull *et al*., 2017; Johnston, 2017b; New York Times, 2018) and the view of the consensus (Lindzen, 2012; Tol, 2016a; Bull *et al*., 2017; Varotsos and Efstathiou, 2019). Several subsequent attempts have been made to quantify the consensus within the scientific literature (Cook *et al*., 2013; Powell, 2016; Cook *et al*., 2016; Powell, 2017), with the later studies finding the consensus had risen to 100 per cent. This consensus is critical in influencing public perception (Rahmstorf, 2004; Oreskes and Conway, 2010; Hamilton *et al*., 2012; Brysse *et al*., 2013; Hamilton and Stampone, 2013; Hawkins *et al*., 2014; van der Linden *et al*., 2015; *Nature*, 2016a; Medhaug *et al*., 2017; Moon *et al*., 2018; American Psychological Association, 2019; Marlon *et al*., 2019; Maslin, 2019).

2.4.2 The planetary boundaries of Earth system processes

The planetary boundaries concept is centred around the premise that Earth system processes have environmental boundaries. By mapping each of the earth's planetary boundaries, the concept identifies where countries are using resources far beyond their planetary boundaries and indicates 'safe operating space for humanity' (Lenton and Schellnhuber, 2007; Ozkan *et al*., 2008; Lenton *et al*., 2008; Jay and Marmot, 2009; Rockström *et al*., 2009a; Rockström *et al*., 2009b; Lang and Ingram, 2013; Lenton and Ciscar, 2013; Poppy *et al.,* 2014b; Levin and Rich, 2017; McGrath, 2018a; Lenton *et al*., 2019).

The premise of Rockström's original model in figure 19 was that humanity had already exceeded three earth-system processes vital for survival (namely through climate change, biodiversity loss, and nitrogen use). The status of atmospheric aerosol loading and chemical pollution had yet to be quantitatively determined; the remaining five earth-system processes were either fast approaching or needed to be pulled back to their respective planetary boundaries. They argue that transgressing just one of these planetary boundaries through anthropogenic pollution would be enough to cause deleterious or even catastrophic environmental change, even if global temperatures were prevented from exceeding a 2°C increase. The Non-Governmental Organisation (NGO) the World Wide Fund for Nature (WWF) subsequently argued biospheric integrity is an apex boundary that is further breached when any of the other boundaries are impacted (Gladek *et al*., 2016). Rockström further recommended that CO_2 levels were kept below 350 parts per million (ppm), even though the recorded level at that time had already reached 387ppm (Hansen *et al*., 2008; Zeebe *et al*., 2016). Solomon *et al*. (2009) predict CO_2 levels will peak around 450–600ppm within the century, with temperature changes becoming irreversible, whereas Morison and Matthews (2016) predict 540ppm by 2050 and as much as 760ppm by 2080.

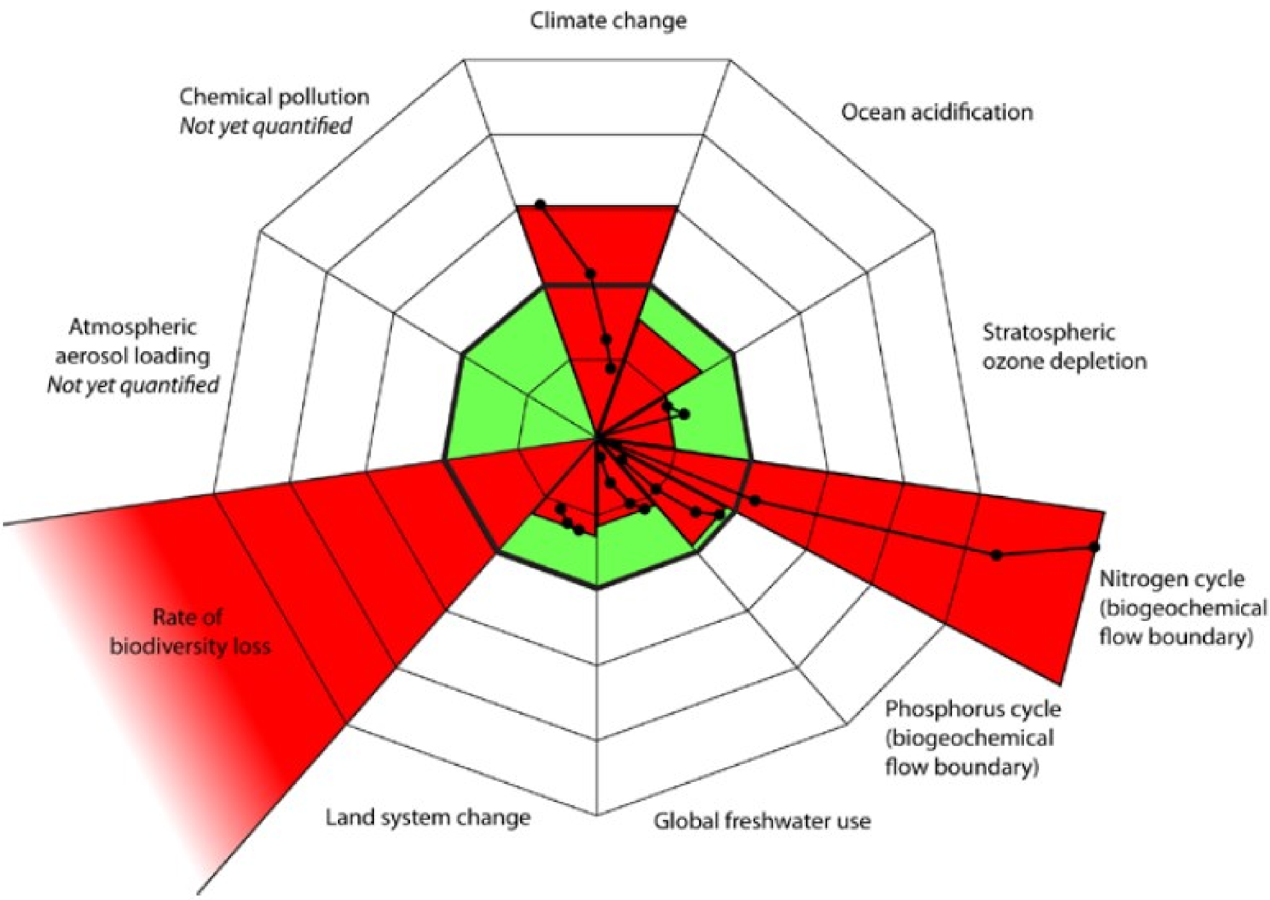


Figure 19: The original 2009 version of the planetary boundaries

The original version estimated seven planetary boundaries, with the inner green shaded areas representing the safe operating space and the extent of the red areas an estimation of the 2009 position. The points indicate the estimated time trajectory since 1950.

Source: Rockström *et al*. (2009b).

Reflecting upon unsustainable consumption levels that are far beyond the means of the planetary systems, Assadourian (2010) estimates that if all nations consumed like the Americans, the capacity of the earth would be limited to 1.4 billion (20 per cent of the current world population). Vásquez *et al*. (2018) similarly estimates that human mass has grown by 146 per cent since 1976. The UN (2011) argue that planetary boundaries are being stretched to a perilous degree (UN, 2011), whereas the IPCC (2019c) warn that anthropogenic emissions will persist for centuries to millennia. Many studies focus on the unsustainability of growth: Pelletier and Tyedmers (2010) and Steffen *et al*. (2015b) argue that reining-in growth should be a policy priority to remain within the planetary limits; Kosoy *et al*. (2012) similarly that sustainability will not be achieved with policies based upon neo-classical economics; and Running (2012) contends the original projections made about the depletion of global resources in the 1972 publication *'Limits to Growth'* (Meadows *et al*., 1972) have turned out to be remarkably accurate. Their latest missive (Ulrich von Weizsäcker and Wijkman, 2018) warns of a philosophical crisis, cites the warning from Pope

Francis that humanity's common home is in danger, and calls for a new enlightenment to redress the balance between humans, the environment, markets, and the state. Steffen *et al*. (2011) also contend that effective planetary stewardship is urgently needed to avoid a hostile trajectory.

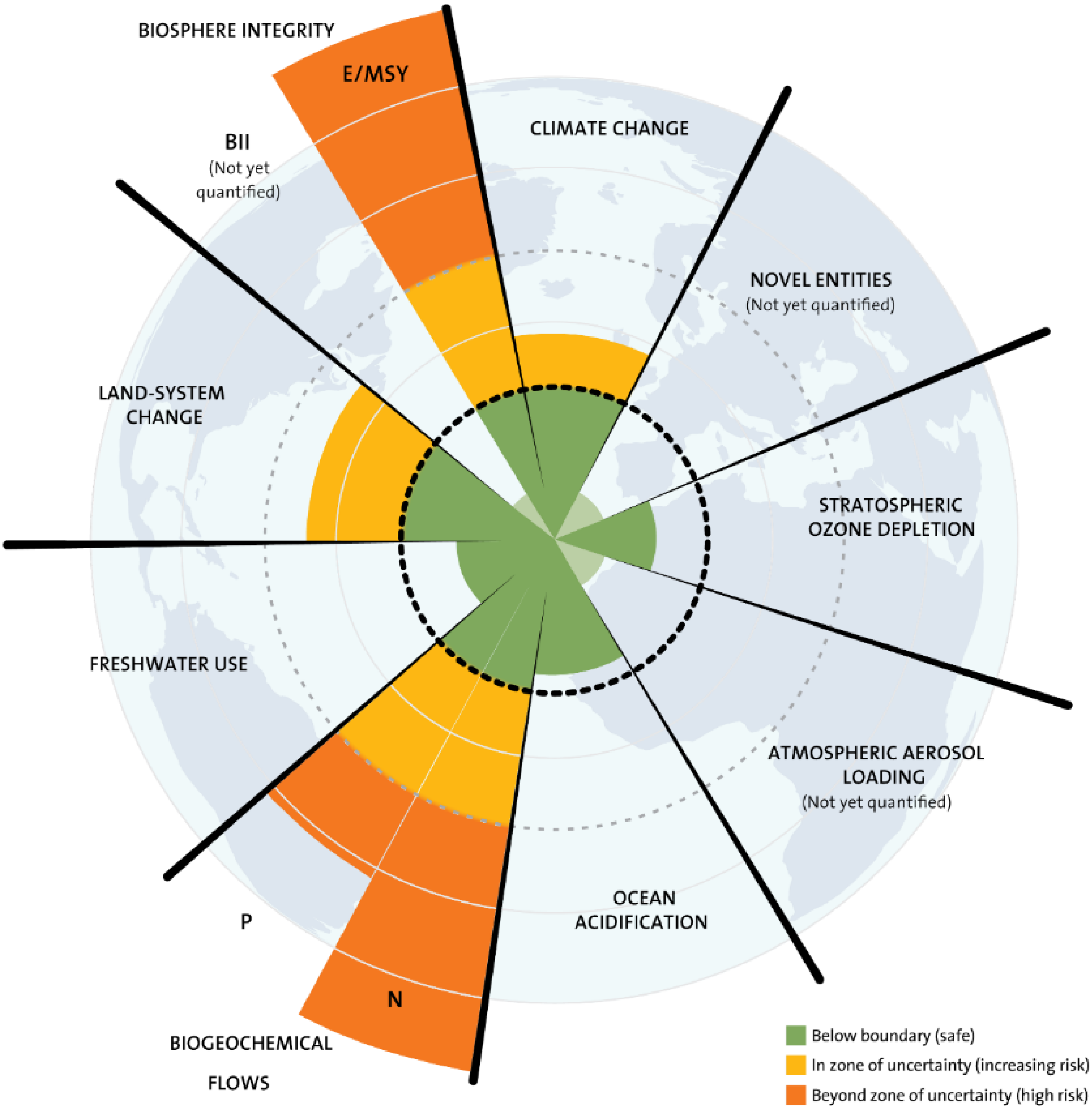


Figure 20: The 2015 status of the planetary boundaries

The updated planetary boundaries concept showing the nine planetary boundaries which humanity requires to survive and thrive. This version differs by providing both updates to the original data and by providing uncertainty (yellow shaded areas). It now shows the actual planetary boundary as a darker, inner circle with the grey areas indicating boundaries that cannot yet be quantified.

Source: Steffen *et al*. (2015a).

The sheer scale of climate change makes it one of the most difficult variables to model (Meehl *et al*., 2000; Pierce *et al.*, 2009; Wise, 2013; Bodirsky *et al.*, 2015; Ewert *et al.*, 2015; McMichael *et al.*, 2015; Allen and Prosperi, 2016; Dawson *et al.*, 2016; Gohar and Cashman, 2016; Krapivin *et al.*, 2017). The planetary boundaries model has enabled the extensive research of quantitative global limits. Various iterations of the model now exist with a second, major update being published in 2015 (figure 20). A common theme throughout this later literature is the need for urgency in response, and the corresponding warnings of the likely consequences of inaction: McMichael (2017) calls for an extraordinary civilisational response to the world's '*mega-problem*'; Poppy and Baverstock (2019) suggest placing human health at the centre of a redesigned food system to ensure planetary health. Likewise, other studies argue for a planetary health infrastructure approach to safeguard the health of future generations (Brooks, 2007; Whitmee *et al*., 2015; Fraser *et al*., 2016; Horton, 2017a; Horton, 2017b; Bhunnoo, 2018; Béné *et al*., 2019; Lade *et al*., 2019; Moysés and Soares, 2019; Watts *et al.,* 2019).

The limited availability and environmental consequences of using chemical fertilisers (Humes, 2016; Barling, 2017; Muhammed *et al*., 2018), especially nitrogen (Tilman, 1999; Bouwman *et al*., 2002; Erisman *et al.*, 2008; Cordell *et al*., 2009; Woods *et al*., 2010; Cordell *et al*., 2011; Davidson, 2012; EC, 2014; Elbehri, 2015; Zhang *et al*., 2015; Fagodiya *et al*., 2017; Houlton *et al*., 2019) and phosphorus (Rhodes, 2013; Scherer and Pfister, 2015; Oszvald *et al*., 2018; Macintosh *et al*., 2019; Vaccari *et al*., 2019) are a particular concern, with recommendations for the development of alternative technologies (Schösler and de Boer, 2018).

Collectively, these issues raise questions regarding the seemingly impossible tasks of meeting the SDG goals, or the Paris Climate Agreement, without radical transformation of the global food system (Rockström *et al*., 2016). There are already concerns about the distinct lack of actual progress in cutting emissions (Friedlingstein *et al.*, 2014; Briggs *et al.*, 2015). The interconnections between diet and the planetary boundaries receives similar scrutiny. This research, however, has yet to make significant global impacts in relation to resource use and emissions by national and sub-national governments and businesses (Häyhä *et al.*, 2016). Mitigation strategies and new integrated governance structures are both required, as is private and public investment (Smith *et al.*, 2008; Antle and Capalbo, 2010; Costello *et al.*, 2011; Beddington *et al.*, 2012; Wickramasinghe *et al.*, 2013; Clapp *et al.*, 2015a; Clapp *et al.*, 2015b; MacLeod *et al*., 2015; Tubiello *et al.*, 2015; Mohammed *et al.*, 2017; Niles *et al*., 2017; Scherer and Verburg, 2017; Niles *et al*., 2018; van Vuuren *et al*., 2018). Finally, Raworth (2012) extends the planetary boundary concept to the individual, based on governmental priorities identified at the UN Rio conference, arguing that the critical earth systems needed to ensure human well-being are dependent upon individual access to resources such as food, water, health and energy. This can be seen in figure 21, where the social boundaries lie within the planetary boundaries. Although some human biological thresholds can be determined by suitable metrics, others will require judgements on what constitutes an acceptable human outcome. The aim with this model is to identify a space whereby all of humanity can thrive, albeit whether applied at local, national, regional, or global levels.

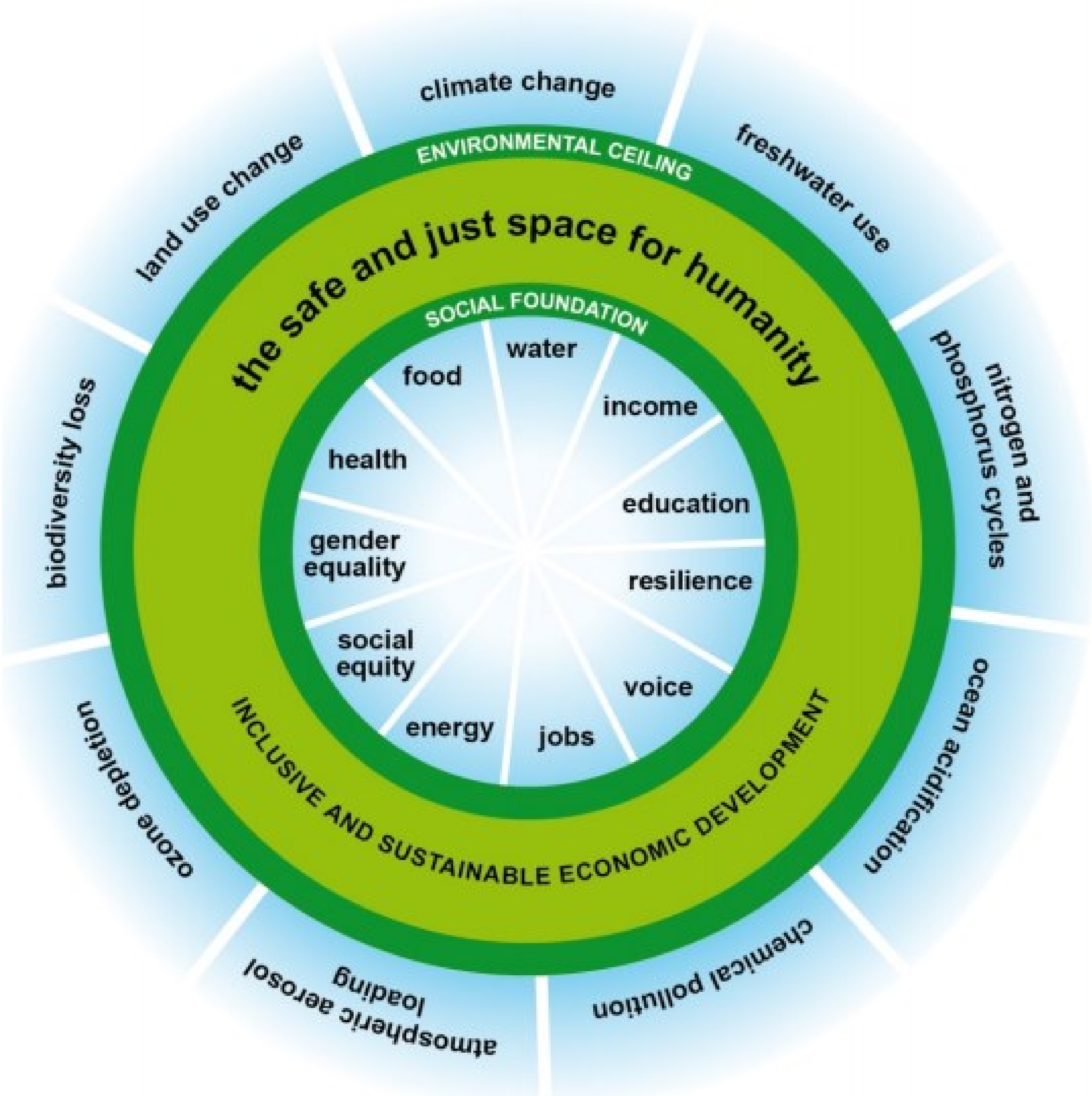


Figure 21: Social and planetary boundaries

Source: Raworth (2012).

2.4.3 Biodiversity degradation and the risk of ecosystem collapse

The continued decline in biodiversity is a consequence of human actions. The sheer scale of these actions is difficult to contextualise: the WWF argue that the food system is the largest contributor to biodiversity depletion (Gladek *et al*., 2016); Bar-On *et al*. (2018) estimates that total human biomass is now greater than the biomass of all other species combined. This scale of human activity and its current behaviour has resulted in too much carbon passing into existing ecosystems (ASC, 2013; NAP, 2015; McCarty *et al*., 2017; Committee on Climate Change, 2018d; DeWeerdt, 2018). This is further exacerbated by anthropogenic climate change impacting the biodiversity of critical ecosystems, especially the air, water, and food essential to human well-being (Jackson *et al.*, 2007; Kumar *et al*., 2010; Power, 2010; Calvet-Mir *et al.*, 2012; Carrington, 2018d; Pennekamp *et al.*, 2018; Biodiversity International, 2019; NAP, 2019a; Osborn, 2019; GEO, 2020). Although atmospheric CO_2 increases plant growth rates, it also reduces the nutritional value of plants for insects, which ultimately affects the whole food chain (Hesman, 2009). Research also indicates that it reduces the nutritional value of food (Craine *et al*., 2018), reduces the quality of grazing pastures (Ehleringer *et al*., 2002), reduces the ability of trees to absorb carbon (Bastin *et al*., 2019), and, increases the range and severity of disease threats (Evans *et al*., 2008; Evans *et al*., 2009; Fischer *et al*., 2012; Guis *et al*., 2012; Nilsson *et al*., 2013; Parkinson *et al*., 2014). As global temperatures continue upwards, additional carbon stores held within the frozen permafrost and peat lands will add very significant volumes of additional carbon into existing ecosystems (Tubiello *et al*., 2016; Anthony *et al*., 2018; Zalasiewicz *et al.*, 2018; Neumann *et al*., 2019; Wild *et al*., 2019; WMO, 2019a). Further, specific agricultural ecosystems are associated with human food, the grasslands used for livestock, bioenergy, and even pharmaceuticals (Altieri, 1995). In addition to changes in phenology, climate change is also responsible for the introduction of non-native species into ecosystems, which Hayhow *et al*. (2019) claim has been a contributory factor in 58 per cent of known extinctions. One recent study assesses the ecological, economic, and societal impacts of both terrestrial and marine species arriving in the UK over the past 10 years (Pettorelli *et al*., 2019). The results find 55 new species have arrived within the decade, examples of which are shown in table 2, and calls for the speedy identification of new arrivals and more research on the threats to biodiversity that they cause. The continued expansion of human activities puts the ecosystem services that regulate the quality of air and water, provide nutrient cycling and decomposition, soil maintenance, hydrological services including flood control and, of course, pollination are under increasing risk (Ehrlich, 1995; Rocha *et al*., 2015; Abbas *et al*., 2017). IPBES (2018) describe the current position as an '*ecological crisis*': the historical competition for land caused by population growth, trade, dietary preference, inappropriate environmental use, and ineffective socio-economic-political policies are causing a rapid decline in biodiversity that, potentially, poses a greater problem than even climate change (Walther *et al*., 2002; Thuiller, 2007; Smith *et al*., 2010; Smith *et al*., 2013; Van Passel *et al*., 2016; DeFries and Nagendra, 2017; Carrington, 2018d; Green *et al*., 2019). Furthermore, globalised supply chains invariably mean that the losses incurred are often far removed from where the products are consumed (Green *et al*., 2019).

Impacts	*Location of colonisation*	*Species*
Crop pests	Manchester London	Oak borer *beetle (Agrilus biguttatus)* Box tree moth *(Cydalima perpectalis)*
Biofouling	NW Scotland	Leathery sea squirt *(Styela clava)*
Disease spread	Essex	Ornate cow tick *(Dermacentor reticulatus)*
Risk of injury	Leicester NW Scotland	Tube-web spider *(Segestria florentina)* Leathery sea squirt *(Styela clava)*
Increased fish stocks	Dorset Lundy Island Islay	Bluefin tuna *(Thunnus thynnus)* Jack fish *(Seriola rivoliana)* Red mullet *(Mullus surmuletus)*
Increased local tourism	Scotland Nottinghamshire Kent	Little egret *(Egretta garzetta)* European bee-eater *(Merops apiaster)* Purple heron *(Ardea purpurea)*
Expansion of threatened wildlife alters planning permissions and farming and fisheries practices	Shetland Kent Dorset	Nathusius pipistrelle bat *(Pipistrellus nathusii)* Purple heron *(Ardea purpurea)* Bluefin tuna *(Thunnus thynnus)*

Table 2: Examples of species arriving in the UK due to climate change (2008-2018) with reported impacts associated with these species

Source: Pettorelli *et al.* (2019).

In the UK, one comprehensive study of 400 species concluded that both intensive land management practices and climate change were negatively impacting biodiversity (Burns *et al*., 2016). These land management practices are correlated with farm size: as farms get larger, crop diversity declines and post-harvest loss increases (Samberg *et al*., 2016; Trudge, 2016; Hannah *et al*., 2017; Herrero *et al.*, 2017; Mann, 2017; Cui *et al*., 2018; Lesiv *et al*., 2018; Niles and Salerno, 2018; Rai *et al*., 2018; Ricciardi *et al*., 2018; Smythe, 2018). Reporting on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) modelling of future biofuel demand and the potentially catastrophic prediction of a 10-30 fold increase in land use (up to 1.8bn acres) that this would cause, Adorno (2018) claims such a policy would threaten ecosystems to such an extent that humans would also be at risk. The IPBES recommend '*combating land degradation and restoring degraded land is an urgent priority to* *protect the biodiversity and ecosystem services vital to all life on Earth and to ensure human well-being'* (IPBES, 2018b, p.10). Species decline is further confirmed by the 2019 '*State of Nature'* report (Gentle, 2019; Hayhow *et al*., 2019) that finds UK wildlife, after being decimated by centuries of persecution and threats, has continued to decline since the 1970s. Key indicator species all show similar trajectories: birds have declined by 44 million (National Science Foundation, 2016; RSPB, 2016; Chambers, 2019; DEFRA, 2019m); insects show similar declines across a number of studies (Bale *et al*., 2002; Sharma, 2010; Sharma 2012; Selvaraj *et al*., 2013; Tilman *et al*., 2017; Goulson, 2019; Kunin, 2019; Sánchez-Bayo and Wyckhuys, 2019) and marine species face similar risks. Similar parallels are also made to the last ice age, when temperature increases of 4°C dramatically altered ecosystems and caused the extinction of many larger species (Grove, 2004; Nolan *et al*., 2018). Several estimates put current extinction rates at between 1,000 to 10,000 times higher than natural background rates of extinction (de Vos *et al*., 2014; Ceballos *et al*., 2015; Ceballos *et al*., 2017; Cumming and Peterson, 2017; Carrington, 2018d; Singh and Abhilash, 2018). Finally, should the current trajectory be maintained, this could reduce biodiversity by a further 11 per cent by 2040, with up to one million species being at risk of extinction (Speers *et al*., 2016; Sulpis *et al*., 2018; Egli *et al*., 2018; Díaz, 2019).

Biodiversity degradation is also detrimental to health, by promoting infectious diseases, increasing the risk from natural disasters, and impacting both nutrition and food security (Duffy *et al.*, 2017; Horton, 2017a). Hixson and Arts (2016) predict reductions in omega-3 production within aquatic ecosystems, caused by climate change, which has the potential to further cascade through the world's ecosystems. Hoegh-Guldberg *et al*. (2007) expect further ocean acidification with global temperature increases over 2°C; CO_2 levels above 500ppm will push coral reef ecosystems to functional collapse, with inevitable consequences on fisheries and humans. One study into freshwater diversity reports an 81 per cent reduction in species diversity (Bakker and Stvenning, 2018). The understanding of the mutual co-dependency between biodiversity and health is, however, largely lacking in both the health community and the public as well. To address this lack of understanding and to ensure an ability to respond to these sustainability challenges, Balgopal *et al.* (2014) call for training to improve the climate literacy of all future leaders. The IPBES (2019) also warn about the main declines in nature that is being caused by the increasing levels of degradation (figure 22). Other impacts on biodiversity include trade (Hertwich and Peters, 2009; TEEB, 2015; Green *et al*., 2019). Whilst acknowledging that humanity is currently failing to change the trajectory of environmental destruction caused by economic expansion and the consumption of natural resources, zu Ermgassen and Yoh (2019) believe that the best hope for the future will be a combination of consumer awareness of their lifestyle choices on the environment, meat substitution, and rewilding.

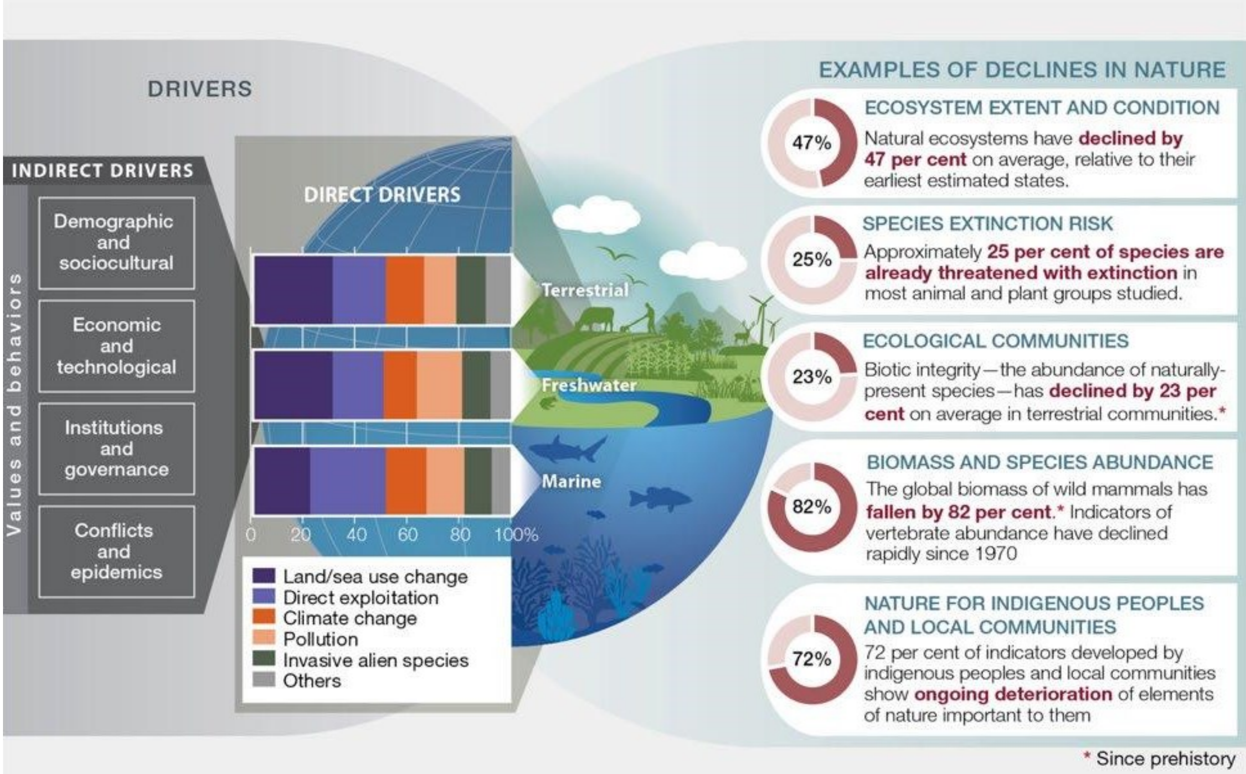


Figure 22: Examples of global declines in nature, emphasising declines in biodiversity, which have been and are being caused by direct and indirect drivers of change

The direct drivers (including changes in land and sea use, direct exploitation of organisms, climate change, pollution, and the invasion of alien species) result from an array of underlying societal causes such as demographic (e.g. human population dynamics), sociocultural (e.g. consumption patterns), economic (e.g. trade), technological, or relating to institutions, governance, conflicts and epidemics. These indirect drivers are underpinned by societal values and behaviours. The colour bands represent the estimated relative global impact of direct drivers based on the literature. Land and sea use change and direct exploitation account for more than 50 per cent of the global impact on land. The circles illustrate the magnitude of the negative human impacts on a diverse selection of aspects of nature over a range of different time scales based on a global synthesis of indicators.

Source: IPBES (2019, p.25).

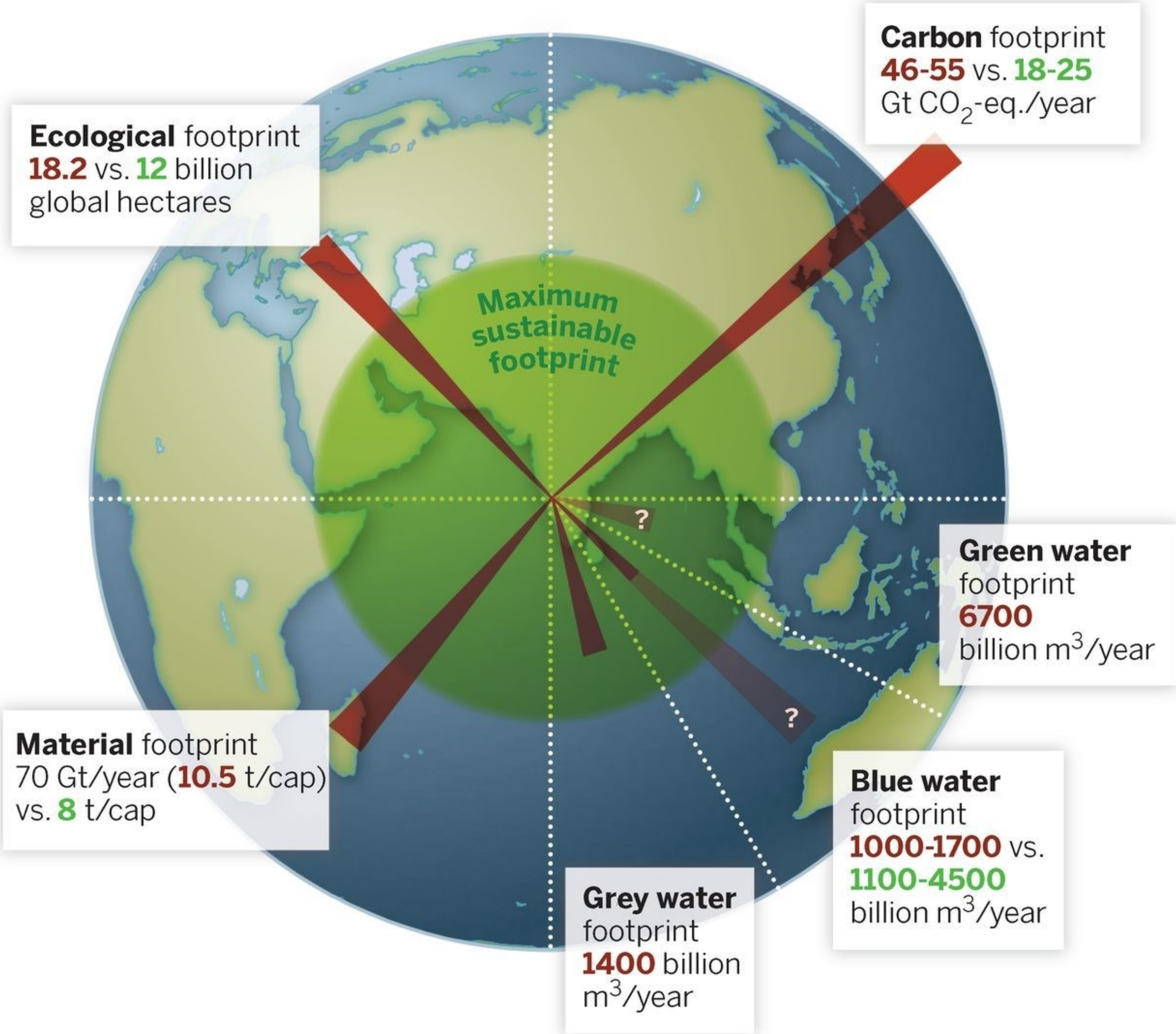


Figure 23: Estimated global footprints versus their suggested maximum sustainable level

The inner green shaded circle represents the maximum sustainable footprint. Red bars represent estimates of the current level of each global footprint. The red numbers indicate actual footprint compared to the green numbers which indicate maximum sustainable capacity (where known).

Source: adapted from Hoekstra and Wiedmann (2014).

The current literature identifies many gaps within the knowledge, recommends a wide range of solutions, and priorities for future food policy. The central assumptions are both that the existing human footprint is not sustainable and that urgent, transformative changes are required to ensure future sustainability. Hoekstra and Wiedmann (2014) provide estimates of current global footprints for carbon, ecology, material, and water, comparing each to its maximum sustainable level, where known (figure 23) to quantify the sustainability, efficiency, and equity of resource consumption. Water is sub-divided into the virtual water categories, with green water being held within soils, blue water in the oceans, and grey water being used water from households. This overview is useful when considering individual food systems, such as Spanish strawberry growing in Seville, which currently uses half of the green water from nearby, wildlife-rich wetlands (Leahy, 2015), or viticulture increasing irrigation needs as future temperatures increase (Hannah *et al*., 2013).

The research on the biodiversity of ecosystems also has implications for future food policy (Parsons and Hawkes, 2019a). Generic recommendations include the need to conserve, restore and use the natural environment in a sustainable way (Wilson, 1985; Jackson *et al*., 2007; State of Nature Partnership, 2019), and especially to meet the SDGs (Díaz, 2019; Pahl-Wostl, 2019). This includes maintaining global temperature-increases to 1.5°C rather than 2°C as per the 2015 Paris Agreement, which will significantly reduce the number of species facing changes to their current habitat range, thereby improving environmental and human health (deClerck *et al.*, 2017; Smith *et al*., 2018b). Many studies see an urgent need to appraise existing policies and evaluate any unintended consequences to the environment (Lim *et al*., 2017), such as with the Common Agricultural Policy of the EU (CAP) (Barkham, 2018). Smith *et al*. (2018a) suggest that demand-reducing policies offer the greatest potential but can take longer to realise, so these will be needed in conjunction with quicker, supply-driven policies. Further papers call for the reformulation of food systems, so they can feed people, maintain the environment, and provide financial payments for ecosystem services (Biodiversity International, 2016; Schroter *et al*., 2017; Bell *et al.*, 2018). Some see this policy transformation as being critical for future food security (Lenné and Wood, 2011; Burlingame and Dernini, 2012; Bommarco *et al.*, 2018). Chaudhary and Kastner (2016) find biodiversity losses were 83 per cent for domestically consumed products, compared to 17 per cent for exported products. In addition, developing countries with higher GDPs were major net importers of the biodiversity impacts, especially for crops with disproportionately high biodiversity impacts such as palm oil, sugar, and coffee. Stewart and Lal (2017) evaluate cereal grains, which provide 50 per cent of the world's calories, and raise serious concerns in relation to the environmental impacts of the nitrogen and phosphorus fertilisers applied every year. In the case of nitrogen, for example, Erisman *et al.* (2008) suggest 83 per cent is lost to the environment, resulting in water and air pollution, GHG levels and the loss of biodiversity. Alders and Knock (2017) suggest biodiversity could be better achieved by creating nutrition-sensitive landscapes, to help facilitate consumer understanding of food systems. Numerous studies recommend improving sustainability metrics and performance assessment, such as environmental impact assessments (Pullman *et al*., 2009; ITC, 2012; Allen *et al*., 2014; Knight *et al*., 2014; Motesharrei *et al*., 2014; Horwitz, 2015; IUFN, 2015; Pasqualino *et al*., 2015; Sala *et al*., 2015a; Sala *et al*., 2015b; Chaplin-Kramer *et al.*, 2017; Hubeau *et al*., 2017; Norgaard, 2017; Allen *et al*., 2018; Hamlin *et al*., 2018; Olawumi and Chan, 2018; Alison *et al.*, 2019; Crenna *et al.*, 2019; JNCC, 2019; NAP, 2019c) and improved modelling techniques (Hirsch *et al*., 2018). Other studies evaluate the potential for new agricultural technologies such as conservation agriculture (Lim *et al*., 2017; Hirsch *et al*., 2018; Michler *et al*., 2019), conservation partnerships (Monahan and Theobald, 2018), key directions for further research (Pretty *et al*., 2010; Little, 2013), and the need to identify and conserve those crop wild relatives most at risk from climate change (Jarvis *et al*., 2008; Bharucha and Pretty, 2010). The JNCC (2019), the public body that advises the UK Government on nature conservation, provides regular updates on achieving the 20 Aichi biodiversity targets for the 1993 multilateral treaty '*Convention on Biological Diversity*'. Their latest assessment of UK performance is mixed: good progress in some areas but much more required in others; areas that are particularly challenging include pollution, vulnerable ecosystems, the conservation status of species, and restoring degraded ecosystems; with the fall in funding for biodiversity making it increasingly difficult to assess. This status reinforces the persistent calls for a more robust, scientific approach to ecological protection (Watson *et al*., 2015). Sutherland *et al*. (2013) suggest that ecology will increasingly need to merge related disciplines to enable a new ecological synthesis that transcends traditional boundaries to emerge. Further studies see genetic manipulation as a way of ensuring future food security (Swaminathan, 2012; Frewer *et al*., 2013; Klümper and Qaim, 2014; Ortiz, 2015; Schnurr, 2015; Yin-Ling, 2015; NAP, 2016; NRC, 2016; NAP, 2017a; NAP, 2017b), although warnings regarding the private ownership and control over future genetic resources is acknowledged (Zerbe, 2015; Cookson, 2017; Cowling *et al*., 2019). Despite the claims of robust evidence in favour, consumer perceptions remain a significant differentiating factor in many markets (Stauss, 2008; FAO, 2010d; Dunwell, 2014; Lynas, 2018; McFadden and Malone, 2018). Others advocate agro-ecological food production as essential in maintaining genetic diversity and ensuring food security (Trace, 2014).

2.4.4 Environmental pollution from food production

As global diets continue to shift towards foods associated with higher environmental impacts, further and rapid increases in environmental degradation are projected. Food production and consumption substantially contributes to pollution at every stage in the food system; exposure to such pollutants can also bring about the demise and ultimate extinction of species. Carson (1962) provides one of the early warnings about human poisoning of the biosphere through the bioaccumulation of chemicals. It can take years for the environmental impacts of such chemicals to become apparent and there is no regulation or monitoring in many markets, including the UK, to limit pesticides across whole landscapes (Lee *et al*., 2002; Antelo *et al*., 2012; Carrington, 2017a; Milner and Boyd, 2017; Keulemans *et al*., 2019). This is also of concern to human health. For example, von Ehrenstein *et al*. (2019) found a correlation between an offspring's risk of autism spectrum disorder following prenatal exposure to ambient pesticides within 2000 metres of their mother's residence during pregnancy. The glyphosate herbicide also presents a direct risk to human health as a carcinogen, with the Zhang *et al*. (2019) meta-analysis finding a compelling link between exposures and increased risk of non-hodgkin lymphoma. Bøhn and Millstone (2019) estimate 2,500-10,000 tonnes of glyphosate enter global food chains every year. An example of the extreme level of damage pollutants cause can currently be seen in the marine environment off the west coast of Scotland. This is home to one of the last remaining, resident pods of Orcas (killer whales). A post-mortem on one that died in 2016 showed 950mg/kg of polychlorinated biphenyls (PCBs) stored in its body fat. Not only is this one of the highest levels ever recorded (McKain, 2017), it is more than 100 times over the 9mg/kg threshold beyond which damage to health is known to occur; well above the 150mg/kg that are known to affect reproductive health, which probably explains why no new orcas have been born into this pod in the last quarter of a century. This present inability to breed, is seen a strong evidence that the pod is doomed to extinction (Carrington, 2017c; McKain, 2017; WWF, 2017g). Other UK species of Cetaceans including dolphins and porpoise are thought to be at similar risk from the consequences of PCBs. PCBs were once widely used in electrical products, hydraulic fluids, and lubricants prior to being banned in 1979, following concerns over their risks to human health. They are highly toxic, carcinogenic, endocrine disruptors with half-lives of 10-15 years that can bioaccumulate in living organisms. Some estimates suggest more than 50 per cent of the PCBs produced by companies like Monsanto remain in the environment, following many years of improper disposal. They can also be transported over long distances and bind strongly to soil and sediment, remaining in the environment as a pollutant and entering the food chain where they are commonly found in fish, meat, and dairy products. Further evidence that pollution may cause future, global extinctions includes over 600 species of sea creature ingesting plastic in the deepest parts of the ocean (Jambeck *et al*., 2015; Embury-Dennis, 2017; Foot Print, 2018). Around 80 per cent of the increase in the amount of plastic entering the ocean is from waste generated on land (Jambeck *et al*., 2015; Tearfund, 2019) with predictions that the global quantity of plastic in the ocean will double to 250m tons by 2025 (McKinsey, 2015, Verdict, 2018).

2.4.5 Soil degradation

Soil degradation is posing an increasing risk both to food security and the environment. Defined as the physical, chemical and biological decline in soil quality, it can be caused by a multitude of factors depending on what humanity does to it; examples would include the loss of organic matter, falling fertility, structural problems, erosion, excessive flooding changing salinity, acidity or alkalinity, and the effects of toxic pollutants. Much of the research considers the impact on current locations of food production. Al-Amin and Ahmed (2016) suggest the impacts of climate change cannot be measured on a global basis because of regional differences, between countries, or even within countries. A number of studies call for the need for further research into technological solutions to improve resource-use efficiency of soils (Lal, 2004; Pimentel, 2006; Montgomery, 2007; Meacham, 2013; Stockmann *et al*., 2013; Melchett, 2014; Chappell *et al*., 2015; Gregory *et al*., 2015; Sustainable Food Trust, 2015; Verma and Jaiswal, 2015; Folberth *et al*., 2016; Rojas *et al*., 2016; Gregory, 2017; Hermann *et al*., 2017; Vidal Legaz *et al.*, 2017; Chen and Mueller, 2018; Rumpel *et al*., 2018; Green 2019; Union of Concerned Scientists, 2019), land-use, genotypes and biotechnology (Pimentel, 2006, Royal Society, 2009; Global Panel, 2015; Gregory and George, 2011; Quaye, 2012; Schonwald, 2012; Klümper and Qaim, 2014; Anderson *et al*., 2016; Moomaw and Tzachor, 2017; Gao, 2018; Mattick, 2018; South, 2018; Tyczewska *et al*., 2018), soil macroporosity (Hirmas *et al*., 2018), and soil organic carbon (Chabbi *et al*., 2017; Johnston, 2017; IFOAM, 2018).

Similar studies have attempted to identify strategic research priorities for the UK food system, which has become increasingly dependent on overseas countries for food over the past two decades (Maye and Kirwan, 2013). During this time, the land area required has increased by 23 per cent with 70 per cent of the associated cropland and 64 per cent of the GHG emissions being in countries such as South America, the EU and south-east Asia (de Ruiter *et al.*, 2016). Although the historical argument weighs the economic development benefits of such trade against the environmental damage (Brooks and Place, 2019), there are growing concerns about the future consequences in terms of the UK's own food security and consumption patterns. As food crises in the UK is no longer unthinkable (Ambler-Edwards *et al.*, 2009), the UK cannot risk taking food supply for granted (Maye and Kirwan, 2013). An earlier DEFRA funded study (Parry *et al.*, 2005) identified the need for policymakers to adapt to a more uncertain world where the risk of crop failure is more common. The 2008 Climate Change Act set a target reduction in the total annual GHG emissions by 80 per cent by 2050 (Wickramasinghe *et al.*, 2013). Ingram *et al.* (2013) suggest UK research priorities should include impacts on availability of raw materials, improving sustainability without expanding the social and environmental footprint overseas, and how food prices or other financial mechanisms can account for the environmental and health externalities in food. The UK Adaptation Sub-Committee (ASC, 2016) has identified six key areas of climate change risk that need to be managed as a priority. Specifically, the ASC is calling for further research to offset the risks to domestic and international food production, and to understand and manage the potential for long term shifts in global food production.

2.4.6 Land scarcity and degradation

Land degradation is the decline in the productive capacity of land and the associated diminution of its potential uses or value. Land is always fixed in terms of availability and often faces competing uses depending on the prevailing economic need. In terms of food production, the carrying capacity of land ultimately determines the number of calories available to feed a given population. Land use and degradation are determined by a complex interaction between numerous policy variables, such as soil erosion, degrees of land degradation, population demands, and ecological fragility. Global human activity currently exploits more than 70 per cent of the Earth's ice-free land surface (IPCC, 2019a), with agriculture accounting for 38 per cent of this land use; around 12 per cent is used for growing crops and a further 26 per cent used for pastures (Smith *et al*., 2008; FCRN, 2019h). One early study found that 23 per cent of all agricultural and forest lands had become degraded since the mid-1900s (Easterling and Apps, 2005). Global croplands, pastures, plantations, and urban areas have all expanded in recent decades, accompanied by large increases in energy, water, and fertiliser consumption (Lotze-Campen *et al.,* 2008; Cohen and Garrett, 2009; Tacoli *et al*., 2013; Garnett, 2015; Mathijs, 2015; Morgan, 2015; Ravetz, 2015; Goldstein *et al*., 2016; Roseland and Spiliotopoulou, 2016; SFC, 2016; Thyberg and Tonjes, 2016; Alberti *et al*., 2017; Chapman *et al*., 2017; Hamman *et al*., 2017; Tapia *et al*., 2017; Tefft *et al*., 2017; Capulto, 2018; Desmit *et al.,* 2018; Diekmann *et al*., 2018; Krayenhoff *et al*., 2018; Vieira *et al*., 2018; Wei *et al*., 2018; Zimmermann *et al*., 2018; Goodman and Minner, 2019; Lohrberg, 2019; Nie *et al*., 2019; Urban Food Futures, 2019; Diekmann *et al.*, 2020). Intense urbanisation in Europe between 1990 and 2006, for example, is estimated to have reduced food production capacity by more than the equivalent of six million tonnes of wheat (Gardi *et al*., 2015). High-resolution satellite imagery from the European Space Agency has revealed 22 per cent of the Earth's habitable surface has changed, primarily from forest to agriculture, since 1992 (Nowosad *et al*., 2018). The result is loss in biodiversity and habitat, meaning many species of wildlife are forced to share land with food production (Lambin and Meyfroidt, 2011; Lambin, 2012; Committee on Climate Change, 2018d; FCRN, 2019e) and increasing rates of marine eutrophication (Döll and Schmied, 2012; Bailey *et al*., 2015b; Sinha *et al*., 2017; Desmit *et al*., 2018; Poore and Nemecek, 2018; Sinha *et al*., 2019). Humans have traditionally only been able to produce as much food as the local ecology and soil conditions would support. These crops removed nutrients which had to be replenished if production was to be sustained. More recent production techniques have used fossil fuels for fertilisers to maintain soil productivity. Mechanisation has enabled major land-use change, but it has come at a cost. In the Lincolnshire Fens, for example, the drained peat-land soils are disappearing at a rate of 2cm a year (Krzywoszynska, 2019), with the UK Adaptation Sub-Committee warning they could disappear altogether within a few decades (Krebs, 2013). Historically, when phenomena were not particularly well understood, myths arose to provide ætiologies that explained the origins of various social or natural phenomena. In the Lincolnshire Fens, even the bog spirit '*Tiddy Mun's*' control over the waters and therefore the curse of pestilence, a prominent feature in local folklore throughout the 1600-1800 period (Balfour, 1891), has more recently been specifically linked to the ecological consequences of land reclamation (Horn, 1987). Similar ecological problems are reflected globally, with press reports (Arsenault, 2014; Monbiot, 2018) and politicians (van der Zee, 2017) claiming that soils are at risk of being pushed beyond their capacity to recover, although the scientific basis that underpin these claims is less clear (Wong, 2019).

The amount of land needed to feed a population is a factor of both the production system and consumption patterns. In the UK, food production accounts for around 75 per cent of land use (Khan and Powell, 2012; DEFRA, 2013a). This amount does not, however, include food imports. The current level of food imports means the UK is heavily dependent on land overseas (RSA FFCC, 2019b), which Tukker *et al*. (2014) estimate requires 5.6 times the UK's own land area. Furthermore, more affluent, meat-based diets require more than three times as much land compared to vegetarian diets (Gerbens-Leenes *et al*., 2002) and six times more land than cereal-based diets (Gerbens-Leenes and Nonhebel, 2003), making consumption pattern more important than population growth (Grunert, 2011). One study suggests that the combined land requirement and carbon footprint of the most efficient protein sources is up to 100 times smaller than those of the least efficient (Nijdam *et al*., 2012). Such studies have helped galvanise the case for population level dietary change strategies in addition to the need for sustainable management practices (Peters *et al*., 2016). Population level dietary change can contribute substantially to meeting future food needs, though ongoing agricultural research and sustainable management practices are still needed to assure sufficient production levels.

Land-use change is arguably the most prevalent factor driving ecosystems, with food production seen as having the most severe ecosystem consequences. The process of land-use change, either directly (e.g. through deforestation) or indirectly (e.g. biofuels production leading to increased food production elsewhere) risks triggering feedbacks, increasing stresses, and further threatening vulnerable communities. Although changes in land use have enabled humans to appropriate an increasing share of the planet's resources, such changes have often undermined the capacity of ecosystems to sustain food production, maintain fresh water and forest resources, regulate climate and air quality, and regulate flooding. Tilman *et al.* (2011) suggest an additional 2.5 billion acres of land will need to be cleared globally by 2050, if current rates of demand are maintained. Land use and land-use change is also an underlying factor for a range of infectious disease risks (Shah *et al*., 2018). The challenge is managing trade-offs between immediate human needs and maintaining the capacity of the biosphere, to provide goods and services in the long-term. Land is both a critical natural asset and an increasingly important global issue, where worldwide changes to forests, farmlands, waterways, and air are being driven by the need to provide food and water (Foley *et al*., 2005; Johnson *et al*., 2016; Committee on Climate Change, 2018d). Changes in land use cause further changes to the climate (IPCC, 2019a; Krzywoszynska, 2019), with estimates for land-use change ranging from 12.5 per cent (Houghton *et al.*, 2012) to 25 per cent (Searchinger *et al.*, 2018) of anthropogenic carbon emissions, although the Tubiello *et al.* (2015) analysis suggests that it reduced from 29 per cent in the 1990s to 21 per cent in 2010. Land-use change can also cause a rapid loss of carbon (Ostle *et al.*, 2009; Cantarello *et al*., 2011). The drivers of land-use change are often separated geographically; they may be across international borders; or be the result of differing national policy regimes. Meyfroidt *et al*. (2013) provides a useful analysis of the various research frontiers that provide an understanding of land-use change (see appendix 8.13). While such changes have enabled humans to take over an increasing share of the planet's resources, they have also undermined the capacity of ecosystems that sustain food production, maintain resources, regulate the climate, and ensure air quality (Ellis *et al*., 2013; Hong *et al*., 2020). The challenge for humanity remains one of reducing nutrient emissions by changing land use without compromising food security (Hijmans *et al*., 2005; Zabel *et al*., 2014; Webb *et al*., 2017; Desmit *et al.,* 2018; Met Office, 2018a).

Future changes in land use, particularly the need for more land for food production and bioenergy, will have considerable impacts on the carbon stored within UK soils. The aim of such transformations is to reduce emissions from UK land use by 64 per cent (to 21mtCO_2e by 2050), without reducing food production or increasing food imports. It is seen as essential if the UK is to meet its SDGs and Paris Agreement commitments whilst becoming a Net Zero economy by 2050 (Vlek *et al*., 2017; Met Office, 2018f; Murphy *et al*., 2018; Brown *et al*., 2019; Committee on Climate Change, 2020). Non-governmental organisations (NGOs), such as the National Trust also advocate changes to agricultural policy support and moves to rapidly decarbonise the economy (via the *'Clean Growth Strategy'*) as an opportunity to incorporate land-based carbon reductions (Francis and Elliott, 2019). Some studies suggest that societal collapse can be avoided if the rate of environmental depletion can be reduced to a sustainable and equitable level (Motesharrei *et al*., 2014). Leal Filho and Consorte McCrea (2019, p. 126), however, cite the words of the environmental campaigner, Gus Speth, who used to believe that science would be able to address global problems such as biodiversity loss, ecosystem collapse and climate change within 30 years. He now thinks he was wrong: *'the top environmental problems are selfishness, greed and apathy, and to deal with those we need a spiritual and cultural transformation. And we scientists don't know how to do that'.*

The way land is managed is also critical in the mitigation of climate change and the natural sequestering and storing of carbon (Smith *et al*., 2008; Friel *et al.*, 2009; Almås *et al.*, 2012; FAO, 2014a; King *et al*., 2015; EPA, 2016; Mann, 2017; Dass *et al*., 2018; Lal, 2018; Poulton *et al*., 2018). As with food production, climate change poses an additional layer of risk to the ones already facing land management. Peat land, for example, contributes to climate change mitigation and adaptation in many ways, including carbon sequestration and storage, biodiversity conservation, and water regime and quality regulation (Fresco, 2009; Fleischwirtschaft International, 2017; Conservation Evidence, 2019; WMO, 2019a). Ostle *et al*. (2009) estimate over 95 per cent of the UK's land carbon stock is located in soils which are subject to a range of land uses and global changes. Previous land use policies are described as fragmented, incomplete, and unsustainable (Foresight, 2010; Committee on Climate Change, 2018d). The UK is also regarded as one of the world's more nature-depleted nations (Hayhow *et al*., 2016; RSA FFCC, 2019b). These policies have been a complex amalgam of national, EU and international policies that have prioritised food production over other land use services; the overall net effect has resulted in low innovation, slow productivity growth, wide-ranging performance, a loss of soil fertility through intensive monocultural practices, biodiversity losses, loss of peat lands, and unproductive forests. Furthermore, should the existing food production practices continue, the Committee on Climate Change (2018d) predict that the available land will not be able to support the ecosystem needs or maintain food production. They advocate new policies to promote transformational land use and deliver climate mitigation and adaptation objectives; earlier calls for a more strategic approach in the UK to land use planning (Foresight, 2010) have again been reiterated by the RSA FFCC (2019b) and is frequently advocated within the academic literature (Ostle *et al*., 2009; Martinez-Harms *et al*., 2017; Webb *et al*., 2017; Mayer *et al*., 2018; Searchinger *et al.,* 2018; van Reenen, 2019).

Much of the focus within the literature is on reversing deleterious land-management practices or revising techniques to bring about positive interventions. Although sustainable agricultural production systems are still seen as being difficult to define (German *et al*., 2017), those that include ecologically-based management strategies and habitat creation would appear to have the greatest impact (Matson *et al*., 1997; Smith *et al*., 2007; Burns *et al*., 2016; Biodiversity International, 2017; Liu *et al*., 2019) and are seen by Frison *et al.* (2011) as essential in responding to the impacts of climate change. Further studies evaluate the agronomic and ecological performance of organic production systems (Foster *et al.,* 2006; Connor, 2008; de Ponti *et al.*, 2012; Doberman, 2012; Niggli, 2014; Barbieri *et al.*, 2017a; Barbieri *et al.*, 2017b; Karlsson and Roos, 2019). Organic food production is generally perceived as being more sustainable (IFOAM, 2017; Billen *et al.*, 2018), especially as it enhances organic matter and thereby improves soil quality (IFOAM, 2018), with less risk to the environment, albeit with lower yields. The literature remains, however, rather inconclusive. Despite lower yields, these require 34 – 53 per cent less energy and 97 per cent less pesticide inputs (Mäder *et al.*, 2002; Fuller *et al*., 2005; Leifeld, 2012; Seufert *et al*., 2012; EU, 2016b; Muller *et al.,* 2017; Seufert and Ramankutty, 2017; Adhikari *et al*., 2018; Smith *et al*., 2019) and with additional benefits to both soil fertility and biodiversity. Leifeld (2012), however, found that soil organic matter was not used more efficiently within organic systems and Seufert *et al*. (2012) found yields were only 13 per cent lower, when best organic practice was used. An earlier study by Stanhill (1990) found for milk production and beans, yields were higher in organic systems over the four-year study. Other benefits include reduced exposure to organophosphate, pyrethroid, and neonicotinoid pesticide residues in humans (Hertz-Picciotto *et al*., 2018; Hyland *et al.,* 2019), albeit contrary to the EU agency European Food Safety Authority (EFSA) view on the probability of exposure to pesticide residue levels being low, and the biodiversity of concentrating organic farms into hotspots (Gabriel *et al.,* 2013; EFSA, 2019). Connor (2018), however, sees serious flaws in some of the methodological approaches previously used, arguing instead that transformation to organic methods would require land use conversion to legumes for biological nitrogen fixation, thereby further reducing the land available for food production. Liu *et al*. (2018) advocate the potential for plants to fix their own nitrogen from air, as 78 per cent of the earth's atmosphere is made of nitrogen. Currently, this is inhibited by the enzyme 'nitrogenase' which is unable to function alongside oxygen. Rather than being able to feed all the future world's population organically, Connor (2018) suggests 50 per cent as a more realistic guide. More recently, Smith *et al*. (2019) estimates the greenhouse gas impacts of converting UK food production to organic methods.

Although they found that direct GHG emissions were lower with organic production, there were major shortfalls in most food products and when imports were used to compensate for shortfalls in domestic supply, net emissions were greater.

The need to change and improve land management policies to support future sustainable production is also considered. Here the predominant issues include alternative farming techniques, such as wildlife-friendly farming and land sparing (Balmford *et al*., 2005; Ewers *et al*., 2009), no-till farming (Davin *et al*., 2014), agroecology (Lamine and Dawson, 2018; Poux and Aubert, 2018; HLPE, 2019; Perfecto *et al*., 2019), improved land-use practices (Helms, 1977; Wijedasa *et al*., 2016; Smith *et al.* 2013; Kremen and Merenlender, 2018; Ramankutty *et al.,* 2018; Mace, 2019), land ownership (Wildlife Conservation Society, 2018), the potential benefits from rewilding and habitat restoration (Monbiot, 2015; Houses of Parliament, 2016**;** Bakker and Svenning, 2018; Barkham, 2018; Cromsigt *et al.***,** 2018; Lewis, 2019), and, the differing land requirements for western diets compared to no-meat alternatives (Gerbens-Leenes and Nonhebel, 2003; Hamblin *et al*., 2018). Given the seriousness with which biodiversity loss is associated, Lanz *et al*. (2018) call for the immediate cessation of all further land-use changes, until further research has been done. Some studies advocate adherence to the '*half-earth*' principle, whereby half of the earth's surface is committed to conservation schemes by 2050 (Wilson, 2016; Dinerstein *et al.*, 2017). Roe *et al*. (2019) also argue that positive land-use change is unparalleled in terms of mitigating against climate change, but calls for immediate action now to keep temperature increases below 1.5°C.

Agricultural intensification, whereby more inputs are used to increase production, is also scrutinised within the literature (Matson *et al*., 1997; Tilman *et al*., 2002; The Royal Society, 2009; Godfray and Garnett, 2014; Pretty, 2018; Mahon *et al*., 2017; Rockström *et al*., 2017a; Rockström *et al*., 2017b; McKay *et al*., 2018; Rasmussen *et al*., 2018; Scherer *et al*., 2018; Weltin *et al*., 2018a**;** Weltin *et al*., 2018b**;** Ickowitz *et al*., 2019) and, the intensification of agriculture through the use of modern technologies such as drones, predictive weather analytics, precision agriculture, other innovations, and economies of scale to maximise production (Balmford *et al*., 2005; Garnett and Godfray, 2012; Davis, 2013; Firbank *et al*., 2013; Searchinger *et al*., 2013c; International Social Security Association, 2014; Balmford *et al*., 2015; Knickel *et al*., 2017; Sakr, 2017; Woetzel *et al*., 2017; Firbank, 2018; FCRN, 2019h; Silvestre and Tirca, 2019; Sodano, 2019; Herrero *et al*., 2020). In the case of sustainable intensification, Smith (2013) argues this must be accompanied by a fundamental change in global food systems. Sustainable intensification is not a simple solution. For example, intensive livestock production can have a smaller carbon production per kilogram of meat produced, but the water consumption may be much higher than other systems. Tansey (2013) questions whether sustainable intensification is necessary given the level of food waste, that 40 per cent of US maize is used for biofuel, and 90 per cent of the global soya crop is used for animal feed. The WWF also argue that previous intensification practices were directly responsible for ecological degradation, unsustainable resource consumption, and entrenching dependency on non-renewable resources like fossil fuels (Gladek *et al*., 2016; Waheed *et al*., 2018; Leahy, 2019). Further detail on changing land use can be found in appendices 8.9 and 8.11.

2.4.7 Ocean ecosystems and sea-level rise

Anthropogenic climate change is both weakening the ocean ecosystem through the loss of marine biodiversity and causing sea-level rise. The latter is due to meltwater from glaciers and ice sheets as well as the thermal expansion of warming seawater. Not only is the ocean home to millions of species, it also acts as a global ecological and climate regulator, so any threat to its functionality is of particular concern. Sea-level rise increases the frequency and severity of coastal flooding, so being able to establish the rate and amount of the rise is critical in terms of planning, adaptation, and mitigation strategies. Sea-level rise and coastal flooding due to global warming since 1850 is already locked-in and inevitable (Chang *et al*., 2015; Mohammed *et al*., 2017; WHO, 2017; Hook, 2018; Sellers *et al*., 2018). More than 90 per cent of the excess heat caused by climate change is stored in the oceans (WMO, 2019b), where warmer oceans accounted for 40 per cent of the sea level increase between 1993 and 2015 (Edwards, 2017). Predicting the rate and amount of this rise is extremely complex and estimates vary widely (Etheridge *et al*., 1992; Chambers *et al*., 2016; Edwards, 2017; Fasullo and Nerem, 2018; Li *et al*., 2018; Vaughan, 2020), but such estimates are invariably linked to the temperature stabilisation targets, such as 1.5°C and 2.0°C above pre-industrial level targets that originate from the Paris Agreement. Understanding these complexities is essential in being able to predict how oceans will respond to climate change. The British Antarctic Survey (BAS) is currently involved with several investigations such as the '*International Thwaites Glacier Collaboration'* in Greenland. This vast glacier is melting much faster than expected (Dieng *et al*., 2017; Vaughan, 2020), with ice loss doubling in the past two decades, equating to approximately 35 billion tonnes per annum. Should it disappear entirely, scientists predict this would not only cause an additional 65cm sea-level rise on top of the 19cm rise in the 20th Century, but also trigger a wider collapse of the entire West Antarctic ice sheet. This would have the potential to increase sea levels by a further 3.3 metres, putting many global cities such as London at risk of flooding and more extreme coastal events (Abadie *et al*., 2016; Amos, 2018; Wing *et al*., 2018; Vaughan, 2020). Around two-thirds of the world's cities with over 5 million people each are located just 30 feet above current sea level (Li *et al*., 2018). A further study by Shepherd *et al*. (2019) suggests the total loss from the Greenland ice sheet was responsible for 335 ± 62 billion tonnes per year in 2011. The Greenland ice-sheet probably can't survive above atmospheric carbon levels of 400ppm, and certainly won't survive above 550ppm (King *et al*., 2015). Furthermore, if the ice sheets in both the Arctic and Antarctic regions should melt altogether, Bamber and Oppenheimer (2019) predict sea levels would increase by 65 metres, noting the considerable difficulties in modelling exactly how ice sheets will continue to respond to climate change.

Much of the literature is focused on determining the extent of future, sea-level rise. Li *et al*. (2018) suggests the average data from models is for 0.3 to 2.5 meters (1 to 8 feet) of sea-level rise to the year 2100 due to ice sheet melting and thermal expansion; noting that the IPCC data excludes the impact of water table changes. Further estimates include an early study by Church and White (2006), for example, which suggests rises of between 28cm to 34cm by 2100. Later studies suggest significantly higher figures. Rasmussen *et al.* (2018), estimate sea-level rises by the year 2100 of 48cm (90 per cent probability of 28-82cm), 56cm (28-96cm), and 58cm (37-93cm) for each of the 1.5°C, 2.0°C, and 2.5°C scenarios. Further estimates include: 52cm by 2100 at 1.5°C rising to 86cm at 2°C and a worst-case rise of 180cm (Jevrejeva *et al*., 2016; 2018); 65cm (± 12 cm) (Nerem *et al*., 2018); Bamber *et al*. (2019) propose a sea-level rise of 200cm is used for planning purposes to 2100, beyond which 750cm is then possible, whereas (NERC, 2018) use the metric of 3 mm per year; and Mengel *et al*. (2018) predict 70-120cm providing that net-zero greenhouse gas emissions are sustained globally, but add that sea levels will continue to rise long after emissions of GHGs stop. Hinkel *et al*. (2015) warns about the reliability of IPCC data, in that their scenarios are generated by one group which aims to understand and reduce uncertainty, whereas a separate group uses a different approach to reduce risks in coastal management. King *et al*. (2015) argue that the lack of knowledge on sea-level rise thresholds for coastal communities and infrastructure is of real concern, adding the faster it rises the more expensive adapting to it will become. They also fear that it may already be impossible to avoid longer-term sea-level rise of more than 10 metres, due to the melting of polar ice sheets. Evidence from previous periods of warming during the Holocene, the last interglacial, and the mid-Pliocene has recently led scientists to predict that estimates of both temperature rises and sea levels have been under-estimated; they conclude that sea levels could rise by 6m even if the 2°C increase from the Paris Agreement is met (Cox, 2018; Fischer *et al*., 2018; Lovins, 2019). Should the current rate of carbon emissions continue, the IPCC expect temperature increases will exceed the 1.5°C limit by around the year 2034 (Matthews *et al*., 2018), whereas NERC (2018) predicts higher UK summer temperatures of up to 4°C by the 2080s.

The UK Committee on Climate Change (2017b; 2017c; 2017d) suggest that rising sea levels are one of the greatest risks to the UK; a view which is reflected in the government's environmental plan for the next 25 years (DEFRA, 2018a; DEFRA, 2018i). A further study on climate change impacts within Europe sees the UK as especially sensitive to sea-level rise, mainly in terms of its coastal systems, agriculture, and risk of river flooding (Ciscar *et al*., 2011). Warming seas, reduced oxygen levels, ocean acidification and sea-level rise are already affecting the UK (MCCIP, 2020). For example, flooding in 2007 affected 104,000 acres of farmland and cost around £90k per farmer (Benton *et al*., 2012). Despite the government's plans, however, the Committee on Climate Change (2018e) see the current approach towards protecting the most vulnerable areas to sea-level rise as not fit for purpose. Their analysis finds 1.5 million properties will be in flood-risk areas by 2080, with a further 100,000 properties at risk from coastal erosion. In addition, 1,600km of major roads, 650km of railway line, 92 railway stations and 55 historic landfill sites will also be at risk by 2100. This increased flood risk is expected as early as 2020, with large areas (over 320,000 acres) of best arable land under significant annual chance of flooding (Sayers *et al*., 2015). Figures from Lincolnshire County Council, however, suggest that Sayers' calculation is an under-estimate. They estimate that around 40 per cent of Lincolnshire lies at or below current sea level (LCC, 2019). Although currently protected by 80 miles of raised sea defences, these are now seen as being under increased risk from coastal flooding. The Fens account for around 1,500 square miles (960,000 acres) of highly productive arable land, which currently produces 30 per cent of home-grown vegetables and 20 per cent of the potatoes (BBC, 2019c) with over 80 per cent of its land area being used for agriculture (Gill, 2012). Although just 3 per cent of this original peat land habitat remains today, Lindsay (2019) estimates that one acre of tilled peat soil emits 5-12 tonnes of CO_2 equivalent per year, with these Fen emissions equating to around 30 per cent of the UK's annual car emissions. The city of Lincoln and towns including Boston, Spalding and Holbeach will also be affected by 2050 (Kulp and Strauss, 2019). DEFRA recently commissioned a report into the resilience of food supplies to port flooding on the east coast. As more than 90% of UK food imports arrive by sea, the resilience of these ports is critical to UK food security (Becker *et al*., 2013; Asgari *et al*., 2014; Achuthan *et al*., 2015; Bailey *et al*., 2015a; Bailey *et al*., 2015d). Bailey and Wellesley (2017) also see major impacts on ports and waterways as port terminals flood and river passage becomes impassable, with significant consequences for food supplies from major crop-producing regions. The east coast ports from the Tyne to Dover are responsible for 57 per cent of UK food imports including 69 per cent of pig meat, 65 per cent of fresh vegetables, 53 per cent of palm oil, and 72 per cent of the imported sugar (Achuthan *et al*., 2015). The report concludes that other ports will need to develop contingency plans, should these east coast ports be unavailable due to coastal events, and recommend that the food industry should reduce its current dependency on EU refining, processing, and consolidation centres. The Environmental Agency has similar concerns about the Port of Immingham on the highly vulnerable Lincolnshire coast. A 5-metre storm surge in 2013 caused £115m of damage and disruption to the port, which supports more than 25 per cent of the UK's electricity generation and over 25 per cent of its rail freight distribution (EA, 2018). The Committee on Climate Change (2019b) currently predict sea-level rises of between 30cm to 115cm by 2100. These latest IPCC predictions are illustrated in figure 24. They are 10 per cent higher compared to their earlier assessment reports (IPCC, 2014c; IPCC, 2014d); a trend which has continued since 2001. Importantly, they suggest that the 30cm rise associated with a 1.5°C scenario would be tough but manageable, but their expectations of 82cm for a 2°C scenario would be unmanageable. This unmanageable factor is thought to have been an element in the first mass extinction that happened at the end of the Ordovician period about 443 million years ago (Saltré and Bradshaw, 2019). The Committee on Climate Change (2018e) are assuming a 100cm or more increase as early as 2100. Beyond the year 2100, sea-level rises could increase by several metres if the temperatures stay within the 1.5°C threshold, or by over 9 metres for the 2°C scenario (Clark *et al*., 2018b). Similar predictions appear in the consumer and trade press, warning that sea levels could rise by 6 metres, threaten 1.5 million homes, and that they are rising more quickly than previously thought (McGranahan *et al*., 2007; Nicholls *et al*., 2011; Cox, 2018; Hook, 2018; Climate Central, 2019; McGrath, 2019).

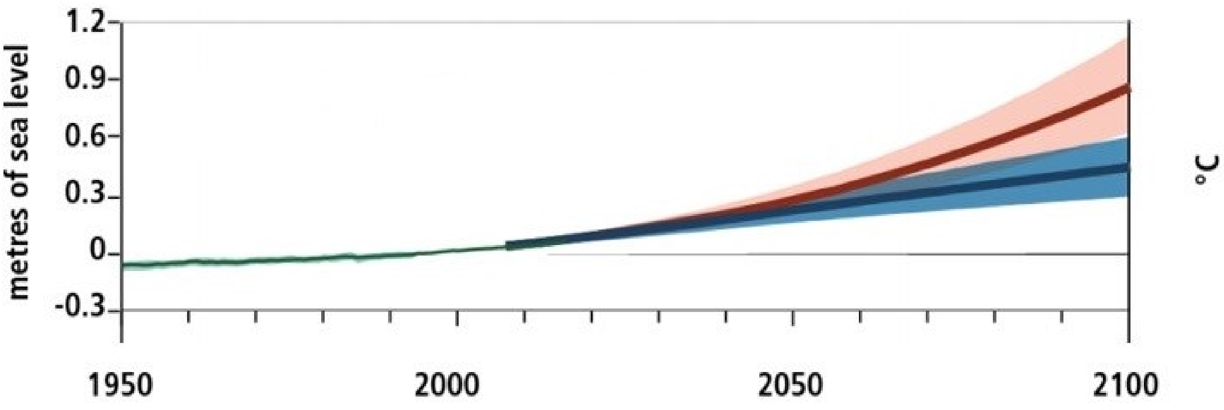


Figure 24: Changes in the global mean sea level change that have already occurred 1965-2005 and projected future changes this century under low (blue shading) and high (pink shading) greenhouse gas emission scenarios

Source: IPCC (2019b).

The additional costs associated with future sea-level rise are equally difficult to calculate. These costs include to economic growth caused by losses of land, infrastructure and physical capital, the loss of social capital, as well as the additional costs associated with coastal floods and increased coastal protection expenditure (Hallegatte, 2012; Hallegatte *et al*., 2013; Dietz *et al*., 2018; Murphy *et al*., 2018). Some studies suggest that the economic literature has under-estimated the total economic costs of sea-level rise and predict that such losses will affect developed country GDP figures (Ciscar *et al*., 2011; Chatzivasileiadis *et al*., 2018). An earlier study (Chatzivasileiadis *et al*., 2016) foresees sea-level rise causing significant changes to the global economy, especially through impacts on transport. Estimates on the number of people affected globally by 2050 range from 200m (Bamber and Oppenheimer, 2019) to 300m (Kulp and Strauss, 2019). One recent study estimates that around 66 per cent of industrial carbon and methane emissions can be traced to just 90 industrial producers; these emissions are responsible for 42-50 per cent of the increase in global mean temperatures and 26-32 per cent of global sea-level rise (Ekwurzel *et al*., 2017). They conclude that the ability to trace historical emissions should be used to inform policymaking. Brown (2018) concludes that most countries are not doing enough to prepare for the risks and Sayers *et al*. (2016) reinforce the need for urgent action against additional flood risks in the UK. The UK government allocated £1.2bn for coastal erosion and sea-flooding schemes between 2015 and 2021, but the Environment Agency estimates the cost of both river and sea defences will be in excess of £1bn a year over the next 50 years (Wall, 2019). In the case of the Fens, this includes hard decisions over what areas can be protected and what will have to be lost (BBC, 2019c) as well as how to prevent the existing high levels of soil degradation (Committee on Climate Change, 2013). Further concern raised by the government's advisors includes continued infrastructural development on floodplains (Committee on Climate Change, 2014), disjointed and ineffective legislation (Committee on Climate Change, 2018e), and the need for clear, stable and well-designed policies to achieve '*net-zero*' carbon emissions by 2050 (Committee on Climate Change, 2019b). Their '*managing the coast in a changing climate*' report (Committee on Climate Change, 2018f), however, makes few references to expected impacts on agriculture and none on food systems. Their over-riding assessment of readiness for flooding and coastal erosion, however, would appear to be one of unfit for purpose and the government must wake up to the real challenges ahead (Committee on Climate Change, 2018e).

2.4.8 Declining freshwater availability

Freshwater availability is being driven by both increasing usage and the depletion of available resources, with climate change once again being a major causal factor. The metrics for water are especially complex and problematic. For example, the social and ecological impacts of water use vary, depending on scarcity and alternative uses of water in any given location (Hoekstra, 2011). Numerous studies provide calculations on the water footprints as benchmarks for a wide array of foods and production systems (Mekonnen and Hoekstra, 2010; Mekonnen and Hoekstra, 2012; Mekonnen and Hoekstra, 2014; Green *et al*., 2018) although Thornton (2018) dismisses water footprints as lacking scientific validity and ineffective in understanding the environmental impact of water use, recommending instead that industry and location-specific measures are used. Food consumption uses 85 per cent of humanity's water footprint (Hoekstra *et al*., 2009; Hoekstra, 2011), abstraction rates are exceeding the natural replenishment rates (Strzepek and Boehlert, 2010; Wada *et al*., 2010; Turner *et al*., 2019) and contributing to current sea-level rise (Wada *et al*., 2010), with Rockström *et al*. (2009c) predicting that 59 per cent of the world's population will face blue water shortage and 36 per cent will face green and blue water shortage by 2050. The growing consumption of animal products will put further pressure on global water resources. Mekonnen and Hoekstra (2010) estimate the global average water foot prints for beef cattle (15,400 m^3/tonne), sheep (10,400 m^3/tonne), pigs (6,000 m^3/tonne) and chicken (4,300 m^3/tonne), concluding that it is more efficient to obtain calories, protein and fat through crops than animals. This is further complicated by the type of production system used, with grazing systems having smaller water footprints than industrial livestock systems (Mekonnen and Hoekstra, 2012). Crop production is also causing increasing pressures on water and land resources around the globe, with irrigated crops of wheat, rice, cotton, maize, and sugar cane seen as being largely responsible for water scarcity (Pfister *et al*., 2011).

The WWF had previously commissioned work into the impact of the UK's food consumption on water resources across the world. It found that fresh water was being withdrawn from ecosystems in the Middle East, India, Mexico, China, the USA, Africa, Spain, and Asia more quickly than it was able to be replenished (Chapagain and Orr, 2008). This then impacted each country's potential to produce its own food, as well as impacting ecosystem services for local communities such as, for example, regulating water flows, purifying water, detoxifying waste, regulating climate, providing storm protection, and mitigating against erosion. Their report finds that every British consumer used 4,645 litres of the world's water every day, compared to just 150 litres per person per day of domestic water. In total, 62 per cent of this virtual water is coming from other nation's supplies and suggests that the UK is a long way from water self-sufficiency. Other estimates suggest that it takes around 3,000 litres per day (Thornton, 2018; Vanham *et al*., 2018) to produce food for British consumers; in the USA, the comparative figure is more than 9,000 litres per day. To grow a tonne of wheat, for example, Cohen (1995) estimates takes 900 tonnes (900,000 litres) of water. As the dependency of food imports continues to increase, the amount of embedded water imported from overseas raises numerous concerns (Benzie *et al.*, 2017). Hoekstra and Mekonnen (2016; 2016a; 2016b) evaluate the UK's dependency on the import of water-intensive commodities from overseas, finding that 55 per cent of the unsustainable part of the UK's blue WF is located in six countries (Spain: 14 per cent; USA: 11 per cent; Pakistan: 10 per cent; India: 7 per cent; Iran: 6 per cent; and South Africa: 6 per cent). Around half of the water consumption is inefficient, 37 per cent of which is located in Indonesia (7 per cent), Ghana (7 per cent), India (7 per cent), Brazil (6 per cent), Spain (5 per cent), and Argentina (5 per cent). Their findings are shown in figures 25, 26, and 27. They also conclude around half of the consumption in countries such as Indonesia, Ghana, India, Brazil, Spain, and Argentina is inefficient. Turner *et al*. (2019) similarly lists India, Pakistan, the Middle East, western United States, Mexico, and Central Asia as being most at risk of unsustainable water abstraction. Of the 5.5 billion m^3 of surface and groundwater per year the UK consumes, 5 billion m^3 of that is accounted for abroad through imported food (*Nature*, 2016b). The problem is increasingly associated with certain food imports, with avocados and almonds being of particular concern (Merrigan *et al.*, 2015; *Nature*, 2016b; Facchini and Laville, 2018; Wilkinson, 2018). Finally, to mitigate against these risks, the research recommends the UK becomes more self-sufficient in food, switching to importing from water-abundant regions, avoid importing from most severely water stressed regions altogether, and collaborating with countries to increase water productivity (Hess *et al*., 2015; Hess *et al*., 2016; Hoekstra and Mekonnen, 2016; *Nature*, 2016b). Figure 28 shows countries classified into five groups. Europe is seen as being virtual water-dependent, with Africa and Asia affected by water stress. Most significantly, however, it shows that for one-third of the world's nations (i.e. water-rich and virtual water-dependent countries) their maximum sustainable population is dependent upon food availability and ultimately the available water resources. The paper also predicts that exporting countries will soon reduce the amount of virtual water they export to meet their own food demand, leaving import-dependent countries without the water needed to sustain their populations.

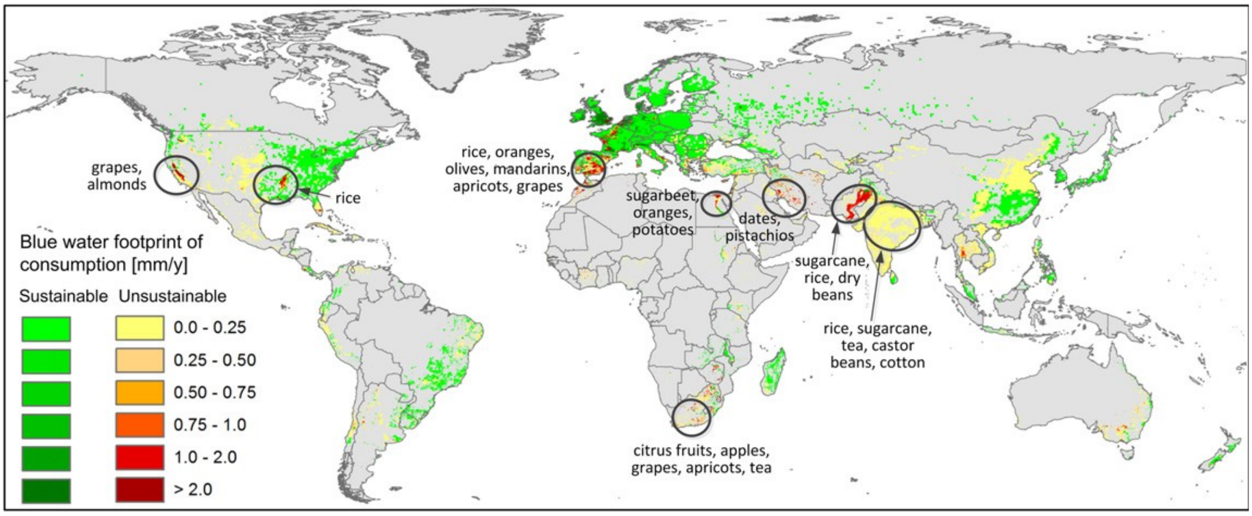


Figure 25: The sustainable and unsustainable parts of the global blue water footprint of UK food consumption with critical products in some hotspot areas.

Source: Hoekstra and Mekonnen, (2016).

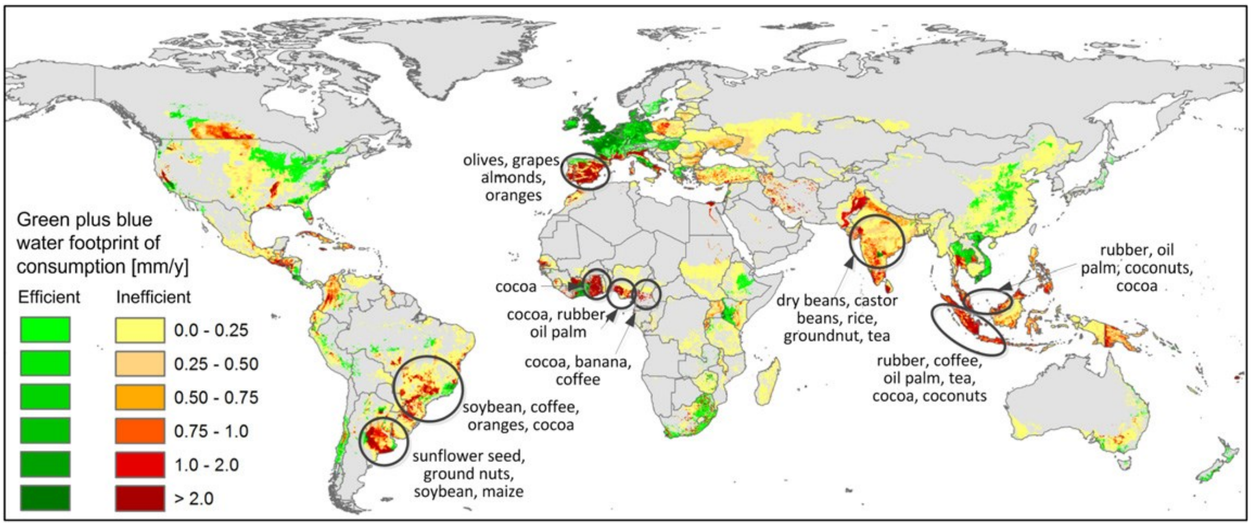


Figure 26: The efficient and inefficient parts of the global consumptive water footprint of the UK's direct and indirect crop consumption, with an indication of crops for which water productivity can be substantially increased and through which water footprints can thus be reduced.

Source: Hoekstra and Mekonnen, (2016).

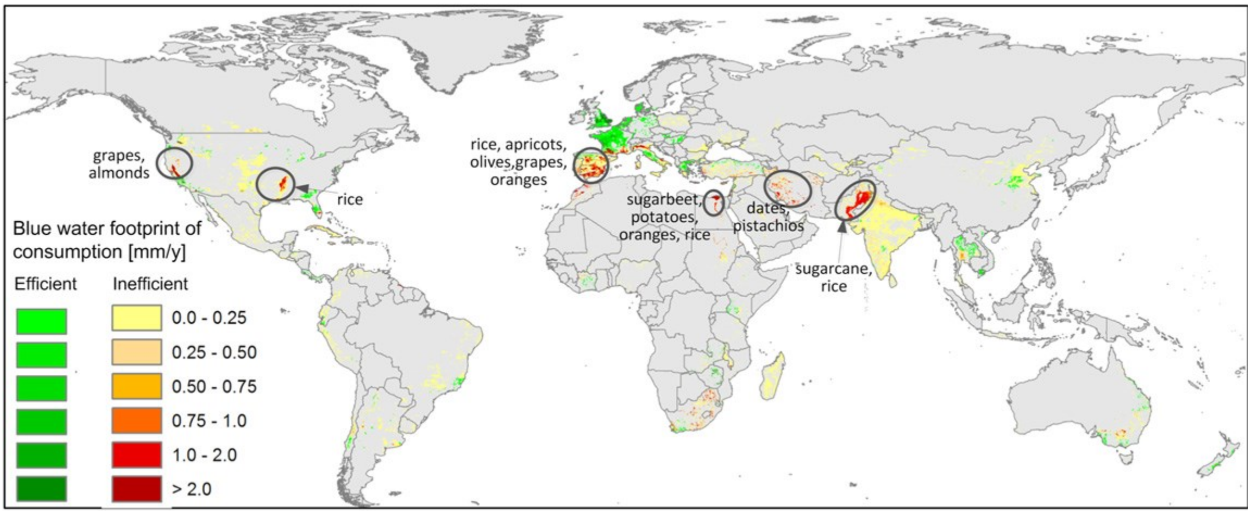


Figure 27: The efficient and inefficient parts of the global blue water footprint of the UK's direct and indirect crop consumption, with an indication of crops for which water productivity can be substantially increased and through which blue water footprints can thus be reduced.

Source: Hoekstra and Mekonnen, (2016).

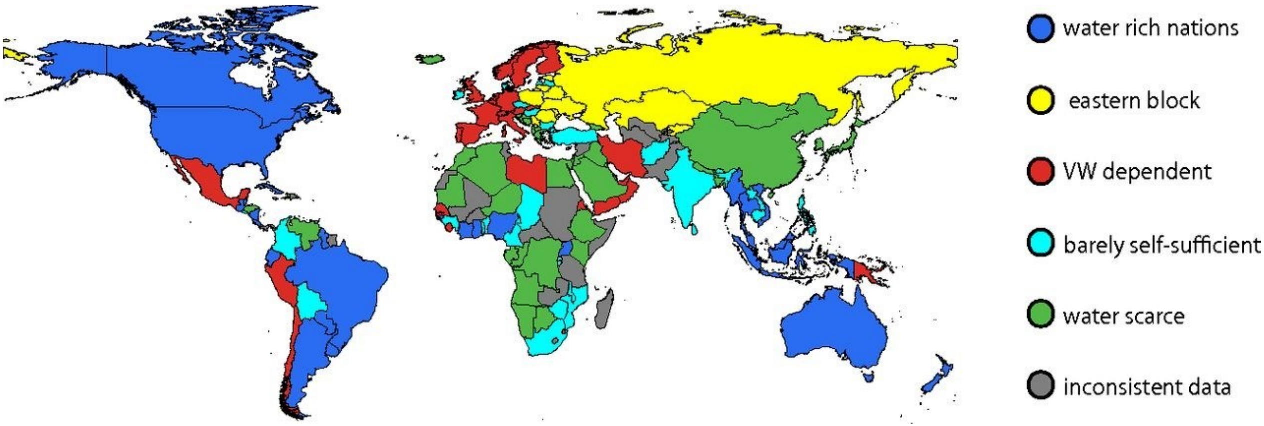


Figure 28: Countries classified on their dependency on local and virtual water (VW) resources, 1996-2005

Source: Suweis *et al.* (2013).

The food sustainability literature offers several recommendations on the policy options that would improve and ensure future water security. The FAO makes a significant contribution to the sustainability literature within its own right (FAO, 2012d; 2013c; 2014b; 2016b; 2018c; 2018d; 2018i; FAO-UNEP, 2018); similarly, the WHO (World Bank, 2016a; World Bank, 2016b; World Bank, 2016c). Early studies, such as the Swedish International Development Cooperation Agency, recommend producing more food from each unit of water and each plot of land, in response to the challenge of increasing food production without further depleting natural aquatic and terrestrial ecosystems (SIWI, 2005). Hoekstra (2014), however, states that national water policies should focus on 'sustainable consumption' rather than the present 'sustainable production'. Further studies call for major transformative changes within the global economy to reduce environmental footprints to sustainable levels (Hoekstra and Wiedmann, 2014), the need to better understand water-use efficiency in the food system (i.e. the nutritional value per drop) (Hoekstra, 2014), the opportunity to use dietary change to save water (Vanham *et al*., 2013a; 2013b), the increasing need for integrated, participative and scalable solutions for water management (Pereira, 2017), and the need to anticipate future changes and start adapting now (NERC, 2018). Any previous perceptions that the onset of climate change would be slow and measured have been proved wrong in Cape Town, for example, where water shortages have already become a major disruption (Winter, 2018). In the case of water use, Rockström *et al*. (2009c) recommend continually re-examining the range of countries that are chronically water short, as climate change is likely to impact precipitation patterns. Further studies warn of difficulties in achieving food security and environmental goals where water is limited (Rockström and Falkenmark, 2015; Rosa *et al*., 2018; Sušnik, 2018; Vanham, 2018). Rockström *et al*. (2009c) had previously raised concerns about future water shortages by 2050, predicting 59 per cent of the world population would be short of blue water, and 36 per cent short of green and blue water; the UN (2018b) further estimate this will affect 5bn people by 2050 and recommend nature-based solutions as a strategy to resolve (UN-WWAP, 2018). Science and technological advances are also critical in ensuring the future sustainability and security of global water resources (Lopez-Gunn and Llamas, 2008; Schewe *et al*., 2014; Hertel, 2015; Kantor *et al*., 2017), and especially in meeting the SDGs.

2.5 The correlation between planetary health and human health

Planetary health extends research from within the human body to include the natural systems required to sustain human health (Haines *et al*., 1993; McMichael 1993; Haines, 2016; Horton, 2016b; Prescott and Logan, 2019). The Rockefeller Foundation–Lancet Commission description, regarded as the established definition states planetary health '*is the health of human civilisation and the state of the natural systems on which it depends'* (Whitmee *et al.*, 2015, p.1978). Its aim is to bridge the gap between health sciences such as nutrition and dietetics and the natural and physical sciences that include, for example, food production, biodiversity, ecology, and environmental science (Kirkhorn and Schenker, 2001; Confalonieri *et al*., 2007; WWF, 2008a; Pitesky *et al*., 2014; Kovats, 2015; Nielsen, 2015; Scovronick, 2015; Davidson, 2016; EEA, 2018; Gamso, 2018; Inman *et al*., 2018; ISO, 2018; Readfearn, 2018). Cannon and Leitzmann (2005) also call for nutrition science to extend its reach beyond personal and population health to encompass planetary health, that is, both the welfare and future of the world in which humans inhabit. The speed of which current natural systems are being degraded is an existential threat to both health and the planet, therefore alternative directions are urgently needed to enable natural systems to regenerate, natural resources to be safeguarded, and health to flourish (Horton *et al*., 2014; Soussana, 2014; *The Lancet*, 2014; Tripathi *et al*., 2016; Endo *et al*., 2017; Horton, 2018). Horton (2013) considers the 50/50 odds given for civilisation surviving the current century, arguing that today's human-induced threats cannot be survived for long and doubting whether governments could cope when such disasters strike. Planetary health also promotes the need for evidence-based policies to promote human health and preserve the environment on which humans depend (Medical Research Council, 2019), as well as monitoring risk exposure and epidemiological research (Laurance, 2012; Rolland *et al*., 2012; Leigh and Lorkowski, 2018; Williams, 2018; Nätt *et al*., 2019).

2.5.1 The impacts of climate change on health

Climate change essentially affects health by increasing existing health problems and creating new ones. Specific impacts will affect public health, mental health, air, and water pollution, increase the risks from allergens and infectious diseases, and increase food insecurity (Costello *et al.*, 2009; Goklany, 2009a; 2009b; McMichael, 2017). These impacts on health from global environmental change and climate change are shown in figure 29. Despite concerns that climate change will be the biggest global health threat of the 21st century, studies raise concerns over the 25 years of inaction in public health (Patz *et al.*, 2005; Anderson and Bows, 2011; Adedeji *et al.*, 2014; Balbus and Malina, 2017; WHO, 2017; Watts *et al*., 2018a; Watts *et al.*, 2018b; Florin and Allen, 2019; Macmillan, 2019; Watts *et al.*, 2019).

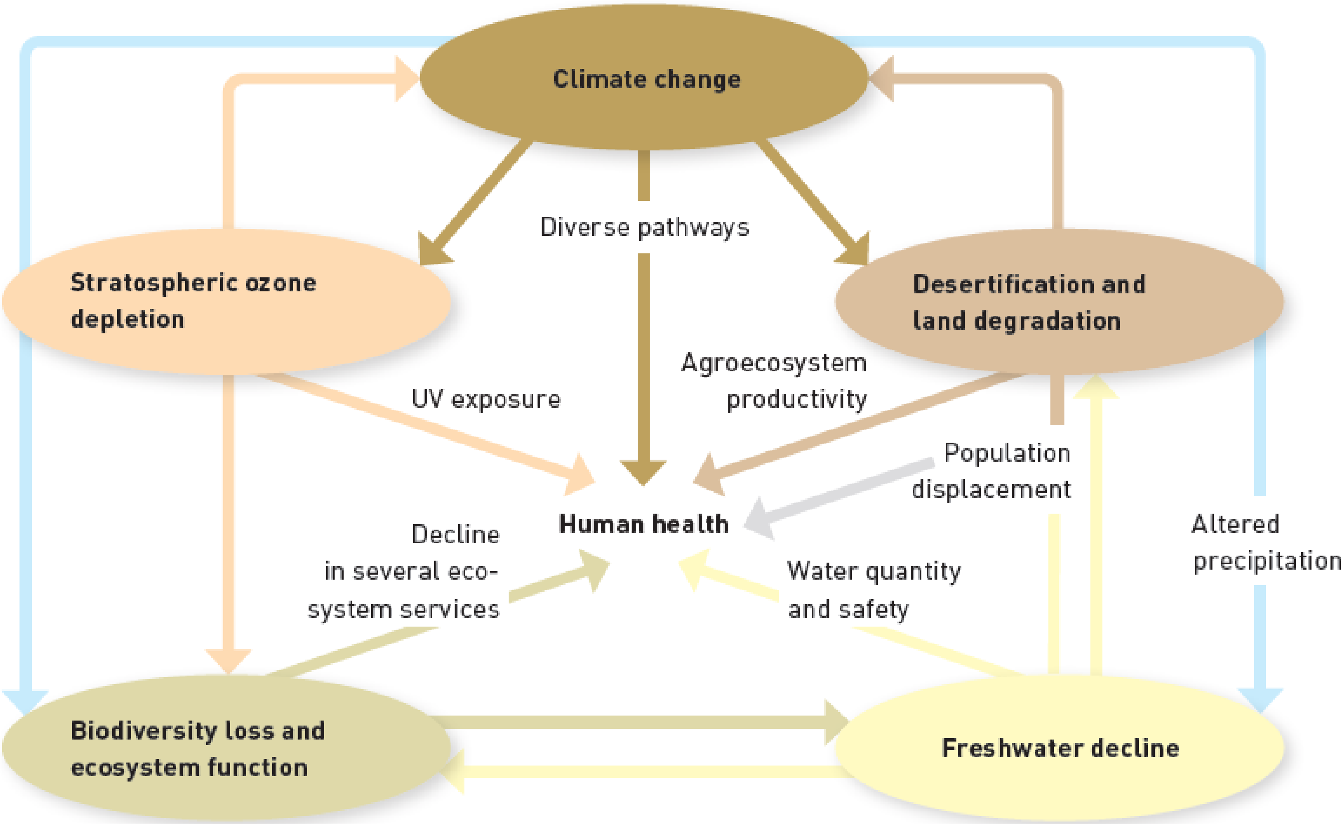


Figure 29: Global environmental change and climate change impacts on health

Source: WHO cited in Kickbusch (2010).

Various climate change models have been suggested to assess the state of the science (McMichael *et al.*, 2015; WHO, 2017; Watts *et al*., 2018). McMichael *et al*. (2015) propose a schematic diagram of the main categories of climate change-influenced health outcomes and associated pathways (figure 30). Figures 31 and 32 show the pathways provided by Adedeji *et al.* (2014) and Macmillan (2019) respectively. Although these pathways can be both positive and negative impacts, most are in fact negative (Bell *et al*., 2007; *The Economist*, 2014b; Bailey *et al*., 2015b; UK-US Taskforce, 2015; Allen *et al.*, 2018). Further studies recommend greater interdisciplinarity between governments, international agencies, NGOs, communities, CSOs, and academics to agree the adaptations necessary in response to climate change (Costello *et al.*, 2009; Costello *et al.*, 2011; Adedeji *et al.*, 2014; Kuruppu and Capon, 2016; Rutter *et al.*, 2017; Acunzo *et al.*, 2018). The public health response to climate change is essential in reducing risk, manage uncertainty and optimise the health and environmental outcomes. Surprisingly, climate change did not significantly feature in the World Health Organisation Mental Health Action Plan 2013–2020 (WHO, 2013), despite its mandate to identify solutions and help prevent or reduce health impacts (Kendrovski and Schmoll, 2019).

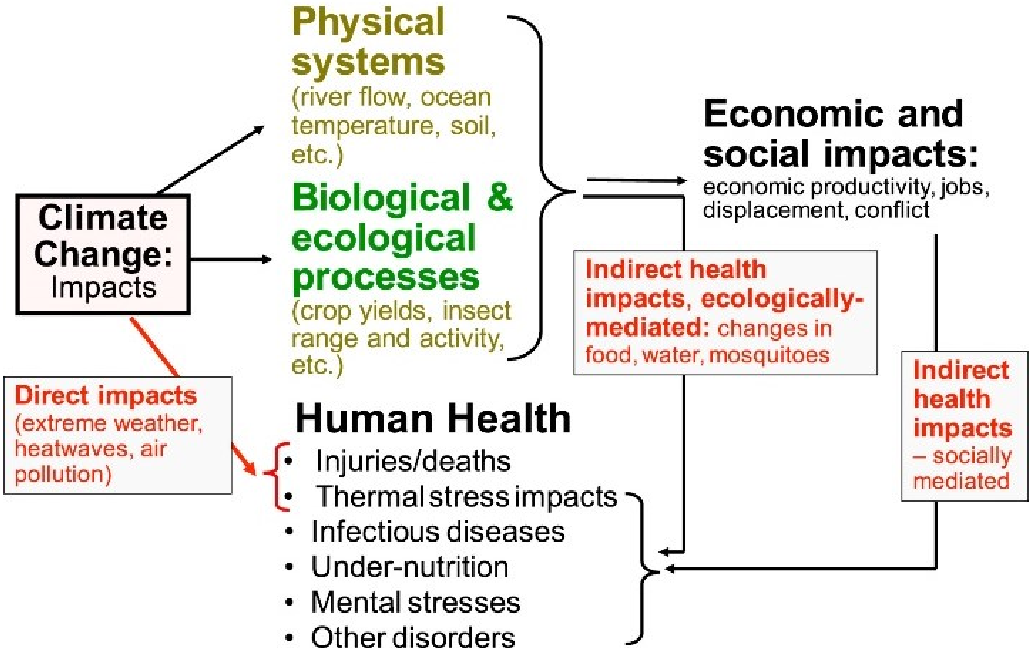


Figure 30: Schematic diagram of the main categories of climate change-influenced health outcomes and associated pathways

Source: McMichael *et al.* (2015).

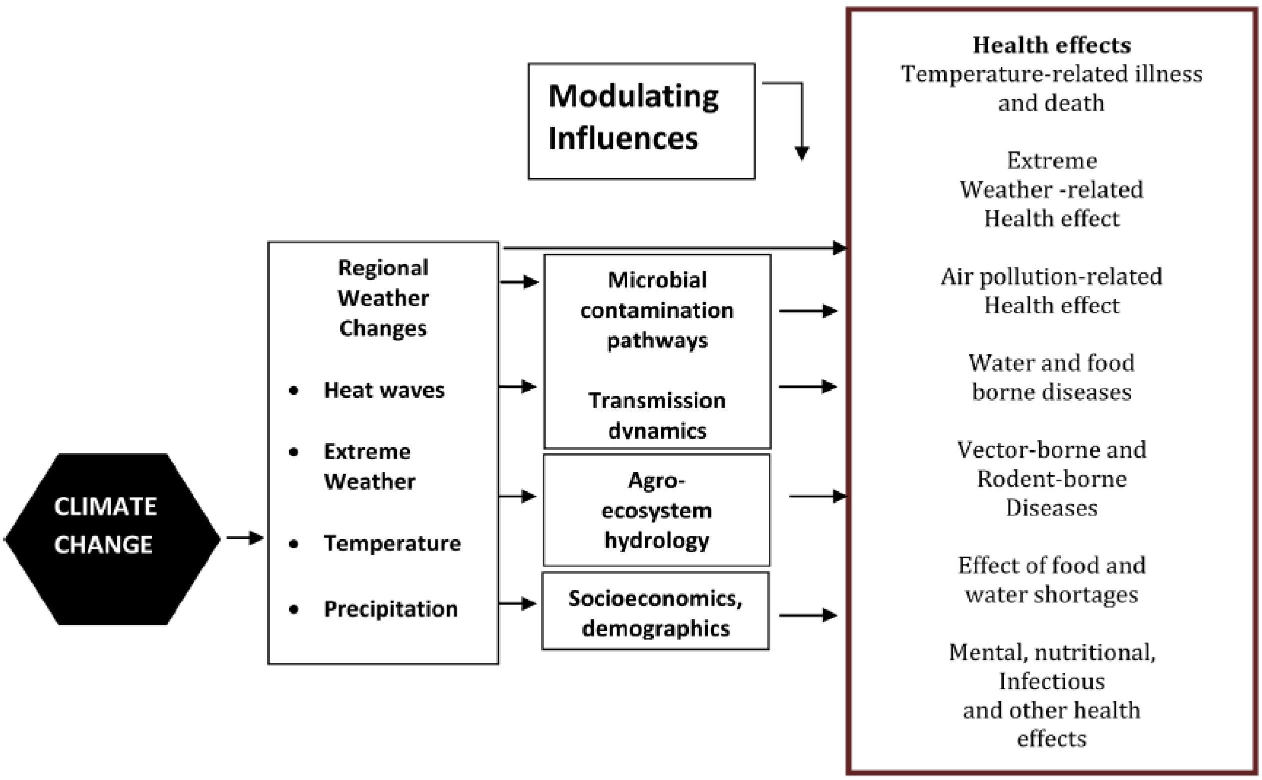


Figure 31: Pathways by which climate change affects human health

Source: Adedeji *et al.* (2014) adapted from Patz *et al.* (2000).

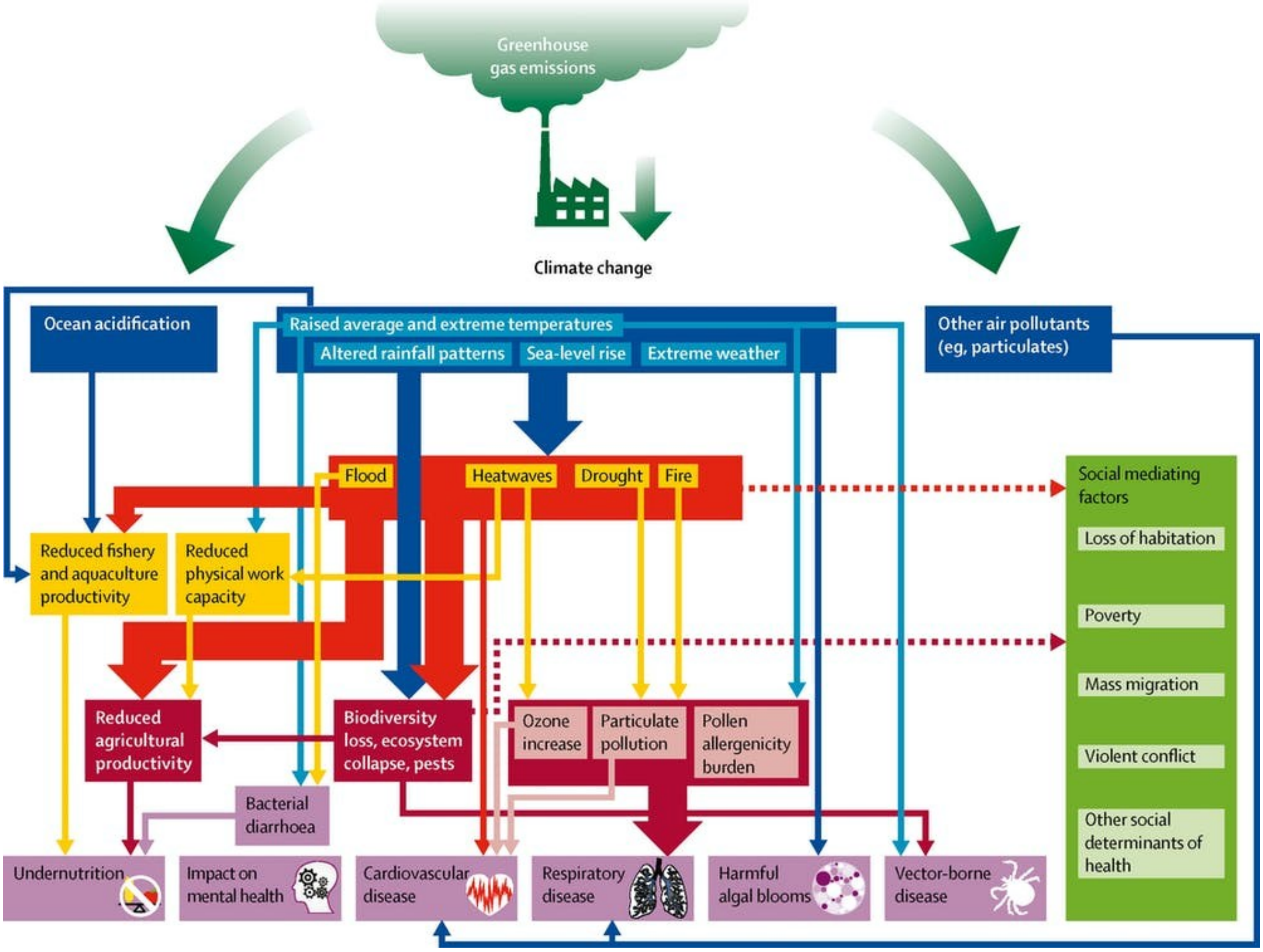


Figure 32: The pathways between climate change and human health, from the 2018 global report of the Lancet Countdown on health and climate change

Source: Macmillan (2019).

The changes brought about by climate change have the potential to affect mental health, whereas ecosystems are also sources of mental well-being and human recreation (NAP, 2019a). Numerous empirical studies attempt to assess the epidemiological evidence on how climate change might have the potential to affect mental health (Berry, 2008; Gillespie and Smith, 2008; Berry, 2009; Berry *et al.*, 2010; Reifels *et al.*, 2013; Berry and Peel, 2015; Berry *et al.*, 2015; Ejeta *et al.*, 2015; Padhy *et al.*, 2015; Robbins, 2015; Clayton *et al.*, 2017; Maxwell and Lovell, 2017; Berry *et al.*, 2018; Obradovich *et al.*, 2018). Figure 33 shows an example of how climate change accelerates a series of reactions with the potential to further exacerbate risks to mental health and well-being. Further studies cover a plethora of primary mental health issues: the anxiety caused by climate change (Berry and Peel, 2015) especially in younger generations (Majeed and Lee, 2017); the consequential impacts of flooding (Tapsell *et al.*, 2003; Reacher *et al.*, 2004; Hajat *et al.*, 2005; Munro *et al.*, 2017; Waite *et al.*, 2017; WHO, 2017), and drought (O'Brien *et al.*, 2014; Reifels *et al.*, 2014; Vins *et al.*, 2015); the temperature effects on human performance and occupational health (Hansen *et al.*, 2008; Berry *et al.*, 2011; Vardoulakis and Heaviside, 2012; Vida *et al.*, 2012; Padhy *et al.*, 2015; Kjellstrom *et al.*, 2016); and reducing the body's immune response to influenza (Food Matters Live, 2019; Moriyama and Koshiba, 2019). Further studies also cover further mental health issues: the propensity to self-harm (Williams *et al.*, 2015); disturbed sleeping patterns (Obradovich *et al.*, 2017); mental health following disasters and emergencies (Reifels *et al.*, 2013; Ejeta *et al.*, 2015; Scher, 2018). There are significant gaps within this literature, however: the mental health consequences of climate enforced migration (Hugo, 2011; McMichael *et al.*, 2012); the amplifying relationship with poverty (Hallegatte and Rozenberg, 2017); and the unintended health consequences from climate change interventions (Robbins, 2017).

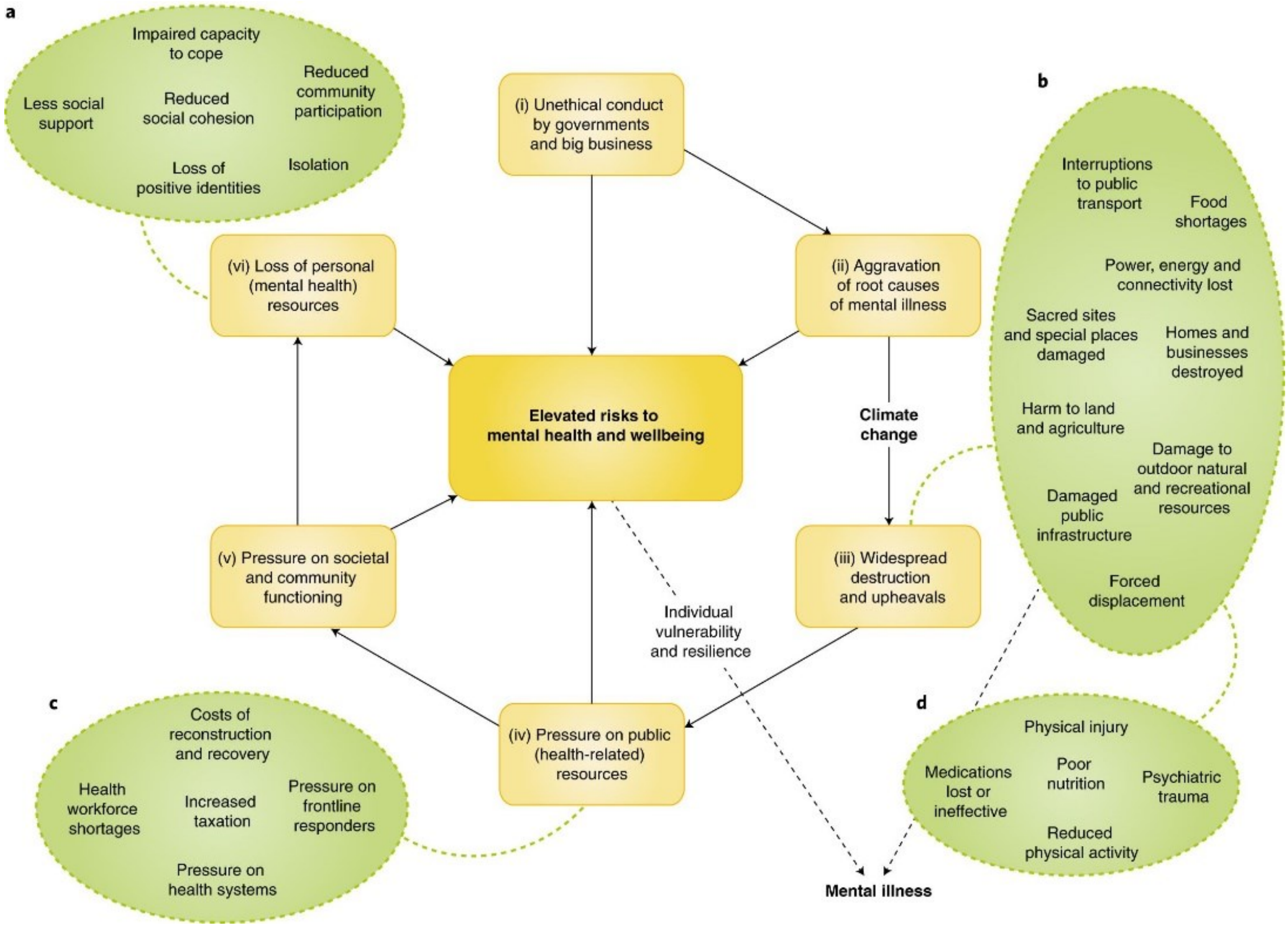


Figure 33: Elevated risks to mental health and wellbeing caused by climate change

Source: Berry *et al.* (2018).

Climate change can further affect the social and environmental determinants of health. It is also altering the distribution of some infectious disease vectors. Of particular concern is the increasing risk from animal-to-human pathogen shifts such as SARS, swine flu, avian flu, and Ebola (Kahn, 2013; Horton *et al*., 2014; Kahn *et al*., 2014; Parkinson *et al*., 2014; Davidson, 2016; Haines, 2016; Horton and Lo, 2015; Olivero *et al.*, 2017) as well as the 2020 Novel Coronavirus (COVID-19) global pandemic (WHO, 2019; Akpan, 2020; BBC, 2020; Carrington, 2020a; Lang *et al*., 2020; Settele *et al*., 2020; WHO, 2020). It can also increase the risk of heat-related illness and death (Milner *et al*., 2017). Higher temperatures can also affect human health, especially by increasing ozone level pollution and making air less healthy to breathe (Li *et al*., 2013; Tilman and Clark, 2014; Arbuthnott and Hajat, 2017; Conduto *et al*., 2017; Milner *et al*., 2017; *The Lancet*, 2018). *The Lancet* (2017b) estimate 92 per cent of the world's population live in areas over the 10 $\mu g/m^3$ WHO Air Quality Guideline and this long term exposure resulted in 27 per cent of deaths from chronic obstructive pulmonary disease, 17 per cent from ischaemic heart disease, 17 per cent from lung cancer, and 14 per cent from stroke in 2015. Landrigan *et al*. (2018) claim that this pollution is responsible for 9 million premature global deaths per annum (16-25 per cent of all deaths worldwide) and, as such, is the largest environmental cause of disease and death. Furthermore, food security is also threatened by reduced availability (Joyce *et al*., 2014; McMichael *et al*., 2015; Aleksandrowicz *et al*., 2016; de Ruiter *et al*., 2018) and lower nutrient levels in many crops (Thomas, 2007; Woodward and Porter, 2016). Figure 34 shows the population health outcomes from Friel *et al.* (2009), who also contend that whereas technological improvements to reduce emissions offer no benefits to health, reducing livestock consumption would improve health. These estimates do not include the further reductions that would be necessary to mitigate for the additional emissions resulting from land-use change overseas that is attributable to UK livestock production. Multiple studies therefore call for mitigation policies to both limit global warming and reduce the associated health risks (Kriflik and Yeatman, 2005; Smith *et al*., 2007b; Cordell *et al*., 2008; Falloon and Betts, 2010; Denton *et al*., 2014; Kahn *et al*., 2014; Gasparrini *et al,* 2017; Haines *et al*., 2018; Jenking, 2018; Moysés and Soares, 2019).

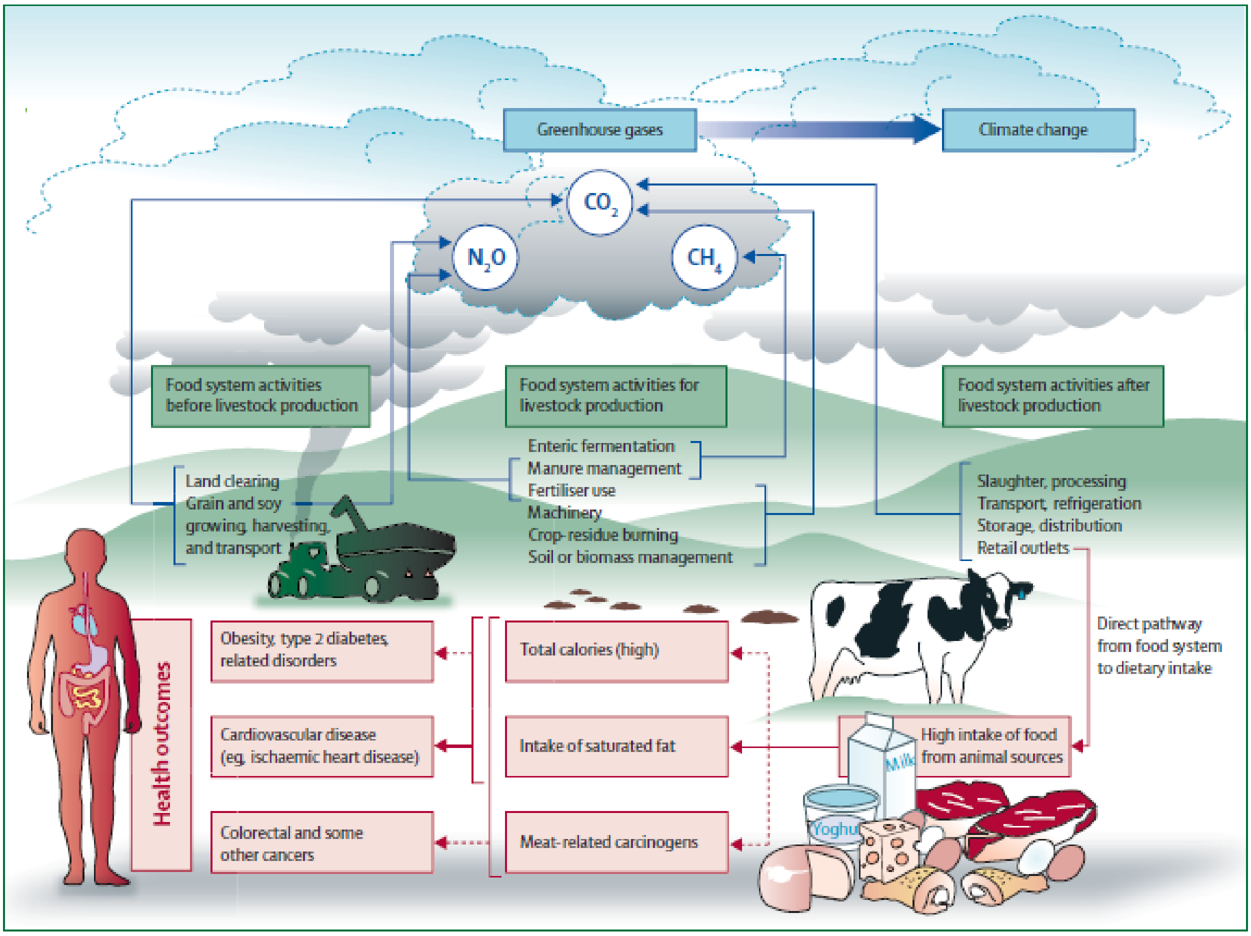


Figure 34: Processes in the food system that lead to greenhouse-gas emissions and population health outcomes

Source: Friel *et al*. (2009).

2.5.2 The health burdens associated with current UK diets

Unhealthy diets are increasingly seen as the greatest risk to health, with the way food is produced not only threatening climate stability and ecosystem resilience, but as the largest driver of environmental degradation and cause of planetary boundary transgression (World Bank, 2013b; Haddad *et al*., 2016; Worland, 2016; IPES-Food, 2017; Sifferlin, 2017; Oliver *et al*., 2018; Peeters, 2018; EAT Foundation, 2019; PWA, 2019). Table 3 illustrates some of the possible health effects as identified by Butler (2016b). These health effects invariably lead to calls for dietary guidance to promote planetary health (Aleksandrowicz *et al*., 2016; Blackstone *et al*., 2018; Chen *et al*., 2019; Lawrence *et al*., 2019; Willett *et al.,* 2019a). There is, however, a lack of consensus as to how this might be best achieved: no single change in diet will enable humanity to stay within the planetary boundaries (Sundaram, 2014); simple substitutions to individual diets can substantially reduce GHG emissions (Rose *et al*., 2019). There is much focus on animal products from diets (Cumberlege *et al*., 2015; Dinu *et al*., 2016; Bijl *et al*., 2017; Bianchi *et al*., 2018; Conijn *et al*., 2018). Plant-based diets such as the EAT-Lancet Commission's provide renewed focus (Esnouf *et al*., 2013; de Vries *et al*., 2013; Lang, 2014c; WHO, 2017c; Shepon *et al*., 2018; Einarsson *et al*., 2019; Willett *et al.*, 2019a; Willett *et al*., 2019b) but also scepticism (Cohen and Leroy, 2019) especially from industry funded research such as that by the National Cattlemen's Beef Association (Zagmutt *et al.*, 2019).

The political science literature is particularly relevant for health professions, especially with reference to improved and integrated governance structures (Barling and Lang, 2003; Lang, 2004; Costello *et al.*, 2009; Lim *et al.*, 2009; Audsley *et al*., 2010b; Stevens, 2010; Costello *et al*., 2011; Downing, 2012; Vinnari and Tapio, 2012; Whitmee *et al*., 2015; Cohen, 2018; HM Government, 2018a; Hawkes and Parsons, 2019). The WHO also call for politicians and policymakers to engage in and to support action on health (WHO, 2013; WHO, 2017). Affordability is seen as a significant barrier (Riley and Buttriss, 2011; Clonan and Holdsworth, 2012; Winkler, 2013; Donati *et al*., 2016; Dötsch-Klerk *et al*., 2016; Wood *et al*., 2018; EAC, 2019), although the evidence for this is limited and inconsistent (WWF, 2011; Macdiarmid *et al*., 2012; Saxe, 2014; McGuinness *et al*., 2016; Nelson *et al*., 2016). Nonetheless, costs for poorer consumers is arguably a barrier (Steptoe, 1999; Middleton, 2008; Lake *et al*., 2010; Barton *et al*., 2011; Steenhuis *et al*., 2011; Lammers and Kok, 2013; Padley and Hirsch, 2013; Cooper *et al*., 2014; Oxfam, 2018; FCRN, 2019f). The cost of existing UK dietary recommendations has a population-level barrier (Jones *et al*., 2018) and could cost some consumers as much as 42 per cent of their disposable income (EAC, 2019; *The Lancet*, 2019b). Insufficient access to nutritious food is a constant theme within the more recent narrative (Garnett, 2016a; Breewood, 2018; Dehghan *et al*., 2018; FCRN, 2019i; Forouhi and Unwin, 2019). Monboit (2018) suspects obesophobia and inequality may be factors in the UK's diet being seen as one of the worst in Europe and the Organisation for Economic Co-operation and Development (OECD) nations.

Planetary boundary	*Health benefit*	*Main identified existing health harm*
Atmospheric aerosol loading	Heating living areas, cooking food, electricity production	Respiratory and cardiac disease; coal burning is a major source of mercury accumulation in the marine food web
Biogeochemical flows (nitrogen and phosphate)	Increased soil fertility and food production, reduced pressure on forests (due to more intensive farming)	Can contribute to algal blooms reducing fresh water quality and quantity. Coastal blooms may reduce fishery productivity, are unsightly and in some places (e.g. China) are expensive to remediate
Loss of biological diversity	Human colonisation (e.g. in Arctic), reduced predation, increased food production	Loss of potential pharmaceuticals and other valuable products, potential 'reprogramming' of some ecosystems towards more human and animal disease, including those transmitted by insect and mammalian vectors such as mosquitoes and bats
Chemical pollution	Enables many modern technologies and materials	Endocrine disruption, cancer, birth defects, neurological conditions (including to sensitive sub-groups). Mining disasters including from failed tailings dams, Minamata disease, Bhopal, etc.
Climate change	Industrialization enabled by climate change generating processes	Heat stress, disasters, some infectious diseases, regional food scarcity, population dislocation, conflict, mental health effects, and distress
Fresh water use	Agricultural and industrial production, electricity production from dammed water	Scarcity can exacerbate 'water washed' diseases (e.g. scabies, trachoma) and also be associated with reduced water quality and thus diarrheal diseases; drought harms vulnerable farmers including their mental health
Land-use change	Increased food production	Reduced ecological integrity and climate change (see above), loss of livelihood and well-being for displaced populations
Ocean acidification	*See* climate change	Potential to reduce quantity and quality of marine food, an important source of protein and micronutrients to humans
Stratospheric ozone depletion	Fire-fighting chemicals and some fertilisers	Cataracts, skin cancer, both human and animal, including among domesticated animals

Table 3: The nine original planetary boundaries and some of their health effects

Source: adapted from Butler (2016b).

A plethora of studies raise further concerns with current UK diets. Numerous studies find concerns with childrens' diets (The Children's Society, 2014; McGuffin *et al*., 2015; Temme *et al*., 2015; Harrison *et al*., 2017; Borzekowski and Pires, 2018; Guy's and St Thomas' Charity, 2018; Soil Association, 2018; Stewart and Cole, 2019). Further studies highlight location and proximity issues (Mayén *et al*., 2014; Boseley, 2018b; Cook *et al*., 2018) or practical issues with application in particular sectors such as sports nutrition (Meyer and Reguant-Closa, 2017) or the restaurant and convenience settings (Lee and Shavitt, 2009; Shokri *et al.*, 2014; Espinoza-Orias and Azapagic, 2018; Leake, 2018). The unforeseen health impacts of antibiotic use in food production is a growing concern (WHO, 2014; Cahill *et al.*, 2017; McGettigan and Pollock, 2017; Mundaca-Shah *et al.*, 2017; *The Lancet*, 2017a; Bailey *et al.*, 2018; Bianchi *et al.*, 2018; FAIRR, 2018; Jørgensen *et al.*, 2018; Schwenkenbecher, 2018; WHO, 2018a; Bash and Donnelly, 2019; DEFRA, 2019; *The Independent*, 2019; Pradyumna *et al.*, 2019; Scott *et al*., 2019) and threatens the attainments of the SDGs (Woodward and Porter, 2016; Bailey *et al.*, 2018; European Public Health Alliance, 2018; Kruk *et al*., 2018; Rochford *et al.*, 2018; Watts *et al.*, 2018b; Clark *et al.*, 2019; FAO, 2019; Lucas and Horton, 2019). Finally, additional layers of complexity can be found in the ambiguity surrounding perceptions that organic food is healthier and safer (Magkos *et al*., 2006; Seyfang, 2006a; 2007; 2008; Vaclavinkova, 2012; Thorsøe, 2015; Mie *et al.*, 2017; Jørgensen *et al*., 2018) or more sustainably grown (Seufert *et al*., 2012; Seufert and Ramankutty, 2017); the need to conserve forests (Lambin and Meyfroidt, 2011; Lucey and Hill, 2015; Rainforest Alliance, 2015; Bebbington *et al.*, 2018; Freitas *et al*., 2018; Bastin *et al.,* 2019; Kehoe, 2019; Maslin and Lewis, 2019; May and Rehfeld, 2019; Sills, 2019); and ensuring consumers are well informed with the correct knowledge (Hughner *et al*., 2007; Lorenzoni *et al*., 2007; Krystallis *et al*., 2012; Rayner, 2017; Araus and Kefauver, 2018).

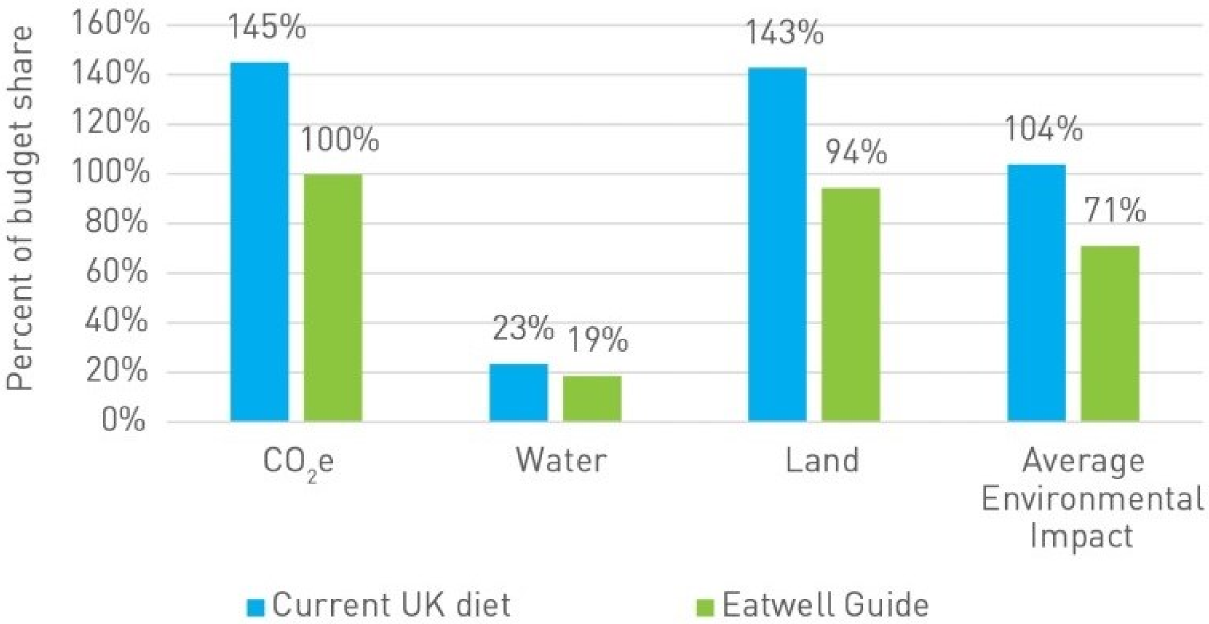


Figure 35: Impacts of the 2016 Eatwell Guide compared to the current UK diet

Source: Carbon Trust (2016a).

The definition of a healthy diet is continually shifting to reflect the evolving understanding of nutrition. The British Nutrition Foundation believe that there is no single formula for good nutrition, arguing instead that different dietary patterns derived from foods available locally is invariably the best solution (Buttriss, 2010). Their basic principles that can be applied to all global dietary patterns is shown in table 4 as dietary recommendations for a balanced UK diet. To shift the existing diet to the UK's recommended diet, Williams *et al.*, (2017) argue, would require large changes with major implications for food supply chains. The Eatwell Guide currently represents the basis by which the UK Department of Health recommends dietary intake (Lake *et al*., 2010; Public Health England, 2016; IGD, 2019a). The WWF have their own interpretation, the *Livewell Plate* that aims to enable healthy and sustainable food choices (Macdiarmid *et al*., 2011; WWF-UK, 2011; WWF, 2011; WWF, 2017c; WWF, 2017d; WWF, 2017f). Harcombe (2017) raises several weaknesses with the current iteration of the Eatwell Guide: that it has remained largely unchanged since it was introduced in 1994; that it is not evidence-based (especially no significant randomised controlled trials of the dietary guidelines); and it was originally formulated by a group comprising mainly of members of the food and drink industry rather than independent experts (see the example of Flora vegetable spread in appendix 8.16). The Carbon Trust (2016a) calculates the Eatwell Guide has a 32 per cent lower environmental footprint than the current national diet and, should consumers commit to it, they would reduce their GHG emissions to a sustainable level. Figure 35 shows the comparison to the current national (NDNS) diet graphically. Despite its lower environmental impact, it still needs to be updated to incorporate sustainable diets that will enable the 20 per cent reduction in meat and dairy consumption to meet the targets set in the Committee on Climate Change's Net Zero report (Carbon Trust, 2016; EAC, 2019; Gren *et al*., 2019; *The Lancet*, 2019d; Lassen *et al*., 2020). Although others argue that former weaknesses have largely been addressed (Rayner, 2016; Scarborough *et al.,* 2016), the Food Foundation (2018b) argue differential nutrient intakes, increasing food bank usage, and higher childhood obesity statistics are all indicators that low income households are struggling to afford the Eatwell Guide; this concern is also apparent in further studies (Jones *et al*., 2018; Ebadi and Ahmadi, 2019).

Recommendation		*Reason for the recommendation*	*Is the recommendation being met?*	
Fruit and vegetables	At least 5x80g portions/day	↓ risk some cancers, CVD and other chronic diseases	4.4x80g portions/day in adults	✗
Oil-rich fish	At least 1x140g/ week	↓ risk CVD	0.3x140g portion/week among adults	✗
Non-milk extrinsic sugars	< 11 per cent food energy (~60g/day)	↓ risk dental caries	Average 12.5 per cent energy	✗
Fat	Reduce to average of 35 per cent food energy	↓ risk CVD and ↓ energy density of diets	Average 33 per cent energy across the population	✓
Saturates	Reduce to average of 11 per cent food energy	↓ risk CVD and ↓ energy density of diets	Average 12.8 per cent energy	✗
NSP (fibre)	Average 18g/day (adults)	To improve gastrointestinal health	Average 13g/day	✗
Alcohol	Alcohol limits 3-4 units/day	Minimise risk of liver disease, CVD, cancers, injury from accidents and violence	60 per cent (♂) exceed 44 per cent (♀) exceed	✗
Salt	Average 6g/day (2.4g/day sodium)	↓ risk hypertension and CVD	Average 8.6g/day	✗
Vitamins/ minerals	Dietary reference values	To promote optimum health and prevent deficiency	Low intakes seen for a number of these in various age groups	Not all
Energy intake	2,500kcal (♂) 2,000kcal (♀)	↓ risk of obesity, some cancers, CVD and type 2 diabetes	80-90 per cent EAR	✓
Body weight	BMI 18.5-25kg/m^2	↓ risk of obesity, some cancers, CVD and type 2 diabetes	66 per cent (♂) & 53 per cent (♀) over BMI 25	✗

Table 4: Summary of achievement of dietary recommendations for a balanced diet in the UK to 2010

Notes: BMI = body mass index; CVD = cardiovascular disease; EAR = estimated average requirement; ♂ = male; ♀ = female

Source: British Nutrition Foundation (Buttriss, 2010).

The recently introduced EAT-Lancet diet (Willett *et al*., 2019a) is arguably the first global benchmark diet designed for planetary health (Hirvonen *et al*., 2020). The EAT-Lancet Commission planetary health plate can be found in appendix 8.6 and the Lancet Countdown indicators are listed in appendix 8.7. It has been overwhelmingly supported by scientists, health professionals, and NGOs for its potential to reduce heart disease and diabetes, although its association with stroke or mortality remains unproven (Anthony, 2019; BANT, 2019; Dangour, 2019; Knuppel *et al*., 2019; Lawrence, 2019; RSA, 2019c; Soil Association, 2019).

Other stakeholders, however, have raised numerous concerns: the loss of animal husbandry jobs, impact on traditional diets, and centralised control eliminating consumers' freedom of dietary choice (Torjesen, 2019). Three subsequent responses published in *The Lancet* provide further critique: on microbial species diversity in the gut (McCarthy and Li, 2019); its reliance on meaningless data that '*contributes to the fictional and physiologically illiterate discourse . . . and failed diet-centric public policies*' (Archer and Lavie, 2019, p.214); and the scale of its omissions and methodological flaws in assumptions, data collection, and modelling (Zagmutt *et al.*, 2019). Such criticisms have been robustly defended by the original authors (Willett *et al.*, 2019c; Willett *et al.*, 2019d). Furthermore, as higher carbon footprints can be associated with consumption in restaurants, confectionery, and alcohol, more needs to be done in addition to reducing meat consumption (Kanemoto *et al*., 2019). The most recently available analysis on the affordability of the EAT–Lancet diet suggests it costs, on average, more than 1.6 times the minimum cost of nutrient adequacy and, as such, would be presently unaffordable for at least 1.58 billion (or 20 per cent) of the world's poorest people without additional intervention (Hiroven *et al*., 2020). The reception to the EAT-Lancet diet from within the grey literature has, rather predictedly, been much more negative (Banta *et al*., 2018; AHDB, 2019; Blythman, 2019b; IGD, 2019a; Leroy and Cohen, 2019; Leroy and Cohen, 2019b; NFU, 2019b; Shiva, 2019b; Steele, 2019; Sustainable Food Trust, 2019a; Teicholz, 2019). One article in the Spectator, the right-leaning political and cultural magazine, describes the *'increasingly loony Lancet'* diet as a draconian, step-change designed by *'a militant coalition of vegetarians, environmental activists and health campaigners'* (Snowdon, 2019). Similar negativity is perhaps best summarised by coverage in *The Grocer*, that calls for resistance to '*a top-down attempt by a small, unrepresentative, dogmatic global elite to mould public agriculture policy*' that '*could lead to cranky diets and nutritional deficiencies in affluent countries and acute protein shortages in the poorer ones*' by a '*well-financed transnational organisation*' (Blythman, 2019a).

2.5.3 Implications of the dietary cost to health

Current food systems are seen as increasingly unaffordable in terms of both the environment and health (O'Neil, 2007; NAP, 2012b; National Research Council, 2012b; O'Kane, 2012; Fitzpatrick and Young, 2017; Fitzpatrick *et al*., 2018; Science for Environment Policy, 2018). The 2017 '*Global Burden of Disease*' ranks diet-related, non-communicable diseases (NCDs) such as Type-2 diabetes, heart disease and some cancers as the main causes of global disability and death, being responsible for 11 million deaths and 255 million disability-adjusted life years (DALYs) (Eyles *et al*., 2012; World Cancer Research Fund International, 2014; De Ridder *et al*., 2017; GBD, 2017; Haddad and Nabarro, 2018; Afshin *et al.*, 2019; Bradbury *et al*., 2019; Lawrence, 2019; Mozaffarian, 2019; *The Lancet*, 2020). Diseases associated with affluence are becoming more prevalent (Drewnowski, 2009; Swinburn *et al*., 2011; Buttriss and Riley, 2013; Imamura *et al*., 2015; Hill, 2018; da Silva, 2019). This now equates to 20 per cent of deaths being associated with poor diet (*The*

Lancet, 2019b) significantly higher than the Ng *et al*. (2014) study of 2013. In the UK, Watson and Mwatsama (2018) estimate £120bn per annum of hidden costs, £45bn of which is directly attributable to food consumption-related health costs. Air pollution alone accounts for 40,000 premature deaths and an annual £3·1bn health cost (RCP and RCPCH, 2016; *The Lancet*, 2016a; UKHACC, 2016). The annual cost of obesity is estimated at £60bn (Davies, 2019) or equivalent to 3 per cent of GDP, and it reduces life expectancy 12 years (IEA, 2017). Obese patients typically cost 30 per cent more to treat medically and have 20 per cent higher GHG emissions (an additional 700 megatons per year of CO_2e, or 1.6 per cent of worldwide GHG emissions) (Magkos *et al*., 2020). Some see this as a market failure that requires government intervention, where imperfect information has led to consumers making poor choices (McCarthy, 2004; Furceri *et al.*, 2016; Food Ethics Council, 2017b; Freebairn, 2018; Food Foundation, 2018b; *Food Service Footprint*, 2018b; Baggini, 2019). Similarly, the annual cost to treat the UK's 3.5 million diabetics ranges from £10bn, or around 10 per cent of its annual budget (Poppy and Baverstock, 2019), to £27bn (RSA-FFCC, 2019) or £4,000 per capita. Bailey *et al.* (2018) estimate diabeties treatment will reach 5 per cent of global GDP within the next decade; Hex *et al.* (2012) suggest this will rise to 17 per cent by 2035.

The true cost of food is not fully covered in its price, with many consumers unable to afford a sufficient diet, or to follow the UK's Eatwell Guide (Food Foundation, 2018b; Lambert, 2018). Furthermore, the Food Foundation (2019) cite the United Nation's Food and Agriculture Organisation measure of food insecurity, which estimated 8.4 million UK people were living in food insecure households. Research undertaken by the NGOs suggest this is contributing to the increase in use of food banks and charities (Jitendra *et al*., 2017; Loopstra and Lalor, 2017; Jitendra *et al*., 2018) and '*should be a cause for shame in the sixth richest country in the world*' (RSA FFCC, 2018b). UNICEF estimate that 10 per cent of British children are living in severely food insecure households, and Cooper and Dumpleton (2013) suggest at least 500,000 are food insecure. The government's own data acknowledges that childhood obesity rates in the UK are the worst in Europe (Sedghi, 2014; Hawkes *et al.*, 2015; Department for Health and Social Care, 2016; HM Government, 2018b; HSCIC, 2019; London Child Obesity Taskforce, 2019; Shah *et al.*, 2019). Further additional costs for degradation of natural capital such as soil, water, pollution, and biodiversity need to also be considered; Watson and Mwatsama (2018) estimate these at £30bn and £13bn, respectively. The RSA Food, Farming and Countryside Commission argue that the hidden cost of the UK's current food system must include the spiralling public health crisis and environmental destruction. Their report suggests *'what we eat and how we produce it is damaging people and the planet'* and concludes that we have just 10 years left to restore health and wellbeing to both people and the planet (RSA FFCC, 2019 p.9). The Economist Intelligence Unit's Food Sustainability Index ranks the UK 16th out of 28 European countries and 24th out of 67 countries globally on health, environmental, social and economic indicators relating to food (Economist Intelligence Unit - Barilla, 2016; 2017a; 2017c; 2017d; 2018a; 2018b).

Although measuring the economic costs of over-nutrition is notoriously complex, cited figures often ignore the impacts on factors such as learning potential and education system costs, labour productivity, and increases in healthcare, with many estimates suggesting immense public health costs (Cohen and Babey, 2012; NAP, 2012; Dimitri and Rogus, 2014; Lee *et al*., 2016; Mötteli *et al*., 2016; Izraelov and Silber, 2019). Rush (2019) argues that in addition to the direct costs of health care and associated loss in productivity, the tangible and intangible costs to society and families impact across the lifecycle (diagrammatically shown in figure 36). Finally, *The Lancet* (2019d) estimate that £17bn could be saved over 20 years with the appropriate responses to climate change and sustainability; mitigating 28,000 premature deaths in the UK (or 3.6 million globally) by reducing air pollution alone, with further reductions from food associated emissions preventing even more deaths. Maybe these financial consequences will finally compel politicians, business, and policymakers to take effective and pragmatic action on food (Winkler, 2013). Further detail on the increasing costs of health impacts can be found in appendix 8.2.

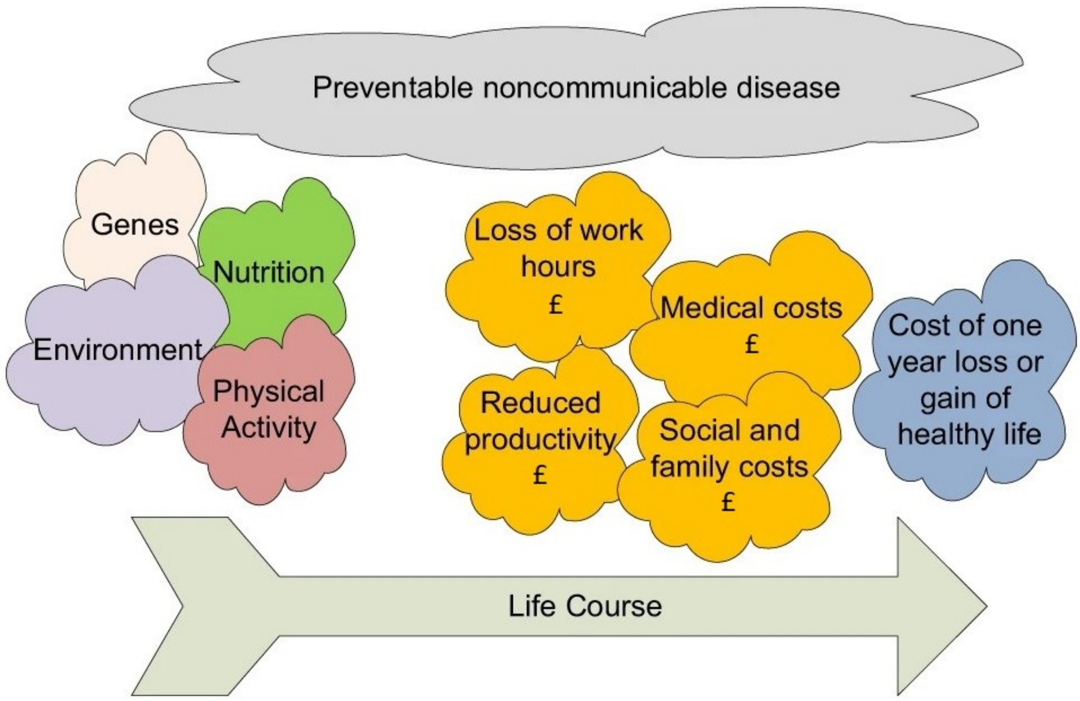


Figure 36: Factors that determine cost effectiveness of interventions over the life course

Source: adapted from Rush (2019).

2.5.4 Developing a narrative for sustainable diets

Sustainable diets need to satisfy the four domains of food sustainability – nutrition, society, the environment, and economics. But achieving these multiple and sometimes contradictory demands is both complex and challenging (Kates *et al*., 2001; Bettencourt and Kaur, 2011; Butler and Dixon, 2012; Davies, 2013; Klauer *et al*., 2013; IOM, 2014; Katz and Meller, 2014; Springer and Duchin, 2014; IPES, 2015a; IPES, 2015b; Garnett, 2016b; Mielke *et al*., 2016; EUPHA, 2017; Farmery *et al*., 2017; Green *et al*., 2017; Herforth, 2017; Kramer *et al*., 2017; Brons, 2018; Danton and Titus, 2018; Lacour *et al*., 2018; Macdiarmid *et al.*, 2018; Nature Conservancy Council, 2018; van der Leeuw, 2018; Cookson, 2019). The term sustainable diet was first proposed by Gussow and Clancy (1986) for *'food choices that support life and health within natural system limits into the foreseeable future':* the more recent FAO definition is more commonly cited within the literature as *'those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations'* which are *'protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources'* (FAO, 2010a; Burlingame and Dernini, 2012, p.7; FAO, 2019k). Although frameworks for sustainable food systems do exist (Imenda, 2014; IOM and NRC, 2015; UNSCN, 2016; FAO, 2018c) none adequately cover sustainable diets as yet (Lang and Mason, 2018). Ultimately, to be sustainable, a diet must be nutritionally adequate, safe, affordable, acceptable, appealing, and environment enhancing (Drewnowski, 2019).

A major challenge within the food–environment–health nexus is the continuing shift towards diets that are more resource intensive and less healthy (Lappé, 1971; Combris, 2006; FCRN, 2014a; Garnett, 2014b; Heller and Keoleian, 2014; Casini *et al*., 2015; Hess *et al*., 2015; Carolan, 2016; Gladek *et al*., 2016; Hess *et al*., 2016; Wilkes *et al*., 2016; FCRN, 2018j; Vieux *et al*., 2018; Hitaj *et al*., 2019). The growing use of ultra-processed food is a particularly significant and recent development within the literature (Stuckler *et al*., 2012; Monteiro *et al*., 2013; Lang, 2014c; Mozaffarian, 2016; Steele *et al*., 2017; Gallagher, 2018; Ha, 2018; Monteiro *et al*., 2018; Smyth, 2018; FCRN, 2019j; Fraanje and Garnett, 2019; Lawrence and Baker, 2019; Hall *et al*., 2019; Mozaffarian, 2019; O'Connor, 2019; Popkin *et al.*, 2019). Furthermore, they are often associated with a plethora of additional problems such as deforestation (Morton *et al*., 2006; Wilcove and Koh, 2010; May-Tobin *et al*., 2012; Carlson *et al*., 2013; Erb *et al*., 2016; Lee *et al*., 2016; McGilvray, 2016). In an observational article for the *BMJ* for example, Winkler (2013, p.1) argues that '*the problem is processed foods, the greedy companies that make them, and cowardly governments that refuse to control them*'. Nutrition is now a cross-cutting theme in all FAO strategies, including the Framework for Action for Nutrition (Thompson, 2015) and the Decade of Action on Nutrition by the United Nations General Assembly. This is, in part, a response to criticisms over a lack of clear priorities on food systems for nutrition. Further detail on the UN 'Decade of Action on Nutrition (2016-2025)' can be found in appendix

8.5. The literature also provides abundant evidence for the various dietary options of vegetarian (Haddad and Tanzman, 2003; Risku-Norja *et al*., 2009; Martindale, 2017; Van Loo *et al*., 2017; Rosenfeld, 2018; Allwood *et al*., 2019; Lawrence and McNaughton, 2019; Lomborg, 2019), vegan (Rosi *et al*., 2017; Breewood, 2018; Elliott *et al*., 2018; O'Donovan, 2019; Selwyn, 2019) and flexitarian (Sundaram, 2014; Jones *et al*., 2015; McGrath, 2018c; YouGov, 2019), although some studies argue that these options are not an inherent guarantee of sustainability. Further studies evaluate the traditional Mediterranean diet with its strong interconnection between nutrition, biodiversity, local production and culture (Burlingame and Dernini, 2011; Dernini, 2012; FAO, 2012c; Germani *et al*., 2014; Pairotti *et al*., 2014; Dernini and Berry, 2015; Dernini *et al*., 2017; Economist Intelligence Unit - Barilla, 2017a; Piscopo, 2017; Azzini *et al*., 2018; Berry, 2019; Springmann *et al*., 2018a; D'Innocenzo *et al*., 2019) and the Atlantic diet (Esteve-Llorens *et al*., 2019). Some studies advocate local food initiatives (Clonan and Holdsworth, 2012; Akenji and Chen, 2016; Dernini, 2016; Brons, 2018; Bryce, 2018; Mattioni and Caraher, 2018), but Milner and Green (2018) argue that a diet that might be sustainable, healthy, economically fair, and culturally acceptable in one region might not meet sustainable criteria in another. Sotiris and Patrick (2019) warn about growing food in urban areas because of the risk of legacy soil contamination.

Recent criticisms about the lack of cross-country comparisons (Milner and Green, 2018) have been addressed to a limited extent by a study encompassing 158 countries (Springmann *et al*., 2018b). The *Lancet Countdown* also encourage case studies as useful tools for highlighting more sustainable diets (Watts *et al*., 2016). Numerous country-based studies have found additional benefits in terms of sustainability (Upadhyay and Sachdeva, 2010; Vieux *et al*., 2012; 2013; Geeraert, 2013; Meier and Christen, 2013; Masset *et al*., 2014; Tjärnemo and Södahl, 2015; Kromhout *et al*., 2016; Röös *et al*., 2016; Khanal and Mishra, 2017; Martin and Brandão, 2017; Rösemann *et al*., 2017;Vetter *et al*., 2017; Rao *et al*., 2018; Rizvi *et al*., 2018; Schösler and de Boer, 2018 Seconda *et al*., 2018; Neset *et al*., 2019; Vetter *et al*., 2019).

The remaining sustainable food domains of society, the environment, and economics are more difficult to analyse given the diversity of scientific disciplines. Here the safety, affordability, acceptability, consumer appeal, and environmental consquences of sustainable diets are analysed. Although consumers are increasingly concerned about the sustainability of their food (Statista, 2018), this does not automatically mean it is a focal goal of purchasing behaviour (Vermeir and Werbeke, 2006; Tukker *et al*., 2008; Tobler *et al*., 2011; Truelove and Parks, 2012; Verain *et al*., 2012; Girod *et al*., 2014; Verain *et al*., 2015; de Boer *et al.*, 2018; Todor, 2019). Allès *et al*. (2017), however, did find a correlation between those with higher concerns for food sustainability and healthier diets. Lang (2017b; 2017c; 2017e) argues that sustainable food systems have to start by focusing on consumption; over-consumption is unsustainable and consumers will need help to be able to stop it (Alexander *et al*., 2016b; Alexander *et al*., 2017b; Lang, 2017e; Monbiot, 2018). Affordability is esstential, so any future policies would need to be tailored towards differing income groups, with appropriate and effective interventions where necessary (Day and Lee, 2011; Reynolds *et al*., 2019). Similarly, where food is produced and the food miles associated with getting it to the consumer remains a concern (Goodland, 1997; DEFRA, 2005; Weber and Matthews, 2008; Coley *et al*., 2009; Barclay, 2012; Allwood *et al*., 2019). There is also the recognition of the need for radical social adaptations to achieve sustainable diets (Donati *et al*., 2016; Berners-Lee *et al*., 2018).

Transitioning to sustainable diets is also urgently needed to safeguard biodiversity (Helms, 2004; Garnett *et al*., 2014; Pörtner *et al*., 2014; Reis *et al*., 2015; WWF, 2016a; Mason and Lang, 2017; Tutwiler *et al.*, 2017; Galli *et al*., 2018; Rocha *et al*., 2018; Springmann *et al*., 2018c; Bird *et al*., 2019; Lamine *et al.*, 2019; Lawrence, 2019). Overall, sustainable diets are increasingly seen as the definitive goal for the Anthropocene and requiring a Great Food Transition (Mason and Lang, 2017), the cornerstone to food security in 2050 (Berry *et al*., 2015; Clapp *et al.*, 2015e; Msangi and Batka, 2015; WWF-UK, 2015; Macdiarmid *et al.*, 2018), a way of mitigating the many effects of climate change (Wickramasinghe *et al*., 2013), and thereby enabling humanity to remain within the planet's safe operating space (Willetts *et al*., 2019). From a food safety perspective, sustainable diets are also needed to address the increasing ecological and health concerns associated with contaminants, microbes, and biotoxins (Miraglia *et al*., 2009; Lake *et al*., 2010; Tirado *et al*., 2010; Lang, 2014c; Levitt and Thomas, 2014; Poppy *et al.,* 2014b; Lloret *et al*., 2015; Golden *et al*., 2016; Jespersen *et al.,* 2017; Koufteros and Lu, 2017; Britwum and Yiannaka, 2019; Russell, 2019). There is some evidence to suggest that foods with the lowest ecological impact tend to be those recommended in healthy diets (Fischer and Garnett, 2016), although anomalies such as biscuits and cakes also exist (Dötsch-Klerk *et al*., 2016). It cannot be assumed, however, that a healthy diet will have lower GHG emissions (Macdiarmid *et al*., 2012). Mwatsama (2018) argues that the UK's food system does not support the UK government's healthy eating goals, recommending instead a framework which incorporates best practice from other food systems. Figure 37 shows the conceptual framework of the relationship between the environment and public health nutrition that is required for sustainable diets proposed by Lawrence *et al*. (2015b). There is also an urgent need for stronger public health programmes that encourage more sustainable diets to prevent the increased risk of mortality (Springmann *et al*., 2016b; *The Lancet*, 2019d).

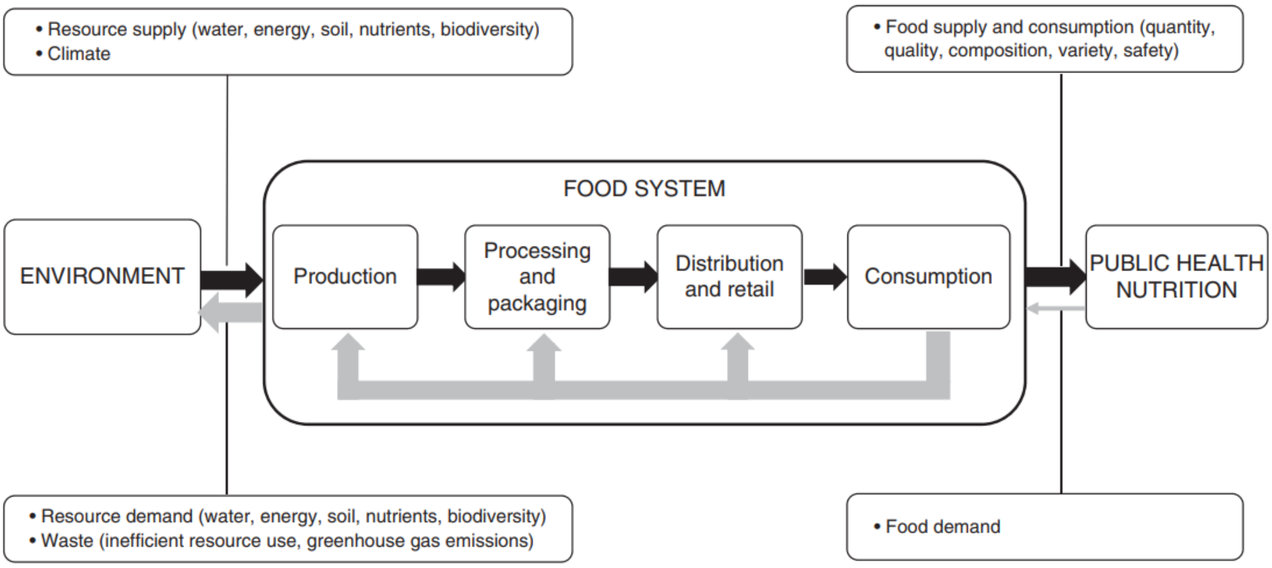


Figure 37: Conceptual framework of the environment–public health nutrition relationship for sustainable diets

Source: Lawrence *et al*. (2015b).

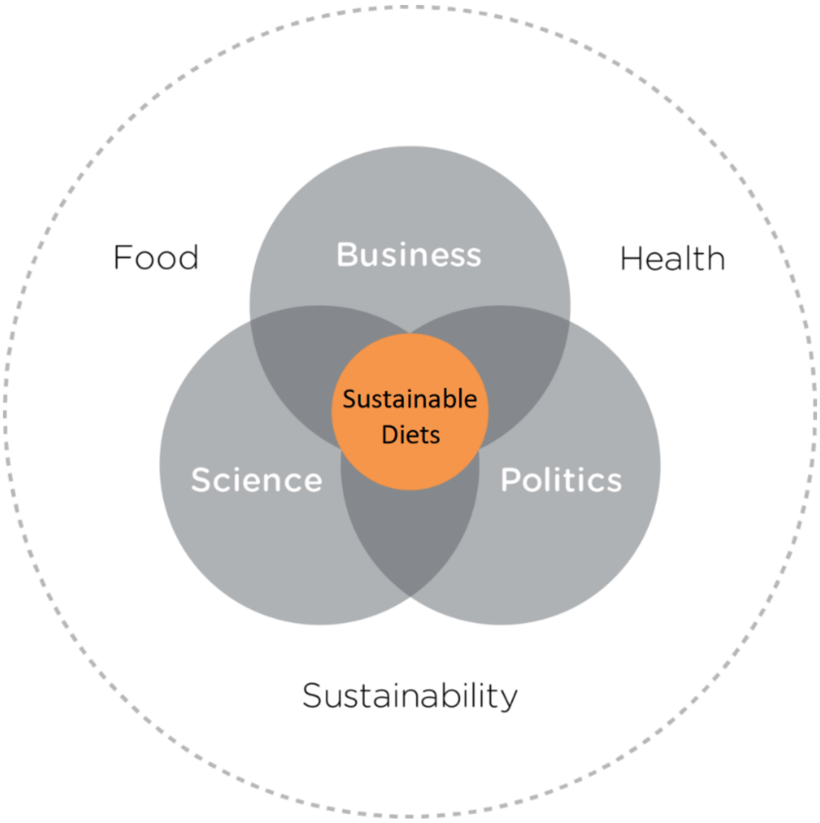


Figure 38: The '*double triple helix'* of sustainable diets merges science, business, and politics, for food, health, and sustainability

Source: adapted from Rockström *et al.* (2017a).

Figure 38 shows the double triple helix proposed by Rockström *et al.* (2017a). This model merges together the three disparate and often disconnected disciplines – science, politics and business, in order to better understand, and provide the essential interdisciplinarity needed to develop a global food system capable of delivering the goals on sustainability, health, and climate change. Macdiarmid and Whybrow (2019) have recently called for each part of the food system, from agricultural production to consumption, to be explored to ascertain where improvements can be made (figure 39), but warn against assuming that producing healthy food automatically leads to healthy and sustainable diets after processing takes place.

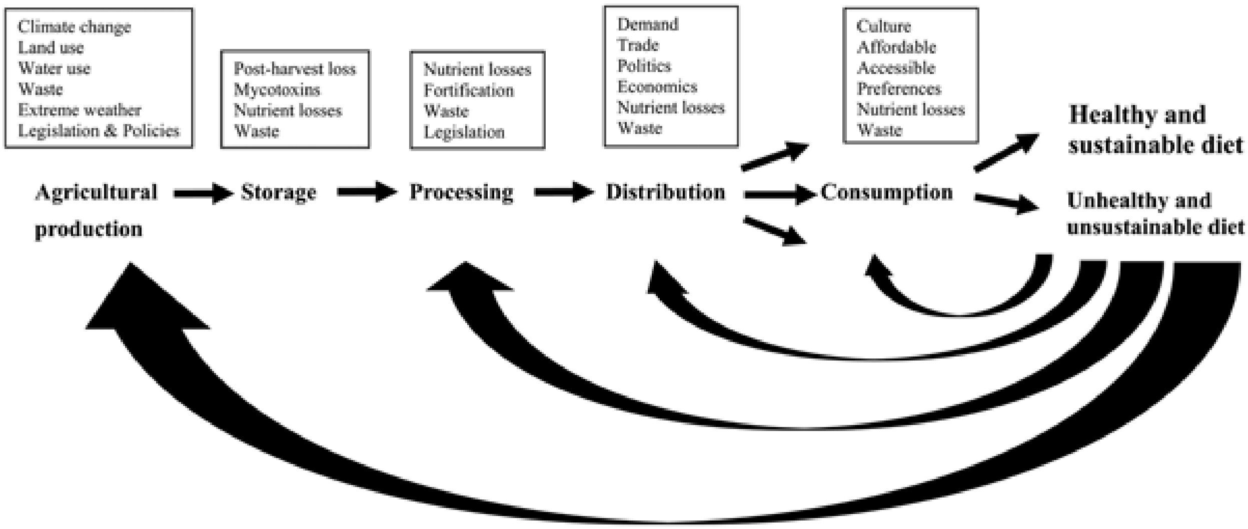


Figure 39: The stages in the food system that drive whether diets are healthy and sustainable

Source: Macdiarmid and Whybrow (2019).

The extent to which animal proteins can be considered as part of a sustainable diet continues to receive special scrutiny within the literature (Dwivedi *et al*., 2017; Kuyper *et al*., 2017; Friend, 2019; Lang and Millstone, 2019). Fish is seen as an inherently unsustainable protein, as climate change is affecting both fishing and aquaculture, threatening protein, and fish supply (Quinn and Collie, 2005; Mitchell, 2011; Earle, 2013; Bryce, 2014). Meat is similarly problematic, with a number of analyses providing a rationale for switching to more alternative, plant-based proteins (Carlsson-Kanyama and González, 2009; Vidal, 2010; Tobler *et al*., 2011; Schösler *et al*., 2012; Ipsos MORI, 2014; Scarborough *et al*., 2014; Machovina *et al*., 2015; Springmann *et al*., 2016b; Lang, 2017d; 2017e; Henry *et al*., 2019). Machovina *et al*. (2015) predict that South America, Africa, and Asia will need a further 30–50 per cent increase in the land used for meat production by 2050, with hugely negative consequences for ecosystem degradation and biodiversity loss (figure 40). Scherer *et al*. (2019) found that most countries reduced the consumption of animal products when they adopted a nationally recommended diet. Macdiarmid *et al*. (2012), however, believes that a sustainable and healthy diet with lower GHGEs is achievable without eliminating meat or dairy products or increasing the cost to the consumer (*New Scientist*, 2017a).

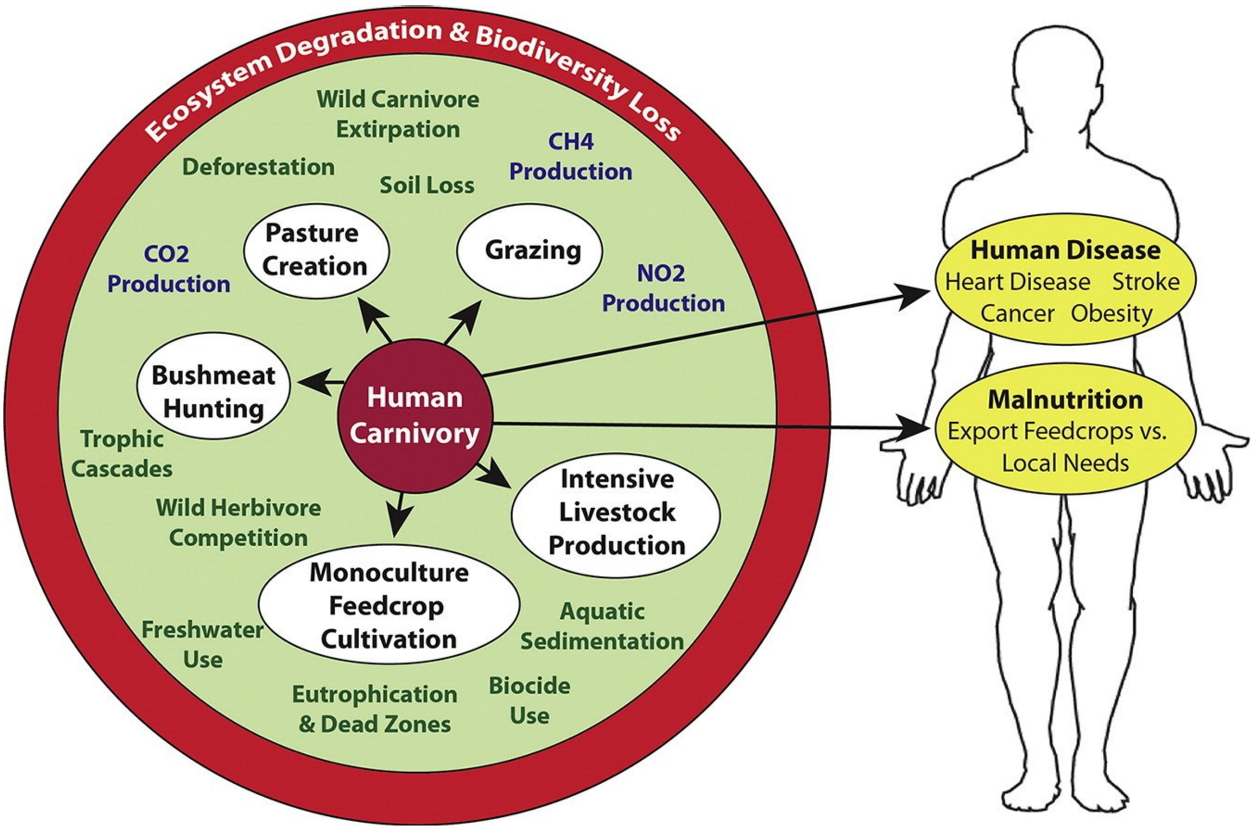


Figure 40: Reducing meat consumption for biodiversity conservation

CO_2 = Carbon Dioxide production; CH_4 = Methane production; NO_2 = Nitrogen Oxide production

Source: Machovina *et al*. (2015).

Interdisciplinary contributions are vital components for both policy engagement and clarification (Lang and Barling, 2013a; Padilla *et al*., 2015). One of the most comprehensive studies of the sustainable diet literature concluded that moving to sustainable diets in the UK would dramatically affect production patterns (DEFRA, 2011c), Aleksandrowicz *et al*. (2016) estimate that reductions of at least 70 per cent of GHG emissions and land use and 50 per cent of water use can be achieved by moving from Western to sustainable dietary patterns; Vanham *et al*. (2018) suggest UK consumers could use 35 per cent less water if they switched to healthier diets, or by 55 per cent if meat is replaced by fish or a vegetarian diet. Harris *et al*. (2019) similarly advocate sustainable diets that both promote health and have a lower water footprint. Scarborough *et al*. (2014) estimate meat eaters have approximately twice the dietary GHG emissions of a vegan, whereas earlier research had suggested sustainable and healthy diets with lower GHGEs are achievable without eliminating meat or dairy products or increasing the cost to the consumer (Macdiarmid *et al*., 2012; New Scientist, 2017a). Elliott *et al*. (2018) also argue that vegan diets had a chronic lack of essential micronutrients, vitamins and minerals, with long-term consequences including lower disease resistance, mental impairment and even death. This is contrary to the previous view that the health of Western vegetarians was generally good (Key *et al*., 2006; Schepers and Annemans, 2018).

Recognising the significant co-benefits of tackling climate change to both food security and public health, several international agencies have interdisciplinary policies to bring about the transition to sustainable diets (Lim *et al*., 2009; Ganten *et al*., 2010; FAO, 2015a; Thompson, 2015; FAO/OECD, 2018). Figure 41 shows that the mean prevalence of adult obesity by United Nations region continued to worsen between 2010 to 2014, meaning that no countries are on target to meet the WHO goal of halting the rise in obesity. Overconsumption is also associated with changes in eating habits (figure 42), especially when such dietary changes lead to the excessive consumption of calories, undesirable nutrients, cause micronutrient deficiencies and, where diets lack sufficient quantities of fruit, vegetables and fibre, contribute to an increased risk of NCDs. Further detail on the co-benefits of health and climate change can be found in appendix 8.13.

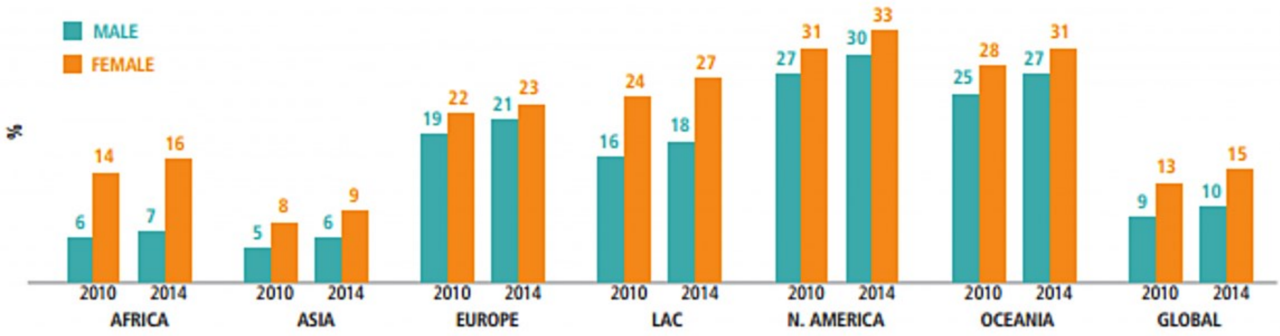


Figure 41: Mean prevalence of adult obesity by United Nations region, 2010-2014

Source: International Food Policy Research Institute (2015).

Gaps within the literature appear around four primary areas: the impacts of changing diets; the potential for alternatives to meat; effectiveness of intervention options, and, transparent metrics for environmental sustainability (Gerbens-Leens *et al*., 2003; BSI, 2008; Fiala, 2008a; Hawkesworth *et al*., 2010; Lock *et al*., 2010; Heller *et al*., 2013; Murray, 2014; McDermott *et al*., 2015; Bartlett and Garnett, 2016; Grönman *et al*., 2016; Herforth, 2016; Kiff *et al*., 2016; Gabrysch, 2018; Stylianou *et al*., 2018; FCRN, 2019l; Benton, 2020). The psychological need to develop '*sustainability leaders*' by reconnecting consumers to the natural world (Amel *et al.*, 2017; Helm *et al*., 2018) and to build sustainability acceptability (Kennedy *et al*., 2017) is advocated. As one seasoned policy researcher recently observed, the scale of the ultimate interdisciplinary scientific task *'has quietly dawned on all who monitor and explore the nature of food's impact on society, ecosystems and economy'* (Lang, 2017a, p.1).

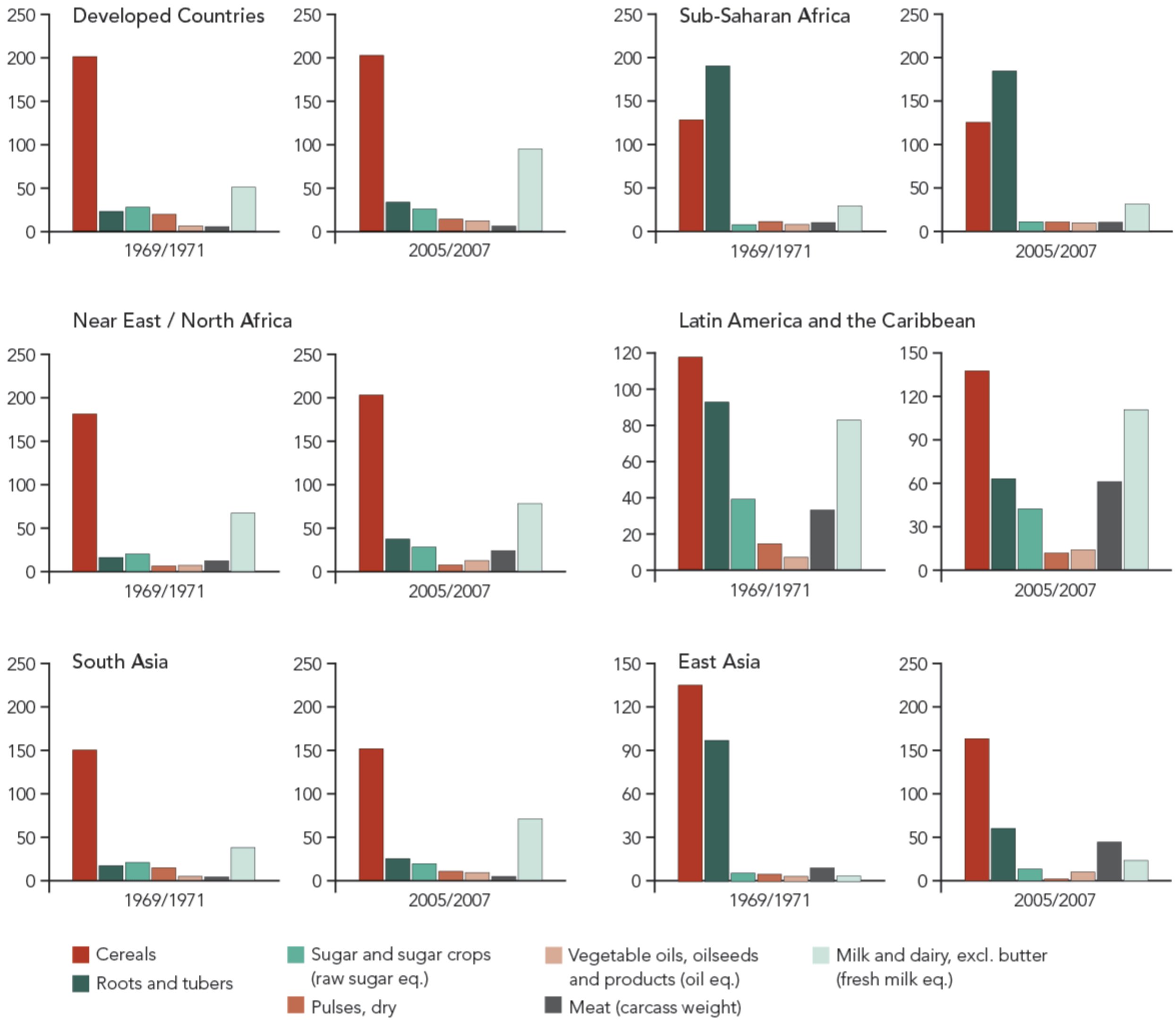


Figure 42: Eating habits are changing

Source: FCRN (2018f) adapted from data in Alexandratos and Bruinsma (2012).

2.5.5 The challenges and responsibilities facing health professionals

The WHO (2015f, p.1) call for health professionals to *'use their knowledge and authority to inform and influence action in key national and international processes that guide policy and resources for work on climate change, such as preparation of national communications, national adaptation programmes of action and international agreements'*. The research literature reinforces this involvement in a variety of ways: by warning them not to assume that climate change is not their responsibility, or is too big and too hard to comprehend, or even that it's not part of their domain (Davidson, 2016); or collectively failing present or future generations (Gill and Stott, 2009); by taking action today to reduce ill-health in the future (*The Lancet*, 2014); and to ensure future food security (Boyer *et al*., 2019).

The social sciences are essential in understanding future food sustainability and especially in achieving the radical changes in food consumption and production advocated by health professionals (EC, 2011; Lucas and Horton, 2019). Such improvements in well-being will require advances in resource efficiency, conservation, diversity and transdisciplinarity. Wilde (2015, p.1999) puts it more succinctly: '*change our ways or be obliterated from the face of the Earth*'. Given the catastrophic threats from climate change, global pandemics and ecosystem collapse that humanity faces recommendations for health professionals are centred around five main tranches (Gill and Stott, 2009; Jay and Marmot, 2009; Davidson, 2016; Capon *et al*., 2018). Firstly, learn, assess and plan to increase awareness of the pending threats (Sayre *et al*., 2010; Davidson, 2016; Capon *et al*., 2018) which will require significant changes to the education and training curricula for all health professionals (Sayre *et al*., 2010; Davidson, 2016; Gabriel *et al*., 2017; Galea, 2017; Jamie Oliver Food Foundation, 2017). This will involve learning from best global practice to understand how to address the health impacts from food, environmental degradation, and climate change (Pearson *et al.*, 2012; Deloitte, 2017) such as the USA's training on the planetary health challenges (United States Government, 2015; Davidson, 2016). This learning would then enable better health promotion and convey sufficient anxiety to provoke appropriate consumer action (Butler, 2016a; Stone *et al*., 2017; Stegeman *et al*., 2019). Secondly, strengthen adaptive capacity by educating, informing, and exchanging knowledge to help bring about the behavioural changes needed in food consumers (Cook *et al*., 1998; Griffiths *et al*., 2008; Gill and Stott, 2009; Gill and Johnston, 2010; Millward and Garnett, 2010; Sayre *et al*., 2010; Burlingame and Dernini, 2012; Macdiarmid *et al.,* 2013; McGowan, 2013; O'Neill *et al*., 2015; FSA, 2016; Schanes *et al*., 2016; *The Lancet*, 2016a*; The Lancet*, 2016c; Macdiarmid *et al*., 2016; *Nature*, 2016a; O'Kane, 2016; Woodward, 2016; Benavot, 2017; GFS, 2017; Beckage *et al.* 2018; Cole-Hamilton, 2018; Pettinger, 2018; Bauer and Reisch, 2019). Examples include the challenges of reducing the financial barriers to healthier diets (Rao *et al.*, 2013), the potential of tailoring sustainable diets to income groups to make them more achievable (Reynolds *et al.*, 2019; de Grave *et al.*, 2020), and concern over commercial and political interests exerting far too much influence over health (Lucas and Horton, 2019). Here the roles of the NGOs and CSOs are increasingly important (Lang, 2017b); especially *International Union for Health Promotion and Education*' (IUHPE), the umbrella organisation *European Public Health Association* (EUPHA), *International Panel of Experts on Food* (IPES-Food), the *EAT-Lancet Commission*, the *Global Alliance* coalition, collaboration through bodies such as the *Lancet Countdown* (Wang and Horton, 2015), and with funders such as the *Wellcome Trust*. With a healthier diet, for example, Hawkes *et al.* (2015) suggest health professionals have four opportunities to influence: enable learning about healthy preferences; disable barriers to the expression of healthy preferences; encourage resistance to unhealthy options; and to bring about a food systems response (figure 44). Furthermore, health professionals can help implement and set healthy food policies even in the absence of government action (Peeters, 2018). Thirdly, by acting as stewards of health-related mitigation to consider the environment in practice and engage in the debate on how environmental degradation and climate change can be addressed (Sayre *et al*., 2010; Davidson, 2016). This would need to include evaluating the role of public–private partnerships, especially the negative impacts to health caused by the food industry, and promote sustainable and healthy food with reliable and user-friendly consumer information (Traoré *et al*., 2012; Dangour *et al.*, 2017; EUPHA, 2017; Galea, 2017; Sackler Institute for Nutrition Science, 2017; Bhunnoo, 2019). This would necessitate health professionals shifting focus onto addressing environmental change, food system activities, and health outcomes within specific socioeconomic, societal, and political contexts shown in figure 43. Fourthly, lead by example and provide a voice for those most at risk through professional organisations, such as the *Climate and Health Council* and the *UK Health Alliance on Climate Change* (Limetz *et al*., 2009; Lugsdin and Hook, 2016; *The Lancet*, 2016; *The Lancet,* 2016c; Galea, 2017; Myers, 2017; Capon *et al*., 2018). The UKHACC (2020) recommendations on climate change are detailed in appendix 8.12. As a trusted profession, this includes speaking out to demand that politicians listen and use appropriate policies and governance (Seyfang, 2006b; Gill and Stott, 2009; Sayre *et al*., 2010; British Medical Association, 2016; Davidson, 2016; *The Lancet*, 2016c; Haines *et al*., 2018; Ingram and Zurek, 2018; *The Lancet*, 2018d). For nutritionists, this will necessitate a realignment in focus to face the new problems posed by the globalised food system and how to achieve sustainable nutrition (*The Lancet*, 2017c). And finally, using this skill-set to advocate for health to be at the centre of all climate change policies and plans (Myers, 2017; *The Lancet*, 2018d; El Bilali, 2019), including examples such as delivering the Paris Agreement commitments (Watts *et al.*, 2019) and mitigating against the many threats of Brexit to both health in general and the NHS in particular (Lang, 2019b; van Schalkwyk *et al*., 2019).

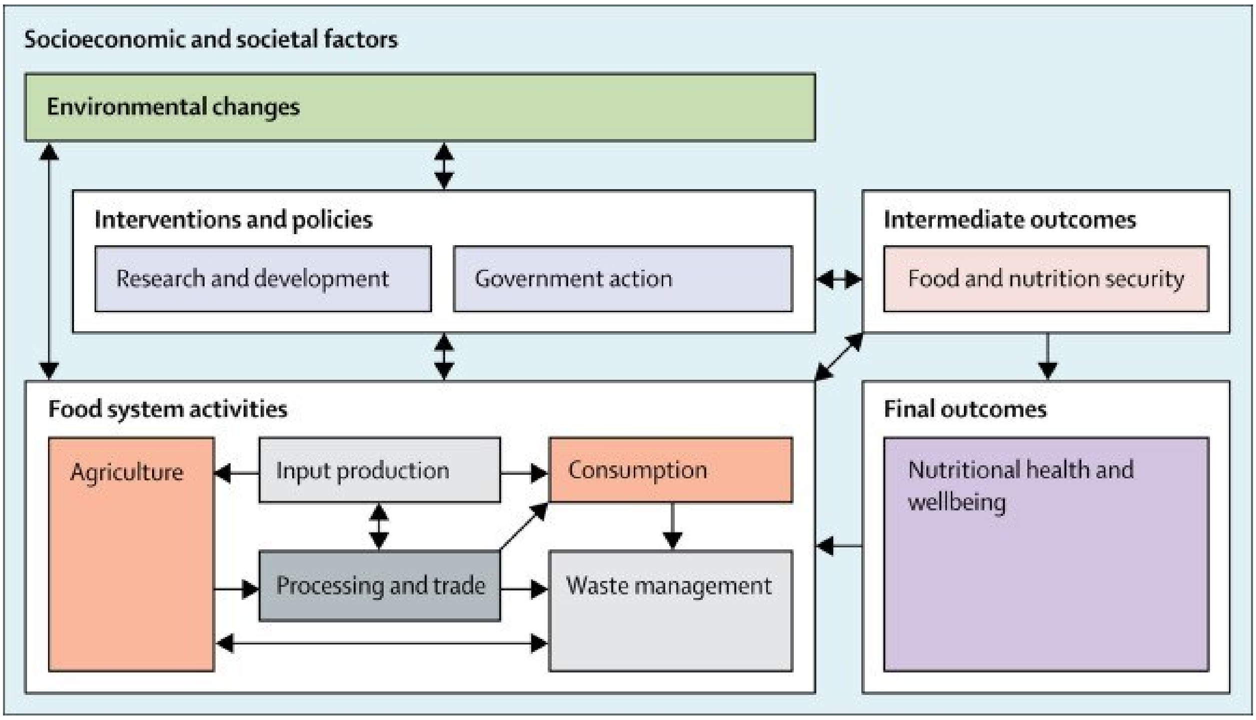


Figure 43: Framework of environmental change, food system, nutrition, and health

Source: Dangour *et al.* (2017).

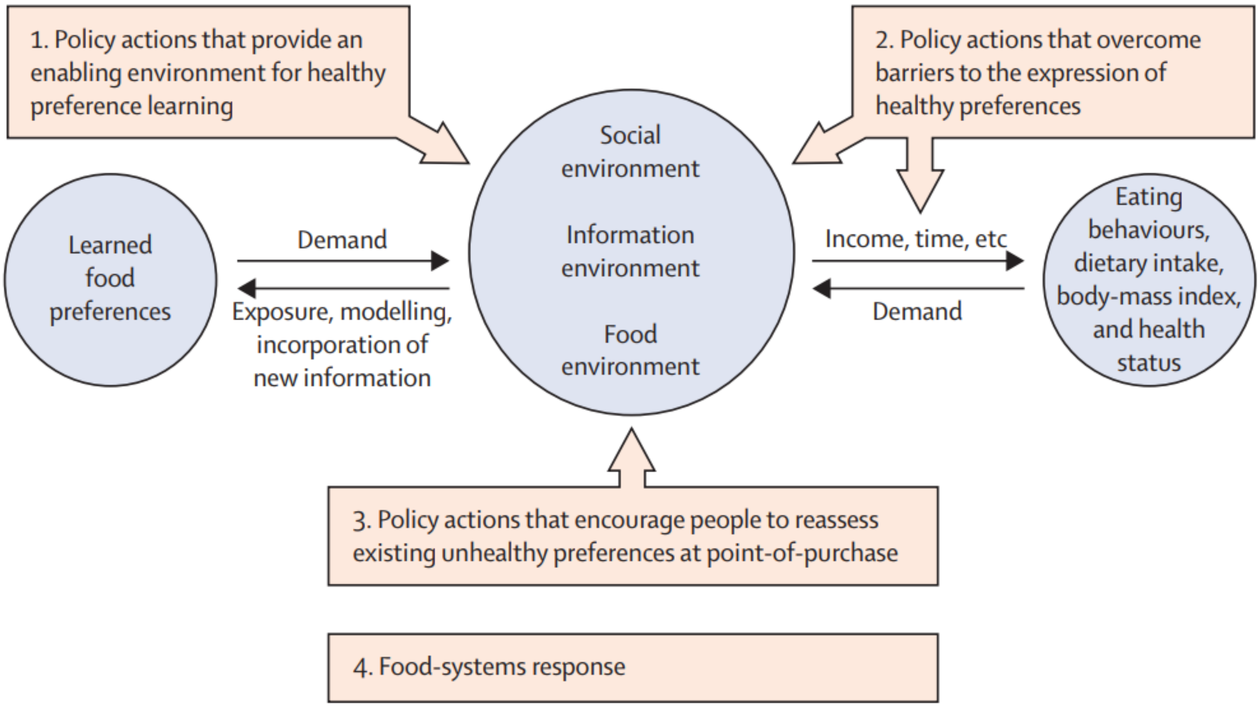


Figure 44: Framework of the theory of change and the four mechanisms through which food-policy actions could be expected to work

Source: Hawkes *et al*. (2015).

Figure 45: Priority action areas for dietitians and nutritionists in the intersection of agriculture, nutrition, and health

Source: Vogliano *et al*. (2015).

Figure 46: From farm to fork: dietitian and nutritionists' contributions

Source: adapted from Vogliano *et al*. (2015).

Figure 47: Increasing the global workforce capacity of dietitians and nutritionists

Source: adapted from Vogliano *et al*. (2015).

2.6 The challenges for existing food policy frameworks

This section examines the evidence base on how the current and future challenges facing food systems will impact policymaking at the national and international level. Climate change is increasing the urgency for food system transformation, while at the same time, ensuring improved food security and resource sustainability. Numerous studies raise concerns about future food security, including climate change bringing about greater political instability (Gleditsch, 2012; Hendrix and Salehyan, 2012; UN, 2012; Hsiang *et al*., 2013; Adger *et al*., 2014; Gleick, 2014; Hsiang and Meng, 2014; Tanentzap *et al*., 2015; von Grebmer *et al*., 2015; Clapp *et al.*, 2018; Frankelius, 2019; Miles-Novelo and Anderson, 2019; Wagner *et al*., 2019), multiple crop failures (Janetos, 2017), the need to transform resource utilisation (Carrington, 2019), and increasing household food insecurity (Cafiero *et al*., 2018; HM Government, 2018b; Food Foundation, 2019). The over-riding consensus would appear to be one where the international community has made insufficient adaptations and there is an urgent need to strengthen future resilience (Smith, 2011; CAN, 2014; Moore and Lobell, 2014; Trace, 2015; Müller *et al*., 2017; Maia *et al*., 2018; Mpandeli *et al*., 2018). Bailey and Wellesley (2017) predict more conflicts over scarce resources, including land and water, as well as an increased likelihood of a greater use of protectionist measures to defend home food security. In figure 48, Benton (2019c) shows how future food systems might develop, against the current back-drop of shifts towards more sustainable diets and global changes such as the dismantling of earlier trade architectures and more protectionist policies. This produces four possible future scenarios, two of which are both healthier and more sustainable.

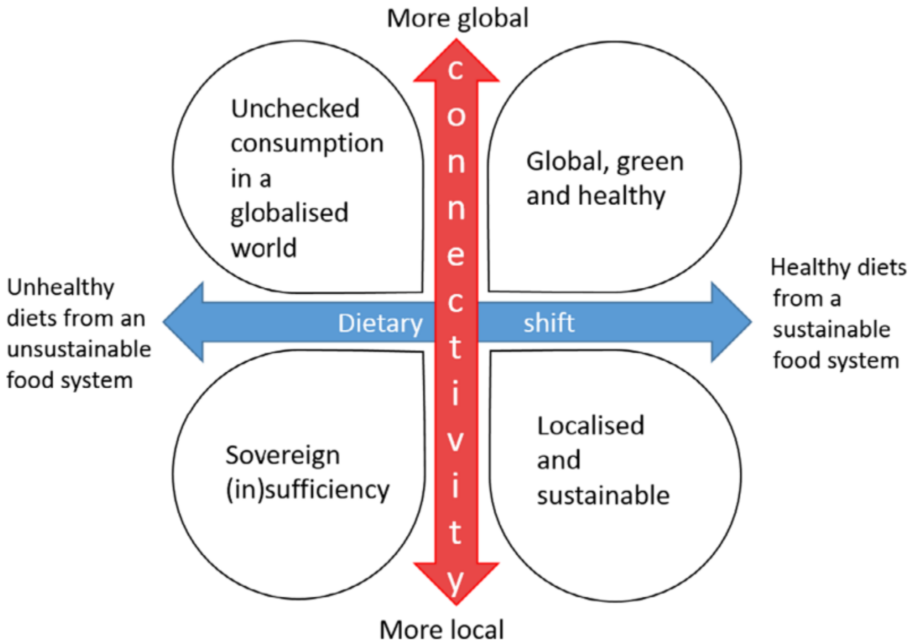


Figure 48: Four plausible, alternative, futures for food systems, based on axes of global-local connectivity, and degree of dietary shifts

Source: Benton (2019c).

2.6.1 Policies on trade

The role of international trade in ensuring food security and the growing notion regarding the virtual transfer of resources embedded within these food imports is the focus of several studies. The increasing dependency on food trade within the past fifty years has improved overall food availability, but uneven distribution has increased food insecurity in many countries (Porkka *et al.*, 2013). In addition to the notion of virtual water (Allan, 1998; Carr *et al.* 2013; Suweis *et al.*, 2013; D'Odorico *et al.,* 2014; Merrigan *et al.*, 2015; Hoekstra and Mekonnen, 2016; Kundu *et al*., 2017; Cuthbert *et al.*, 2019), further studies evaluate how food trade is associated with virtual land (Kitzes *et al*., 2009; Tilman *et al.*, 2011; Meyfroidt *et al*., 2013; Weinzettel *et al.*, 2013), virtual carbon (Kastner *et al*., 2011), virtual nitrogen (Galloway *et al*., 2007; O'Bannon *et al.*, 2014), and other land based resources (Hermele, 2014) that exporting countries provide without accounting for true environmental cost (Galloway *et al.*, 2007; Schmitz *et al.*, 2012; D'Odorico and Rulli, 2013; O'Bannon *et al*., 2014). Using carbon offsetting and trading as alternatives to true emissions reduction will mean that reaching the UK's target of zero emissions will be very difficult, and technologies such as carbon capture and storage will need many more years of development before they can operate at scale (FAO, 2017c; Zurek *et al*., 2018; Costain, 2019; Díaz, 2019; Hale, 2019; Hudson, 2019; Jackson, 2019b; Landzettel, 2019; May and Rehfeld, 2019; *The Lancet*, 2019d; Committee on Climate Change, 2020). The '*tragedy of the commons*' debate has once again been reignited to describe various recent land grabs around the world, which regularly take place with political support (Cotula *et al*., 2009; Almås *et al.*, 2012; Prášková, 2012; GRID-Arendal, 2013; Nabudere, 2013; Kugelman and Levenstein, 2014; Seaquist *et al*., 2014; Akram-Lodhi, 2015; Lawther, 2015; Clapp *et al*., 2015c; Visser, 2015; Dell'Angelo *et al*., 2017a; Dell'Angelo *et al*., 2017b; Desquilbet *et al*., 2017; Hules and Singhba, 2017; Zoomers *et al*., 2017). Fader *et al.* (2013) find 16 per cent of the world's population is currently dependent on the global trade in food but predict this could increase to over 50 per cent unless population growth is not accompanied by dietary change. Other observers suggest that food businesses are simply failing to face up to their responsibilities (PwC, 2013a; Goldstein *et al*., 2018), especially the global companies in the meat, dairy and seafood supply chains (Grant, 2019). Here, supply chain transparency is seen as a key prerequisite (Bastian and Zentes, 2013; Grimm *et al*., 2014; Shokri *et al*., 2014; Kougioumoutzi, 2016; Malochleb, 2018; Wach, 2018). Further concerns include food trade causing new sources of security threats and the uncertainty of depending on food imports (McDonald, 2010; MacDonald, 2013; Murphy, 2015). MacDonald (2013) specifically considers the origins of maize, rice, soya bean, and wheat imports (figure 49) and the uneven role undertaken by a small number of nations in providing food security to many food importing countries, where equity and cooperation will become increasingly critical to food security. With climate change further threatening to disrupt markets, distort prices, food utilisation and access, the stability of the whole food system and the businesses within it are now at risk (Pinstrup-Andersen, 2001; Green, 2010; Carbon Trust, 2014; Engel *et al*., 2015; Goldstein *et al*., 2018; UNEP, 2018). A number of resources are also available to food businesses to assist them in reducing carbon footprints (e.g. WWF, 2009; Murphy-Bokern, 2010; Carbon Trust, 2011a; Carbon Trust, 2011b; Carbon Disclosure Project, 2012; IGD, 2012; WWF, 2012; Carbon Trust, 2014; WWF, 2015; BSI, 2018). Also, in a DEFRA commissioned study, Evans (2012) devises an adaptation to climate change strategy to protect both the food chain and food security, which includes initiatives such as adaptation based on the evidence of cost benefit, building partnerships, regulatory enforcement, and utilising change agents.

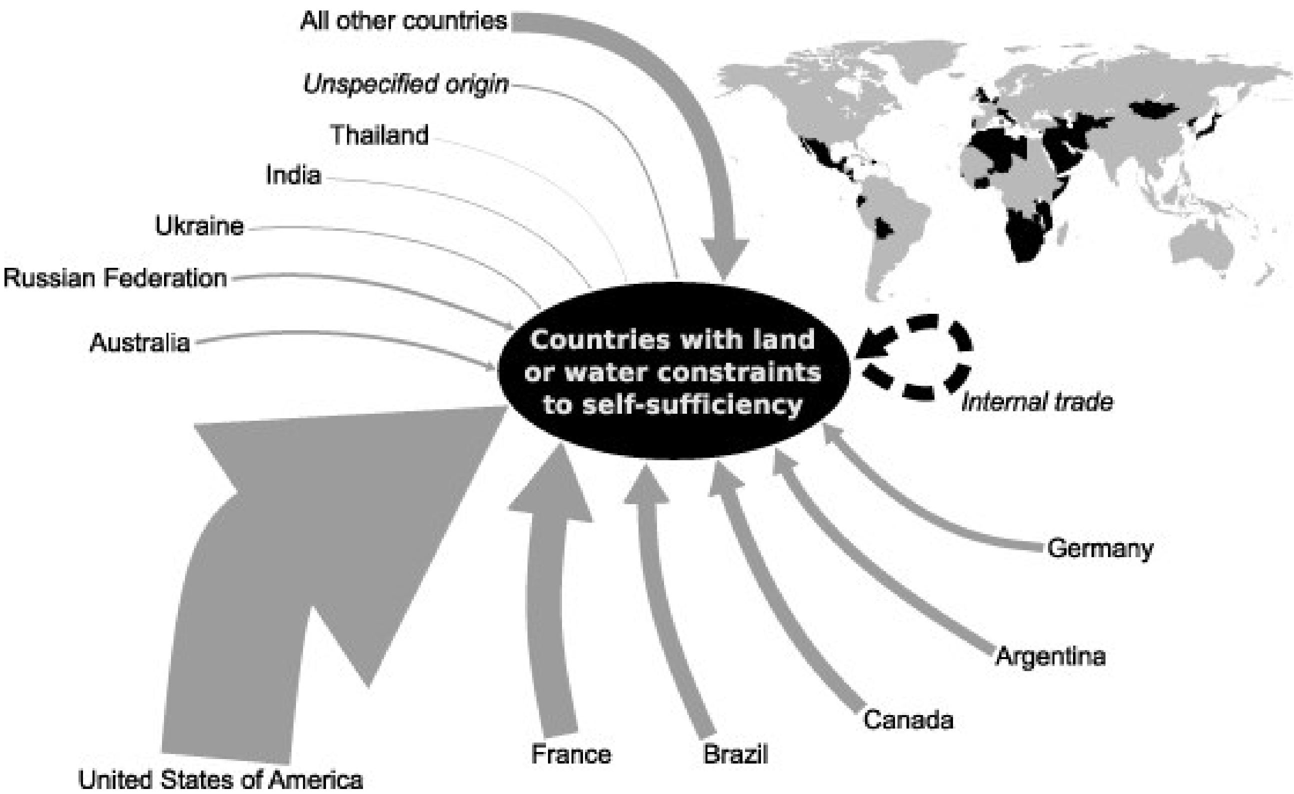


Figure 49: The origins of key crops (maize, rice, soya bean, and wheat) imported by 49 countries that have exceeded a land or water constraint boundary currently limiting food self-sufficiency.

Countries shaded in black have exceeded at least one boundary by the year 2000. The size of the lines indicates the relative quantity of kilocalories imported.

Source: MacDonald (2013).

Beddington's perfect storm analysis prompted a number of projects from Foresight charged with identifying where new or emerging science can inform policy; all called for urgent, decisive action to start immediately in order to mitigate against the risks ahead (Foresight, 2011a; 2011b; 2011c). Many government departments provide their own analyses on sustainability (DEFRA, 2006b; 2006c; 2010c; 2011a; 2018f), the environment (DEFRA, 2011b; 2017c; 2018d; 2018g), climate change (DEFRA, 2008a;

2012a; 2012b; 2018h; 2019j; 2019k), healthy diets (DEFRA, 2011c; 2012c; 2019e), policy options (DEFRA/DfIT, 2016; DEFRA, 2019f; 2019i), as well as statistics on carbon (DEFRA, 2017d; 2019l) and general metrics (DEFRA, 2017a; 2019; 2019a; 2019b; 2019c; 2019d; 2019g; 2019h; 2019i). There are concerns, however, in DEFRA's ability to successfully implement such a major and significant policy initiative that involves wide-ranging change. DEFRA's current draft Agriculture Bill proposes paying landowners for delivering environmental goods but Wach (2018) argues, in the absence of evidence that government will support or require the integration of ecology and food production, that the option of increasing productivity alone could encourage more environmentally destructive, industrial-scale food production methods. The National Audit Office's (NAO) role is to scrutinise public spending, so Parliament can both hold government to account and improve public services. Their first review of DEFRA's new food policy (NAO, 2019) raises concern based on previous track record and difficulties with DEFRA implementing change. Their audit concludes that the ten-year timeline proposed for the changes will be insufficient, especially to evaluate and avoid the unintended consequences on both environmental and food security. Food is also an integral part of the UK's industrial strategy (Department for Business, Industry, Energy and Skills, 2017; 2018). As the Government's independent statutory committee, the Committee on Climate Change has produced a plethora of recommendations covering evidence, risk assessment, and regulation (Committee on Climate Change, 2016c; 2017a; 2018a; 2018g), alternative low-carbon fuels (Committee on Climate Change, 2018b; 2018c), and monitoring progress (Committee on Climate Change, 2019a; 2019e). Their latest advice to government includes reducing emissions from land-use by 64 per cent to around 21mtCO_2e by 2050. To achieve this, the Committee on Climate Change (2020) are recommending increasing forestry cover from 13 per cent to over 17 per cent by planting 90 - 120 million trees every year, low carbon food production, restoring 50 per cent of upland peat and 25 per cent of lowland peat reserves (Lindsay, 2019), reducing food waste by 20 per cent, increasing bioenergy crops by 57,000 acres per annum, and reducing meat and dairy consumption by 20 per cent per person. The annual cost of these measures is estimated at £1.4bn, but the Commission argue they will generate wider benefits of £4bn per year. This compares to the £3.3bn that the UK receives each year through the CAP. By way of comparison, Dai *et al*. (2016) note that the Chinese government is spending around 20 per cent of total investment on protecting public health from climate change; the UK government is spending just 5 per cent.

2.6.2 Policies conflicting with growth

The unrelenting pursuit of exponential economic growth is ultimately seen as increasing unsustainable consumption and detrimental to healthy and sustainable diets. Several critiques draw attention to the shortcomings of GDP as a measurement in a world facing three existential crises which threaten humanity's ability to live within the planetary boundaries, namely: climate change, inequality, and a crisis in democracy (Timmer, 2010a; Peters and Mayhew, 2015; Whitmee *et al*., 2015; Greenpeace, 2018f;

Krznaric, 2019; Lawrence, 2019; Stiglitz, 2019). The growth in consumption has been driven by productivity growth which, in turn, generated economic growth (Lawrence *et al*., 2015b; Benton, 2019; Zhai *et al*., 2020). Fundamental to this issue is the possibility of Meadows *et al*. (1972) scenario analyses still predicting a sudden and uncontrollable decline (Lucas *et al*., 2006; Benson *et al*., 2008; Graefe, 2009; Howard, 2009; Maynard, 2009; Macalister and Badal, 2010; Panitchpakdi, 2010; Peak Food, 2010; Graham-Rowe, 2011; Almås *et al.*, 2012; Turner, 2014; Turner and Alexander, 2014; Alders, 2016; Hirschnitz-Garbers *et al*., 2016; Pearce, 2018; Hilton, 2019). Caradonna (2014) argues humanity is 250 years into an unsustainable ecological assault on the planet and Doré (2015) predicts the global food system will catastrophically collapse when food production falls permanently short of consumption. Similarly, Purvis *et al.* (2019, p.690), refer to the '*blind pursuit of economic growth*', a '*short-sighted profit-driven agriculture*', and industrialism without '*regard to the fragility of complex ecosystems*'. *The Lancet* similarly claim that commercial and political interests have *'far too much influence with human health and our planet suffering the consequences'* (Lucas and Horton, 2019, p.2). despite this, however, governmental departments responsible for food production continue to advocate investing in growth strategies, even where they have a dual responsibility for environmental protection (Agri-Food Strategy Board for Northern Ireland, 2013; DEFRA, 2013b; Department of Agriculture and Rural Development, 2014; Scottish Food Coalition, 2016; DEFRA, 2018b; Scotland Food and Drink, 2018). In addition, the future viability of capitalism, as the root cause of climate change is also questioned, with state intervention and centralised planning seen as the only way to realistically achieve the reductions in carbon needed (Vanberge, 2017; Elliott, 2018; Dyke, 2019; Mason, 2019; Monbiot, 2019). The continued use of the GDP metric is also examined, especially where this growth comes at the expense of the environment or uses scarce resources (IMF, 2010; Higgins, 2013; ISSA, 2014; Whitmee *et al*., 2015; Hickel, 2018; Stiglitz, 2019). Additional concerns include the growing impact of climate change on food security (Barrett, 2013), social tensions (Barnett and Adger, 2007; Bush, 2010), marginalisation of vulnerable people (IPES-Food, 2017), and estimates of forced migration affecting up to one billion climate refugees by 2050 (Scott *et al*., 2008; Black *et al*., 2011; de Haas, 2011; Fielding, 2011; Findlay, 2011; Foresight, 2011c; Piguet *et al*., 2011; Harper, 2012; EC, 2013; EC, 2015; DeWeerdt, 2017; Hauer, 2017; WHO, 2017; Bukvic, 2018; Mach, 2018; Likić-Brborić, 2018; Abel *et al*., 2019; EAC, 2019). Xu *el al*. (2020) argue that humanity has traditionally settled within very narrow climate ranges (typically mean annual temperatures around 11°C to 15°C); in the future one third of all humanity may be outside this traditional environmental niche where mean annual temperatures could exceed 29°C. Finally, the latest coverage of the impact of climate change on global food markets in the *Financial Times* predicts that developed markets will '*win*' and emerging markets '*lose*' (Ash, 2020) and Steinberger (2020) argue governments should prioritise human well-being rather than economic growth for its own sake.

Although Baldwin (1995) originally suggested that '*sustainable growth*' was a contradiction in terms, the enduring view of growth and its impact on the planet's limited resources is becoming increasingly challenged, with policies that deliver circular economies (*Ellen MacArthur Foundation*, 2015; 2016; Jurgilevich *et al*., 2016; McKinsey, 2016; Geissdoerfer *et al*., 2017; *Ellen MacArthur Foundation*, 2018; Ruben and Verhagen, 2019) and de-growth strategies undergoing serious scrutiny (Jackson, 2009; Rockström *et al*., 2009a; Rockström *et al*., 2009b; IMF, 2010; Victor, 2011; Raworth, 2012; Little, 2013; Båtstrand, 2015; Dermer, 2016; Jackson, 2016; Backhaus *et al*., 2017; Raworth, 2017; Barrett, 2018a; Barrett, 2018b; Beuret, 2018; and Dyke, 2019). Interventions to promote sustainable food production and consumption will, however, likely be insufficient to reverse current trends, where economic growth remains the primary objective (Gladek *et al*., 2016; Hadjikakou and Wiedmann, 2017). Carney *et al*. (2019) also warn the catastrophic effects of climate change will include enormous human and financial costs. This will need a massive reallocation of capital to reduce carbon emissions decline and those companies who fail to engage will fail altogether. To survive in the inevitable aftermath of the market economy, further studies propose new economics for a post-growth world, arguing this is the only system offering realistic longevity into the future (UN, 2012; Fleming, 2016; Antal, 2018; Allwood *et al*., 2019).

2.6.3 Policies to address the food–environment–health nexus

Although the food system risks to both the environment and health are often analysed within differing scientific disciplines, they need to be addressed by policies simultaneously. There is a real sense of urgency within the literature to determine the exact nature of effective, future policies, but the sheer range and complexity of the issues involved makes it especially challenging. Tilman and Clark (2014) argue the food–environment–health nexus will be a major contributor to the estimated 80 per cent increase in carbon emissions expected by 2050, caused by the growth in food production and deforestation. Undoubtedly, one of the more useful tools here is the recently published Common Food Policy framework from IPES (2019b), which groups the required policy reforms into five overarching objectives, or parallel paradigm shifts, in the transition to sustainability. Firstly, ensuring access to land, water, and healthy soils. Food production continues to be critically threatened by land degradation (WWF-UK, 2009; Nabarro, 2010; Premalatha *et al*., 2011; O'Mara, 2012; David and Lucile Packard Foundation, 2013; Bajželj and Richards, 2014; Bailey *et al*., 2015b; Sabiha *et al.,* 2016; Barilla Center for Food and Nutrition Foundation, 2018; Benton *et al*., 2018; Pellegrini and Fernández, 2018; Benton, 2019a; Díaz, 2019; Volenzo *et al*., 2019), soil erosion (FAO, 2006; DEFRA, 2009a; O'Mara, 2012; Gladek *et al*., 2016; Fargione *et al*., 2018), and water contamination and over-extraction (Garnett, 2013; Hanson, 2013; Adger *et al*., 2014; Jones and Hiller, 2015; Adger, 2016; Sharif and Irani, 2017; Alonso *et al*., 2018; Changing Markets Foundation, 2018b; Desmit *et al*., 2018; FAO, 2019b; Landholm *et al*., 2019), industrial agricultural systems (Almås *et al.*, 2012; Florea, 2012; IPES-Food, 2016; ETC, 2017; IPES-Food, 2017; Wasley *et al*., 2017; Wach, 2018) and loss through urban development (Wheeler, 2015; Development Initiatives, 2017; IAP, 2018; *The Lancet*, 2018). Secondly, the need to rebuild climate-resilient and healthy agro-ecosystems to restore the destruction done by the most highly damaging food production systems (International Sustainability Unit, 2011), such as industrial livestock production (FAO, 2006; FAO, 2012a; FAO, 2013d; Bianchi *et al*., 2018; Baggini, 2019; Garnier *et al*., 2019; FAO, 2019f), chemically-dependent systems (Ziska and Goins, 2006; King *et al*., 2015; Milner and Boyd, 2017; Barilla Center for Food and Nutrition Foundation, 2018; Barkham, 2018; Lang 2019a), and monocultures (Almås *et al.*, 2012; Florea, 2012; Niman, 2014; King *et al*., 2015; Benton, 2017; Shepon *et al*., 2018; Sun *et al*., 2018; Trase Yearbook, 2018; Wach, 2018; Leng and Hall, 2019; Willett *et al.*, 2019) that are undermining critical ecosystem services. Further studies argue that food production systems should be developed as a foundational source of social and ecological sustainability (McMichael, 2011; Heymans *et al.*, 2011; Colloca *et al.*, 2013; McKenzie and Williams, 2015; McClenachan *et al.*, 2016; Steyn *et al.*, 2016). Thirdly, promoting healthy and sustainable diets for all through social and fiscal policies (WHO, 2008; Dower and O'Connor, 2012; Davis *et al*., 2014; Garnett and Wilkes, 2014; ISSA, 2014; FAO, 2015e; IOM and NRC, 2015; Cumming and Peterson, 2017; Beckage *et al.*, 2018; Dowler *et al.*, 2018) that tackle food poverty (FoE, 2008; Dower and O'Connor, 2012; Brown, 2013; Cooper *et al*., 2014; Elbehri, 2015; Lambie-Mumford and O'Connell, 2015; Arezki *et al*., 2016; Borch and Kjærnes, 2016; Dharmasena *et al.*, 2016; Sharpe, 2016; World Hunger Organisation, 2016; de Coninck *et al*., 2018; *The Lancet*, 2018c; Benton, 2019a; House of Lords, 2019; Parsons and Hawkes, 2019; Springmann, 2019) and promote healthier food (Richards and Padilla, 2007; Headey, 2015; Springmann *et al*., 2017; Hand, 2018; Hill, 2018; EAC, 2019; Giner and Brooks, 2019; Recanati *et al.*, 2019; Webster, 2019). Fourthly, building fairer, shorter, and cleaner supply chains (Barclay, 2012; Galli and Brunori, 2013; Carbon Disclosure Project, 2015; Economist Intelligence Unit, 2017b; Allwood *et al.*, 2019; Committee on Climate Change, 2019d). Finally, putting trade in the service of sustainable development by addressing power imbalances (Almås *et al.*, 2012; Carolan, 2014; King *et al*., 2015; Gladek *et al*., 2016; Helgason, 2016; Haines, 2017; Beuret, 2018; Hale, 2019; Lamine *et al*., 2019) and replacing trade-distorting policies with sustainable trade agreements (Greenville *et al*., 2017a; Greenville *et al*., 2017b), especially those that are already giving cause for concern such as land acquisition (Almås *et al.*, 2012; Brown, 2013; D'Silva, 2017), deforestation (FAO, 2006; Urquhart *et al*., 2012; Gibbs *et al*., 2015; Lawrence and Vandecar, 2015; Vira *et al.,* 2015; Gladek *et al*., 2016; Kastens *et al*., 2017; Larsson, 2017; Lewis *et al.*, 2019; Phillips *et al*., 2019), and rights violations (Dower and O'Connor, 2012; ETC, 2017; Kauffman and Martin, 2017).

An unhealthy diet is the largest modifiable factor in morbidity and mortality globally (Peeters, 2018). To address this, comprehensive and effective policies are needed to systematically develop and disseminate the evidence for the feasibility, effectiveness and sustainability of policies that will provide healthier food systems. This is now seen as *the* defining issue for public health nutrition (SDC, 2007; Lawrence *et al.*, 2015a; Valenta, 2015; WHO, 2015; WHO, 2017; Kwon *et al.*, 2019; Lawrence *et al.*, 2019), with the growing recognition of the finite availability of the resources required to produce food and the unprecedented risks that threaten public health nutrition (Beddington, 2011; O'Neil *et al*., 2014). Lang (2005) originally identified four conceptual problems for nutrition and, despite the plethora of subsequent studies, all four would appear to still have relevance today: meaning different things to different people; a failure of policy to inform practice; an unawareness of how it affects the environment; and having too much choice along with an information overload. Nutrition science therefore needs to become more focused on the amount of carbon embedded in a good diet, the consequences of how each component is produced (Lang, 2017d), enabling sustainable diets to replace the current policy focus of simply raising output (Lang, 2010; Lang, 2014b) with a more environmentally friendly and socially responsible food policy (Lang *et al*., 2009). Furthermore, nutrition science also needs to contribute to balancing the health, environment, consumer aspirations, and commercial policy imperatives alongside bridging existing tensions such as land within food systems (Lang, 1999; Lang, 2014a). Influencing health through food policy, for example, is further complicated for many foods that are processed, distributed, and promoted through the supply chain (Hawkes *et al*., 2012; Dania *et al*., 2018). Springmann *et al*. (2018b) analyse future pressures on the five environmental domains to 2050 (shown on the *y*-axis in figure 50) and conclude that a synergistic combination of policies will be required to mitigate against projected increases in environmental pressures of around 50 - 90 per cent. Their findings suggest that although different foods have varying environmental impacts, policies will be required to ensure all stay within the planetary boundaries. Specifically, such policies will need to address dietary change, reduce food waste and loss, land and water use, and limit fertiliser applications (Lake *et al*., 2010; Dorward, 2012; Kummu *et al*., 2012; Institution of Mechanical Engineers, 2013; Tansey, 2013; HLPE, 2014a; WRAP, 2015; Thyberg and Tonjes, 2016; Notarnicola *et al*., 2017b; Schweitzer *et al*., 2018; WRI, 2016; Anthony, 2019; WRAP, 2019).

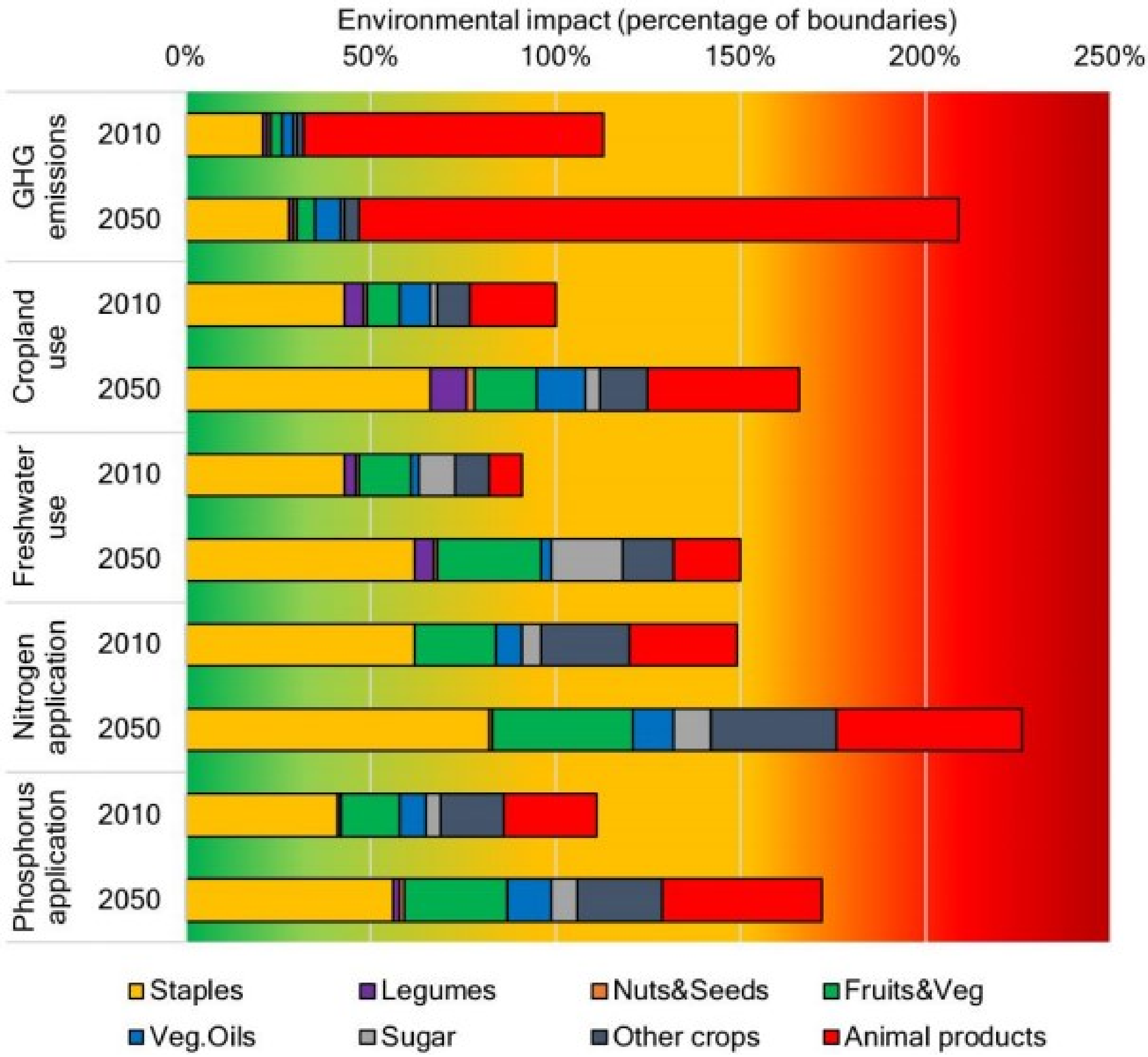


Figure 50: Current and future environmental impact by food groups on various Earth systems and assuming trends in consumption and production follow a business-as-usual trajectory

Source: Springmann *et al*. (2018b) cited in Willett *et al*. (2019).

Current policies that promote global trade to increase food availability and make food cheaper, such as the current UK food system, have also negatively impacted both the environment and health (UNEP, 2010a; UNEP, 2010b; Denis *et al*., 2015; UN, 2017; Helmstedt *et al*., 2018; Benton *et al.*, 2019; Benton and Bailey, 2019). The root causes of poor health are poorly understood (IPES-Food, 2017) and food sustainability has not been a consideration in public health nutrition activities (Lawrence *et al.*, 2015a). The health impacts of food systems are rarely examined systematically (IPES-Food, 2017) and have been neglected for decades (Tilman and Clark, 2014; Lawrence *et al.*, 2019). Evidence from other developed economies such as the USA show that diet-related, chronic disease rates are increasing rapidly, with 50 per cent of all adults having one or more preventable, diet-related chronic disease (USDH and USDA, 2015). This further stimulates the need for urgent, preventative policy in the UK. In order to be effective, Hawkes argues that the sector must identify and bring together all the improvements that the various stakeholders are taking; greater convergence will bring about more effective change and also enable gaps to be filled; new leadership to ensure collaboration, courageousness, and compassion (Lane, 2019; Parsons and Hawkes, 2019). Numerous studies consider the double burdens of malnutrition (i.e. the coexistence of over-nutrition alongside under-nutrition) across different populations (Kraak *et al*., 2011; Alders and Kock, 2017; Hawkes *et al*., 2019; Nugent *et al*., 2019; Wells *et al*., 2019; *The Lancet*, 2020). As individuals can be affected by the various forms of this double burden throughout their lifetimes, Wells *et al*. (2019) considers the many, interconnected biological pathways which are shown in figure 52. To mitigate against the double burden of malnutrition, Wells concludes, requires major societal shifts in nutrition and public health over many decades. Kraak *et al*. (2011) provide a socio-ecological model to illustrate the various stakeholders involved in promoting healthy food environments for populations to guide stakeholder involvement in addressing unhealthy food environments (figure 51). Lang and Barling (2012), however, argue the socio-ecological perspective lacks the coherent framework needed to enable the required policy response. More recently, Branca *et al*. (2019) have called for stakeholders to power the food system revolution capable of ending malnutrition by addressing the growing patterns of inequality, the political economy of food, and the commodification of food systems. Table 6 shows the roles and responsibilities for the stakeholder groups needed to create the systemic changes needed.

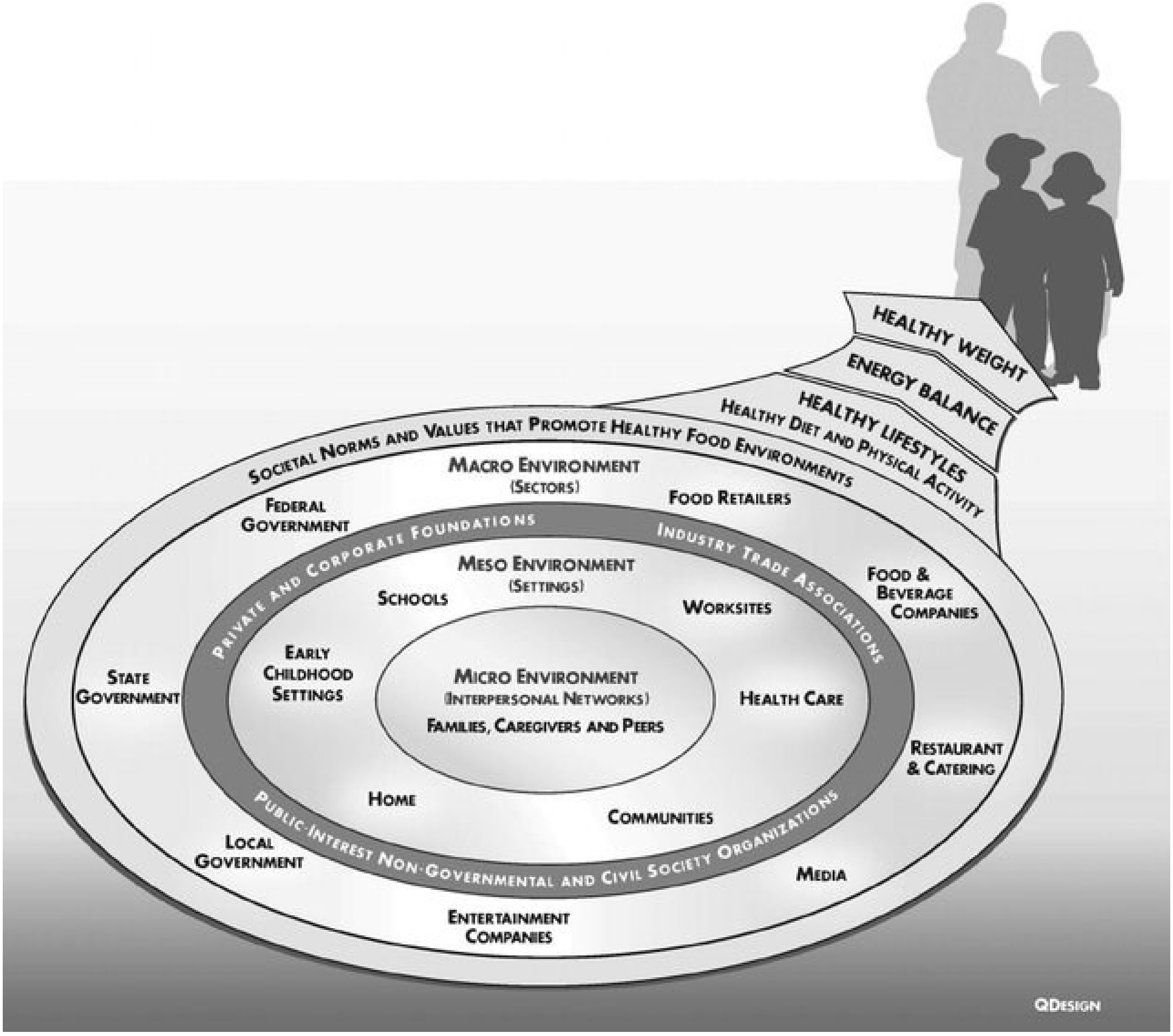


Figure 51: A socio-ecological model illustrating stakeholders involved in promoting healthy food environments for populations

Source: Kraak *et al*. (2011).

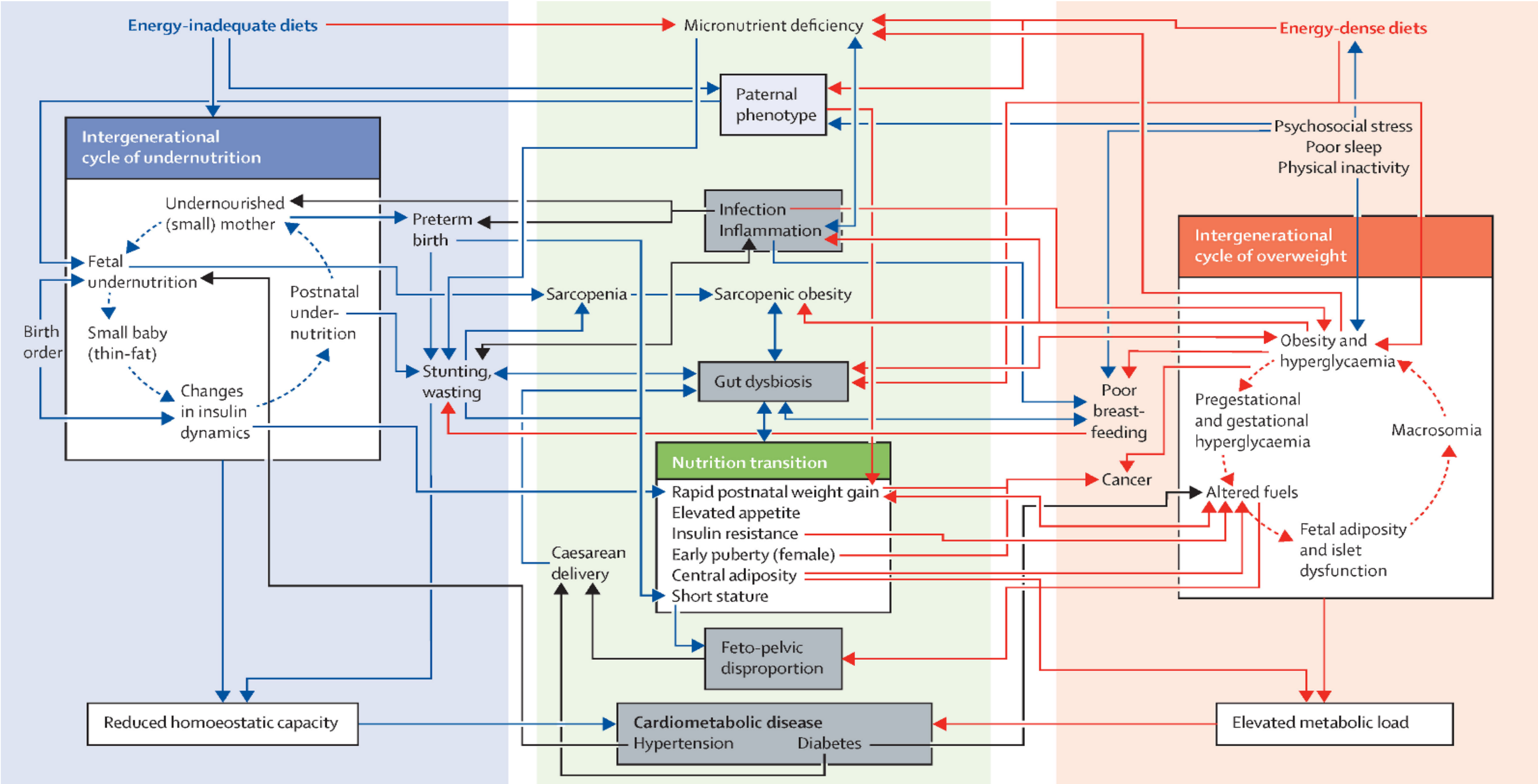


Figure 52: Complex interconnections between intergenerational cycles of undernutrition and nutritional excess and the effect of nutrition transition

The intergenerational cycle of undernutrition (blue) associated with energy-inadequate diets and micronutrient deficiencies constrains growth and reduces the metabolic capacity for homoeostasis. The intergenerational cycle of overnutrition (red) associated with energy-dense diets is characterised by excess metabolic fuel and elevated adiposity, each of which challenges homoeostasis. Both cycles of malnutrition contribute to a wide range of adverse health outcomes (grey boxes), and specific diseases also increase the risk of malnutrition (black arrows). Through nutrition transition, individuals shift between these cycles within the life course, both increasing the risk and exacerbating the magnitude of health consequences. This framework helps identify how nutrition transition generates biological connections between many different forms of ill health (e.g. low birth weight, stunting, central obesity, diabetes, and caesarean delivery).

Source: Wells *et al.* (2019, p.78).

Framing climate change as an integral public health issue that permeates research, teaching, policy and professional practice is now recognised as having the potential to help galvanise public support for the civilisational crisis (Dowler *et al*., 2011; Lawrence *et al.*, 2015a; Wang and Horton, 2015). Although most studies agree that climate change will reduce the overall availability of food and hence threaten food security, wide variations exist across differing commodities and regions. The negative impacts of climate change (e.g. increased water stress) will continue to be more common than positive ones (e.g. increasing yields) (Fiscus *et al*., 2005; Kang *et al.,* 2009; Knox *et al.,* 2010; Poppy, 2014a; Porter *et al*., 2014; Menhas *et al.,* 2016; Gutteridge, 2018; Liu *et al*., 2019). Additional dimensions for food security include food sufficiency, nutrient adequacy, cultural acceptability, safety, certainty and stability (Coates, 2013), rapid urbanisation and dietary transition (Delgado, 2003; Naylor, 2008; FACCE, 2010; Satterthwaite *et al.,* 2010; Richards *et al.,* 2016; Geels *et al*., 2017; Nixon *et al.,* 2018; *Rural 21*, 2018; Siegner *et al*., 2018; Sonnino *et al.*, 2019). Studies also call for a better understanding of the dynamics of both food security and nutrition (Brown and Funk, 2008; FAO, 2008; Pinstrup-Anderson, 2009; Fullbrook, 2010; Durham and Avant, 2011; Gaus, 2012; National Research Council, 2012a; Pinstrup-Andersen *et al*., 2012; Kadir *et al*., 2013; Brown, 2014; Prosperi *et al*., 2014; *The Economist*, 2014e; Brown *et al*., 2015; *The Economist*, 2015a; Campbell *et al*., 2016; Fan and Brzeska, 2016; McCarthy *et al*., 2018; UN, 2018a). This is one of the main focus areas for the FAO (FAO, 2011; FAO, 2013e; FAO, IFAD and WFP, 2015; FAO, 2016g; 2016k; FAO, IFAD, UNICEF, WFP and WHO, 2017; FAO, 2017a; 2017b; 2017d; 2017f; 2018f; 2019e; 2019g) as well as other international bodies (Porter *et al*., 2014; CFS, 2015a; CFS, 2015b; CFS, 2017; CFS, 2019a; CFS, 2019b). Further impacts are expected on yields through higher temperatures and reduced rainfall (Ainsworth *et al.*, 2008; Ainsworth and Ort, 2010; Beniston, 2010; Bernabucci *et al.*, 2010; Ainsworth *et al.*, 2012; Smith and Gregory, 2013; Met Office, 2014; Hatfield and Prueger, 2015; Aleixandre-Benavent *et al.*, 2017; Clark and Tilman, 2017; Borunda, 2019) with increasingly frequent and severe extreme weather having the potential to impact food seasonality (Rosenzweig *et al*., 2001; Li *et al*., 2009; Beniston, 2010; Benton *et al*., 2012; Ecker and Breisinger, 2012; Forster *et al.*, 2012; Liapis, 2012; Miller *et al.*, 2013; Met Office, 2014; Centre for Environmental Risks and Futures, 2015; Cranfield, 2015; Easterling and Aggarwal, 2018; Park *et al*., 2018; NAS, 2019). An early study by Cline (2007) on the impact of climate change on global agricultural yields is widely cited within the literature (figure 53). This map illustrates the percentage change to yields of major commodities such as wheat, rice, and soya, with a correlation between higher temperatures and lower yields. These food crops of particular concern, given that they provide food security for more than half of the world's population. Further impacts are expected on yields through higher temperatures and reduced rainfall (Ainsworth *et al.*, 2008; Ainsworth and Ort, 2010; Beniston, 2010; Bernabucci *et al.*, 2010; Ainsworth *et al.*, 2012; Grassini *et al.,* 2013; Smith and Gregory, 2013; Met Office, 2014; Hatfield and Prueger, 2015; Aleixandre-Benavent *et al.*, 2017; Clark and Tilman, 2017; Borunda, 2019). The increasing threat of aridification, if the 1.5°C temperature limit is exceeded, will both impact regions that are already hot and dry, reduce availability, with shorter growing seasons impacting the most important foods (Beddington *et al.*, 2012; Park *et al*., 2018). In the tropical latitudes, Africa and parts of South Asia for example, this is already where the greatest food security challenges persist (Nelson *et al.*, 2009; Schlenker and Lobell, 2010; Dubey *et al*., 2016; Song, 2017; Smith *et al.*, 2017; *The Lancet*, 2018a). Furthermore, should global temperatures exceed 3°C, the impacts on global food production would be profoundly destabilising (Hegerl *et al*., 2004; Christensen *et al*., 2007; Easterling *et al*., 2007; Allouche, 2011; Iglesias *et al*., 2011; Beddington *et al.*, 2012; Aleksandrowicz *et al.*, 2016; Tripathi *et al.*, 2016). Even above 2°C, Peterson and Wood (2017) argue, will prove catastrophic for humans and animals; this will be reached within 30 years without decisive action. The past three decades has seen the Earth's surface become successively warmer (see NASA, 2019); the pace of this change is now seen by the IPCC (2014a) as rapid and accelerating. The strong correlation between the environmental and human systems and climate change will affecting all regions of the globe (UN, 2015d; UN, 2015b; WEF, 2018b).

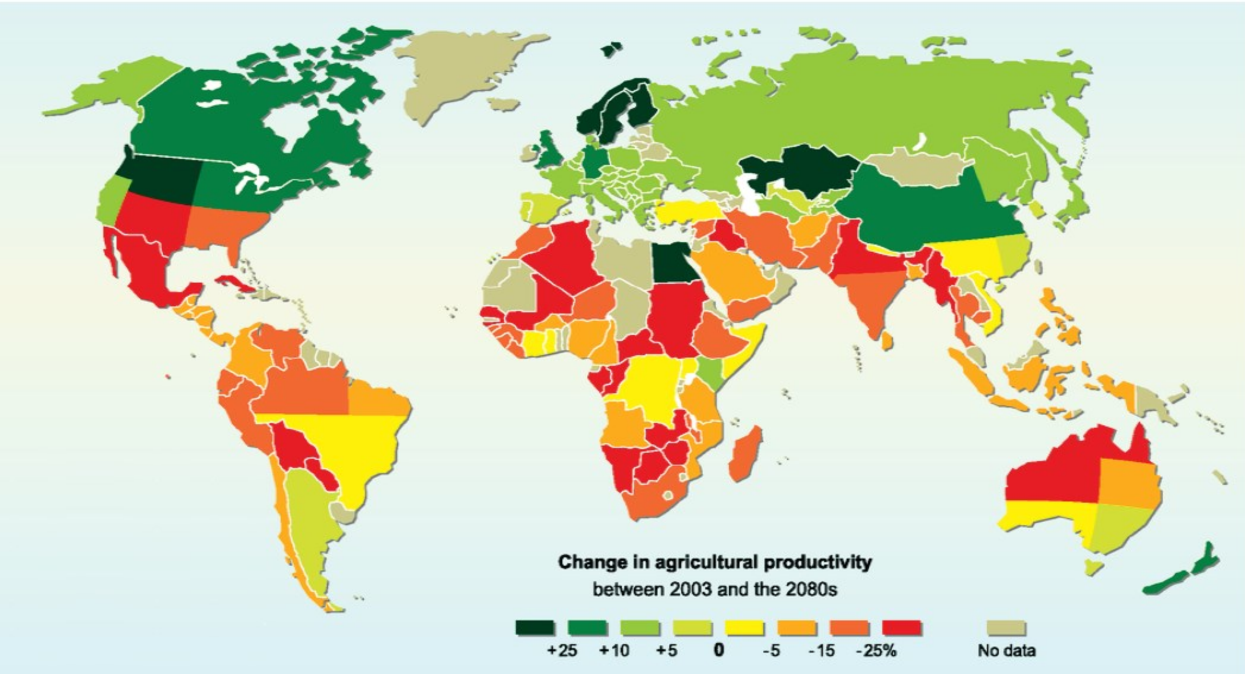


Figure 53: Projected impact of climate change on agricultural yields globally by the 2080s compared to 2003

Projections assume a uniform 15 per cent increase in yields due to the fertilisation effect of rising carbon dioxide in the atmosphere on some plant species

Source: Cline (2007) cited in Beddington *et al*. (2012).

The sustainability of biofuel production is a particular concern (Naylor, 2008; UNEP, 2009; Walker, 2009; Shatrugna, 2012; Christoplos and Pain, 2014; Moioli *et al*., 2018; Naylor and Higgins, 2018), with perspectives including the emissions from land-use change (Searchinger *et al*., 2008; Fargione *et al*., 2009; Hiederer *et al*., 2010; Ernst and Young, 2011; Poudel *et al*., 2012; Rudel, 2013; Searchinger, 2013; Elbehri, 2015), their contribution to price volatility and food insecurity (Barrett, 2010; Lake *et al*., 2010; Alexandratos, 2011; HLPE, 2011; IMF, 2012; Gregory and Coleman-Jensen, 2013; Schmitz, 2013; IMF, 2014) and their impact on biodiversity (IPBES, 2018). Although the EU is gradually shifting away from farm subsidy policies to ones that support bioenergy, understanding the impacts of such policies is complex (Bureau and Swinnen, 2018). Also, and of particular relevance to the UK, EU policies that encourage the increasing use of crop feedstocks such as maize, sugar, soya, rapeseed, and palm oil for biodiesel, indirectly leading to the cutting down of more rainforests, the conversion of more forest and peat land for palm oil plantations, resulting in more carbon emissions (Shatrugna, 2012; Charles *et al*., 2013; IISD, 2013; Levidow, 2013; Tubiello *et al*., 2016; Naylor and Higgins, 2018). Smith *et al*. (2018) and Carbon Brief (2016) advocate the potential for BECCS as part of the strategy to limit the temperature increase from 2°C to a 1.5°C maximum to meet the Paris Agreement commitments. Noting the obvious opportunities to use BECCS to capture carbon, Benton (2020) however suggests the global land requirements needed for the anticipated emission trajectories would be more than 50 per cent of all the land used for arable production.

The most widely cited definition suggests '*food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life'* (FAO, 2019g, p.186). Traditionally, the four critical components of availability, access, utilisation, and stability were seen as essential (Hanjra and Qureshi, 2010; FCRN, 2018f; FCRN, 2019d); today, many studies have added the challenge of climate change (Watson *et al*., 1996; IPCC, 2007a; Ericksen *et al.,* 2009; Parry *et al*., 2009; Muldowney *et al*., 2013; PwC, 2013b; Christoplos and Pain, 2014; Poppy *et al.,* 2014a; FACCE, 2015; Food Source, 2018; Scarlett, 2019). The literature on food security has changed little over the past two decades, when Smil (2000) promoted the more effective use of resources, increase efficiency, reduce waste, and dietary transition as responses to the global challenges facing food security. Smil also warned about the consequences of inaction, late action, or misplaced emphasis would only exacerbate future problems; today, this is framed as the immense threat that planetary health poses for food security and global stability (Morisetti and Blackstock, 2017; Pérez-Escamilla, 2017; Schmidt and Matthews, 2018) that urgently requires new governance systems (Whitmee *et al*., 2015; Campbell *et al*., 2017; Acunzo *et al*., 2018; Heck *et al*., 2018; Newell *et al*., 2018). The socio-economic research advocates analysis of the costs and benefits of the economic, environmental, and social trade-offs that are fundamental for a sustainable economy (Davis, 2015; Davis *et al*., 2015; Helm, 2019) and to address climate change as '*the mother of all externalities*' (Tol, 2009, p.29). Consequently, Stern (2013) now advocates treating policy analysis as a risk management problem, especially given the scientific consensus on existing models grossly under-estimating the risks.

Several perspectives attempt to address the global food security and sustainability challenge. Some studies argue food production could double and its environmental impacts reduce by halting the expansion of land use, closing yield gaps, increasing cropping efficiency, shifting diets and reducing waste, thereby ensuring global food security and environmental sustainability for all (Foley *et al.*, 2011; West *et al.*, 2014). EU-funded research into these policy challenges (Smith *et al*., 2015; Smith *et al.*, 2016) recommends recognising the hybridity and interconnectedness of food systems, informed by science-based evidence and socio-cultural values. The metrics to assessment the performance of food security and sustainability remains challenging (table 5) and requires a multi-criteria approach to cover a range of factors such as volatility, uncertainty, complexity, ambiguity, low-carbon food production, waste, and a low-carbon society). The same challenges with the variability in Life Cycle Analysis (LCA) methodologies are also extensively covered (Andersson *et al*., 2005; Hauschild and Potting, 2005; Tukker, 2006; Garnett, 2013; Notarnicola *et al*., 2012; Hellweg and Canals, 2014; Moresi, 2014; Auestad and Fulgoni, 2015; Bjørn *et al.*, 2015; Bjørn and Hauschild, 2015; DeFries *et al*., 2015; Goglio *et al*., 2015; Hall, 2015; Allen *et al*., 2016; Bartlett and Garnett, 2016; Dötsch-Klerk *et al*., 2016; Park *et al*., 2016; Pernollet *et al*., 2016; Notarnicola *et al*., 2017a; Sala *et al*., 2017; Allen *et al*., 2018; FCRN, 2018b; Karabulut *et al*., 2018). Bjørn *et al.* (2015) further argue that LCA needs to include carrying capacity, to enable comparisons between the environmental impacts from a product and sustainable levels of impacts, thereby ensuring LCA indicators become absolute environmental sustainability indicators. Staying below thresholds is essential to safeguard ecosystem services and biodiversity, for environmental sustainability and staying within the planetary boundaries (WWF, 2016b; Bell *et al.*, 2018; WWF, 2018b).

Target relative to 2015	*Indicator*	*Metric*
By 2030, reduce the rate of food loss and waste by 50 per cent	Share of food produced or harvested that is lost or wasted between the farm and fork	Per cent of food loss and waste
By 2030, reduce the greenhouse gas emissions from food production by 25 per cent	Total greenhouse gas emissions from food production, including both crops and livestock	Tonnes of carbon dioxide equivalent
By 2030, reduce the water-intensity of agricultural production by 25 per cent	Tonnes of food produced per cubic metre of irrigation water consumed to generate those tonnes	Tonnes per cubic metre of water

Table 5: Proposed food security targets that integrate sustainability

Source: Hanson (2013).

Stakeholder groups	*Role and responsibility*
Governments	Prioritise solving the problem; regulate to set standards and their enforcement; implement policies that are equitable, inclusive, and financed; collect and use data to inform action; and mobilise public investments
UN	Convene and connect actors; demonstrate cost-effective solutions; monitor implementation of commitments and achievement of targets
Civil society	Advocate, organise, mobilise people; monitor commitments; and create a generation of activists
Academia	Generate a diverse evidence base; build capacity and conduct research to solve problems, create sustainable solutions, and promote interdisciplinary systems thinking and research
Media	Inform public opinion, tell stories, create debate; facilitate demand for public accountability; focus on structural drivers not individuals and avoid stigma
Philanthropy and multi / bilaterals	Foster innovation; embrace complexity; fund systems-based problem solving; and convene stakeholders
Private sector	Commit to responsible business by production and distribution of affordable nutritious foods; prioritise population health and wellness agenda over profits; consent to appropriate conduct by removal of undue influence on relevant policy and research; and abide by national and international marketing and other codes and regulations
Regional economic platforms	Reshape trade and investment policies in line with public health policies and protect policy space for nutrition

Table 6: Roles and responsibilities of stakeholder groups who must create the systemic changes needed to end malnutrition

Source: Branca *et al*. (2019).

The literature calls for further research into a better understanding of food systems, more integrated cross-governmental policies, and food systems making a greater contribution to human well-being (Devlin *et al*., 2014; Durrant, 2015; Centre for Food Policy, 2018a; Centre for Food Policy, 2018b; Food Ethics Council, 2018b; Benton, 2019a). Similarly, the CSOs make numerous contributions, including the value of local foods and farms (CPRE, 2016; CPRE, 2017), best business practice (Food Ethics Council, 2013; 2018a; 2018d; 2018f), taxing unhealthy foods (Bähr, 2015; Food Ethics Council, 2018e; Harrabin, 2018; Baggini, 2019), better children's diets (Food for Life, 2018), tackling obesity (Food Foundation, 2016a), improving dietary choice (Food Foundation, 2016b), and food security (Food Foundation, 2016c; 2016d). The subject also generates intense interest in the trade and consumer press, with recent examples variously calling for government regulation of industry and to intervene in markets (NFU, 2017; 2018; Harvey, 2018; King, 2019; National Policy Forum, 2019; NFU, 2019) and the UK's poor performance in the Food Sustainability Index due to the continuing absence of a coherent government strategy on food (Hughes, 2018).

The fenland area surrounding The Wash falls under the control of a number of local authorities, three of whom (East Lindsey, Boston and South Holland) are in the top ten of regions with the most properties at risk in a flood plain (LRO, 2012). Despite the obvious risks, early local authority publications make little reference to flooding (EMSDRT, 2000; LRO, 2007). Following the Adaptation Sub-Committee's (ASC) first report in 2010, however, this brought about a number of sequential publications (LRO, 2011; North and North East Lincolnshire, 2011; Evans, 2012; LRO, 2012; Collison, 2014; Curry and Allen-Collinson, 2016; Collison, 2017; DEFRA, 2017b; ELDC, 2017; North East Lincolnshire Council, 2018; LLEP, 2019; SEL-JPU, 2019). Despite the region's historical development (i.e. being reclaimed from the sea through complex systems of drainage) meaning much of the area remains at, or below, current sea level, and its importance in terms of national food security, even very modest levels of sea-level rise could have huge consequences for food production throughout the area. This would also potentially impact the health and wellbeing of the people who live there.

2.6.4 Policies to meet global commitments

Much of the global preoccupation within the literature is focused on SDG attainment and meeting the commitments laid down in the 2015 Paris Agreement. Food is connected to all the SDGs, as is the need to decouple economic growth from resource use and environmental degradation (UN, 2015a; UN, 2015e; UN, 2015f; Rockström and Sukhdev, 2016; Tan, 2016; UN, 2019). Many studies suggest, however, that the world is not on track to attain these goals (Development Initiatives, 2017; EU, 2018b; *The Lancet*, 2018b; Allwood *et al.*, 2019; Branca *et al*., 2019; EC, 2019; FAO, 2019h; King and van den Bergh, 2019; Scown *et al*., 2019). Critics of the SDGs also argue they lack clear goals and effective guidance on how to ensure sustainable consumption and production patterns (Dubuisson-Quellier and Gojard, 2016; SCP, 2016; Engebretsen *et al*., 2017; Bengtsson *et al*., 2018; Benton *et al*., 2018; Rush, 2019). As affordability remains a major barrier to the SDGs, UNEP (2020) have introduced a series of personal actions (goodlife goals) that people around the world can take to help support the SDGs (see appendix 8.17); others advocate using the Economist Intelligence Unit's Food Sustainability benchmark index to help meet the SDGs (Barilla, 2018; Food Ethics Council, 2018c). The International Union of Food Science and Technology recommends seven actions to achieve the SDGs: more diverse and sustainable primary food production;

new processes and systems for sustainable manufacturing; the elimination of waste; product safety and traceability; affordable and balanced nutrition for the malnourished; improved health through diet; and, the integration of big data, information technology, and artificial intelligence into food systems (HLPE, 2017; Olsen and Borit, 2018; IUFoST, 2019).

The Paris Agreement requires signatory countries to limit global temperature below 2˚C above pre-industrial temperatures, with the aim to limit rises to 1.5°C (Climate Focus, 2015; United Nations, 2015; GFS, 2017). Although arguably a major political achievement towards reducing the impacts from climate change (Timperley, 2017; Beuret, 2018; Food Ethics Council, 2019a), subsequent studies suggest the actual temperatures are likely to be 2.0-4.9°C higher even after the changes made (Haines, 2017; Raftery *et al*., 2017; Miman, 2018). The latest IPCC report warns that '*without societal transformation and rapid implementation of ambitious greenhouse gas reduction measures, pathways to limiting warming to 1.5°C and achieving sustainable development will be exceedingly difficult, if not impossible, to achiev*e' (Roy *et al*., 2018, p.448). Despite food production's considerable contribution to GHG emissions, the threats that climate change will cause it, and the increasing risk of food insecurity (WEF, 2019e), it isn't specifically mentioned within the Paris Agreement. Verschuuren (2016) sees this as an oversight; one which was also common with earlier UNFCCC policies, but takes solace from ambitious EU policies aimed at climate friendly and resilient food production such as Maciulevičius (2016). Rather concerningly, the initial response from the Committee on Climate Change (2016a) was that the Agreement was more ambitious than existing plans which were already stretching the UK, therefore its priorities would remain with the original targets. Failing to achieve the Paris climate goals is also expected to cost trillions of dollars (Patel, 2018). Various forums involving multidisciplinary contributors from academia, industry and government have discussed scenario options (Kreit *et al*., 2011; Fenger, 2016; GFS, 2017c; WEF, 2017; Jacob *et al*., 2018; Rogelj *et al*., 2018; GFS, 2019a; WRI, 2019). The purpose of the UN Decade of Action on Nutrition (2016–2025) is also to accelerate action to achieve the SDGs (FAO/WHO, 2016; Rugg, 2016). The original agreement was predicated on the idea that countries would ramp up their pledges every five years (Committee on Climate Change, 2016b; Hale, 2019), with the first opportunity to review these being the 2021 climate summit (COP26). Rising atmospheric concentrations of methane are also seen as a challenge, especially given the current uncertainty regarding the exact source of the increase (Hook, 2019; Mikaloff Fletcher and Schaefer, 2019; Miller *et al*., 2019).

The policy options to mitigate and adapt to the effects of climate change are also thoroughly considered (Reilly and Schimmelpfennig, 2000; Vermeulen *et al*., 2012a; Vermeulen *et al*., 2012b; Hansen *et al*., 2013; Vermeulen *et al.*, 2013; Smith *et al.*, 2014; Masud *et al*., 2017; Sa *et al*., 2017; Sanz-Cobena *et al*., 2017; Committee on Climate Change, 2018d; Garrett *et al.*, 2018; Jacob *et al*., 2018; Karimi *et al*., 2018; Steffen *et al*., 2018; Fujimori *et al*., 2019; Henderson and Frezal, 2019). Here again, however, the situation is complex and multi-faceted (Jarmul *et al*., 2019). Biesbrook *et al*. (2010) is critical of EU climate policy, for example, as it originally focused entirely on mitigation with adaptation been considered much more recently. The IPCC (2018) argue CO_2 emissions must be limited to 420 billion tonnes annually, with a further 720 million tonnes being removed from the atmosphere. This will require the immediate restoration of natural vegetation such as forests to reach net zero emissions by 2050. Doelman *et al.* (2019), however, estimates this will increase food prices by 11 per cent, reduce availability by 230 kcal/day per person, and expose an additional 230 million people to hunger by 2050. Springmann *et al.* (2018d) advocates climate policies that include GHG emissions into pricing policies to reduce diet-related diseases. In *The Lancet*, Harwatt *et al*. (2020) similarly stress the need to reduce demand for livestock products and insist that wealthier nations must not outsource their livestock production to other countries. Further guidance is forthcoming from a variety of sources: the OECD, whose main focus is promoting the market economy (OECD, 2006; OECD, 2016), CAP reform (OECD, 2011), climate change (OECD, 2015), the environment (2017c), policy (OECD, 2017a), health (OECD, 2017b) and food (OECD-FAO, 2019); market-centric analyses by McKinsey (McKinsey, 2011; McKinsey, 2013; McKinsey, 2016; McKinsey, 2017; McKinsey, 2018a; McKinsey, 2018b); the Nature Conservancy believes natural climate solutions such as protecting, restoring and managing land to reduce emissions and enhance carbon storage could contribute to over one third of the temperature reduction needed (Scarlett, 2019); Franco *et al*. (2020) recommend multifunctional landscapes for food production, natural resources, and ecosystem services. Further food-related adaptation and mitigation policy options as recommended by the IPCC are detailed in appendix 8.10.

Numerous studies argue individual country Nationally Determined Contributions (NDCs) express good intent but are not nearly enough and therefore need to be more ambitious (Beuret, 2018; Gomez-Echeverri, 2018; McGrath, 2018b; Northrop, 2018; Brown *et al*., 2019) and transparent (Kougioumoutzi, 2016; Doelman *et al.*, 2019; King and van den Bergh, 2019). One recent assessment of progress to date is particularly down-beat: 75 per cent of the 184 country pledges were insufficient to reduce GHG emissions by 50 per cent by the 2030 target date (Watson *et al*., 2019); of particular concern were China (26.8 per cent of global GHG emissions which had increased by 80 per cent from 2005 to 2018), the USA (13.1 per cent but temporarily withdrew from the Paris Agreement and cut carbon regulations), India (7 per cent but increased 76 per cent between 2005 and 2017), and the Russian Federation not even submitting its plan to cut emissions yet. Out of the top-five emitters, only the EU are on track to cut GHG emissions. The voluntary nature of the climate pledges and an array of technicalities, loopholes and conditions are used to regularly postpone actions. Key to all the Paris Agreement commitments is energy use. Here, the UK's Carbon Brief call for more rigorous carbon budgets, speeding up the transition, doubling current investments, developing renewable and energy efficient resources, and using price mechanisms such as subsidies and carbon pricing (G20, 2015; G20, 2017; Kampers and Fresco, 2017; Springmann *et al*., 2017;

Timperley, 2017). Kougioumoutzi (2016) and GFS (2016 and 2017d) call for more government guidance for businesses. *The Lancet* argue the Paris Agreement legislation needs to be turned into public health policy that health professionals can implement at local and national levels; to do this, however, the UK would need to overcome poor inter-departmental sharing of policy between government departments (*The Lancet*, 2018d; Benton, 2019a). Morse *et al*. (2018) advocates greater investments in health research partnerships. Nutrition is also seen as critical in driving greater environmental sustainability, providing the infrastructure for economic development, reducing the burden on health systems, for supporting equity and inclusion, and in helping to provide peace and stability (MacFarlane and O'Reilly de Brún, 2011; Rüttinger *et al*., 2015; Development Initiatives, 2017; Hendriks, 2018).

The recent literature on sustainable food policy within the EU includes how the planetary boundaries can be operationalised into national and sub-national governments, businesses, and local stakeholder decision-making (Häyhä *et al*., 2016; Dao *et al*., 2018; O'Neill *et al*., 2018; Osofskya and Pongsiria, 2018). The European Commission produces regular policy updates on sustainable food (SCAR, 2011; EC, 2013f; 2014), food security (EC, 2013c; Maggio *et al*., 2015), climate change (EC, 2013a; JRC, 2014; EC, 2013b; 2018f), economics and competitive impacts (EC, 2016; 2017; 2018b), resource efficiency (EC, 2011), LCA (EC, 2013d), the SDGs (EC, 2019c), fishing (EC, 2018d), labour migration (EC, 2015), innovation (EC, 2013e), neonicotinoid risks (EC, 2018a), the impact of the CAP (EC, 2018c), vulnerable cities (EC, 2018e; Heidrich and Reckien, 2018), biofuels (EC, 2019a), and the Environmental Implementation Review (EC, 2019b). Their EU EATWELL project also provides best practice guidelines for healthy eating policy interventions (Pérez-Cueto *et al*., 2012). The EU has a disproportionately large environmental footprint due to its large import volumes (de Boer *et al*., 2019; Osei-Owusu *et al*., 2019); shifting the source of these imports could, however, lower this environmental footprint by around 60 per cent. Vieux *et al.* (2018) found significant differences between member-country diets, especially with fish, poultry, and dairy product consumption. Moving the current CAP towards a common food policy for the EU is an opportunity to promote sustainable diets for all Europeans (Barling, 2007; Breen *et al.*, 2010; Barclay, 2012; Capacci *et al.*, 2012; OECD, 2013; Fresco and Poppe, 2016; Barling, 2017; EC, 2018c; European Public Health Alliance, 2018; Food Service Footprint, 2018a; Maas, 2018; Parsons and Hawkes, 2018; De Schutter, 2019; Eating Better, 2019; De Schutter *et al.*, 2020). Building on this need for reform of the CAP, Recanati *et al.* (2019) outlines how this opportunity might address both the complex environmental issues and provide the required nutritional outcomes at the same time (figure 54). Critics of CAP reform, however, claim it will do little to improve health such as increase fruit and vegetable consumption; nor will it improve soil fertility, reduce antibiotics and pesticide use, or measures to tackle waste (Doherty, 2018); address obesity or reduce the current NCDs that account for over 70 per cent of mortality (De Schutter *et al.*, 2020). Instead, De Schutter advocates adopting the IPES-Food EU Common Food Policy blueprint (see appendix 8.15). Galli *et al.* (2020) similarly review how various policy processes can be used to remove barriers to sustainable food systems within the EU and propose a strategic framework to enable the transition to sustainable food policies (figure 55).

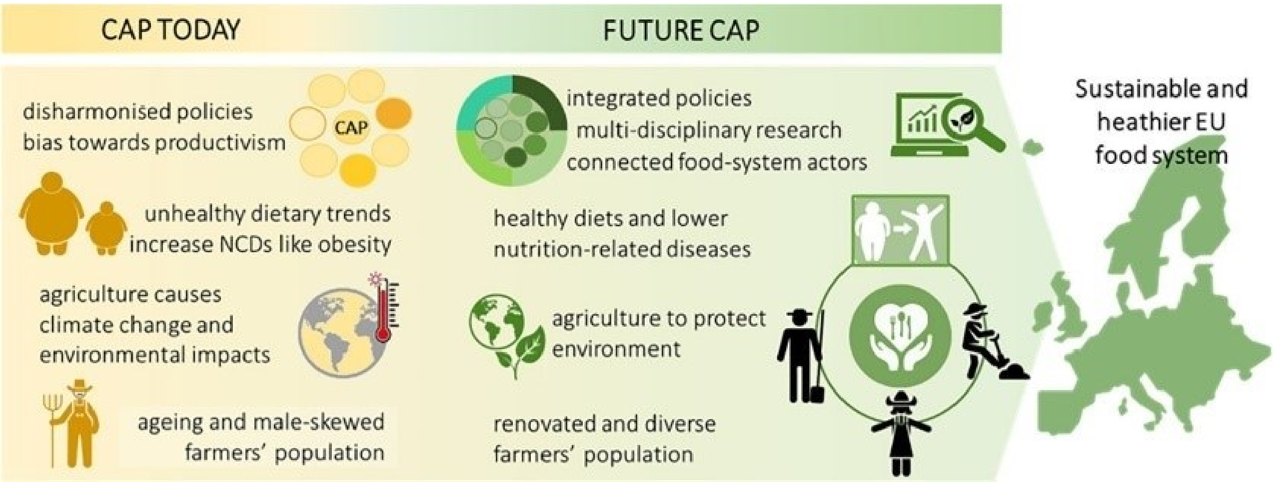


Figure 54: Reforming the role of Common Agricultural Policy for more sustainable and healthier food systems in Europe

Source: Recanati *et al.* (2019).

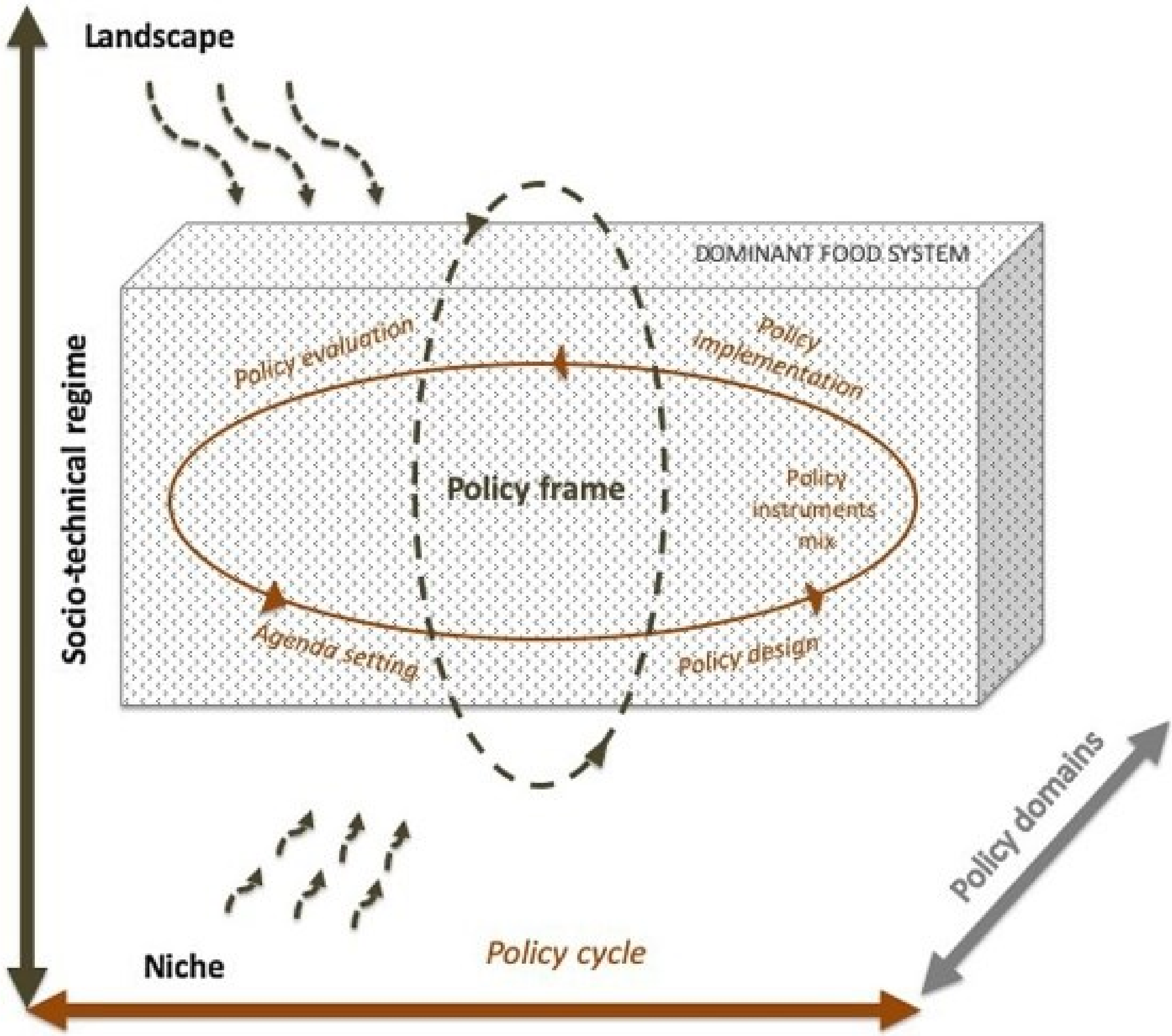


Figure 55: A conceptual framework for transition to sustainable food policies

The dominant food system is represented in the dotted box and is shaped by three relevant dimensions. The vertical dimension (in dark grey) indicates the multiple levels of socio-technical transitions (niches, socio-technological regime, and landscape) which can trigger change in the dominant food system affecting its policy frame. The horizontal dimension is the policy cycle in its key phases: agenda setting, policy instruments mix and policy implementation, policy evaluation (in brown). This dimension takes place in different policy domains that are relevant for the food system (agriculture, health, environment, social policies etc.). The third dimension is represented by policy domains (in light grey). The dynamics among these key dimensions is relevant to the policy process towards sustainable food systems in Europe

Source: Galli *et al.* (2020, p.2).

The UK's Climate Change Act of 2008 was originally seen as pioneering and far-sighted but, with the passage of time, its central ambition of reducing carbon emissions by at least 80 per cent by 2050 (based on 1990 levels) is now increasingly seen as insufficient and too slow (Krebs and Haigh, 2018; Harrabin, 2019b; Hudson, 2019; Jackson, 2019a; Jackson, 2019b; *The Lancet*, 2019d). Although responsible for producing a wide range of literature on the subject from central government (EUC, 2010; House of Commons, 2012; 2013; 2015; 2016; Houses of Parliament, 2017; House of Commons, 2018; Environmental Audit Committee, 2018; 2019), at local authority level (e.g. NHS, 2016; Greater London Authority, 2018; London Food Board, 2018; Manchester City Council, 2018), and through the devolved administrations (Welsh Assembly Government, 2010; Agri-Food Strategy Board for Northern Ireland, 2013; Marsden *et al.*, 2016; Foord *et al*., 2018; McFarlane *et al.*, 2018; Deckard, 2019; Morris, 2019), the latest review of progress by the Committee on Climate Change (2019f) suggests poor performance on 24 out of the 25 required policies. This is despite the Climate Change Act placing a statutory requirement on the government to meet the targets. Reviewing this performance, Willis (2019) argues the fundamental problem is one of no single person or department having overall responsibility. Although the Department for Business, Energy and Industrial Strategy (BEIS) oversees progress, no other departments have carbon targets or responsibilities, with the BEIS unable to instruct them on what needs to be done. Despite transport being responsible for around 25 per cent of UK emissions, the Department for Transport's 2019 strategic plan makes little reference to climate change and continues to work with the Treasury to maximise oil and gas extraction from the North Sea. From 2011-2012 concerns over climate change and security started to appear in reports by the Foreign and Commonwealth Office and the Ministry of Defence (MOD, 2014) but, Harris (2012) argued, this still did not prompt the formation of any tangible mechanisms from government. Here, the energy businesses arguably have a disproportionate influence over governance decisions. Local authorities also lack both the statutory responsibility and resources to tackle climate change; constant budget reductions also leave them with few options, even though they may have declared a 'climate emergency'. Another Government Chief Scientific Adviser, David King, went on to serve as the UK Foreign Secretary's Special Representative for Climate Change from September 2013 until March 2017. He predicts that the world will very likely follow a medium to high carbon emissions pathway for the next few decades and argues much more needs to be done to limit the impacts of climate change below a harmful level. Furthermore, the current level of action falls well below what a risk-based assessment of the science would imply is necessary (King *et al*., 2015).

As for the UK, in the decade since Tim Lang wrote the closing words for the Sustainable Development Commission '*we do not have a sustainable food system, by any stretch of the imagination, and the evidence of the need to change the UK food system to face the immense challenges ahead is so strong that the policy development within Government still remains inadequate'* (SDC 2011, p.5) it is important to ascertain what progress has subsequently been made. As for food security, Kneafsey *et al.* (2012) argues that governance is required both to alleviate problems and to ensure access to affordable, healthy food. Previous policy from the mid-1970s had included building a resource base for food production (Ministry of Agriculture, Fisheries and Food, 1975). Gibson (2013) sees the need for a greater understanding of complex topics including, *inter-alia*, sustainability, free trade, national self-sufficiency, nutrition, poverty, and reducing female subjugation. More recently, Lang and Ingram (2014, p.1) see food security as '*combining the politics of population growth, diet, and the globalisation of food production and distribution with the limitations of soil, water, land use availability, and climate change*'. Ritson (2016) argues food security has fractured and lost its potency in terms of human wellbeing, warning that higher internationally traded food prices and the vulnerability of food imports are real possibilities in the future. Hoekstra and Mekonnen (2016) similarly warn food imports from water stressed regions will decline or become impossible altogether and warn that government does not appropriately appreciate the risks involved. Food seasonality is also considered; climate change will impact food availability through extreme weather events, degradation and desertification, and more gradual risks such as rises in sea levels will make flooding more likely in low-lying areas, limit freshwater availability, and alter growing seasons (Met Office, 2014; Watts *et al*., 2015; Morison and Matthews, 2016; Lowe *et al*., 2018; NERC, 2018). In their recent case study, Parsons *et al.* (2018) sees the potential for a more integrated UK food policy being held back by a legacy of old policy frameworks and poor institutional capacities. Commenting on the National Food Strategy consultation Jay Rayner, the British journalist, writer, and food critic claims powerful retailers have jeopardised the food supply chain to such an extent, that the country is no longer able to adequately feed itself (Rayner, 2017); the effects of previous naïve and short-sighted food policy whereby responsibility was devolved to the food retailers; and changing global demographics meaning limited access to global food imports at a time of increasing risk in international food markets (*see* DEFRA, 2006d; DEFRA, 2008b; DEFRA, 2009b; DEFRA, 2009c; DEFRA, 2010b). Further warnings include climate change altering the chemical and pathogen content of food, especially with changes the quantities of imported food or the geographical location where it is grown; and pathogens and chemicals being transferred from animals to humans, reinforcing the need for the FSA to work with the EFSA to monitor animal health to be able to detect threats before human infection occurs (Baylis and Githheko, 2006; Lake et al., 2010; Luck *et al*., 2011; Baylis, 2017; NAP, 2019d).

The level of self-sufficiency in food has long been part of the food policy narrative and this is increasingly the case with growing market fragility (Timmer, 2010b; Benton, 2017; Hamm, 2019). In the UK, it has been decreasing over the past 30 years (figure 56) and figure 57 shows relative cereal and starchy root self-sufficiency in global comparison. From a policy perspective, the focus on self-sufficiency is often criticised by economists for putting political priorities before the benefits of economic efficiency offered by international trade. More recently, research recommends it is politically and economically prudent to pursue policies to increase domestic food production where the capacity exists (Barling et al., 2008;

Barling et al., 2015; Clapp, 2016; Benton, 2017; Clapp, 2017; Wegren and Elvestad, 2018; EAC, 2019; Armstrong-McKay et al., 2019; Schramski et al., 2019). The grey literature also shows a resurgence of interest in self-sufficiency, especially given the probability of higher prices post Brexit (Fairlie, 2007; Carrington, 2014; EAC, 2019).

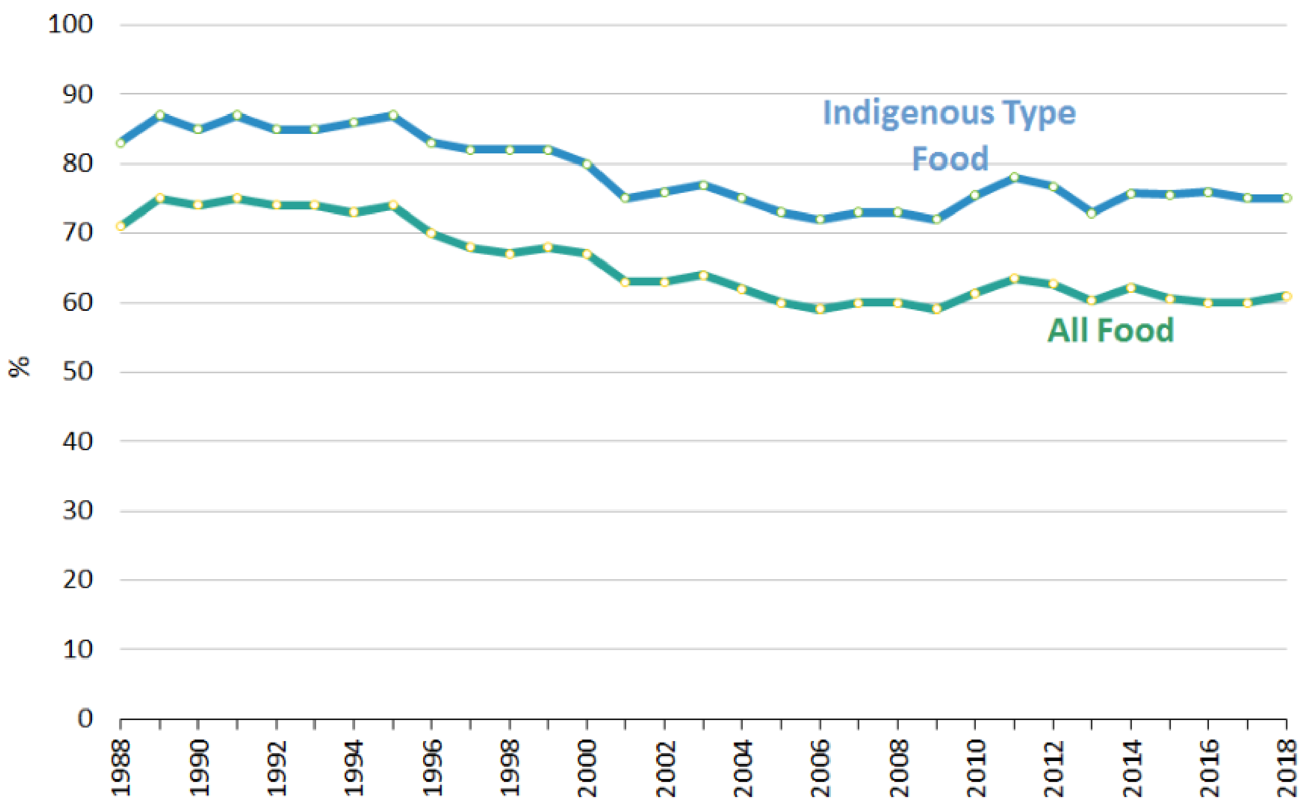


Figure 56: The UK's food production to supply ratio (self-sufficiency ratio) from 1988 to 2018

Source: DEFRA (2019n; 2020).

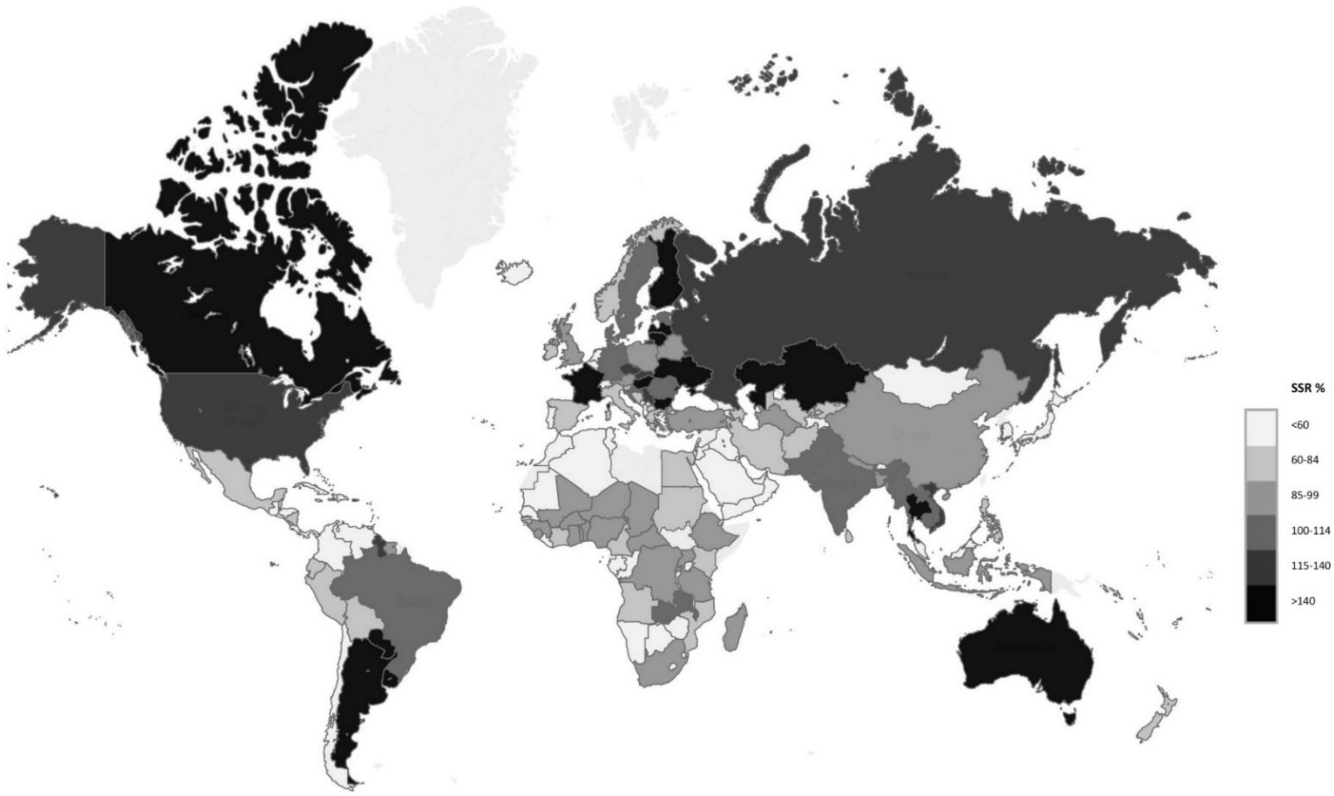


Figure 57: Food self-sufficiency ratios (SSRs) for cereals and starchy roots, 2007–2011

Source: FAO data cited in Clapp (2017).

The interdisciplinarity of food requires integrated solutions but the lack of clarity remains a major challenge. The recent trend towards food-systems thinking is not only facilitating a better understanding of the complex interactions influencing health, the environment, and the economy, but also the conflicts that often prevent the co-benefits from being realised (Parsons and Hawkes, 2018). Various thoughts on future directions are emerging: the need for a radically new approach that includes healthier, plant-based diets, less waste, and better technologies to improve the way food is grown to ensure the world is able to feed its population in 2050 (Springmann *et al*., 2018b); the fallacy of thinking technological solutions will enable humanity to get around the limitations in growth implicit within the planetary boundaries concept (Dyke, 2019); concerns over further delay in addressing the accelerating civilisational crisis caused by both the increasing power of corporations and the political self-interest that fuels denialism (Lucas and Horton, 2019); fake news' stories, such as claiming that scientists agreed that palm oil plantations did not have a negative impact on tropical peat lands (Wijedasa *et al*., 2016); denial also obscuring the public's recognition of the health hazards, as was demonstrated previously by the tobacco industry (McMichael *et al*., 2015; Häyhä *et al*., 2016; Carbon Brief, 2017a); and, the need for governments to act specifically against those corporations responsible for carbon emissions on the premise that climate change is a global threat that needs planetary-scale reform (Byskov, 2019; Carbon Disclosure Project, 2019).

2.6.5 Conflicting interests between policies and politics

Several studies raise ongoing concerns about the disconnect between the scientific consensus on future policy trajectories and political direction. The IPCC (2018b) is largely acknowledged as the final call to avoid climate catastrophe (Denkenberger and Pearce, 2015; McGrath, 2018b; Shine, 2018): specifically, the impacts of climate change are worse than anticipated and expected sooner than originally thought, with the global temperature increase heading for 3°C with rapid, far-reaching and unprecedented changes in all aspects of society; addressing this challenge will be expensive; but warning that the current political consensus remains focused on economies and living standards. Maintaining temperature increases at 1.5°C or even 2°C will be impossible without full political backing and the market interventions required (Abraham, 2018; Betts *et al.*, 2018; Harvey, 2018; Leahy, 2018). The differences in political approach between the left and the right is marked: right-wing populism promotes scepticism and hostility towards policies addressing climate change (Lockwood, 2018); impacts funding of the SDGs (Hatefi, 2017); conservative think-tanks deny and manufacture uncertainty on the reality and significance of climate science (Poortinga *et al*., 2011; Dunlap and Jacques, 2013; Supran and Oreskes, 2017; Cowtan and Lewandowsky *et al.*, 2018; Lawrence, 2019); personal experience driving political affiliation (Whitmarsh, 2011; Aleksandrowicz *et al.*, 2015); influences from the USA (NAP, 2011; Seekell *et al.*, 2017; Funk and Kennedy, 2018; Leiserowitz *et al*., 2018; Holden, 2019; Harrabin, 2020; Landler and Sengupta, 2020) and other countries such as Australia, Brazil, Russia and Saudi Arabia falling short on their international commitments (Murphy, 2019); and the propensity of the left to be more engaged with climate science (Saunders *et al*., 2018; Franzen, 2019). The type and nature of the political consensus ultimately influences decisions on a wide range of issues, including investments, governance, and policy developments. Even when policies to address climate change have broad public support, opposition can soon arise where certain communities are seen to bear the burden of associated costs (Pinstrup-Andersen, 2013; Stokes, 2015; Tol, 2018b), making successful policy integration difficult (Candel and Pereira, 2017). Carbon Brief (2018) argue carbon pricing may be near-impossible on a national level, let alone on a global scale. However, numerous examples of successful carbon tax and emissions-trading schemes do exist, where the key to success was passing the money raised back to citizens garnered support equally from the political left and right (Carattini *et al.*, 2019; Maestre-Andres *et al*., 2019). The UK government acknowledge responsibility for turning public expenditure into better public services to improve people's lives and to delivering world-class services that citizen's value (HM Government, 2017a). Until their National Food Strategy is published, however, it is not possible to determine the exact level of this commitment to food, the environment, or health. Although the contributions of political science to health will be discussed later, two current medical perspectives are worthy of mention at this juncture. The first is the arguments for resource-centred science to provide solutions for planetary health (Acunzo *et al.*,

2018) and the second, that political interests already exert a disproportionate influence to the detriment of health (Lucas and Horton, 2019). Both questions will be addressed shortly.

The food policy literature has developed significantly over the past decade and is now seen as increasingly critical in finding a way forward (Brambila-Macias *et al.*, 2011; Thomson *et al.*, 2018). The scale of this current challenge appears gigantean, as with '*no stretch of the imagination could our complex web of food supply, consumption patterns and impact be currently described as sustainable'* (Lang *et al.*, 2011, p.6). The term food policy is used to describe all the various policies that influence food systems and consumer diets, including food imports, prices, food safety, waste, labelling, and education. Where policies are successful, food security, safety, and healthy nutrition are both compatible and complimentary; where political trade-offs between them are made, conflict arises (Walls *et al.*, 2019). Other policies such as social, energy, migration, and taxation policies may also affect food indirectly. As many of these policies are then implemented by the private sector on behalf of government, the private sector has a strong influence over policy (Hawkes and Parsons, 2019). Emerging themes within the literature include policy malfunctions (Barling *et al*., 2002; Lang, 2009; Barilla Center for Food and Nutrition Foundation, 2018), calls for planetary (Haines, 2017; Bianchi *et al*., 2018; EAC, 2019) and ecological public health (Barling *et al*., 2002; Raynor *et al*., 2008; Lang, 2009; Lang and Rayner, 2012), growing governance needs (Gupta, 2004; Barling, 2007; Coppola and Pascucci, 2008; Biesbroek *et al.,* 2010; Clapp and Cohen, 2012; Cook and Bakker, 2012; FAO, 2012b; FAO, 2012e; Marsden, 2013; Candel, 2014; Duncan, 2015; Escajedo San-Epifanio, 2015; San-Epifanio, 2015; Gladek *et al*., 2016; Constantine and Santarelli, 2017; Moragues-Faus *et al.,* 2017; Beumer *et al*., 2018; Candel and Biesbroek, 2018; Parsons and Hawkes, 2018; Benton, 2019a), trade liberalisation versus national economic competitiveness (Serrano and Pinilla, 2010; Hawkes *et al*., 2012; Brooks *et al*., 2013; DEFRA, 2014a; Brooks and Matthews, 2015; Clapp, 2015; Brown *et al*., 2017; Benton, 2019b; Hawkes and Parsons, 2019; Parsons, 2019), the disconnect with nutrition (Sundaram, 2014; van't Veer *et al*., 2017; Maas, 2018; Marten *et al*., 2018; Hawkes and Parsons, 2019) and, within the past 5 years, the threat to availability and affordability of food in the UK when it leaves the EU (Committee on Climate Change, 2016d; Bellora *et al*., 2017; European Parliament, 2017; Food Foundation, 2017; Landworkers' Alliance, 2017; Lang, 2017a; Lightfoot *et al*., 2017; Ries *et al*., 2017; Research for AGRI Committee, 2017; The Collective Psychology Project, 2017; DEFRA, 2018e; Food Foundation, 2018a; House of Commons Environment, Food and Rural Affairs Committee, 2018; House of Lords, 2018; Lang and McKee, 2018; McFarlane *et al.*, 2018; Springmann and Freund, 2018; Billiet, 2019; EAC, 2019; Economist Intelligence Unit, 2019; Heron *et al*., 2019; Poppy *et al*., 2019; Soil Association; 2019; Barons and Aspinall, 2020). More recently, calls have been made for greater food policy integration within domains such as health, environment, education and migration, thereby overcoming past conflicts, disconnects and irrationalities (Development Initiatives, 2017; Development Initiatives, 2018; IAP, 2018; Mwatsama, 2018; Parsons *et al*., 2018; Benton, 2019a; Parsons, 2019; Parsons and Hawkes, 2019b; RSA -

FFCC, 2019d; Biesbroek and Candel, 2020). An indication of the roles undertaken by the UK policymaking institutions and their policy responsibilities is detailed in table 7.

Department	***Policy responsibility***
Food Standards Agency	Food safety aspects of food labelling, and for investigating incidents in the UK, including misleading labelling and food fraud
Department for Environment, Food and Rural Affairs	Food composition, authenticity, and labelling policy in England, when it does not relate to food safety or nutrition. Leads on EU labelling negotiations for the UK
Department of Health	Nutrition labelling and health claims policy and leads on relevant EU negotiations
Public Health England	Identifying and investigating outbreaks of foodborne infection
Local Authorities	Delivering and enforcement of food safety and food authenticity, tasked by and submitting results to the FSA

Table 7: Responsibility for food policy in the UK

Source: Parsons *et al*. (2018).

2.6.6 United Kingdom policy directions after leaving the European Union

The full impact of the UK leaving the EU has yet to be fully understood. Although earlier consultations propose replacing production subsidies with the environmental schemes that many farmers already benefit from under the existing EU's CAP (DEFRA, 2018e; HM Government, 2019), they do not include the scientific prerequisites essential for sustainable policy, for example: addressing the direct health and environmental impacts of agriculture; reversing the decline in soil health; mitigation and adaptation of livestock systems to meet emissions targets; and, opportunities for regenerative agriculture. Nor is there any detail on the intended shape of future food policy (Lin, 2011), despite EAC concerns over Government complacency about the current risks to food security or the need for a National Food Strategy to ensure healthy diets for all (EAC 2019). As such, the potential implications resulting from Brexit prompts much debate (Lightfoot *et al*., 2017; Lang and McKee, 2018; McFarlane *et al*., 2018; *The Lancet*, 2019a; Monbiot, 2019). Early analyses identified many disadvantages (loss of funds for the environment, higher food prices, reductions in collaborative research, and concerns over trading standards) but also potential benefits in bringing food, health, and the environment together with mutually beneficial policies (Schoen and Lang, 2016; Barling, 2018). The decision to close the Department of Energy and Climate Change soon after the referendum removed a critical part of the governance infrastructure and gave the impression of Brexit's relative importance ahead of climate change (Institute for Government, 2015). As the Paris Agreement is essentially discretionary rather than obligatory, with the expectation that countries set their own NDCs, this discretion lies entirely with the incumbent government (Allen *et al*., 2016). Inside the EU, the UK is bound by the EU's collective commitments; outside the EU, however and without an NDC, Murphy (2018) argues the UK will become a climate '*laggard*'. Responsibility has now passed to the Committee on Climate Change, who are supposedly independent and able to critique the governments' objectives, policies, and performance, but this is limited to an advisory role. Furthermore, whilst warning about current strategy shortcomings and expectations that the 2030 carbon emissions targets will not be met, they also recommend government remain on the same trajectory (Committee on Climate Change, 2016d), giving rise to criticisms over both its independence and the short-term perspective of government departments (Paulson, 2015; Murphy, 2018; Benton, 2019). Benton *et al.* (2019) summarise the EU influence over the UK food system into five key areas: CAP subsidies (£2.3bn per annum); intra-EU trade; the EU providing around 98 per cent of the labour in agriculture and 30 per cent in food manufacturing; regulation for environmental and safety standards of food; and extra-EU trade, whereby UK both exports and imports with countries which have an EU trade agreement.

Numerous concerns are already starting to appear within the scientific literature. These include additional risks to UK food security (Lang *et al.*, 2018a; Rickard, 2019; Barons and Aspinall, 2020), weaker regulation and food standards (Garnett, 2011; CiWF, 2014; Clonan *et al.*, 2015; Lang and Schoen 2016; Millstone, 2017; Herzog *et al.*, 2018; Lang and McKee, 2018; RSPCA, 2018; Stevenson, 2018; Benton *et al.*, 2019; CiWF, 2019; McCulloch, 2019; SCWG, 2019), labour shortages (Lang and McKee, 2018), increased food prices (Clarke *et al.*, 2017; Chakraborty and Dobson, 2018; Lang and McKee, 2018; Lang and Mason, 2018; Case, 2019; Heron *et al*., 2019; Barons and Aspinall, 2020), damage to supply chains (Barling, 2017; Lang and McKee, 2018; Rickard, 2019) and disruption in regional food supplies in areas such as Wales (Powell and Castle, 2019), Ireland (Lang and McKee, 2018), and especially food flows through Northern Ireland (Lang *et al.*, 2018b; Lang and McKee, 2018), taking the UK further away from sustainable food policies (Lang and Mason, 2018; Bash and Donnelly, 2019; Benton *et al.*, 2019), and multiple impacts on health and mortality (Springmann and Freund, 2018; Millstone *et al.*, 2019; Barons and Aspinall, 2020). Springmann and Freund (2018) calculate Brexit will lead to reductions in the average per-capita consumption of fruits, vegetables, root-crops, and dairy, with further, moderate reductions in beef, pork, poultry, sugar, and vegetable oils. More significantly, however, a hard Brexit resulted in 5,600 additional deaths (see figure 58) compared to only 2,700 additional deaths for a soft Brexit (see figure 59). The relative, additional health care costs associated with the two scenarios were £600m for the Hard Brexit and £290m for the Soft Brexit, with approximately one-third due to direct costs and the remainder attributed to related, informal care and lost productivity.

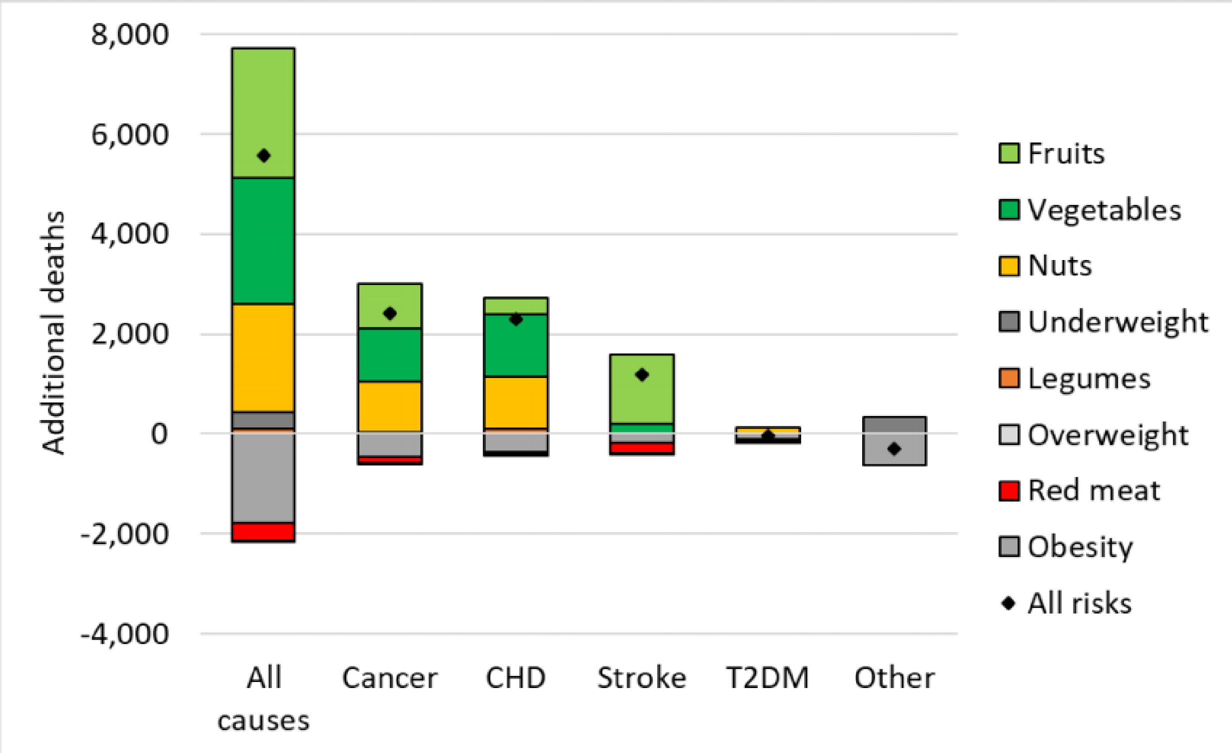


Figure 58: Changes in mortality in the UK by risk factor and cause of deaths in the Hard Brexit scenario

Coronary heart disease (CHD); stroke, type-2 diabetes mellitus (T2DM)

Source: Springmann and Freund (2018).

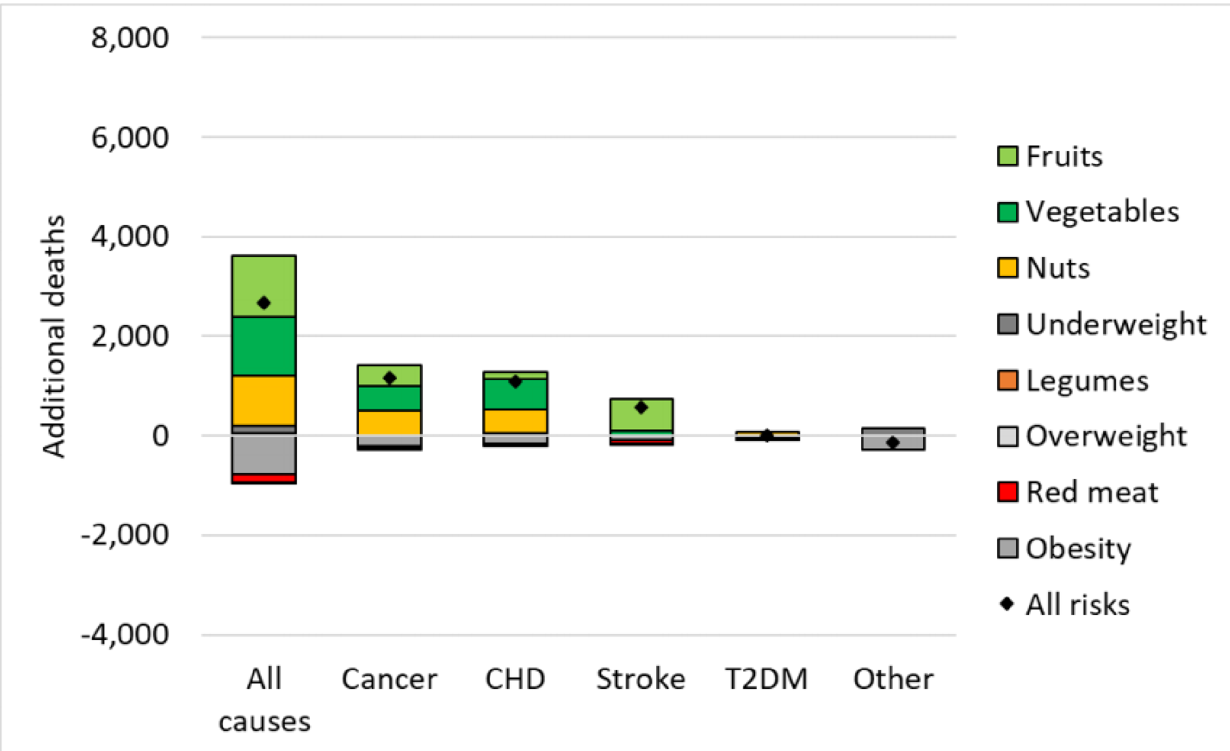


Figure 59: Changes in mortality in the UK by risk factor and cause of deaths in the Soft Brexit scenario

Source: Springmann and Freund (2018).

Further comparisons to the similar free market transition undertaken by New Zealand are made, but Arnott (2018) highlights the devastating impact on their environment that this transition had. Further research studies consider the impacts of Brexit on particular products or issues such as fishing rights (Alberro, 2018; Greenwood, 2019), pesticide regulation (Milner and Boyd, 2017; Cohen *et al.*, 2018), bottled water regulations (Nobajas, 2018) and impact on sustainable intensification (Flavell, 2010; Garnett *et al*., 2013; Abraham *et al.*, 2014; Franks, 2014; Godfray, 2014; Gunton *et al*., 2016; Rasul and Sharma, 2016; Rees *et al*., 2016; Whitfield and Marshall, 2017; Acevedo *et al.*, 2018; Dicks *et al*., 2018; Armstrong McKay *et al.*, 2019). As a large purchaser of emission permits from the EU Emissions Trading System for GHG, Tol (2018a) calculates that in leaving the EU, the UK will find it much more difficult to meet its climate policy targets and incur additional costs equating to 0.2 to 0.4 per cent of GDP. Jackson and Shepotylo (2018) found all post-Brexit scenarios would make the UK poorer, with a Hard Brexit generating GDP losses of 4.1 - 5.3 per cent (£77 to £99bn). Hauk (2020) warns that Brexit could reduce the impacts of globalisation in the UK and suggests the real challenge will be keeping the gains in global prosperity that it enabled without ceding control through international trade. Brexit is succinctly described by Clutterbuck (2017, p.1) as *'a woefully misconceived agricultural export drive that cannot possibly deliver'* and by Lang *et al.* (2017, p.4) as *'the worst policy situation imaginable'* which represents a new form of imperialism with the expectation that other countries will feed us. Further detail on the health impact assessment of a no-deal Brexit can be found in appendix 8.3.

2.6.7 Governance structures

Food governance is shared between many different public, private, and CSOs globally; most are seen as needing to be redesigned to deliver the systemic changes needed. Many global bodies have come under recent criticism: the UN (Conforti, 2011; Brown, 2013), the WTO (Shatrugna, 2012); investors (Clapp *et al*., 2015d; Lambek, 2015; Hodson, 2017; UN, 2017a). The lack of political will to address the challenges that threaten life on Earth is a concern (*The Lancet, 2019*), with Kahn *et al*. (2014) seeing an urgent need for governance that can both comprehend the impacts of ecosystem changes and better develop strategies to prevent and mitigate the resulting health effects. They argue that, when it comes to environmental protection, no single, international agency is in charge; instead responsibility is fragmented between many entities. Despite the UNEP being around for nearly 50 years, the debate remains ongoing regarding both its effectiveness and future role; similarly, although the WHO has an environmental health section, it receives only a fraction of the overall budget and does not really address the human impact on the environment. Watts *et al*. (2018, p.581) see two divergent trajectories: anthropogenic climate change undermining 50 years of public health gains; or, a comprehensive response to climate change could be '*the greatest global health opportunity of the 21st century*' with the potential to realise '*the highest attainable standard of health, wellbeing, and equity worldwide*' (Maini *et al*., 2017, p.1).

The long-established debate over the type and scope of UK food system governance has received a resurgence of interest within the last five to ten years, caused in part by several sequential changes. The traditional challenges of bringing together the disparate functions of agricultural production and dietary needs, compounded by initiatives such as World Trade Agreements and the CAP (Barling, 2007; Day and Lee, 2011; Doberman and Nelson, 2013), have been superseded by the SDGs, the Paris Agreement, and Brexit (Clarke *et al.*, 2017; Arnott, 2018; Barling, 2018; Ziv *et al*., 2018; Benton *et al*., 2019; Stewart *et al*., 2019). The current picture remains one of flux, with much discussion over the type of governance needed and how to improve issues such as integration, connectivity, and inclusion (Whitmee *et al*., 2015; Hawkes and Parsons, 2019; Parsons *et al.*, 2019). A number of theoretical questions remain: the role and increasing power of big food companies as global environmental governors (Dauvergne and Lister, 2012; Österblom *et al.*, 2015; Richards *et al.*, 2015; Scott, 2015; Clapp, 2017; Clapp and Scrinis, 2017; IPES, 2018; Lawrence, 2019; Rossi *et al.*, 2019); the extent of responsible consumption through food citizenship (Wilkins, 2005; Maniates, 2010; de Tavernier, 2012; Henderson *et al*., 2013; Lang, 2014c; Crawford and Montague, 2017; Food Citizenship, 2017; New Citizenship, 2017; New Citizenshift, 2017; Food Ethics Council, 2019a; Mi and Coffman, 2019); whether current governance systems are equipped to handle challenges such as those raised by the SDGs (Acunzo *et al.*, 2018); the types of political and institutional leadership and market incentives required (Balgopal *et al.*, 2014; Anderson, 2016; James *et al*., 2017); and, the food system actions and transformations required (Campbell *et al.*, 2018). Having originally been critical of the governments deregulated '*free-market*' approach (Lang and Mason, 2018), some studies provide a critique on the governments Agricultural Bill. Not only does this Bill lack any vision for food or health, Lang (2018) argues the UK will in addition soon lose the protection of more than 35 infrastructural food institutions as it leaves the EU. Similarly, there are calls for the precautionary principle to be enshrined into UK law, to halt the serious decline in biodiversity (Carrington, 2018; IPBES, 2018; Chambers, 2019). Further studies recommend developing policy guidelines (Willett, 2001; King, 2007; Day and Lee, 2011; American Heart Association, 2015; Health Council of the Netherlands, 2015; Monteiro *et al*., 2015; British Nutrition Foundation, 2016; Head, 2017; Louie and Rangan, 2018).

2.6.8 Power relations and potential conflicts

In continually striving for growth food businesses are better able to acquire more assets and fund investments. The consolidation that then follows places key decisions into the hands of an ever-decreasing number of companies, enabling them disproportionale influence over lobbying policymakers, directing research, and influencing media coverage. Numerous studies call for a paradigm shift to reform the business-as-usual approach (Welch and Graham, 1999; Fritz and Schiefer, 2008; Food Ethics Council, 2013; Marsden and Morley, 2014; Wynn, 2014; Grafton *et al.,* 2015; Leisinger, 2015; Rasmussen and Storm, 2015; Swannell, 2016; WRAP, 2017; Barkham, 2018; de Pee *et al*., 2018). The overall impact, however, means these companies are shaping the field of global health (Cohen, 2011; de Sá, 2014; O'Connor, 2015; Ireland and Ashton, 2017; Lang, 2017b; Fleming, 2018; Greenhalgh, 2019). One systematic review established such financial conflicts of interest had biased conclusions on consumption and impacts on obesity (Bes-Rastrollo *et al.*, 2013). The social cost of political lobbying is also examined within the literature (Brulle, 2018; Ferns, 2018; Meng and Rode, 2019), with claims from climate scientist James Hansen over the major international oil companies buying off the UK government with Canadian produced Tar sands oil, threatening to make climate change unstoppable being reported in the mainstream press (Carrington, 2013). Also of grave concern are reports from the NGO Global Witness (2018) who are focused on breaking the links between resource exploitation, conflict, poverty, corruption, and human rights abuses worldwide. Their latest report linked 53 killings to government security forces in 2017, with a further 90 killings to corporations with vested interests, especially in Africa. Although the grey literature frequently contains warnings of the consequences to health of consuming industrially-made food (Blay-Palmer and Donald, 2008; O'Connor, 2016; Oxfam, 2016; Riley, 2017; Boseley, 2018d; Lawrence, 2018; New Food Magazine, 2018; Steele and Sarcevic, 2019), the academic discourse is sparse. Further studies also recommend changing the food system to address the conflicts of interest between public health and commercial powers (Weldegebriel, 2005; Cohen, 2011; Chandon and Wansink, 2012; Igumbor *et al.*, 2012; Stuckler and Nestle, 2012; Moodie *et al.*, 2013; Gorski and Roberto, 2015; Loder, 2015; Scrinis, 2015; Williams and Nestle, 2015; Häyhä *et al.*, 2016; Howard, 2016; Food Ethics Council, 2017a; Garst *et al.*, 2017; Hawkes and Watson, 2017; IPES, 2017a; Tempels *et al.*, 2017; Cancer Research UK, 2018; Freidberg, 2018; Haddad, 2018; Mozaffarian *et al.*, 2018; Richards *et al.*, 2018; Scrinis, 2018; Branca *et al*., 2019; Cairns, 2019; *Foot Print*, 2019; IPES, 2019; Rossi *et al.*, 2019; Steele *et al.*, 2019; Swinburn, 2019). One of the most prolific academic authors in this field, Marion Nestle, argues that although these issues have been criticised within the nutrition community for decades, they have been largely ignored within the medical literature (Nestle, 2018). There is particular concern about marketing disguised as nutrition science and food industry finance being used to fund not-for-profit professional or research bodies (Fleming, 2018). Nestle recommends instead that no commercial funding is allowed; instead, funding could be raised through a tax payable by all food companies. Boseley (2019, p.395) concurs, stating that the food industry must now be publicly challenged over the *'marketing of high sugar, high fat, high salt products that cause obesity and damage health'*. Concerns are also raised over the concentration of ownership of '*climate-smart*' agriculture, with both knowledge and power being controlled by a handful of global corporations, which not only threatens the democratic governance of food and policy, but also insecurity and environmental degradation as well (Long *et al*., 2016; Krishna, 2017; Mann, 2017; Brouziyne *et al*., 2018; Dass *et al*., 2018; Kakraliya *et al*., 2018; Lan *et al*., 2018; Thornton *et al*., 2018).

2.6.9 Chapter summary

This chapter firstly presents the research objectives for this thesis; to synthesise the challenges from the food– environment–health nexus, the anticipated impacts of climate change on this nexus, and identify the dietary behaviours that need to be adopted to reduce the impacts on human health. It then evaluates the existing published literature to understand the impact of the identified risks to UK food security in the immediate future. It synthesises the latest findings on sustainability science, the challenges of producing food sustainably, the correlation between planetary health and human health, what constitutes a healthy diet, and how the existing policy instruments can be adapted and coordinated to ensure both future food sustainability and security. Lang and Mason (2017) provide a useful overview of the policy approaches available (see appendix 8.14).

3. Research questions and methodology used to address them

3.1 Introduction

This chapter outlines the qualitative and quantitative approaches employed, the overall research design, how the data was collected, the tools used to model the impacts of climate change, the scenario analyses, and the requirements for the conceptual framework. The initial review of the literature identified gaps in the knowledge base on future policy options for the UK. From each gap five research questions were identified, as detailed in table 8. Three separate methods were then used. A synthesis of published systematic reviews and meta-analyses (umbrella review) was used to determine the extent of existing evidence for each of the five research questions. This was specifically chosen due to health professionals' familiarity of such a method providing answers to specific clinical questions, thorough and unbiased data on the relevant literature, and using explicit criteria for assessing and structuring the results. Modelling predictions were also employed for research question three on how climate change will impact the UK's ability to produce healthy food; specifically to provide a case study on the impacts on food production in one area of the UK. Finally, scenario analyses were used to evaluate how climate change will impact the UK's ability to produce and import food.

The research predominantly adopts a qualitative approach, which is typical within the field of health behaviour, where it is used to further the understanding of the processes that direct the development of health policy and practice. The final section of the methodology chapter considers how the data was analysed to answer the five questions of this thesis. The research synthesises recent evidence to evaluate the effectiveness of the current policies that influence food and determine what needs to be done to address systemic failures in terms of biological, outcome, consumption, and security effects in the United Kingdom's current food systems. It also attempts to both further identify specific knowledge gaps that need to be addressed to enable effective socio-political decision-making, and address the previously identified problems associated with the reliability and lack of uniformity of existing data. In systematically mapping the latest evidence on how climate change will impact the UK's ability to both produce and import healthy food and developing recommendations for a new policy framework, it attempts to make an original contribution to the research field. The second original contribution comes from synthesising what constitutes a healthy diet and providing a framework for UK health professionals that will enable them to deliver evidence-based information.

No:	Question:	Method		
		UR	MP	SA
RQ1:	What constitutes a healthy diet, how sustainable are current UK diets, and the potential benefits of changes in dietary behaviour towards healthier eating?	✓		
RQ2:	How effective is the existing regulatory framework and what should a new policy framework comprise to ensure both risk minimisation and the security of sustainable, healthy food in the UK?	✓		
RQ3:	How will climate change impact the UK's ability to produce healthy food?	✓	✓	✓
RQ4:	How will climate change impact the UK's main imported food commodities and what will this mean for major UK food supplies?	✓		✓
RQ5:	What should health professionals be doing to inform and enable the behavioural changes needed in the transition to more sustainable and healthy diets?	✓		

UR = Umbrella Review

MP = Modelling Predictions

SA = Scenario Analyses

Table 8: Research questions for this thesis

The methodology adopts an inductive reasoning approach, whereby it assimilates various observations at the onset and then looks to propose policy solutions in its conclusions. The methodology is also aligned to an ontological (the philosophical study of the nature of reality) and epistemological (truth, belief and justification) perspective of critical realism. This philosophical approach combines ontological realism with epistemological constructivism (Sayer, 1992; 1999; Dyson and Brown, 2005), both of which are associated with disciplines including sustainability (Zachariadis *et al*., 2013) and health (Benoliel, 1996). Ontological realism assumes that truth is correspondent with fact where a mind-independent reality exists and defends the possibility of causal explanation. It also assumes that knowledge is communicatively constructed, where concepts and beliefs are historically generated and conditioned. Finally, it accepts that the explanatory knowledge formed through realist analysis will always be open to challenge and subject to change on theoretical and empirical grounds, as reality is based on individual experiences.

The aim of this research was primarily to evaluate the effectiveness of the current policies that influence food and determine their appropriateness in terms of being able to tackle the imminent threats to future

UK food security. The effectiveness of current policies and their ability to tackle the rapidly approaching, increasing burden of risk is a particular challenge for UK policymakers, following several decades of minimal, direct market interventions and devolved responsibility to the EU. The government's own auditors have recently claimed that the UK government is ignoring advice issued by its own statutory committee on food security and not doing enough to prepare for future risks.

Although the understanding of threats to, and need for, sustainable food systems has been gathering momentum for the past four decades, this has taken on a new urgency over the past ten years as the scientific consensus has become centred around the realisation of high magnitude risks caused by climate change and the likelihood of them increasing. Only in 2017, for example, has the UK Committee on Climate Change published the top three main risks to the UK: namely flooding; temperature affecting domestic food production; and, the threats to imported food supplies caused by trade disruptions, as other nations struggle with their own climate change problems. This raises five urgent issues for UK policymakers and therefore the research questions for this thesis (table 8):

3.2 Research design

Research design is critical to ensure that the evidence obtained effectively addresses the research problem. The last decade has witnessed a huge growth in the number of studies, many of which fundamentally change the understanding of what policies and regulations will be needed to mitigate against the risks of climate change and environmental degradation to ensure future food systems provide sustainable, secure and healthy diets. The initial literature review considered these studies and identified the growing scientific consensus for sustainable food systems to address future high magnitude risks with increasing urgency (Webster and Watson, 2002). The introductory chapter lays out the research problem, the overall objective and main purpose for this thesis. The research problem originates from the growing sense of urgency among the scientific and professional communities to mitigate against the increasing risks to food systems: from the impacts of climate change (more flooding, temperature effects on food production, and trade disruptions increasingly threatening imported food supplies); from the growing health concerns associated with current UK diets; concerns regarding the perceived weaknesses with the existing policy and regulatory frameworks, especially in their ability to minimise risk and ensure future food security; and, the general lack of suitable and accessible information for health professionals to enable them to play a part in helping mitigate against these risks and bring about positive change. The subsequent literature review further reinforces the urgency and importance of mitigating against these risks and the general lack of preparedness. In order to achieve the overall research objective of a better understanding of the risks to UK food security in the immediate future, this thesis uses meteorological predictive models to systematically map the latest evidence on how climate change will impact domestic production factors and overseas risks to imported food security. It synthesises what constitutes a healthy diet, how existing policy instruments can be adapted and coordinated to ensure future food sustainability, resilience, and security, and how the growing trends in diet-related diseases might be reversed. It will also recommend specific proposals for UK health professionals to enable them to deliver evidence-based information to inform and bring about the behavioural change needed in the transition to more sustainable and healthy diets.

The original literature review was initially conducted in April 2019, to synthesise existing literature and identify gaps using three university databases, each with its own subject specialisms. This included all articles published since 2010, with the search being repeated regularly up to June 2020 to capture any subsequent publications. Both scholarly (peer-reviewed) articles and the grey literature (including from organisations such as the FAO and CSOs) were included. To assist in identifying the grey literature, the Prague definition was assumed. This defines grey literature as '*manifold document types produced on all levels of government, academics, business and industry in print and electronic formats that are protected by intellectual property rights, of sufficient quality to be collected and preserved by library holdings or institutional repositories, but not controlled by commercial publishers i.e. where publishing is not the primary activity of the producing body*' (Schöpfel, 2011, p.11).

The empirical study comprises two core methodological steps. For the first part of the study, a synthesis of existing systematic reviews and meta-analyses was used to determine what constitutes a sustainable and healthy diet, the potential benefits of changing dietary habits towards healthier eating, and the available policy options to minimise risk and ensure a secure supply of sustainable, healthy food in the UK. Evidence-based primary research is expanding fields in both health and policy (Aromataris *et al*., 2015). Systematic review methods are increasingly being used within food systems as well, with their information retrieval methods being informed by experience gained from health (Wood *et al*., 2018) where they have been used progressively since the 1970s (Aromataris and Munn, 2017) and are now widely regarded as the gold standard for determining evidence-based practice (Aromataris and Riitano, 2014). Their main strengths include providing comprehensive and unbiased syntheses, their international scope, their ability to provide evidence to inform practice and policy, and results that are both meaningful and reliable (Aromataris and Riitano, 2014; Aromataris and Munn, 2017).

The second part addresses research questions three and four on how climate change will impact both domestic food production and the availability of food imports. Here, scenario analyses are used to systematically map the possible trajectories for a number of the major food commodities to assess the risks to address how climate change will impact both domestic food production and the availability of food imports. Formative scenario analysis is a scientific technique that constructs sets of assumptions into the potential development of scenarios (Scholz and Tietje, 2002). The technique is especially useful for the efficient synthesising and communicating of complex and extensive information to decision makers and consumers (Alcamo, 2001), helping understand the severity and probabilities of such scenarios (Denkenberger and Pearce, 2015), supporting strategy and public policy especially when disruptive change requires new coping mechanisms (Ramírez and Wilkinson, 2016), pushing trends to their logical end (Billen *et al.*, 2018), assisting with both imagining plausible futures and unlocking '*business as unusual'* thinking (Benton, 2019c), especially where long-term horizons such as 2050 are involved (Reilly and Willenbockel, 2010). It is also commonly used to assess climate change impacts (Arnell *et al.*, 2004; Victor, 2011; Carney *et al*., 2019), the environmental impacts of food systems (Cazcarro *et al.*, 2015; World Economic Forum, 2017; Foresight4food, 2019), and for health and dietary change (Stich *et al*., 2009; Popp *et al*., 2010; Hallström *et al*., 2015).

3.3 Search strategy for the umbrella review

The rationale for doing the umbrella review was essentially to find and select studies that were more likely to produce reliable and accurate conclusions, as well as synthesising findings from multiple studies. Systematic reviews and meta-analysis are both seen as useful scientific tools that can help with large amounts of data that otherwise would be confusing or statistically difficult. The initial review of the literature covered in chapter two demonstrates the massive expansion of research output, both in peer-reviewed publications and the grey literature such as conference papers and symposia. This volume of research makes it more difficult to ensure that recommended policies keep up to date with the best research evidence. The next stage in the PRISMA process was to formulate the problem which, for the purpose of the systematic review, was determined as what constitutes a sustainable and healthy diet, the potential benefits of changing dietary habits towards healthier eating, and the policy options to minimise risk and ensure a secure supply of sustainable, healthy food in the UK. As far as the three search engines were concerned, this topic has not yet been the subject of a systematic review. Ultimately, the review will be registered once other academics are able to add to the specific expertise required.

The relative newness of umbrella reviews means there is little published evidence on the most effective ways to conduct searches, design studies, the most appropriate databases and, the extent of publication bias within the present food system literature. The initial literature review showed that hundreds of relevant studies have already been published; Bastian *et al*. (2010) estimated 11 systematic reviews were published every day, far too many for most people involved within the health professions to identify and consider when making decisions (Smith *et al*., 2011; Aromataris and Munn, 2017). In addition, in part to avoid confusion between systematic reviews and meta-analyses, more recent systematic approaches have been developed to reduce bias and thereby distinction between the two techniques. Today, meta-analyses are mostly used for statistical synthesis and may be part of the systematic review (Egger *et al*., 1997; Aromataris and Munn, 2017). As the literature increases, the methodological approach and conduct of reviews has also increased and evolved (JBI, 2015; Peters *et al.,* 2017), enabling them to become increasingly influential within the biomedical literature (Fusar-Poli and Radua, 2018; Schultz *et al*., 2018). A systematic review of systematic reviews and / or meta-analyses is a recognised method within this professional sector of helping decision makers to gain a better understanding of a broad topic area, and thereby make better decisions (Smith *et al*., 2011; Aromataris *et al*., 2015). They are particularly useful where previous empirical studies have been published but there is uncertainty about the results, or where the findings of different reviews need to be compared and contrasted in relation to a particular challenge or question (Aromataris *et al*., 2015). They can also enable a more rapid response to given problems (Khangura *et al*., 2012). The main reasons for conducting an umbrella review are to examine, compare, and summarise the results from published research syntheses (Aromataris *et al*., 2015). One study into the typology of such reviews found 14 review types and their associated methodologies (Grant and Booth, 2009). Although the terminology of such approaches tend to vary (e.g. synthesis / overview / summary / umbrella review of existing systematic reviews), they all share one common feature in that they only include systematic reviews or meta-analyses as a study type (Grant and Booth, 2009; Becker and Oxman, 2011; Smith *et al*., 2011; Hartling *et al*., 2012; Aromataris *et al*., 2015). For this thesis, the term umbrella review is adopted henceforth, as per the classification provided by Fusar-Poli and Radua (2018) and shown in figure 60. As such, Fusar-Poli and Radua (2018, p.95) argue that umbrella reviews '*represent one of the highest levels of evidence synthesis currently available*'; this was also the view of earlier observations by Aromataris *et al*. (2015) and Romund (2017). The Cochrane Handbook (Becker and Oxman, 2011) gives five objectives for undertaking an overview of reviews: essentially, they summarise evidence on different interventions for the same condition or problem; on the same intervention for the same condition or problem where different outcomes are addressed; of the same intervention for different conditions, problems or populations; about adverse effects of an intervention from the use of the intervention for one or more conditions; and, to provide a comprehensive overview of an area, including studies not included in systematic reviews.

Several major repositories of systematic reviews are available, including the Joanna Briggs Institute (Aromataris *et al*., 2014; JBI, 2015; JBI, 2020), the Cochrane Database of Systematic Reviews (Becker and Oxman, 2011; Cochrane Library, 2017; Higgins and Thomas, 2019), and the PROSPERO register. In addition, organisations within the UK health professions sector, such as the National Institute of Health and Clinical Excellence (NICE) and the Cochrane Collaborations (named after the British epidemiologist Archie Cochrane), are dedicated to the preparation of systematic reviews. According to the Cochrane Library (2017), which contains over 4,000 registered health-related reviews, a systematic review attempts '*to identify, appraise and synthesize all the empirical evidence that meets pre-specified eligibility criteria* *to answer a given research question*'. A systematic review of individual studies that appraises, summarises, and brings together existing studies in a single place would seem a logical and appropriate step. It also enables judgements to be made on the quality of the evidence base and conclusions to be compared. Systematic reviews comprise clearly defined objectives and eligibility criteria, an explicit and reproducible methodology, a systematic search to identify all studies, an assessment of the validity of the studies, and are presented in a systematic manner.

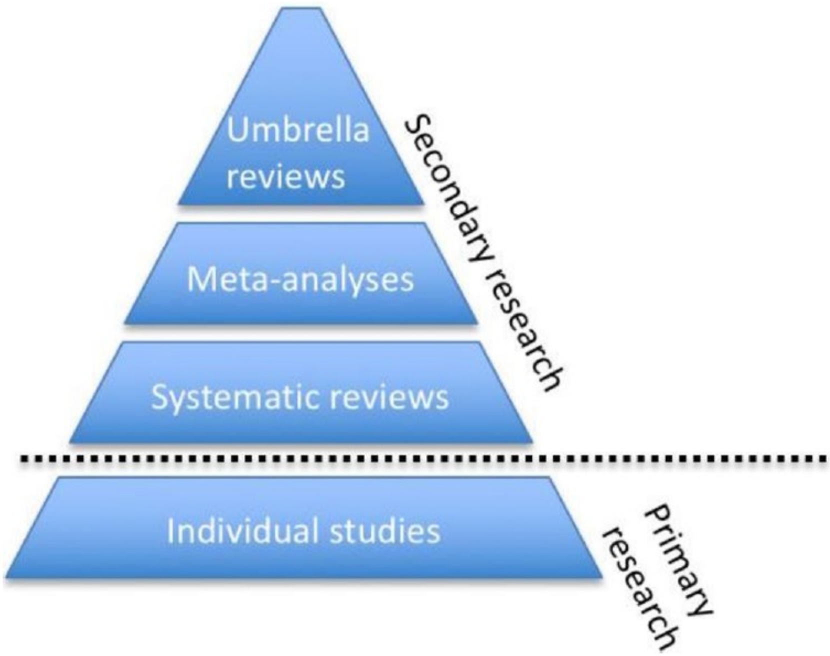


Figure 60: Hierarchy of evidence synthesis methods

Source: Fusar-Poli and Radua (2018).

In response to the increased number of systematic reviews available, there have been recent calls for a more formalised and logical approach to the review of existing systematic reviews (Aromataris *et al*., 2015; Fusar-Poli and Radua, 2018). Of note is the Australia-based Joanna Briggs Institute, who work with over 70 global collaborations to disseminate evidence-based healthcare (JBI, 2020). Recognising the growing importance of systematic reviews and meta-analyses, JBI have developed methodological guidance for the conduct of quantitative and qualitative umbrella reviews (Liberati, 2009; Moher *et al*., 2009; Lee *et al*., 2011; Smith *et al*., 2011; Aromataris and Riitano, 2014; Aromataris *et al*., 2014; Aromataris *et al*., 2015; Moola *et al*., 2015; Haby *et al*., 2016; Peters *et al*., 2017; Kerins *et al*., 2018; Pulker *et al*., 2018; *The Lancet*, 2018; Maynard *et al*., 2020). The latest JBI manual was therefore used as a template for reviewing the systematic reviews, as a guide how to plan, register the review title and protocol, and the expected standards for publishing (Aromataris and Munn, 2017).

3.4 Data collection for the umbrella review

The three databases for this literature search were chosen for specific, identified strengths (Falagas *et al*., 2008) especially in terms of scientific impact rather than volume of coverage (Martín-Martín *et al*., 2018). Europe PMC is one of the most frequently used databases for searching health subjects and offers optimal update frequency; Aromataris and Riitano (2014) argue its use is essential for any systematic review within health and policy. The Web of Science core collection covers science, technology, social sciences, arts and humanities, whereas Scopus covers the physical sciences, health sciences, life sciences, social sciences and humanities. Scopus offers a wider journal range, which Falagas *et al*. (2008) previously estimated offered around 20 per cent more coverage than Web of Science. More recently, Iowa State University (2019) claim Scopus covers 21,950 journals (excluding trade journals) compared to the Web of Science core collection at 13,100 journals. The Web of Science does, however, cover more conference proceedings at 10.5 million, compared with 8 million in Scopus. Screening the title and/or abstract enabled many of the papers initially identified as not fulfilling the inclusion criteria to be discarded (Stern *et al*., 2014). Studies identified in the search databases were initially screened based on the relevance of their titles and abstract. The full text of all those articles deemed to be potentially relevant were then retrieved, before the decision could be made as to which papers would be included in the final review. Only studies conducted between 1st January 2000 and June 30th 2020 were included, to provide recent evidence and up-to-date perspectives (table 15).

The umbrella review of systematic reviews and meta-analyses was conducted according to explicit, rigorous, and transparent methodology (Greenhalgh *et al*., 2004; 2005; Fusar-Poli and Radua, 2018) using predetermined steps as advocated by Sargant *et al*. (2006) and detailed in figure 65. It was undertaken based on the minimum standards guidance provided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) commonly used by researchers working within the health professions sectors, using the recommended nine steps (Moher *et al.*, 2009a; 2009b; Beller *et al.*, 2013) as outlined in table 8 (see also the full PRISMA checklist in appendix 8.18 and 8.19). The data was extracted electronically, to minimise transcription errors, and piloted before the final search in order to refine.

The umbrella review involved the following steps. First, the study question of what policies and regulations are needed to mitigate against the risks of climate change and environmental degradation to ensure future food systems provide sustainable, secure, and healthy diets was formulated. This then was further expanded into the outline umbrella review protocol (Protocol v 1.0 – 20th April, 2020) entitled '*A food sustainability narrative for health professionals*' that can be found in appendix 8.20. It should be noted that not every aspect of the protocol was able to be completed at this stage due to the limitations of this thesis, hence the reference to 'outline' protocol. This will be addressed more fully in the limitations section, but essentially refers to undertaking the process as a sole researcher rather than using the preferred group of researchers with specialist skills. Once these weaknesses can be addressed, the intention is to register the review title and protocol, again following the guidelines laid down in the JBI Manual (Aromataris and Munn, 2017). Then a structured search strategy was used to identify the studies. This involved searching three major databases: Scopus; ISI Web of Science (WoS); and Europe PMC (formerly PubMed, UK). In as much as was possible, the same syntax was used, with the only minor modifications being those required by each individual database, as follows:

1. *The search strategy syntax in Scopus:*

   TITLE-ABS-KEY (systematic review OR meta AND food OR climat* OR change* OR environment* OR sustain* OR health* OR secur* OR diet* (LIMIT-TO (PUBYEAR, 2010) TO LIMIT-TO (PUBYEAR, 2020) AND (LIMIT-TO (DOCTYPE, “re”)).

2. *The search strategy syntax in Web of Science:*

   TOPIC: (systematic review OR meta AND food OR climat* OR change* OR environment* OR sustain* OR health* OR secur* OR diet*) Refined by: DOCUMENT TYPES: (REVIEW) AND PUBLICATION YEARS: (2010 TO 2020) Timespan: 2010 to 2020. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC.

3. *The search strategy syntax in Europe PMC:*

   KW:"systematic review" OR "meta" AND ABSTRACT:"climat*" OR "change*" OR "environment*" OR "sustain*" OR "health*" OR "secur*" OR "diet*") AND (PUB TYPE:"Review" OR PUB_TYPE:"review-article") AND (LANG:"eng" OR LANG:"en" OR LANG:"us") AND (FIRST_PDATE:[2010-01-01 TO 2020-06-30]).

3.5 Study selection and data extraction for the umbrella review

Once the search had been piloted, amended, and completed, the abstracts were screened for relevance and to determine suitability for inclusion in the umbrella review. The results of the search were monitored continually as the search strategy was developed to determine whether the results were relevant (Aromataris and Riitano, 2014). Hand screening was also used with each full paper, to find additional evidence by cross-referencing. Those reviews that were deemed suitable received further critical appraisal; those included in the study were then subject to data extraction and quality appraisal. This data is then available for possible meta-analysis, along with summarising and interpretation. The summary of the umbrella review results is shown in table 15 in chapter four.

Step	*PRISMA guidance*
1	Establish rationale for doing the systematic review
2	Determine who will be involved
3	Formulate the problem and establish if it has been done before
4	Performing the search
5	Data extraction
6	Critical appraisal of studies (quality assessment)
7	Data synthesis
8	Presenting results
9	Archiving and updating

Table 9: PRISMA guidance on what to include when reporting a systematic review

Source: adapted from Moher *et al*. (2009a; 2009b).

To select the relevant studies, inclusion and exclusion criteria were developed to assist in initial screening and abstract coding (table 11). The inclusion criteria were defined by using the PICo-tool for qualitative studies (Methley *et al*., 2014; Perez-Cueto, 2019), which classifies criteria into population or problem, interest, and context (as opposed to the PICOS quantitative criteria of population, intervention, comparison, outcome, study design or setting). Other alternative tools are available for other settings, including ones specifically for public health (Robinson and Lowe, 2015) but, as this study considers a wider range of issues, the PICo-tool was deemed more suitable. Specifically, the criteria used included: for population, all age groups were included, in any developed country (defined by OECD membership) and additional EU-28 members; interventions could include upstream, population level, public health policies in food and nutrition that use fiscal policy, regulation, preventative intervention, behavioural (e.g. nudges, social media), provision of information (e.g. labels) or nutrition education; context considered nutritional status, food choices, food consumption, and dietary behaviour. Any reviews not reporting themselves as systematic were also included where they had applied a systematic review methodology. In addition to removing duplicate studies, papers were also excluded where the reference to sustainability was outside the domain of human food, where reference to health was outside the domain of human health, and where studies looked exclusively at a specific medical condition (e.g. diabetes), target populations (e.g. postpartum), or specific food environment (e.g. primary schools). For the very small number of papers where no abstract was available these were also retrieved and coded, with inclusion and exclusion criteria then applied to the full papers. Where articles could not be retrieved, the authors of the papers were contacted directly through the European commercial social networking site for scientists and researchers, '*ResearchGate*'. The inclusion and exclusion criteria were evaluated in pilot runs which enabled the coding scheme to be refined and finalised. The three databases provided a sum of 134,351 initial titles which, after first screening and the removal of duplicates, provided 845 results for coding. Based on the coding of available abstracts 214 papers were taken to full paper screening, where a further 19 studies were excluded, giving a final 197 studies for inclusion in the qualitative synthesis. Full details of this breakdown are shown in the PRISMA flow chart for selection of studies (figure 61). The choice of PRISMA technique of reporting systematic reviews was made by following the EQUATOR consensus reporting guidelines (http://www.equator-network.org/) shown in appendix 8.19. EQUATOR specifically aims to enable improvements in health research reporting. No further ethical considerations were made as this is an umbrella review and, as such, it did not include individual data or deal with sensitive information. The results from the umbrella review are shown in table 15 (pages 167-180).

Formulate the study question:
What policies and regulations are needed to mitigate against the risks of climate change and environmental degradation to ensure future food systems provide sustainable, secure and healthy diets?
All populations and interests to be studied

↓

Develop a protocol:
All candidate research studies available in the three databases; the search terms were included in the all databases section of the database; for any type discipline but limited to peer reviewed publications; English language only.
See appendix 8.20

↓

Use a structured search strategy to identify studies:
Search term 1 systematic review (OR) meta (AND) search term 2 food (AND) search term 3 climat OR change* (AND) search term 4 (AND) environment* OR sustain* OR health* OR secur* OR diet**

↓

Screen abstracts for relevance:
To determine suitability for inclusion in the umbrella review

↓

Appraise relevant studies critically:
Abstracts judged to be relevant receive further critical appraisal

↓

Extract data from studies of sufficient quality:
Data is extracted if of sufficient quality or appropriate for use in the meta-analysis

↓

Summarise and interpret results:
What policies and regulations are needed to mitigate against the risks of climate change and environmental degradation to ensure future food systems provide sustainable, secure and healthy diets

Figure 61: Steps followed to develop the umbrella review

Source: Based on Sargant *et al*. (2006).

3.6 Quality appraisal and data synthesis for the umbrella review

Although systematic reviews invariably share the same overall goals, the sheer diversity in designs, data collection methods, types of data, and analytical methods employed within existing published studies makes comparing methodological quality difficult. Umbrella reviews need to consider the appropriateness of study design to the research objectives, potential risk of bias to study quality, choice of outcome measure, quality of reporting, and generalisability. As Aromataris and Riitano (2014) argue, systematic reviews have greater validity because of the methods used to minimise bias, so this is particularly critical (Rothstein *et al*., 2006). Here again, there were several options available, including the relatively new ROBIS.14 introduced in 2015 which, the developers argue, is the first rigorously developed tool specifically for systematic reviews risk assessment (Whiting *et al*., 2013; Whiting *et al*., 2015). Ultimately, the critical appraisal tool chosen for these extracted studies was the consensus reporting guidelines proposed by AMSTAR (Assessment of Multiple Systematic Reviews). This tool was chosen as it is specifically designed to assess the methodological quality of systematic reviews within healthcare (Shea *et al*., 2007). Specifically, a recently revised version of AMSTAR (AMSTAR 2) was used, as it assigns an overall quality classification to reviews (Shea *et al*., 2017). AMSTAR 2 does not generate an overall score; instead, it is designed to identify high quality systematic reviews using the metrics high (zero or one non-critical weakness), moderate (more than one non-critical weakness but no critical flaws), low (one critical flaw and may not provide an accurate and comprehensive summary) and critically low (more than one critical flaw and should not be relied on to provide an accurate and comprehensive summary). These quality classification terms are distinct in that they mirror the ones used in Cochrane Reviews (table 10), although the definitions of bias are the same. The systematic reviews were also narratively synthesised into five categories where possible (studies on sustainable and secure food systems; the impacts of climate change on food systems; the impacts of climate change on human health; on sustainable diets; and about food policy) accordance with the research questions, in order to ascertain key contributions and gaps in the literature.

Risk of bias	*Interpretation*	*Relationship to individual bias criteria*
Low	Possible bias, unlikely to seriously affect the study results	All criteria met; if criteria not reported, study does not drop to medium category unless random/concealed allocation criteria not reported
Medium	Possible bias that raises some doubt about the results	One or more criteria partially met
High		One or more criteria not met

Table 10: Scores used to assess risk of bias

Source: The Cochrane Handbook (Higgins and Green, 2009).

The data is primarily synthesised narratively (most typically used for qualitative studies) as the studies were mostly very heterogeneous. Finally, the results are presented according to the PRISMA guidance and research methodological recommendations (Liberati *et al.*, 2009).

	Inclusion/exclusion criteria
Formalities:	• Published between 1st January 2000 and June 30th 2020 • Excluded if not peer reviewed • Excluded if written in a language other than English • Excluded if duplicate studies published in more than one paper • Excluded if failed the critical appraisal
Study Population:	• Excluded if study settings were for specific medical conditions e.g. colorectal cancer or diabetes • Excluded if studies conducted among specific population ages e.g. postpartum • Excluded if studies related to under-nutrition and / or in developing economies
Study Design:	• Included any study design which involved policy, regulation or governance / intervention • Included all study designs which involve aspects of climate change adaptation and mitigation where food might be impacted • Included all study designs which consider environmental degradation that has the potential to impact food • Included all study designs which consider environmental degradation that has the potential to impact human health • Included all study designs that consider the sustainable and secure food systems • Included all study designs that evaluated healthy diets • What policies and regulations are needed to mitigate against the risks of climate change and environmental degradation to ensure future food systems provide sustainable, secure and healthy diets • Excluded study designs that were purely clinical or experimental, clinical or treatment guidelines, and case reports • Included all study designs that were economic evaluation studies • Included all study designs that were synthesis research papers such as systematic reviews and meta-analyses • Excluded study designs that were methodology papers
Outcome:	• Effective policies and regulations • risks mitigation strategies • adaptation and mitigation of climate change • strategies to address and reverse environmental degradation • metrics for food systems sustainability and security • defining and measuring sustainable and healthy diets
Relatedness:	• Systematic Reviews; Reviews of Systematic Reviews; Overview of Systematic Reviews; Systematic Literature Review; Meta-Analysis; Meta-Synthesis; Meta-Regression; Meta-Narrative; Meta-Data

Table 11: Inclusion/exclusion criteria used for the systematic review

3.7 Modelling climate change to predict impacts

Climate change models provide essential primary data that assists policymakers in systematically mapping how climate change will impact the UK's ability to produce and import food. Climate modelling refers to the quantitative and qualitative measurement of the interactions of the main, known drivers of climate change, such as atmosphere, oceans, land surface and ice (de Sherbinin *et al*., 2019). Such models have long been essential tools within the various scientific disciplines such as atmospheric physics and biogeochemistry to understand the Earth's climate, with the qualitative models used to produce narratives for scenario analysis. Hausfather (2018) argues that, over the past fifty years, climate models have been quite accurate in predicting what has happened. As a result, some studies suggest that such modelling approaches could be used for other areas such as crops (Wallach *et al*., 2016; Lobell and Asseng, 2017) and to better understand socioeconomic and emissions pathways (Wiebe *et al*., 2015). Figure 62 shows a timeline for the various model origins. The IPCC Fifth Assessment Report (Stocker *et al*., 2013) suggests 100 per cent of climate change is due to human contribution; this is reinforced by climate model predictions covering the past 150 years (Hausfather, 2017a). Although many different climate models exist, from those covering one region or climate system to those capable of modelling the whole planet, scientists are developing increasingly complex coupled or global scale models (McSweeney and Hausfather, 2018). The UK Met Office, for example, has used a single '*unified*' model for both weather and climate prediction since 1990 (Met Office, 2020). Data produced by this model has been incorporated into all of the IPCC Assessment Reports.

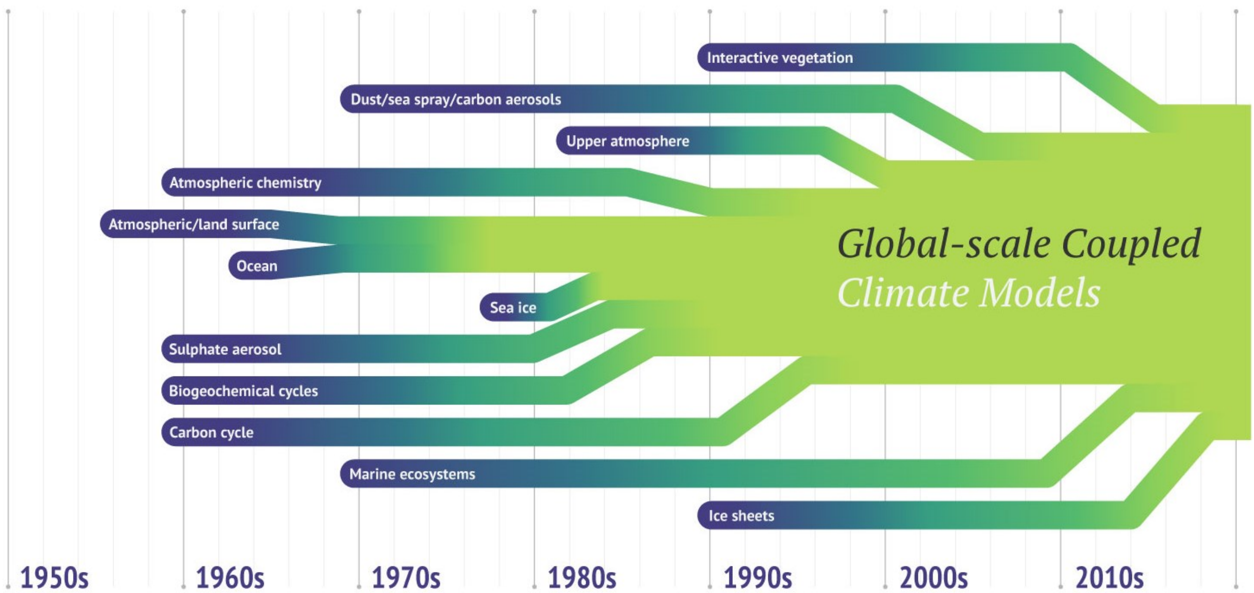


Figure 62: The origins and development of current climate models

Source: Schmidt, cited in McSweeney and Hausfather (2018).

Current modelling predictions provide a range of invaluable interpretations for scenario planning. For example, the proportion of land which suffers from extreme drought is predicted to increase from the current 1 per cent to 30 per cent by 2100 (Burke *et al*., 2006; Sévellec, 2018), with lower rainfall and higher temperatures in the USA (Chiang *et al*., 2018) and the Mediterranean (Brouziyne *et al*., 2018) expected to cause food security problems and shortages of irrigation water (Elliott *et al*., 2014). A number of studies therefore consider climate change mitigation and adaptation options within the food system (Denef *et al*., 2012; Del Prado *et al*., 2013; Wynes and Nicholas, 2017; van Meijl *et al*., 2018), including policies to encourage consumers to combine health and nature-related values with their food choices (de Boer *et al*., 2014), understanding the climate and environmental effects of changing diets and food consumption (Dubey *et al*., 2016; Djekic *et al*., 2018), and the specific risks of climate change on humans and ecosystems (Revesz *et al*., 2014). Although the 2015 Paris Agreement requires countries to limit global-mean temperature rise to 1.5°C, the transition pathways needed to achieve this have not yet been fully explored (Rogelj *et al*., 2018). Some recent climate models also show that the Earth's atmosphere has warmed much faster since 1979 than previous modelling of satellite data had predicted (Hausfather, 2017b; Mears and Wentz, 2017). Emissions from air pollutants continue to rise in China, India, the Middle East, and some South American nations (Crippa *et al*., 2018). These issues led Burke *et al*. (2018) to recently conclude that the Earth system is moving towards climate changes that may be outside the range of evolutionary adaptive capacity.

One critical gap in the literature identified previously in chapter 2.4.7 relates to the climate model anomalies for sea-level rise. Although most of the studies evaluated record around 11-16cm of sea-level rise during the 1900s and further predict around 50-100cm rise before 2100, the majority of these studies are based on medium-emissions scenarios and immediate cuts in carbon emissions (Dasgupta and Meisner, 2009; Mimura, 2013). Future sea-level rise is dependent upon which Representative Concentration Pathway (RCP) emission scenario transpires; Oppenheimer *et al*. (2019) predicts 230 to 540cm of sea-level rise for RCP8.5 but few studies currently address the time scales. One recent study by Kulp and Strauss (2019), however, considers model data under higher-emissions scenarios, where early-onset Antarctic ice sheet instability becomes a contributory factor. Central to this factor is the anticipated tipping point, thought to be between 2°C and 3°C, where these ice sheets will fall into rapid melt which would mean a sea-level rise of at least 200cm within the same timescale. Although it has long been understood that losses accelerate with greater warming, King *et al*. (2015) had already raised concerns over the lack of scientific studies considering impacts of 3°C or above. Other recent studies (Bamber *et al*., 2019; Robinson, 2020; Royal Society, 2020) argue that, despite the modelling advances since the last Assessment Report (IPCC, 2014), the contribution of ice sheets remain the largest source of uncertainty in projecting future sea-level rise and this uncertainty is growing. For the 5°C temperature scenarios expected with unchecked emissions growth, Bamber *et al*. (2019) calculate global sea-levels will rise between 51cm and 178cm. Further contributions from thermal expansion and glaciers could push sea-level rise above 200cm before 2100; and in the century beyond, both uncertainty and sea-level rise increase rapidly for the 5°C scenario to around 750cm, due to the increasing instability in Antarctica. Using a new digital elevation model developed by Climate Central called '*CoastalDEM*', another study (Kulp and Strauss, 2019) was widely reported in the global media (Dobson, 2019; Mooney, 2019; Vaughan, 2019; Watts, 2019) and the local press in the Fens (Verney, 2019). This latter study overcomes some of the previous weaknesses in measuring the population numbers likely to be affected by sea-level rise; the estimates of 630 million people living in areas at risk of sea-level rise is three times higher than previous estimates. This has potentially serious consequences for UK food production in particular, as it would significantly add to the 444,780 acres of the '*Best and Most Versatile*' farmland area identified at risk in the Government Office for Science's Future of the Sea Evidence Review (Edwards, 2017). Barron (2018) argues such weaknesses with climate models continue to distort policy design. This thesis will therefore look to develop scenario data for the Fens using the *CoastalDEM* model to further the understanding on the impacts on food production within this important best and most versatile farmland area.

3.8 Scenario analysis for case studies

UK policymakers also need to have access to research data on the impacts climate change will have on the UK's main imported food commodities, to be able to reduce uncertainty in assessment of the risks to major food supplies. Scenario planning is a deliberative and participatory method to build a range of plausible alternative scenarios using the key drivers of future change (Böjeson *et al*., 2005; Bradfield *et al*., 2005; Paillard *et al*., 2014). Scenario analysis is increasingly used in a wide range of disciplines to consider possible, alternative outcomes or future options where they are efficient tools for synthesising and communicating complex and extensive information to policymakers and consumers (Alcamo, 2001). A scenario is defined by the Oxford English Dictionary as *'a postulated or projected situation or sequence of potential future events*' (OED, 2020). Its origins are in performance theatre and military planning, with business later adopting scenario planning to aid comparative advantage (Alcamo, 2001; Reilly and Willenbockel, 2010). Such scenarios are essential for all those involved in developing long-term plans, policies, and capabilities. Without such a strategic context, the MoD (2014) argue there is a risk that policymakers might assume futures that adhere to preconceived thoughts and assumptions.

Scenarios can be classified as exploratory (descriptive scenarios) or anticipatory (prescriptive or normative scenarios); alternatively, as baseline or policy scenarios, whereby baselines represent the non-intervention (default) perspective compared with the policy scenario which depicts a future with policy intervention (Alcamo, 2001). Börjeson *et al*. (2006) further develops this classification by providing a typology of scenario types that can be used to determine the most appropriate choice (table 12).

Scenario category / type	*Quantitative/qualitative*	*Time-frame*	*System structure*	*Focus on internal or external factors*
PREDICTIVE—what will happen?				
Forecasts	Typically quantitative, sometimes qualitative	Often short	Typically one	Typically external
What-if	Typically quantitative, sometimes qualitative	Often short	One to several	External and, possibly, internal
EXPLORATIVE—what can happen?				
External	Typically qualitative, quantitatively possible	Often long	Often several	External
Strategic	Qualitative and quantitative	Often long	Often several	Internal under influence of the external
NORMATIVE—how can a certain target be reached?				
Preserving	Typically quantitative	Often long	One	Both external and internal
Transforming	Typically qualitative with quantitative elements	Often very long	Changing, can be several	Not applicable

Table 12: The key aspects of scenario analysis types

Source: Börjeson *et al*. (2006).

The benefits of scenario analysis have been variously described as providing a plausible glimpse of the future of food based on assumptions (Matsuoka *et al*., 1995; Börjeson *et al*., 2006; Zurek and Henrichs, 2007; Reilly and Willenbockel, 2010), an efficient scientific technique for synthesising knowledge and communicating complex information (Alcamo, 2001; Scholz and Tietje, 2002; Börjeson *et al.*, 2005; Parson, 2008), to enable a move away from linear thinking towards a better understanding of external change (van der Heijden, 2005), and as a way of pushing trends to their logical end (Billen *et al.*, 2018). Scenario analysis has previously been employed as a methodological approach across a wide range of food studies, including: changes in energy and land requirements for European dietary change (Duchin, 2005); for comparing livestock system greenhouse gases (Garnett, 2010); formulating a research programme on future food production (Öborn *et al*., 2013); the health and GHG emissions co-benefits of reducing meat consumption in Italy (Farchi *et al.*, 2017); impacts on agriculture and marine fisheries (Thiault *et al*., 2019); and most recently, to consider land-use change and food production in the UK after the climate tipping point (Ritchie *et al*., 2020). With the potential to combine quantitative scenarios with qualitative hypotheses (Alcamo, 2001; Hubert *et al*., 2010), Reilly and Willenbockel (2010) argue scenario analysis is replacing predictive forecasting as a more effective approach towards transformative change. These qualitative approaches are of particular use to policymakers (Alcamo, 2001), where narratives can be used to describe how the future might be shaped through events, strategies, and policies (Bowman *et al*., 2012). They are commonly used within the area of sustainability (Alcamo, 2001) by intergovernmental bodies such as the IPCC, to deliver its remit of providing objective, scientific information on the risks of, and possible response options to, anthropogenic climate change through the use of '*narrative story lines*'

(Arnell *et al*., 2004). In the UK, the methodology was employed in DEFRA commissioned research into future UK food scenarios to 2035 (Garnett *et al*., 2014). This means scenario analysis can be used to support strategy and public policy in a world characterised by turbulence, uncertainty, novelty, and ambiguity (Ramírez and Wilkinson, 2016). Moss *et al*. (2010) provide a detailed précis on the needs and capabilities of next generation of climate change scenarios. Figure 63 shows the wide range of facets that this involves; not just on how earth systems change in response to radiative forcings, but human responses in the form of changes in technology, economies, lifestyle, and policy.

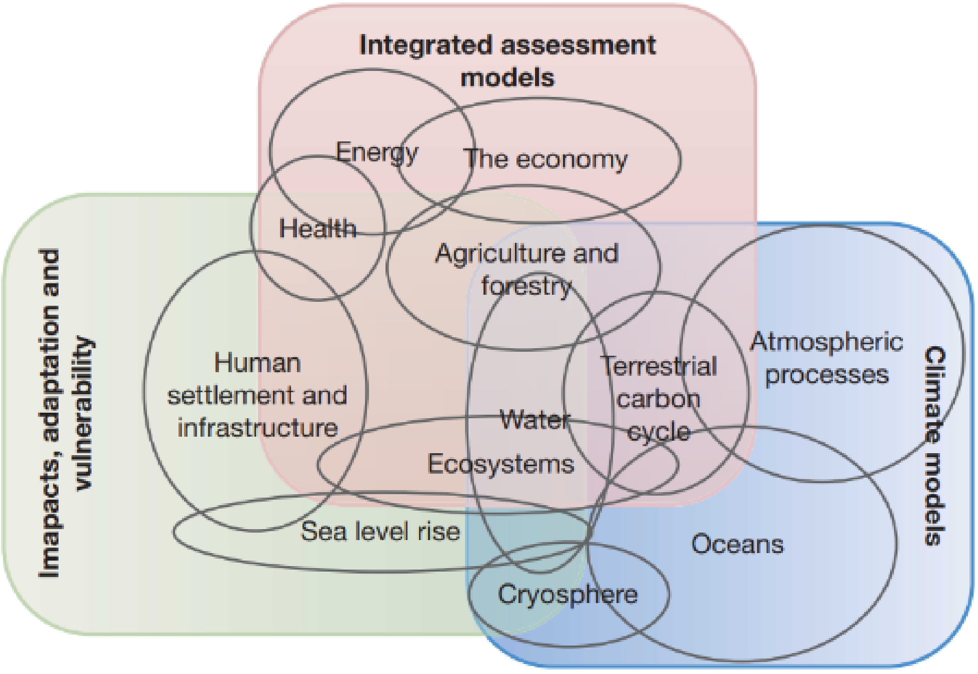


Figure 63: Scenarios for climate change research and assessment

Source: Moss *et al*. (2010).

With much of the focus for food policy being on future-timeline dates such as 2030 and 2050, scenario analysis is increasingly used to conceptualise the contexts of social welfare, food security and natural capital outcomes that impact the food system (Ericksen, 2007). The technique has been used within sustainability science (Swart *et al*., 2004), for climate change impact assessments (Arnell *et al.*, 2004; Moss *et al*., 2010), for assessing emissions reduction measures (Li *et al*., 2015) and was advocated by the Bank of England to assess strategic resilience and financial risks from climate change (Carney *et al*., 2019). The technique is also increasingly used to help understand the effects of climate change on food systems (Parry *et al*., 2004; Reilly and Willenbockel, 2010; Öborn *et al*., 2013; Bodirsky *et al*., 2015). Further studies use this approach to conceptualise the food system within the context of social welfare, food security and natural capital outcomes (Ericksen, 2007; Garb *et al.*, 2008; Vervoort *et al*., 2014), including in response to planning for global catastrophes and crises that might affect food systems (Denkenberger and Pearce, 2015; Foresight4food, 2019). Some studies see scenario analysis as being critical for imagining plausible trade and dietary futures beyond the ‘*business as usual*’ norm (Cazcarro *et al*., 2015; Benton, 2019c;

Foresight4food, 2019). Hallström *et al*. (2015) calls for improved knowledge of dietary scenarios; Moreira *et al.* (2015), for example, calculates 175,000 CVD deaths could be saved in the UK by 2030 through policies that substantially reduce ultra-processed food intake. One major study from the French-based Agricultural Research Centre for International Development and the previously-named National Institute of Agricultural Research (CIRAD-INRA) had earlier suggested two possible future scenarios: one where economic growth feeds the world where environmental protection is not a priority; alternatively, to feed the world while preserving its ecosystems (Chaumet *et al.*, 2009; Hubert *et al*., 2010). This thesis will therefore use scenario analysis to develop case studies for the main UK food commodities: grains; potatoes; fish protein; animal protein; fruit and vegetables. These case studies will specifically consider existing research on production- and import-related variables, policy options, and identify gaps in the knowledge for future research.

3.9 Conceptual framework for health professionals

The initial literature review identified several extremely significant and ongoing challenges in both moving towards sustainable food systems and ensuring the benefits to health and well-being. Despite the plethora of recent research, many important questions remain. Systematic reviews and meta-analyses will also be used to synthesise the latest evidence on what constitutes a healthy diet, how sustainable are current UK diets, and the potential benefits of change in dietary habits towards healthier eating. This data will then be used to develop a framework to guide health professionals, including evidence-based information to inform and enable them to assist with the behavioural change needed in the transition to more sustainable and healthy diets. Alongside the framework, this thesis also considers the UK's existing regulatory framework and synthesises the latest recommendations for a new policy framework capable of ensuring the supply of secure, sustainable, and healthy food.

3.10 Chapter summary

This chapter outlines the qualitative and quantitative approaches employed for each of the three methods used. It first details the search strategy, data collection, selection, data extraction, quality appraisal, and data synthesis for the umbrella review. Secondly, it details how modelling climate change was used to predict the impacts of sea-level rise on one, particularly vulnerable, food producing region of the UK. Finally, scenario analyses were used to evaluate how climate change will impact the UK's ability to produce and import food. This data was then used to develop a framework to enable health professionals to assist with the behavioural change needed in the transition to more sustainable and healthy diets.

4. Results

This chapter details results obtained from the umbrella review of published systematic reviews and meta-analyses, the scenario analyses, and the modelling predictions on how climate change will impact food production. The results from the initial literature searches are shown in table 13. From the initial database of 25,036 items, duplicate articles were then removed, and the articles initially sifted by title and abstract, followed by full contents, which brought the number of articles down to 4,573. An additional 35 key articles, mostly published prior to 2010, were identified through cross-referencing. Thematic analysis was then used to identify, analyse, and interpret themes and patterns of meaning within data (Daly *et al*., 1997), with coding used to identify and tag themes of analytic interest in the data (Boyatzis, 1998). Although thematic analysis is commonly used within qualitative research, it is mostly seen as an over-arching term covering several, distinct philosophical and conceptual assumptions, each with its own procedure. The procedure adopted for this study was originally described by Braun and Clarke (2006) as reflexive thematic analysis, whereby coding precedes the development of themes (Braun and Clarke, 2019).

	Library databases		
Keywords	*University of Reading*	*Manchester Met. University*	*Bangor University*
Sustainable & food	3,487	268	116
Climate change & food	4,078	2,778	1,407
Climate change & health	5,518	3,961	2,545
Sustainable & policy	348	252	75
Sustainable & diet	47	152	4

Table 13: Results from the initial search of literature databases from January 2010 and updated to June 2020, inclusive

4.1 Results from the umbrella review: options for UK sustainable diets, health, and policy [RQ1, 2 & 5]

In total, 197 systematic reviews and meta-analyses were identified reporting 14,251 unique relevant primary studies. The reviews summarised evidence of all types of future policy requirements for sustainable and secure food systems in response to the food production and health impacts of climate change. For inclusion, reviews must evaluate one or more of the essential prerequisites: food; climate change; environment; sustainability; health; food security; and, diet. Many interventions are considered, including fiscal, regulation, education, preventative, mitigation, and adaptation across six public health domains (food, drink, nutrition, health, diet, and the environment). Results were mixed across the public health domains; some studies reported negligible effects, others reported small sample sizes or quality concerns, where others were conclusive in their findings. There were no systematic reviews covering marine fishing. The quality of the included reviews (and their primary studies) were mixed and gaps in the existing knowledge have been highlighted. Table 15 shows the resulting characteristics and main outcomes of the included reviews. The narrative synthesis approach was used, as the papers revealed a large heterogeneity with results that would not be comparable with the same metrics. This narrative synthesis focuses on the six main research fields from this umbrella review: factors contributing to sustainable and secure food systems; the impacts of climate change on food systems; the impacts of climate change on human health; factors contributing to sustainable diets; the requirements for food policy; and any other, general factors that the reviews revealed.

Table 15 shows the summary of the umbrella review results for studies conducted between 1st January 2000 and June 30th 2020 and figure 60 shows the increasing frequency of data publication throughout the 11 years of the study. The PRISMA flow chart for selection of studies can be found in figure 61, followed by the resulting characteristics and main outcomes of included reviews in table 15 on pages 167-180.

	Systematic review search databases		
	Web of Science	*Scopus*	*Europe PMC*
Total number of studies	922	13,761	119,668
Number of studies meeting the inclusion criteria for initial screening	505	330	10
Number of studies retrieved for review	77	84	10
Duplicates	21	22	3
Total number of studies reviewed	213		

Table 14: Results from the umbrella review search from January 2010 to June 2020, inclusive

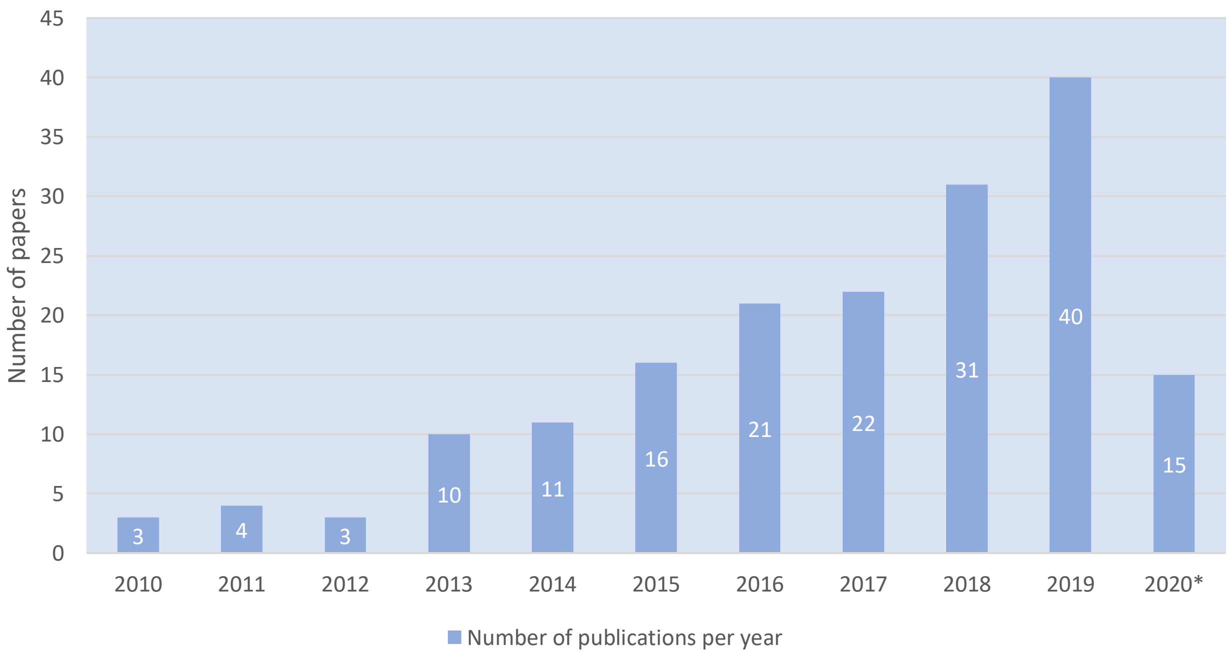


Figure 64: Frequency of data publication 2010 to 2020* (11 years)

** data for January to June only*

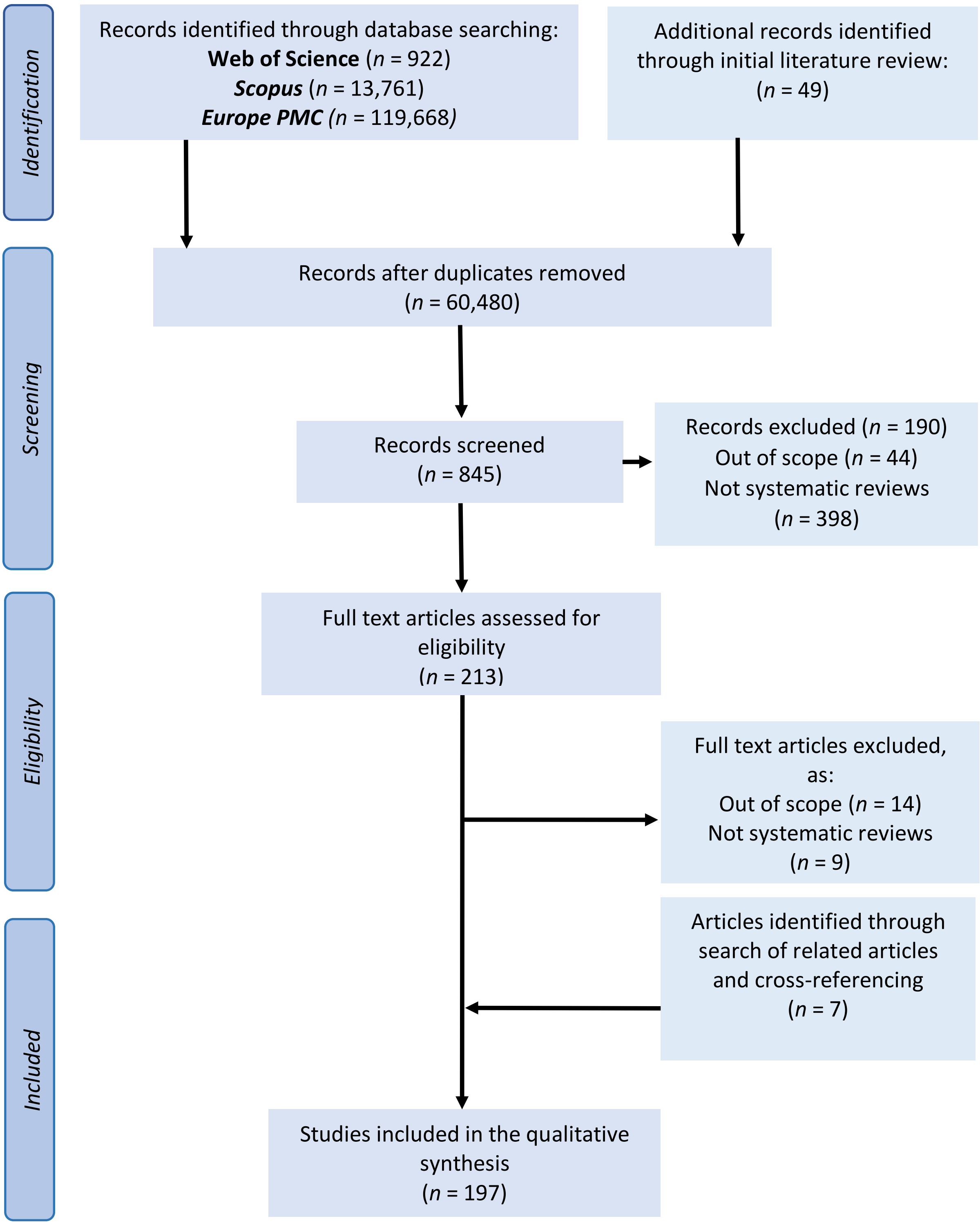


Figure 65: PRISMA flow chart for selection of studies

Author (year):	*Country where review performed:*	*Review design #:*	*No. of articles included:*	*Intervention focus:*	*Reported outcomes:*
Abeykoon *et al.* (2017)	Canada	SR	11	Impact of new food store on health	A new food store does not necessarily improve access or enhance health-related outcomes in the short term. Complex linking pathways / mechanisms are yet to be elucidated. More high-quality research in different communities with longer follow-up periods needed to inform policy decisions
Abril and Dempsey (2019)	USA	SR	14	Effectiveness of social marketing campaigns in healthy eating behaviours	Campaigns with both stop and go outcomes (such as swapping) and outcomes that were not clarifying whether they were stop or go (such as calling a coach) tended to be more successful than campaigns with simple stop or go outcomes. Further, campaigns that were longer than six months seemed consistently successful
Adam and Jensen (2016)	Denmark	SR	42	Effectiveness of obesity interventions in retailers	Carefully designed in-store healthy food interventions which combined price, information and easy access to and availability of healthy foods with interactive and engaging nutrition information can helped consumers buy and consume more healthy foods
Afshin *et al.* (2017)	USA	SR & MA	30	Food pricing impacts on improving dietary consumption	Both subsidies to increase consumption of healthy foods and taxation for unhealthy foods and beverages are effective; the use of subsidies and combined multicomponent interventions appear most effective
Åkesson *et al.* (2013)	Sweden, Norway, and Finland	SR	57	Health effects of the Nordic diet	Mostly inconclusive, except for moderate evidence only for whole grains protecting against type 2 diabetes and CVD
Alae-Carew *et al.* (2019)	India	SR	11	The character of likely future diets in India	Increases in consumption of vegetables, fruit and dairy products, but little projected change in cereal and pulse consumption. Meat consumption expected to remain low. Understanding and mitigating the impacts of projected dietary changes in India is important to protect public health and the environment
Alae-Carew *et al.* (2020)	UK / Finland	SR	105	Yield and nutritional quality of fruits, nuts and seeds	In the absence of adaptation strategies, predicted environmental changes will reduce yields of fruits, nuts and seeds. With global intake already well-below WHO recommendations, declining yields may adversely affect population health
Alagiyawanna *et al.* (2015)	Sri Lanka / UK	SR	14	Food tax & subsidy impacts on consumption & health	Although such interventions can have an impact on healthy food consumption in high income countries, this may not be directly applicable to middle-income and low-income countries
Albrecht *et al.* (2018)	USA	SR	245	Trade-offs and synergies of water, energy, and food systems	To address complex resource and development challenges, mixed-methods and transdisciplinary approaches are needed that incorporate social and political dimensions of water, energy, and food; utilize multiple and interdisciplinary approaches; and engage stakeholders and decision-making
Aleksandrowicz *et al.* (2016)	UK	SR	63	Impacts of dietary change on GHG emissions, land use, water use, and health	Reductions in environmental footprints were generally proportional to the magnitude of animal-based food restriction. Dietary shifts also yielded modest benefits in all-cause mortality risk. Environmental and health benefits are possible by shifting current Western diets to a variety of more sustainable dietary patterns
An *et al.* (2018)	USA/China	SR	50	Relationships between global warming and the obesity	Policies that endorse deployment of clean and sustainable energy sources, and urban designs that promote active lifestyles, are likely to alleviate the societal burden of global warming and obesity
Anastasiou *et al.* (2019)	Australia	SR	26	Relationships between food label use and dietary intake	Nutrition facts labels were associated with healthier diets, but insufficient research on the association between dietary consumption and use of ingredients lists, serving size information and front-of-pack labels. Apart from health-related claims, food labels are associated with healthier diets & should continue to be promoted through policies & education
Andreyeva *et al.* (2010)	USA	SR	160	Impact of food prices on consumption	Increasing food prices or falling incomes create pressure to purchase the foods lowest in cost, making processed, calorie-dense foods more attractive. Future research needed on predicting the impact of specific public health policies aimed at improving diets and reducing the burden of chronic disease
Appleton *et al.* (2016)	Europe	SR	77	Fruit & vegetable health & consumption patterns	Greater per cent success is currently found from environmental, educational and multi-component interventions, but publication bias is likely, and long-term effects and cost-effectiveness are rarely considered
Arno and Thomas (2016)	Ireland	SR & MA	42	Efficacy of nudge strategies in dietary behaviour	Nudge holds promise as a public health strategy to combat obesity. More research is needed in varied settings, however, & future studies should aim to replicate previous results in more geographically and socioeconomically diverse countries
Atallah *et al.* (2014)	Canada	SR	26	Diets, weight loss & CVD	Head-to-head RCTs, providing the most robust evidence available, demonstrated that Atkins, WW, and Zone achieved modest and similar long-term weight loss. Despite millions of dollars spent on popular commercial diets, data are conflicting and insufficient to identify one popular diet as being more beneficial than the others

Bandy *et al.* (2019)	UK	SR	68	Sales data in public health nutrition research	Food sales and purchase data are a valuable tool in nutrition research, despite the cost of access, the lack of transparency on data-collection methods and restrictions on publication. Product and brand-level sales data are particularly useful for assessing how changes by individual food companies can impact on diet and public health
Barlow *et al.* (2016)	UK / Denmark	SR & MA	41	Unhealthy diets, obesity and time discounting	Moderate evidence that high time discounting is a significant risk factor for unhealthy diets, overweight and obesity and may serve as an important target for intervention
Barlow *et al.* (2017)	UK	SR	17	Health impacts of trade and investment agreements	Limitations in existing studies preclude definitive conclusions of the health impacts of regional trade and investment agreements, but some evidence that trade agreements pose significant health risks. Health protections in trade and investment treaties may mitigate these impacts
Barth *et al.* (2017)	Sweden	SR	21	Sustainable business innovation	Proposes a conceptual framework for sustainable business model innovation in the food sector that can be used to meet the challenges encountered in taking a sustainability perspective
Bennett *et al.* (2020)	Australia	SR	16	Price promotions influence on purchasing behaviour	Policies that reduce the prevalence and/or influence of price promotions on unhealthy foods and beverages may shift consumer purchasing away from unhealthy foods and beverages. Empirical studies needed to understand how consumers and industry may respond to such policies
Bes-Rastrollo *et al.* (2013)	Germany / Spain	SR of SR	17	Food company bias of scientific research	Financial conflicts of interest may bias conclusions from systematic reviews on sugar-sweetened beverage consumption and weight gain or obesity
Bianchi *et al.* (2018)	UK / Germany	SR	14	Reducing meat consumption for environment and health	Some interventions restructuring physical micro-environments could help to promote lower demand for meat. Interventions reducing portion sizes of meat servings, providing meat alternatives, or changing the sensory properties of meat and meat alternatives at point of purchase offered the most promise in the context of experimental studies
Bivoltsis *et al.* (2018)	Australia	SR	14	Food environments and dietary intakes	Availability measures may produce significant and greater effect sizes than accessibility measures. However, both availability and accessibility measures may be important concepts of spatial exposure depending on the food outlet type and dietary outcome examined
Black *et al.* (2012)	Australia	SR	14	Less healthy diets in those of low socio-economic status	Limited high-quality evidence of the impacts of food subsidy programs on the health & nutrition of adults & children in high income countries was identified. The improved intake of targeted nutrients and foods, such as fruit and vegetables, could potentially reduce the rate of NCD in adults, if the changes in diet are sustained
Blake *et al.* (2019)	Canada / Australia	SR	107	Healthy food retail strategies	Examination of business outcomes to date has largely focused on objective commercial viability outcomes and customer perspectives, with limited exploration of retailer perspectives or community outcomes
Bourke *et al.* (2014)	UK	SR	5	Dietary interventions to increase fruit and vegetable consumption in children	To tackle obesity narrow interventions focusing on single aspects of behaviour are unlikely to achieve long-term change. Successful public health interventions tackling childhood obesity will need to take a holistic approach & target behaviour change in multiple aspects of children's lifestyles & their surroundings: education; parental support; & physical activity
Bouzid *et al.* (2013)	UK	SR	33	Public health interventions to reduce the health impact of climate change	The evidence base is mostly weak for environmental interventions that could have the most value in a warmer world. Nevertheless, such interventions should not be dismissed. Future research on public health interventions for climate change adaptation needs to be concerned about quality in study design and should address the gap for floods, droughts and other extreme weather events that pose a risk to health
Boyland *et al.* (2016)	UK / Australia	SR & MA	18	Advertising as a cue to consume	Evidence to date shows that acute exposure to food advertising increases food intake in children but not in adults. Support public health policy action that seeks to reduce children's exposure to unhealthy food advertising
Brandstetter *et al.* (2015)	Germany	SR	8	Empowering nutrition in health promotion	Very low number of studies with some having limitations in terms of reporting how the empowerment approach was actually applied. The empowerment approach still seems to be unfamiliar within the field of healthy nutrition
Broers *et al.* (2017)	Belgium	SR & MA	20	Nudging to increase fruit and vegetable choice	Indicates the effectiveness of nudging on fruit and vegetable choice in terms of actual effect-sizes; also highlights the problems that must be addressed before more definitive conclusions can be drawn
Brown *et al.* (2018)	Australia	SR	32	Nutrition and health information on food labels effects on portion size	Nutrition and health information presented on food labels has varying impacts on portion sizes consumed, from increased to decreased intake. Recommendations for future research include evaluating more recent food label types and achieving more consistent reporting standards
Bucher *et al.* (2016)	Australia / Denmark	SR	15	Nudging consumers towards healthier choices	The evidence that food position influences food choice is consistent; but difficult to quantify the magnitude of impact on food choice & intake & the effect size of these choice architecture interventions on actual food consumption & health outcomes. Use of harmonised terminology & indicators allows comparability between experiments or interventions
Calancie *et al.* (2015)	USA	SR	33	Policy and environmental strategies to prevent obesity	The varied populations and settings mean findings were too diverse to empirically assess effectiveness. Instead, the findings provide guidance on adapting and implementing policy and environmental strategies in rural communities

Candel (2014)	Holland	SR	50	Food security governance	Identifies seven main themes that recur throughout the literature. Recommends the design of smart governance arrangements that are capable of addressing food insecurity in more effective ways in the future
Caspi *et al.* (2012)	USA	SR	38	The local food environment and diet	Many measurement challenges remain, but accurate & comprehensive assessments of the food environment–diet relationship can provide insight into how the local environment may be altered to elicit actual improvements in dietary health: combination of rigorous spatial & store audit measures; intelligent use of neighbourhood informant data
Cecchini and Warin (2016)	France	SR & MA	6	Food labelling impacts on choices & eating behaviours	Nutrition labelling may be an effective approach to empowering consumers in choosing healthier products. Interpretive labels, as traffic light labels, may be more effective
Cerri *et al.* (2019)	Italy / Denmark	SR	388	Social desirability bias	Advocates three improvements in survey research about sustainable food: a better description of the data collection process to identify the limitations & strengths of a specific study; procedural remedies against social desirability used more consistently; more research in social desirability scales & specialised questioning techniques for sensitive answers
Chai *et al.* (2019)	Denmark	SR	34	Environmental impact of vegan, vegetarian and omnivorous diets	The environmental impact on land and water differs among the three diets. The more animal protein consumed in a diet, the higher the water use will be. A vegan diet has the lowest land use and water use and the least environmental impact. In order to be sustainable, local products that minimize the environmental impact of transport should be preferred
Challinor *et al.* (2014)	UK / USA / Australia	SR & MA	1700	Crop yield effects of climate change	Without adaptation, losses in aggregate production are expected for wheat, rice, & maize by 2°C of local warming. Crop-level adaptations increase simulated yields by 7-15%, with adaptations more effective for wheat & rice than maize
Chau *et al.* (2018)	USA	SR	16	Social media in nutrition interventions	Social media is a promising feature for nutrition interventions for adolescents and young adults
Chen *et al.* (2013)	China	MA	5	Meat consumption and stroke risk	Indicates that consumption of red and/or processed meat increases the risk of stroke, in particular, ischemic stroke
Christoph and An (2018)	USA	SR/MA	16	Effect of nutrition labels on dietary quality	Nutrition labels had a moderate but positive effect on dietary intake of college students
Clarke *et al.* (2016)	USA	MS	17	The policy process to obesity prevention	The limited application of political science theories indicates a need for future theoretically based research into the complexity of policy-making and multiple influences on obesity prevention policy processes
Clune *et al.* (2017)	UK / Australia	SR & MA	369	GHG emissions for fresh food	Enables streamline calculations of the global warming potential of human diets
Cobb *et al.* (2015)	USA / Canada	SR	71	The local food environment and obesity	Despite the large number of studies, we found limited evidence for associations between local food environments and obesity. The predominantly null associations should be interpreted cautiously due to the low quality of available studies
Colley *et al.* (2019)	Canada	SR	11	School food programmes impact on children's nutrition and health	Programmes incorporated a variety of components: policy; education; family & community involvement; food provision. Positively associated with development of nutrition knowledge, dietary behaviour changes, & healthy foods intake; barriers include intervention duration, intensity, & availability of resources impacted children's diets and overall health
Cornelsen *et al.* (2015)	UK / Italy	SR & MA	78	Global food price elasticities	Changes in food prices had the largest own-price effects in low-income countries. Cross-price effects were more varied and depending on country income level were found to be reinforcing, undermining or alleviating own-price effects
Crockett *et al.* (2010)	UK	SR	28	Nutritional labelling for healthier food choice	Nutritional labelling with energy information on menus may reduce energy purchased in restaurants. Evidence assessing the impact on consumption of energy information on menus or placed on a range of food options in laboratory settings suggests a similar effect to that observed for purchasing, although the evidence is less definite and also of low quality
Croker *et al.* (2020)	UK	SR & MA	14	Nutritional labelling schemes	Labels including an interpretative message (beyond simply provision of nutritional information) appear to have greater potential for impacting behaviour. Evidence from experimental studies support 'high in' and multiple traffic light front of pack label and evidence from interrupted time series studies for 'high in', traffic light and Guideline Daily Amounts
Cullerton *et al.* (2016)	Australia	SR	63	Political science to progress public health nutrition	Limited research into the nutrition policy process in high income countries. Small increase in the use of policy process theory from 2003, an opportunity to expand its use is evident. Nutrition policy would benefit from a pragmatic approach to ensure policymakers are equipped with basic knowledge around these theories
Cullerton *et al.* (2019)	Australia / UK	SR	54	Interactions between population health researchers & the food industry	High levels of agreement in themes relating to research governance, transparency, & publication but less agreement & guidance on how principles should be applied in relation to funding & risk assessment. Agreement on some of the general principles for preventing & minimizing conflicts of interests for population health researchers when interacting with the food industry. For assessing the appropriateness of an industry partner, greater clarity and consensus required
D'Alessandro *et al.* (2019)	Italy	SR & MA	59	Mediterranean diet	The Mediterranean diet is well defined into its characteristics as quantity and frequency of intake is compatible with the Reference Italian Mediterranean Diet. It lowers the risk of type 2 diabetes and coronary heart disease

Dangour *et al.* (2013)	UK	SR	4	Nutrition promotion through food price policies	Paucity of robust direct evidence on the impact of agricultural price policies on nutrition and health. Price policies have rarely been evaluated from a nutrition or health standpoint and the evidence base explicitly linking these policies to nutrition and health outcomes is extremely limited. Needs interdisciplinary thinking and innovations in study design
Dania *et al.* (2018)	Indonesia / Australia	SR	30	Collaboration in sustainable supply chains	Key behavioural factors for effective collaboration system for sustainable supply chain management are identified: joint efforts; sharing activities; collaboration value; adaptation; trust; commitment; power; continuous improvement; coordination and stability
Darmon and Drewnowski (2015)	France / USA	SR	151	Food prices cost disparities in diet quality and health	Socioeconomic disparities in diet quality may be explained by the higher cost of healthy diets. Identifying food patterns that are nutrient rich, affordable, and appealing should be a priority to fight social inequalities in nutrition and health
Dinu *et al.* (2016)	Italy	SR & MA	108	Vegetarian, vegan diets and multiple health outcomes	Significant protective effect of a vegetarian diet versus the incidence and/or mortality from ischemic heart disease (-25%) & incidence from total cancer (-8%). Vegan diet conferred a significant reduced risk (-15%) from total cancer
El Bilali (2019)	Austria	SR	111	Changes needed for sustainable food systems	Research on food sustainability transitions should fill research gaps relating to agency (*cf.* role of social movements and civil society, firms and industries, etc.) and spatiality/geography in transitions
Escarcha *et al.* (2018)	Australia	SR	126	Livestock and climate change	Lack of research in Asia & South America; a lack of mutual investigation & linkages between impacts & adaptation; lack of emphasis on mixed crop-livestock systems; lack of emphasis on monogastric livestock; underrepresentation of quantitative methods including yield impact models
Escaron *et al.* (2013)	USA	SR	58	Retailer promotion on healthy food choices and eating practices	More rigorous testing of interventions aimed at improving food and beverage choices in food stores, including their effect on diet and health outcomes, is needed
Eyles *et al.* (2012)	New Zealand	SR	32	Food pricing strategies, diets and NCD	Taxes on carbonated drinks & saturated fat & subsidies on fruits & vegetables associated with beneficial dietary change, with potential for improved health. Research into compensatory purchasing & population health outcomes is needed
Ferrari *et al.* (2019)	Italy	SR	25	Nudging to improve the environmental impact of food supply chain	Green nudging can be effective in leveraging more sustainable practices. Should not replace stricter environmental and food policies, but rather should be regarded as potential complements to be implemented with the aim of gradually moving society in a direction that might benefit all
Ferreira Gregorio (2018)	Spain	SR	449	Bio, green and circular economy trends	Literature is rich in analysing implemented policies & issues related to the strategies & organisational models of companies looking for a more sustainable path. Case studies and evaluations of the economic impact are needed. To promote, encourage & support companies in cleaner production & approach a more sustainable path must be prioritised
Fleischhacker *et al.* (2011)	USA	SR	41	Fast food access	Fast food restaurants more prevalent in low-income areas and higher concentrations of ethnic minority groups. Higher body mass index was associated with living in areas with increased exposure to fast food. Research needs to understand if & how fast-food access impacts dietary intake and health outcomes; and socioeconomic, race/ethnicity & age
Flies *et al.* (2018)	Australia / USA	SR & MA	22	Future global food demand	Estimates of kilocalorie demand have a broad range, but are not consistently dependent on model complexity or form. Models often make similar predictions to integrated assessments (e.g. with expert opinions, future prices or climate influencing forecasts) despite having different underlying assumptions and mechanisms. Reporting of model accuracy and uncertainty was uncommon, leading to difficulties in making evidence-based decisions about which forecasts to trust. Needs improved model reporting and transparency and improve the pace of development in this field
Frewer *et al.* (2013)	UK / Holland	SR & MA	70	Consumer and societal attitudes to GM food production	Risk and benefit perceptions of GM food production have been increasing with time. European consumers tended to be more negative about GM overall compared to Northern American and Asian consumers. Ethical and moral concerns of consumers were, however, greater in North America (and possibly Asia) compared to Europe.
Gao *et al.* (2018)	China / UK / New Zealand	SR	36	Public health benefits of GHG emissions reduction	Co-benefits of GHG mitigation seen in five economic sectors; measures across various sectors tend to provide greater ancillary health gains; health co-benefits assessments of GHG reductions are based almost entirely on descriptive or modelling studies; overestimation or underestimates may arise during the health co-benefits assessment of GHG mitigation strategies; standard methods to estimate the co-benefits of GHG abatement are needed
German *et al.* (2017)	UK	MA	143	Environmental impact and productivity	Strong evidence of the relationship between crop yields and the negative externalities created by food production across a range of measures
Ghai *et al.* (2017)	India	SR	72	Organic food health claims	Organic food business in India lack standard guidelines for quality, policy framework for domestic and export market. Traceability should be given prime importance to ensure removal of fraudulent practices

Gillespie *et al.* (2019)	USA / UK	SR	11	Nutrition and governance in South Asia	Policies that strengthen the nutrition-sensitivity of food systems is a political task. Navigating and negotiating policy agendas requires an understanding of the competing incentives and interests of the various actors involved, including the private sector and civil society. A better understanding of governance can facilitate such negotiations, helping to identify opportunities, resolve trade-offs and strengthen nutrition-relevant pathways and outcomes. Governance needs commitment, power, accountability, coherence, data, leadership and capacity
Giskes *et al.* (2011)	USA	SR	28	Environmental factors and obesogenic diets	Living in a socioeconomically-deprived area was the only environmental factor consistently associated with a number of obesogenic dietary behaviours. Associations between the environment and weight status are more consistent than that seen between the environment and dietary behaviours. The environment may play an important role in the development of overweight/obesity, however the dietary mechanisms that contribute to this remain unclear and the physical activity environment may also play an important role in weight gain, overweight and obesity
Gittelsohn *et al.* (2017)	USA	SR	30	Pricing strategies for healthy foods	Pricing interventions generally increased stocking, sales, purchasing, and consumption of promoted foods and beverages. Research needed to differentiate the potential impact of selected pricing strategies and policies over others
Gordon *et al.* (2018)	USA / Rome	SR	48	Healthier choices in school cafeterias	This review found successful fast and intuitive thinking school cafeteria interventions to be more common than slow and cognitively demanding interventions with the latter being less effective than the former
Green *et al.* (2013)	London / Italy	MR	136	Rising food prices and food consumption	Changes in global food prices will have a greater effect on food consumption in lower income countries and in poorer households within countries. This has important implications for national responses to increases in food prices and for the definition of policies designed to reduce the global burden of undernutrition
Green *et al.* (2016)	UK / India	SR	11	Dietary patterns in India	Large variability between regions in dietary patterns and some evidence of change in diets over time, but no evidence of different diets by sex or age was found. Consumers of high-fat dietary patterns were more likely to have greater BMI, and a dietary pattern high in sweets and snacks was associated with greater risk of diabetes compared with a traditional diet high in rice and pulses, but other relationships with NCD risk factors were less clear. Shows dietary pattern analyses can be highly valuable in assessing variability in national diets and diet–disease relationships
Grieger *et al.* (2017)	Australia	SR	45	Models to estimate dietary strategies on nutritional intake	Targeting a variety of foods rather than individual foods or nutrients theoretically appears most effective in estimating improvements in nutritional intake, particularly reducing intake of nutrients commonly consumed in excess. Combination of strategies could be used to deliver the best improvement in outcomes
Grosso *et al.* (2014)	Italy	SR	58	Mediterranean diet and CVD	Most studies showed favourable effects of MD on CVD, although a certain degree of controversy remains in the respect of obesity. Methodological differences and limitations in the studies make difficult to compare results, thus further studies, particularly randomized clinical trials, are needed
Haby *et al.* (2016)	Australia / USA / Mexico / Brazil	SR	22	Interventions for sustainable food production and health	Needs careful implementation of interventions with expected positive health impacts but with concurrent, rigorous evaluation. Possible impact on health inequalities needs to be considered and measured by future primary studies and systematic reviews, as does impact of interventions on all dimensions of sustainable development
Halford *et al.* (2018)	Europe	SR	26	Dietary interventions to reduce appetite and energy intake	Maintenance of intervention effects on appetite or energy intake needs to be confirmed but seems likely where acute effects are robust and replicable in adequately powered studies
Hallström *et al.* (2015)	Sweden	SR	14	Environmental impact of dietary change	Dietary change, in areas with affluent diet, could play an important role in reaching environmental goals, with up to 50% potential to reduce GHG emissions and land use demand associated with the current diet. The choice of functional unit, system boundaries and methods for scenario development and accounting for uncertainties are methodological aspects identified to have major influence on the quality and results of dietary scenario analysis
Hallström *et al.* (2018)	Sweden	SR	24	Dietary quality scores to assess sustainability of food and diets	Choosing which method to quantify dietary quality scores as well as how they are combined with environmental assessments can affect the results and the conclusions of which foods that are more sustainable to eat. This is critical to understand for the set-up of studies and for the interpretation of results and drawing conclusions
Harguess *et al.* (2020)	USA	SR	15	Strategies to reduce meat consumption	Correlational studies were useful agents of behaviour change in experimental studies. More studies needed to confirm modifications of the food environment e.g. increasing the number of meatless meals on restaurant menus
Harris *et al.* (2020)	UK	SR & MA	41	Water footprint of diets	Changes toward healthier diets could reduce total water use of agriculture but would not affect blue water use. Rapid dietary change and increasing water security concerns underscore the need for a better understanding of the amount and type of water used in food production to make informed policy decisions

Hartmann and Siegrist (2017)	Switzerland	SR	38	Sustainable protein consumption	Consumer awareness of the environmental impacts of meat is surprisingly low therefore, willingness to change behaviour is low as well. How people can be motivated to decrease their meat consumption behaviour is underexplored
Hartmann-Boyce *et al.* (2018)	UK	SR	35	Retailer interventions to change food purchasing behaviours	Findings suggest that interventions implemented in stores, particularly ones that manipulate price, suggest swaps, and perhaps manipulate item availability, have an impact on purchasing and could play a role in public health strategies to improve health
Hedin *et al.* (2019)	Sweden	SR	15	Digital behaviour change interventions for sustainable consumption	Studies had major quality issues from a behaviour change perspective, therefore unable to find evidence on if digital behaviour change interventions worked or not. Future research needs to expand from the exploratory phase to conducting scientifically rigorous studies of higher quality, thoroughly grounded in behaviour change theory & methods
Hendry *et al.* (2013)	UK	SR	80	Interventions to promote healthy eating	Regulations can achieve compliance in terms of increasing the proportion of food items, people, or organisations that accord with the regulation. Whether regulations affect food choices, nutrition, obesity, or other health outcomes is unclear. Strategies to reduce artificial trans-fats might improve diets without affecting individual behaviours; reinforcing consumer engagement should strengthen public health messages while inducing food producers to reformulate
Hollis-Hansen *et al.* (2019)	USA	SR	15	Retail impacts on fruit and vegetable intake	Studies which change the food environment support increasing access to healthy food to improve diet; studies needed to assess the differences between types of retailers; & to identify strategies for improving impact. Understanding which types of new food retail programs will best impact diet has implications for policies which incentivise new food retail
Horne *et al.* (2020)	USA	SR	25	Nudges to promote healthy food in the school	Identifies the requirement for well-designed and well-controlled investigations into the effects of changing the choice architecture in school cafeterias, assessing short-, medium-, and long-term changes in individual children's consumption, utilizing validated measures, and conducted across a variety of settings
Houghtaling *et al.* (2019)	USA	SR	31	Choice architecture and strategies to encourage healthy consumer purchases	Multiple social-ecological factors impact retailer decision-making and willingness or ability to support healthy food and beverage objectives in food stores. Overall, there is a dearth of retailer information available within the literature. Research approaches and intervention plans must align with retailer goals, business models, and available resources
Hyseni *et al.* (2017)	UK	SR	23	Dietary trans-fat reduction interventions	Multicomponent interventions including legislation to eliminate TFAs from food products were the most effective strategy. Reformulation of food products and other multicomponent interventions also achieved useful reductions in TFA intake. Interventions targeted at individuals consistently achieved smaller reductions
Iaccarino Idelson *et al.* (2017)	Italy	SR	58	Mediterranean Diet	Further validation of MD indexes in terms of reproducibility and consistency with the MD is needed. At the same time, more prospective cohort and intervention studies may better elucidate the relationships of MD adherence with behavioural and health outcomes
Jia *et al.* (2019)	China / Singapore / US/Holland	SR & MA	36	Fast food restaurants and child obesity	Higher fast-food restaurant access was not associated with weight-related behaviours in most studies. It was, however, commonly associated with more fast-food consumption. Systematic review and meta-analysis show insignificant results
Johnson *et al.* (2018)	Australia	SR	18	Parental provision of unhealthy foods	Variation in characteristics and components of interventions, as well as limited effectiveness, emphasize that there is currently no one best approach
Jones *et al.* (2016)	USA	SR	113	Measurement of sustainable diets	GHGEs of foods with the use of the Life Cycle Assessment approach was the most common method applied to measure the environmental impacts of diets. Many components of sustainable diets identified in existing conceptual frameworks and studies that examine consumer demand for sustainable dietary alternatives are under-represented
Jung *et al.* (2015)	Germany	SR	8	Dietitians' and nutritionists' stigma with obesity	Results not homogenous. The degree of negative attitudes by dietitians and nutritionists towards people with obesity appeared to be slightly less pronounced compared to the general public and other health care professionals. Stigma and its consequences should be included into educational programs to optimally prepare dietitians and nutritionists
Jurgilevich *et al.* (2017)	Finland	SR	42	Climate risk and vulnerability assessment	While the number of studies that include dynamics is growing, and while all studies included socio-economic aspects, often only biophysical dynamics was considered. Discusses the challenges of assessing socio-economic and spatial dynamics, particularly the poor availability of data and methods. Suggests that future-oriented studies assessing risk dynamics would benefit from larger stakeholder involvement, discussion of the assessment purpose, the use of multiple methods, inclusion of uncertainty/sensitivity analyses and pathway approaches
Kaur *et al.* (2017)	UK / Holland / Sri Lanka	SR	9	Impact of health-related claims on dietary choices	The prevalence of price promotions is very context specific, and any proposed regulations should be supported by studies conducted within the proposed setting(s)

Kaur *et al.* (2020)	UK / Sri Lanka / Holland	SR & MA	13	Price promotions on food	Very high level of heterogeneity among the studies due to the different food groups, settings and methods of the included studies means the meta-analysis is of limited use. The prevalence of price promotions is very context specific, and any proposed regulations should be supported by studies conducted within proposed settings
Kirkpatrick *et al.* (2014)	USA	SR	51	Dietary assessment	Tendency to use brief dietary assessment instruments with low cost & burden rather than detailed instruments that capture intake with less bias. Use of error-prone dietary measures lead to spurious findings & detections of associations
Klümper and Qaim (2014)	Germany	SR & MA	147	GM crops	The meta-analysis reveals robust evidence of GM crop benefits for farmers in developed and developing countries. Such evidence may help to gradually increase public trust in this technology
Knapp and van der Heijden (2018)	Switzerland	SR & MA	193	Yields of organic and conservation production	Organic agriculture has, per unit yield, a significantly lower temporal stability (−15%) compared to conventional agriculture. Although organic farming promotes biodiversity & is generally more environmentally friendly, future efforts should focus on reducing its yield variability. The use of green manure & enhanced fertilisation can reduce the yield stability gap between organic and conventional agriculture. The temporal stability (−3%) of no-tillage does not differ significantly from those of conventional tillage indicating that a transition to no-tillage does not affect yield stability
Knox *et al.* (2016)	UK / Italy	SR & MA	41	Climate impacts on crop yield	Projected change in average yield in Europe for the seven crops by the 2050s is +8%. Strong regional differences with crop impacts in northern Europe being higher (+14%) and more variable compared to central (+6%) and southern (+5) Europe. Maize is projected to suffer the largest negative mean change in southern Europe (−11%). Evidence of climate impacts on yield was extensive for wheat, maize, sugar beet and potato, but very limited for barley, rice and rye
Labonté *et al.* (2018)	Canada / London	SR	78	Nutrient profile models in policies for health promotion and NCD disease prevention	Given the proliferation of nutrient profile models worldwide, this new resource will valuable for assisting health professionals and policymakers in the selection of an appropriate model when the establishment of nutrition-related policies requires the use of nutrient profiling
Landauer *et al.* (2015)	Finland / Austria	SR	112	Climate change adaptation and mitigation	Finds evidence that supports examining adaptation and mitigation policies together. Urban climate policymaking is important in global climate change governance
Langellier *et al.* (2019)	USA	SR	27	Complex systems approaches to diet	Opportunities remain to advance the state of the science of complex systems approaches to diet & nutrition, including using models to better understand mechanisms driving population-level diet, models for policy decision support, and leveraging the wide availability of epidemiologic, and policy evaluation data to improve model validation
Lara Silva and Sanjuan (2019)	Brazil / Spain	SR	20	LCA of alternative food processing	Case studies help improve the application of LCA in food processing: the functional unit, system boundaries, scale & data source issues, & process water & wastewater composition. Research needs to (re)think technological and operational conditions (with an emphasis on cleaner production techniques), the inclusion of scale decision and consumption, and the importance of incorporating nutritional, sensorial and socio-economic dimensions to assist decision making
Le Mouël and Forslund, (2017)	France	SR	25	Global scenario studies for feeding the world in 2050	Covering additional world needs will require increasing the world supply of agricultural products, by increasing yields and/or expanding agricultural land. Crop and livestock yields as well as land area devoted to agriculture are thus two other levers advocated for feeding the world up to 2050. Alternative scenarios involve dietary change and yield growth
Lee *et al.* (2011)	Australia	SR	49	Effect of food cost on diet and disease	Manipulation of food cost may alter food consumption and therefore risk factors for chronic disease. Further longitudinal studies investigating the impact of pricing strategies on diet quality and disease risk are needed
Lennox *et al.* (2018)	UK	SR	25	Sustainability in healthcare	Choosing a sustainability method can pose a challenge because of the diverse approaches reported in the literature. This review provides a valuable resource to researchers, healthcare professionals and improvement practitioners by providing a summary of available sustainability approaches and their characteristics
Lewis and Lee (2016)	Australia	SR	11	Costs of healthy food	Healthy food price assessment methods lack comparability across all metrics & most do not align with a healthy diet as recommended by the current Australian Dietary Guidelines. Assessment of the price, price differential and affordability of healthy and current diets would provide more robust and meaningful data to inform health and fiscal policy
Liberato *et al.* (2014)	Australia	SR	32	Healthy interventions at point-of-sale	A range of intervention types used at point-of-sale to encourage healthy purchasing and/or intake of healthier food options and to improve health outcomes. Needs more studies on the effectiveness of point-of-sale interventions to encourage healthier eating & improve health outcomes, & the mediating factors that might impact these interventions
Lopez-Medina *et al.* (2019)	Spain / UK / Germany / Holland	SR	32	Climate change threats to public health	Identifies the educational approaches necessary to provide a broad based curriculum and a cross-disciplinary approach, including topics such as the use of resources, food, health promotion, globalism, disease management, and the environmental impact of delivering healthcare, if embedded in nursing education could support the nursing profession's response for this new and important aspect of healthcare

Lynch (2019)	UK	SR	22	GHG emissions from beef production	Very high levels of beef consumption are climatically unsustainable, regardless of carbon dioxide equivalence metric. Where individual GHG compositions were available, significant variation was found for all gases. Non-grass-fed systems generally appear more emissions efficient but, using the 100-year global temperature potential (GTP100) metric, grass-fed beef had lower footprints
Lytle and Sokol (2017)	USA	SR	432	Food environment measures	To strengthen research examining the relationship between the food environment and population health, there is a need for robust and psychometrically-sound measures and more sophisticated study designs
Mackenbach *et al.* (2019)	Holland	SR	4	Food environment and dietary behaviours	No clear evidence for socioeconomic differences in the association between food environments and dietary behaviour, although a limited number of studies focusing on economic and school food environments generally observed stronger associations in lower socioeconomic populations
Mah *et al.* (2019)	Canada	SR	86	Retail food environments	Retail food environments are one of the main sources of diet-related risk, but also hold health promotion policy possibilities. They are physical, social, economic, and cultural spaces that shape our dietary behaviours and where structural barriers to nutritional health such as the power over and ownership of food sources are manifest
Mahon *et al.* (2017)	UK	SR	75	Sustainable intensification	SI viewed with scepticism because of lack of specificity and elucidation of the rationale, scale, and farm type for which SI is proposed. The number of the indicators were so loosely defined that the interventions they imply could be enacted without due consideration of the social impacts of their adoption
Makarem *et al.* (2018)	USA	SR	37	Sugar and cancer risk	Associations between dietary sugars and cancer vary by cancer site. Null results were observed for the consumption of total sugar and sucrose, but some study findings are suggestive of a potential detrimental impact of added sugars, dietary fructose, and sugary beverages on cancer risk
Mandal (2016)	Greece	SR	16	GHG emissions of food groups and diet	While ruminant meat consumption is environmentally costly, healthier and nutrient dense foods such as fruits and vegetables on average have higher GHGE than foods with poorer nutrition that are high in sugar. Therefore, nutritionally suboptimal diets which contribute to diabetes and obesity actually have a lower carbon footprint
Marcano-Olivier *et al.* (2020)	UK/USA	SR	25	Nudges to promote healthy food choices	Identifies the requirement for well-designed and well-controlled investigations into the effects of changing the choice architecture in school cafeterias, assessing short-, medium-, and long-term changes in individual children's consumption, utilising validated measures, and conducted across a variety of settings, including school dining rooms
Mayén *et al.* (2014)	Switzerland	SR	33	Socio-economic determinants of diets	In low- and middle-income countries, high socioeconomic status or living in urban areas is associated with overall healthier dietary patterns. However, it is also related to higher energy, cholesterol, and saturated fat intakes. Social inequalities in dietary intake should be considered in the prevention and control of NCD in LMICs
Maynard *et al.* (2020)	Brazil	SR & MA	31	Sustainability indicators in food services	Studies in food services are seeking to insert indicators that cover the three pillars of sustainable meal production. Many works encompass the importance of sustainability, but few explore which indicators are most applied or detail their implementation in food services
Mayne *et al.* (2015)	USA	SR	37	Policy and built environment changes on obesity-related outcomes	Some policy and built environmental interventions, especially active transportation infrastructure improvements, bans or restriction on unhealthy foods, and altering purchase / payment rules for low-income food vouchers, can increase certain types of physical activity and improve diet
McDermott *et al.* (2015)	Australia	SR & MA	46	Planned behaviour and discrete food choices	There is a clear imperative for the design of interventions to maximise the health and wellbeing populations by increasing rates of health promoting food choices and concurrently discouraging health-compromising food choices. Understanding the key determinants of these behaviours can assist in the development of such interventions
McKay *et al.* (2019)	Australia	SR	57	Food Insecurity	Researchers are using a variety of methods to collect information about food insecurity, including a single item question that has been found to return an inaccurate measure of food insecurity. As a result, there is little understanding of the true prevalence and severity of food insecurity in Australia
Meiklejohn *et al.* (2016)	Australia / Ireland	SR	13	Nutrition education programmes	Multi-strategy interventions can have significant impacts on nutrition of adolescents when the nutrition education is theoretically based and facilitated by school staff in conjunction with parents and families, and includes changes to the school food environment
Mekonnen *et al.* (2020)	USA / Norway	SR	20	Socio-economic inequalities in diet	Consistent mediators of the effects of socioeconomic position on dietary behaviours among the youth were: self-efficacy, food preferences and knowledge at the intrapersonal level; and availability and accessibility of food items at home, food rules and parental modelling at the interpersonal level.
Micha *et al.* (2018)	USA / Greece	SR & MA	91	School food environment policies	Specific school food environment policies can improve targeted dietary behaviours; effects on adiposity and metabolic risk require further investigation. These findings inform ongoing policy discussions and debates on best practices to improve childhood dietary habits and health

Michel-Villarreal *et al.* (2019)	UK / Italy	SLR	61	Sustainability of alternative food networks	No frameworks based on metrics and indicators have been used for the evaluation of sustainability in AFNs. This is surprising considering that AFNs are largely regarded as being more sustainable than the 'conventional' food system. More efforts are needed to establish a common language of sustainability for the study of AFNs
Mills *et al.* (2017)	UK / Australia	SR	38	Determinants and outcomes of home cooking	Home cooking layers of influence include non-modifiable, individual, community and cultural factors. Key determinants included female gender, greater time availability and employment, close personal relationships, and culture and ethnic background. Putative outcomes were mostly at an individual level and focused on potential dietary benefits.
Mytton *et al.* (2014)	UK	SR & MA	8	Effects of increased vegetable and fruit consumption	Promoting increased fruit and vegetable consumption, in the absence of specific advice to decrease consumption of other foods, appears unlikely to lead to weight gain in the short-term and may have a role in weight maintenance or loss. Longer studies or other methods are needed to understand the long-term effects on weight maintenance and loss
Nelson *et al.* (2016)	USA	SR	15	Healthy dietary patterns and environmental sustainability	Concurs with the conclusions of the original US Dietary Guidelines Advisory Committee SR, in that adherence to several well-characterized dietary patterns, including vegetarian diets, dietary guidelines–related diets, Mediterranean-style diets, the Dietary Approaches to Stop Hypertension (DASH) diet, and other sustainable diet scenarios, promotes greater health and has a less negative impact on the environment than current average dietary intakes
Nichols *et al.* (2009)	UK	SR	36	Health, climate change and sustainability	Research reports the potential health effects of climate change and policies & strategies to tackle these effects. An urgent need to identify and report on the implementation of strategies to mitigate and adapt to these challenges and to publish real examples of actions. Actions that are taken need to be evidence/policy based, & implementations monitored, evaluated & published
Niebylski *et al.* (2015)	USA / Canada	SR	78	Healthy food subsidies and unhealthy food taxation	Consistent evidence that taxation and subsidy intervention influenced dietary behaviours. The quality, level and strength of evidence along with identified gaps in research support the need for further policies and ongoing evaluation of population-wide food / beverage subsidies and taxation. Food taxes and subsidies should be a minimum of 10 to 15% and preferably used in tandem
Nour *et al.* (2018)	Australia	SR	10	Vegetable intake and weight outcomes	Provides moderate quality evidence for an inverse association between vegetable intake and weight-related outcomes in adults. When these findings are coupled with no apparent harm from vegetable consumption, the evidence-base can be used with acceptable confidence to guide practice and policy
O'Halloran *et al.* (2020)	Norway / S. Africa / Australia	SR	38	Assessing the school food environment	Reveals there are no standardised methods used to measure the school food environment. Robust methods to monitor the school food environment across a range of diverse country contexts is required to provide an understanding of obesogenic school environments
Olstad *et al.* (2017)	Australia / Canada / USA	SR	20	Policies to reduce obesity	Of the 10 studies of government policies, policies providing information/education and fruit and vegetable subsidies had positive impacts amongst children, but no impact amongst adults. Policies involving changes to built environments yielded nearly uniformly null findings in children and adults. Overall, the largest quantity of high-quality evidence of effectiveness was for comprehensive interventions that included school policies, and government policies targeting disadvantaged children in schools. None of the government policies targeting disadvantaged adults proved effective. Interventions during childhood may ameliorate negative obesity-related manifestations of socioeconomic disadvantage. Gaps in knowledge remain surrounding effective policies in adults, adolescents and very young children
Oostenbach *et al.* (2019)	Australia	SR	11	Impact of nutrition claims	While nutrition claims may lead consumers to improve their nutrition knowledge & select healthier options, may also lead to increased food consumption and overall energy intake, counter to efforts to address overweight and obesity
Ottrey *et al.* (2018)	Australia	SR	92	Ethnography in nutrition and dietetics	Ethnography increases understanding of complex food and nutrition related health issues and their contributing factors across public health nutrition, foodservice, and clinical dietetic practice. Can be used to explain health inequalities, direct policy, and inform more effective intervention design and delivery. Wider uptake of this research approach as a stand-alone or complementary study design will advance efforts to improve health and wellbeing through food and nutrition
Payne *et al.* (2016)	UK	SR	16	Health impacts of low GHG diets	Dietary scenarios that have lower GHGE compared with average consumption patterns may not result in improvements in nutritional quality or health outcomes. Dietary recommendations for reduced GHGE must also address sugar consumption and micronutrient intake
Pearce *et al.* (2016)	Australia	SR	390	How Australia adapting to climate change	Finds compelling evidence that adaptation to climate change is happening in Australia: most focused on eastern Australia, with agriculture, coastal adaptation, and health being primary areas

Pearson and Biddle (2011)	UK	SR	53	Sedentary behaviour and diet	The association drawn mainly from cross-sectional studies is that sedentary behaviour, usually assessed as screen time and predominantly TV viewing, is associated with unhealthy dietary behaviours in children, adolescents, and adults. Interventions need to be developed that target reductions in sedentary time to test whether di*et al*so changes
Pember and Knowlden (2017)	USA	SR	10	Dietary change interventions	Theory-based studies exclusively focused on dietary behaviours are needed that address social norms, upperclassmen and non-residential students, environmental supports, feedback, goal setting, and measures aside from fruit and vegetable consumption
Perez-Cueto (2019)	Denmark	UR of SR	26	Food choice and nutrition	Common indicators for outcome measures on food choice and nutrition studies are nutrition knowledge, healthy food choices, food purchases and food and nutrient intake. The most common strategy implemented to alter food choice with a nutritional aim is nutrition education, followed by provision of information through labels. Among children, parent modelling is key to achieving healthy food choices. In general, combining strategies seems to be the most effective way to achieve healthier food consumption and to maintain good nutrition in all age groups
Pineda *et al.* (2019)	UK / New Zealand	SR & MA	21	School food environments and obesity	Effective interventions in the prevention of childhood obesity were banning of sugary drinks in schools and an increase in availability and accessibility of fruits and vegetables for children from an early age. Multisystem approaches, such as stringent and monitored school meal programmes, alongside the collaboration, training, education, and integration of the school staff, parents, and students, increased acceptability and adaptability according to the local needs and sustainability of the food environment interventions. Changes in the environment lead to behaviour modifications
Porter *et al.* (2014)	UK	SR	15	UK household adaptation to climate change	The ability for quantitative analysis of emergent patterns was limited. UK households routinely take small, low cost, low tech, intuitive, and quickly implementable actions such as changing diets, clothing, and opening/closing windows, as coping responses to existing climatic variability. Past exposure to extreme weather, pressures of social acceptability, and long-term financial rewards appear to be the main drivers of household adaptation. Long-term household adaptations are unlikely to happen autonomously. For evidence-based policymaking, government needs more high-quality empirical research to aid climate adaptation policymaking
Poutiainen *et al.* (2013)	Canada	SR	190	Civil society organizations and adaptation to the health effects of climate change	Key findings include health adaptation actions are predominantly led by environmental CSOs; most actions are occurring at national and regional levels; food and/or water contamination and air quality are dominant climate change stimuli for action; responses reflect awareness and research activities; consideration of vulnerable groups is limited. Indicates a deficit in terms of what needs to be done for health adaptation and what is being done. Coordinated adaptation planning at federal and provincial level is needed, involving collaboration between CSOs and public health bodies
Pulker *et al.* (2018)	Australia	SR	68	Supermarket power and public health	Supermarkets have obtained instrumental, structural & discursive power from many sources that overlap & reinforce each other. Few positive public health impacts of supermarket power were identified, providing many opportunities for improvement in the domains of food governance, the food system and public health nutrition. Examination of supermarket own brands is of particular importance owing to their pivotal role as a source of power and their potential to improve public health outcomes, such as obesity
Quam *et al.* (2017)	Sweden / Athens / UK	SR	31	Lifestyle-related climate change mitigation strategies	Difficult comparison due to variations in assumptions and measurement units. More attention needs to be given to developing realistic and relevant diet and transportation modifications strategies. The most effective approach in the literature is the combination of a Pigouvian tax for GHGE and a “sin” tax on unhealthy food items. A tax on GHGE alone will not necessarily result in a healthier diet. Meat consumption reduction strategies may be best suited to countries with excess consumption of meat & protein; others need to develop low GHGE meat production systems that can supply their nation with a healthy protein source
Rajmil *et al.* (2014)	Europe	SR	24	Financial crisis and child health	Most studies suggest that the economic crisis may pose a serious threat to children’s health, and disproportionately affects the most vulnerable groups. There is an urgent need for further studies to monitor the child health effects of the global recession and to inform appropriate public policy responses
Rao *et al.* (2013)	USA	SR & MA	27	Cost of healthier foods	Challenges and opportunities for reducing financial barriers to healthy eating: lowering the price of healthier diet patterns should be a goal of public health and policy efforts, and some studies suggest that this intervention can indeed reduce consumption of unhealthy foods. Efforts to create an infrastructure and commercial framework that facilitates production, transportation and marketing of healthier foods could increase the availability and reduce the prices of more healthful products. Taxation of less healthy foods and subsidies for healthier foods would also be an evidence-based intervention to balance price differences

Reinhardt *et al*. (2020)	USA	SR	22	Dietary patterns and sustainability	Challenges prior findings that diets adhering to national dietary guidelines are more sustainable than current average diets and indicate that the Healthy US-style dietary pattern recommended by the DGA may lead to similar or increased greenhouse gas emissions, energy use, and water use compared with the current US diet. Among healthy dietary patterns, those higher in plant-based foods and lower in animal-based foods are beneficial for sustainability
Reverter *et al*. (2020)	France / Germany	MA	460	Aquaculture and antimicrobial resistance	Low- and middle-income countries present high AMR levels. Infected aquatic animals present higher mortalities at warmer temperatures. Countries most vulnerable to climate change will probably face the highest AMR risks, impacting human health beyond the aquaculture sector, highlighting the need for urgent action. Sustainable solutions to minimise antibiotic use and increase system resilience are therefore needed
Robinson *et al.* (2014)	UK	SR & MA	15	Effect of informational eating norms on eating behaviour	There was consistent evidence that norms influenced food choices; norm information indicating that others make low-energy or high-energy food choices significantly increased the likelihood that participants made similar choices. Information about eating norms influences choice and quantity of food eaten, which could be used to promote healthy changes to dietary behaviour
Ronto *et al.* (2020)	Australia	MS	28	School-based healthy food policies	Need for better communication strategies, financial & social support prior to school-based food policy implementation. Findings of this review contribute to a thorough understanding of factors that underpin best practice recommendations for the implementation of school-based food policy, and inform those responsible for improving public health nutrition
Sanchez-Sabate and Sabaté (2019)	Chile / USA	SR	34	Environmental concerns of meat consumption	Consumers aware of the meat impact on the planet, willing to stop or significantly reduce meat consumption for environmental reasons, and who have already changed their meat intake for ecological concerns are a small minority. However, environmental motives are already appealing significant proportions of Westerners to adopt certain meat curtailment strategies. Those who limit meat intake for environmental reasons are typically female, young, simply meat-reducer (not vegan/vegetarian), ecology-oriented, and would more likely live in Europe and Asia than in the USA
Sanchez-Sabate *et al.* (2019)	Chile / USA	SR	10	Attitudes towards reducing meat consumption for environmental reasons	Consumer awareness is hindered by beliefs about food, meat, and personal behaviour. Nutrition, health, and taste were found to be both enablers and barriers with regard to willingness. Vegetarians and vegans perceive the environment as simply another reason, among others, to maintain a meatless diet. Based on these results, makes recommendations for future dietary public health interventions, and for future research endeavours
Scheelbeek *et al.* (2017)	UK	SR	12	Effect of environmental change on yield and quality	Effects of environmental change on yields & quality of fruits & vegetables that might pose threats to population health, especially in areas vulnerable to climate-change & food insecurity: directly through reduced consumption, & indirectly through income pathways that might result in restricted household dietary energy intake & dietary diversity
Scheelbeek *et al.* (2018)	UK / Finland	SR (MA)	174 (24)	Environmental changes on vegetable and legume yields and nutritional quality	Impacts of environmental changes on nutritional quality were mixed. In a business-as-usual scenario, predicted changes in environmental exposures would lead to reductions in yields of nonstaple vegetables & legumes. Where adaptation possibilities are limited, this may substantially change their global availability, affordability, and consumption in the mid to long term. Stresses the importance of prioritising agricultural developments, to minimise potential reductions in vegetable & legume yields & associated negative health effects
Siegner *et al.* (2018)	USA	SR	130	Does urban food production improve security	Although strong focus on elucidating the multiple benefits of urban agriculture, few studies robustly measure the impact of urban farms on improving food security in low-income communities. Much of the literature is theoretical, focused on the production potential of urban agriculture, while more work is needed to understand and overcome barriers to access and distribution among communities in need. Concludes with a set of recommendations for researchers, practitioners, and policymakers who seek to create spaces in cities for food justice, equity, access, and sovereignty
Silchenko *et al.* (2019)	Switzerland / Denmark / Italy	SR	190	Health and food marketing	Knowledge is predominantly driven by USA-authored, experiment-based studies with statistical scope that often fail to articulate a discernible theoretical anchor. Despite a plethora of themes, the concept of health is primarily operationalised in the context of isolated, often dichotomous, product evaluations rather than in the context of everyday consumption experiences. Looks at "what," "where," and "how" of research, & contributes to the debate about the current state &the future of this research domain
Sildén (2018)	USA	SR	34	Effects of competitive foods	Discovered substantial evidence that competitive foods are highly available in schools, however, lacking in robust evidence proving causality in increasing BMI or weight. Strong corroboration in the research revealing that other effects are factors worthy of studying further. Additional longitudinal and higher-quality research needs to be performed

Sisnowski *et al.* (2017)	Australia	SR	36	Regulatory interventions targeting population nutrition	Isolated regulatory interventions can improve intermediate outcomes but fail to affect consumption at clinically significant levels. The literature covered six different types of interventions, with 19 studies reporting on calorie posting on chain restaurant menus. The large majority of the identified interventions were conducted in the US. Early results from recent taxation measures were published after the review cut-off date but these suggested more favourable effects on consumption levels. Nevertheless, the evidence assessed in this review suggests that current policies are generally falling short of anticipated health impacts
Smith *et al.* (2019)	Australia / UK	SR	71	Marketing influences on children's attitudes, preferences and consumption	Strong evidence to support the restriction of food marketing to children. However, the review also signposted distinct gaps: Firstly, there is a lack of use of qualitative and physiological methodologies. Secondly, contemporary and sophisticated marketing techniques used in new media warrant increased research attention. More research is needed to evaluate the longer-term effects of food marketing on children's weight
Snuggs *et al.* (2019)	UK	SR	39	Healthy eating interventions in the home	Evidence- & theory-based interventions tended to be more successful than those that did not report detailed formative or evaluative work although details of theory application were often lacking. Results did not show any further systematic similarities shared by successful interventions. Recommends the need for more clearly theoretically driven interventions, consistent approaches to measuring outcomes and clarity regarding target populations and desired outcomes
Sonntag *et al.* (2015)	Germany	SR	36	Influence of the food industry on obesity	Narrative synthesis revealed six key obesogenic environments by which the food industry possibly influences obesity-related dietary behaviours in young children: schools; retailers; mass media 'television'; mass media 'internet'; home; & promotional campaigns. Identifying these obesogenic environments is critical for monitoring and controlling the food industry, the development of effective environmental-level interventions to prevent childhood overweight and obesity
Stefani *et al.* (2017)	Europe / USA	SR	77	Public food procurement	Although a relatively recent literature, it embraces different disciplinary approaches as well as research methods. The studied cases are evenly split between Europe and the USA being influenced by the specific legislative frameworks in the two areas. Differently from the literature on Public procurement where the themes of contracting and cost minimisation are prevalent, the literature on PFP is centred on the concepts of localisation and structured demand and its impacts on food chain actors as well as citizen-consumers and on sustainability at large
Talati *et al.* (2017)	Australia	SR	24	Responses to on-pack health claims	These findings are relevant to policymakers who are considering the effectiveness of mandating an NFP and/or a front-of-pack label alongside health claims
Tang *et al.* (2019)	Canada	SR & MA	127	Antibiotic restriction in food-producing animals	Broad interventions that restrict global antibiotic use appear to be more effective in reducing antibiotic resistance compared with restrictions that narrowly target one specific antibiotic or antibiotic class. Interventions that allow for therapeutic antibiotic use appear similarly effective compared with those that restrict all uses of antibiotics, suggesting that complete bans are not necessary. These findings directly inform the creation of specific policies to restrict antibiotic use in food-producing animals
Taub *et al.* (2008)	USA	SR & MA	228	CO_2 effects food protein concentration	While the magnitude of the effect of elevated CO2 varied depending on the experimental procedures, a reduction in protein concentration was consistently found for most crops. These findings suggest that the increasing CO2 concentrations of the 21st century are likely to decrease the protein concentration of many human plant foods
Thapa and Lyford (2014)	USA	SR	18	Behavioural economics in school lunchtimes	All studies show that nudging in the lunchroom leads to healthier food choice decision. None of the studies found that nudging is not effective. Addressing the childhood obesity epidemic by applying behavioural economics is relatively new and most of the research in this area conducted so far has often focused on increasing healthy food consumption, including fruits and vegetables
Thow *et al.* (2010)	Australia	SR	24	Fiscal policy effects on diet, obesity and chronic disease	Food taxes and subsidies have the potential to contribute to healthy consumption patterns at the population level. However, current evidence is generally of low quality and the empirical evaluation of existing taxes is a research priority, along with research into the effectiveness and differential impact of food taxes in developing countries
Thow *et al.* (2014)	Australia	SR	38	Food taxes and subsidies to improve diets	Taxes and subsidies are likely to be an effective intervention to improve consumption patterns associated with obesity and chronic disease, with evidence showing a consistent effect on consumption across a range of tax rates emerging. Future research should use prospective study methods to determine the effect of taxes on diets and focus on the effect of taxation in conjunction with other interventions as part of a multi-sectoral strategy to improve diets and health
Tobi *et al.* (2019)	UK / India	SR	30	Sustainable diets	Environmental and social responsibility labelling schemes are of more value to food consumers than previously suggested. Consumers show a marked preference for organic labels in particular. With health often cited as a motivation for purchasing organic, despite a lack of evidence demonstrating organic food's nutritional superiority compared to conventional production methods, the 'health halo' effects of green marketing are powerful. Care should be taken to ensure this does not negatively impact on public health nutrition by leading some consumers to choose environmentally friendly products, even if less nutritious

Tørris and Mobekk (2019)	Norway	SR	21	Nudging for healthier food choices to improve CV health	The results show that many of the studies included traffic-light labelling, which may be a promising strategy. The reviewed findings, however, also highlight the challenges that confront experimental studies examining the impact of nudging on diet
Turbutt *et al.* (2019)	UK	SR	14	Hot food takeaways near schools	Most included studies compared anthropometric measures with geographical location of hot food takeaways to find correlations between environment and childhood obesity. There was good evidence of more hot food takeaways in deprived areas and children who spend time in deprived neighbourhoods tend to eat more fast food and have higher BMIs. Few studies were able to quantify the correlation between school's environment and obesity amongst pupils. This lack of evidence is likely a factor of the studies' ability to identify the correlation rather than lack of a correlation between the two variables
Turton *et al.* (2016)	UK	SR & MA	39	Healthier eating habits for eating and weight disorders	In healthy controls the implementation intention approach produces a small increase in healthy food intake and reduction in unhealthy food intake post-intervention. The size of these effects decreases over time and no change in weight was found. Unhealthy food intake was moderately reduced by food-specific inhibition training and attention bias modification post-intervention
Vaitkeviciute *et al.* (2015)	Australia	SR	13	Food literacy and dietary intake	Food literacy may play a role in shaping adolescents' dietary intake. More rigorous research methods are required to effectively assess the causality between food literacy and adolescents' dietary intake in order to confirm the extent of the relationship. Evidence recommends public health practitioners and policy makers consider new public health strategies that focus on increasing understanding of food literacy in adolescence
Valli *et al.* (2019)	International	SR	41	Values and preferences on meat consumption	Low-certainty evidence suggests that omnivores are attached to meat and are unwilling to change this behaviour when faced with potentially undesirable health effects
Vandergeten *et al.* (2016)	Belgium / Ethiopia	MA	73	Land grabbing	According to the results, both host governments and local communities experience loss. This results in a win–loss–loss status of the Trans-national Land Deals. The major challenge remains in establishing good land governance, which can guarantee the benefits to local people and their access to land
Vecchio and Cavallo (2019)	Italy	SR	36	Healthy food choices through nudges	Over 80% of the reviewed empirical research reported positive outcomes. The work provides insights to further analyse the most promising approaches and critically discusses the core shortcomings of available studies. Future research avenues are highlighted as the need for more replications and scalability of interventions
Vins *et al.* (2015)	USA	SR	82	Mental health and drought	Given the increasing concern over the association between climate change and drought, the linkages between drought and mental health are increasingly important. There is a substantial body of literature on the topic that allows for identification of several distinct and inter-related pathways by which drought can adversely impact mental health as well as several coping and adaptation strategies. Most of these relationships are mediated through environmental or economic pathways, and the outcomes most closely studied are mood disorders and, to a lesser degree, intimate partner violence and suicide. Few associations between drought exposure and adverse mental health outcomes have been quantified. This research is an initial step in bringing this important issue forward and outlining possible implications for prevention, mental health services, and future research
Vivero-Pol (2017)	Belgium	SR	70	Food as commons	Results points to the ontological absolute 'food is a private good' developed by the economic scholars as a dominant narrative that locked other valuations of food by legal, political or historical scholars or non-scientific epistemologies. In a world where the industrial food system has clearly proven its unfitness to feed us adequately in a sustainable way, the need for academia to explore other food valuations seems more urgent than ever. Scholars need to approach other narratives of food (as commons or public good) that go beyond the hegemonic and permitted ideas, unlocking unexplored food policy options to guarantee universal access to food for all humans, regardless their purchasing power, without mortgaging the viability of our planet
Walls *et al.* (2018)	UK / Australia	SR	4	Agricultural input subsidy impacts	Both impact and its context are poorly understood but crucial for nutrition-sensitive policymaking. Given the financial resources devoted to AIS in some countries (and resurgence of interest in AIS programmes), this is an important area to be addressed
Weiler *et al.* (2015)	Canada	MA	1414	Food sovereignty, security and health equity	Crosscutting themes include climate change, biotechnology, gender, racialization, indigeneity, poverty, citizenship and HIV as well as institutional barriers to reducing health inequities in the food system. The concept of food sovereignty has important but largely unexplored affinities with health equity. Food sovereignty-based approaches such as advancing healthy school food systems, promoting soil fertility, gender equity and nutrition, and addressing structural racism, can complement the longer-term socio-political restructuring processes that health equity occasions

Wickramasinghe *et al.* (2013)	UK	SR	168	GHG of sustainable diets	Organic foods and locally produced foods do not always produce fewer GHGEs. Little consistency in LCA methods makes direct comparisons of estimates difficult. Future LCA food studies should make efforts to follow a uniform approach, to include common definition of stages in the lifecycle and inclusion of similar activities always under each category of food. These GHGE estimates are for common food groups in a FFQ and could be combined with existing nutrition databases to address questions around sustainable healthy diets. These findings will be used to quantify the GHGE changes of different dietary scenarios in the UK to achieve GHGE reduction targets
Wilson *et al.* (2016)	Australia	SR	13	Nudging healthier food choices	The review had limited ability to determine effectiveness of nudging due to various populations and settings tested and the use and reporting of incomparable outcome measures. It finds minimal uptake of nudging in the academic literature, and mixed effectiveness of nudging for influencing healthier food and beverage choices
Wirehn (2018)	Sweden	SR	60	Nordic agriculture under climate change	Although the agricultural sector in the Nordic region is facing certain benefits from climate change, this review demonstrates profound challenges related directly to climate change. The synthesis of suggested adaptation actions furthermore indicates that adaptation involve trade-offs, however, increased knowledge on this subject is required. Failing to address these challenges might impede Nordic agriculture's potential gains from climate change in a long-term perspective
Wood *et al.* (2019)	UK	SR	102	Health tax policies	Health taxes to reduce consumption of unhealthy products requires the implementation of taxes that increase the price of products by 20% or more. Where taxes are effective in changing health behaviours, the predictability of the revenue stream is reduced. Policy actors need to be clear about the primary goal of any health tax and frame the tax accordingly – not doing so leaves taxes vulnerable to hostile lobbying. Conversely, earmarking health taxes for health spending tends to increase public support so long as policymakers follow through on specified spending commitments
Wrieden *et al.* (2019)	UK	SF		Sustainable diets in the UK	Aimed to develop a systematic, traceable, and comprehensive Life Cycle Assessment (LCA) framework to quantify the various dimensions of environmental sustainability of the main UK food items. Only 16.6% of households could be described as more sustainable; this rose to 22% for those in the lowest income quintile. Increasing the diet quality index criteria to >80% resulted in only 100 households being selected, representing 0.8% of the sample. The framework enabled identification of more sustainable households, providing evidence of how we can move toward better diets in terms of the environment, health, and costs.
Wright and Bragge (2018)	Australia	SR	10	Promoting healthy eating choices when dining out	Results indicate that policies or interventions that aim to improve healthy choices or consumption when dining out would benefit from harnessing social norms and positive positioning of social identity. Provision of health information should always be accompanied by an interpretative guide, such as traffic lights. Manipulation of plate / portion / cutlery size may be effective; however, the effect size is small and further research is required to investigate whether this effect is retained in overweight or obese populations
Xin *et al.* (2019)	Canada / USA / UK / East Asia	SR	41	Convenience stores access and childhood obesity	The density of and proximity to convenience stores in children's residential and school neighbourhoods were positively associated with unhealthy eating behaviours. However, their associations with children's weight status varied significantly by regions. The association between convenience store access and children's weight status was found to be negative in Canada, rather mixed in the USA and the UK, and not significant in East Asia
Yang *et al.* (2020)	China / USA / Holland	SR	11	Fruit and vegetable market access and childhood obesity	The limited amount of relevant evidence may not be a strong guide for policymaking, but rather an important research gap that needs to be filled if successful public health interventions are to be undertaken
Zaçe *et al.* (2020)	Italy	SR	9	Food insecure children in Europe	Achieving food security means designing targeted policies and interventions, both at a national and EU level. Policymakers and governments should make the appropriate efforts to deliver food security as a public good
Zenk *et al.* (2015)	USA	SR	16	Local food environments and diet-related health outcomes	Finds geographic disparities in the availability of healthy foods across the USA and empirical evidence of the relationship between these disparities and dietary intake among some populations. Results continue to challenge investigators to measure geographic disparities of disease patterns
Zhang *et al.* (2019)	USA	SR & MA	6	Glyphosate herbicides and non-hodgkin lymphoma risk	The meta-analysis of human epidemiological studies suggests a compelling link between exposures to GBHs and increased risk for NHL

Table 15: Resulting characteristics and main outcomes of included reviews

*#Key: **SR** = Systematic Review; **SR & MA** = Systematic Review and Meta-Analysis; **SR of SR** = Systematic Review of Systematic Reviews; **SLR** = Systematic Literature Review; **MA** = Meta-Analysis; **MS** = Meta-Synthesis; **MR** = Meta-Regression; **MN** = Meta-Narrative; **MD** = Meta-Data.*

4.2 Results from modelling predictions: the impacts of climate change on the sustainability of UK food production [RQ3]

The Climate Central '*CoastalDEM*' model was used to determine possible UK scenarios for sea-level rise. The literature review identified a significant gap regarding the ambiguity of future rises; estimates of future rises range between 50-100cm before 2100, assuming medium-emissions scenarios and immediate cuts in carbon emissions were possible. Edwards (2017) had also identified areas in the UK seen as most vulnerable to increasing inundation with sea-level rises of 1 metre (SLR = 1m) and 2 metre (SLR = 2m), but this did not allow for a more detailed analysis at a local level. These are shown in figures 66 and 67; both clearly identify the Lincolnshire Fens as being one of the areas at most risk. The *CoastalDEM* model uses peer-reviewed science from leading journals to provide maps for screening; that is, to further identify the places that require deeper investigation of risk. The first analysis considered the extent of the risk by estimating the area of land projected to be below annual flood level and affected by sea-level rise by 2050, assuming moderate cuts in pollution, and an average range of sea-level rise from the literature (e.g. Kopp *et al*., 2014). The results, shown in figure 68, indicate the areas affected by sea-level rise are shaded in red, show around 50 per cent of Lincolnshire's land area will be at risk by 2050, including the majority of land classified as Best and Most Versatile food producing land area. This is consistent with earlier reports (Watts, 2017).

The weaknesses acknowledged with the *CoastalDEM* model are that its accuracy is less reliable when assessing extreme weather events such as floods. The maps are not based on physical storm and flood simulations and do not consider other variables such as erosion, future changes in the storm frequency or intensity, flooding, or rainfall. The real strength of the model, however, lies in its ability to accurately map the permanent future sea-level rise. Further, more detailed scenarios were run through the CoastalDEM model, to establish the rate of change and address the timescale gap identified previously within the literature. Using the same criteria as for the map in figure 68, five further scenario maps were produced: for 1 metre (figure 69); 2 metre (figure 70); 3 metre (figure 71); 5 metre (figure 72), and 10 metre (figure 73). By way of comparison, the Natural England's (2020) map of Grade 1 and Grade 2 showing the Best and Most Versatile food producing land in the Lincolnshire fens is also shown in figure 74 and reproduced at approximately the same scale as the preceding five *CoastalDEM* maps.

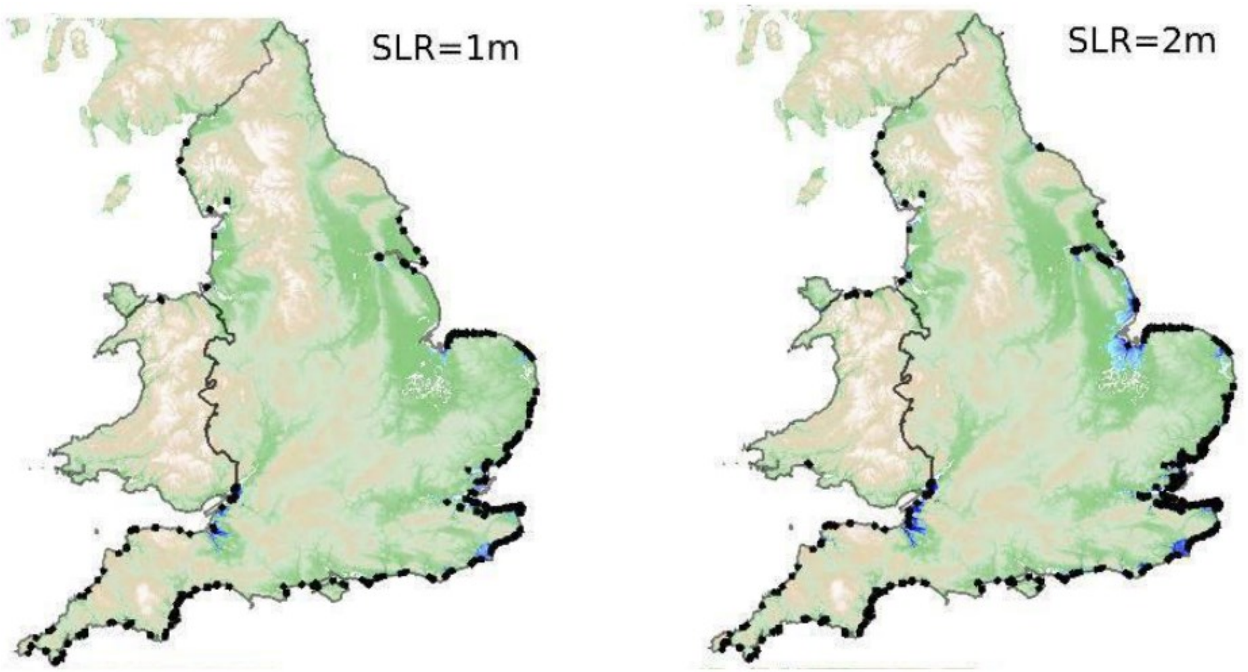


Figure 66: Increasing inundation with sea-level rise of 1 metre (SLR = 1m) and 2 metre (SLR = 2m)

Temporary inundation extent (blue) under a 1:200 year return period tidal surge if vulnerable defences were lost, for different values of local sea-level rise (SLR); defences at risk are shown in black

Source: Sayers *et al.* (2015) cited in Edwards (2017).

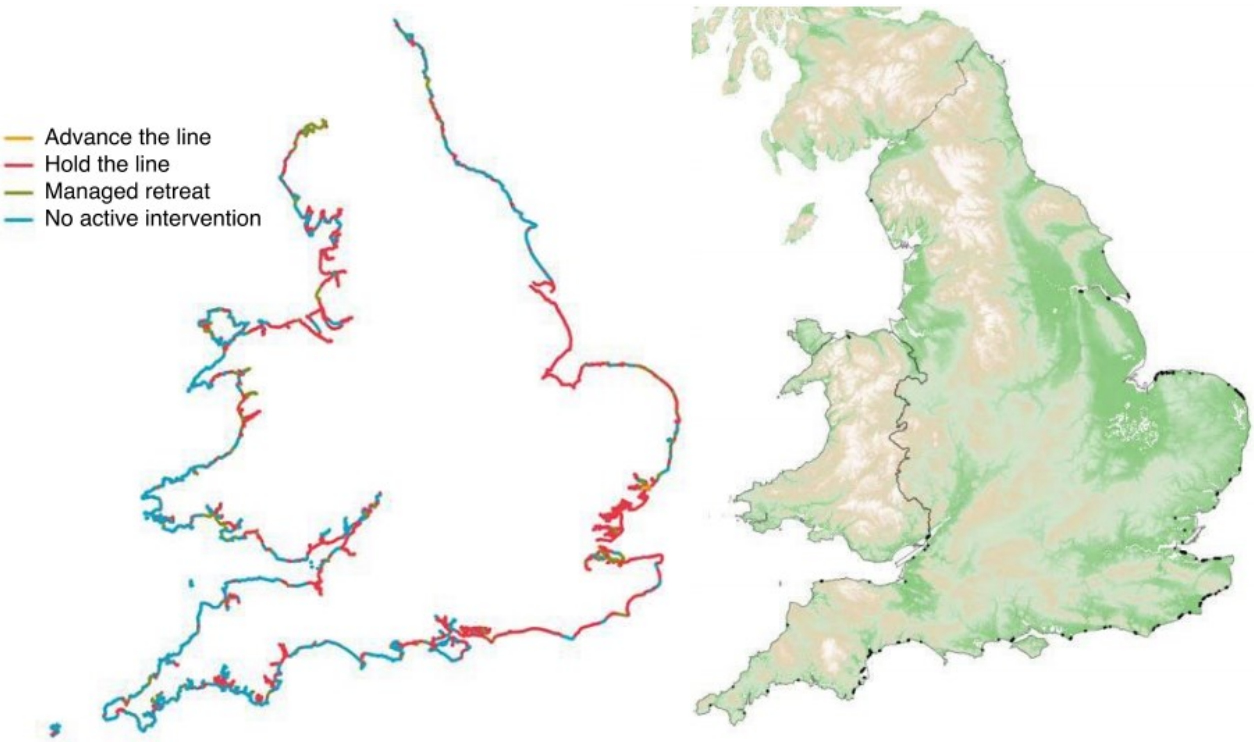


Figure 67: Shoreline Management Plans (SMPs) and vulnerable defences

Left map shows SMP options for 2010–2030; Right map shows estimated vulnerable defences with no sea-level rise, shown as black lines, for England only

Source: Sayers *et al.* (2015) cited in Edwards (2017).

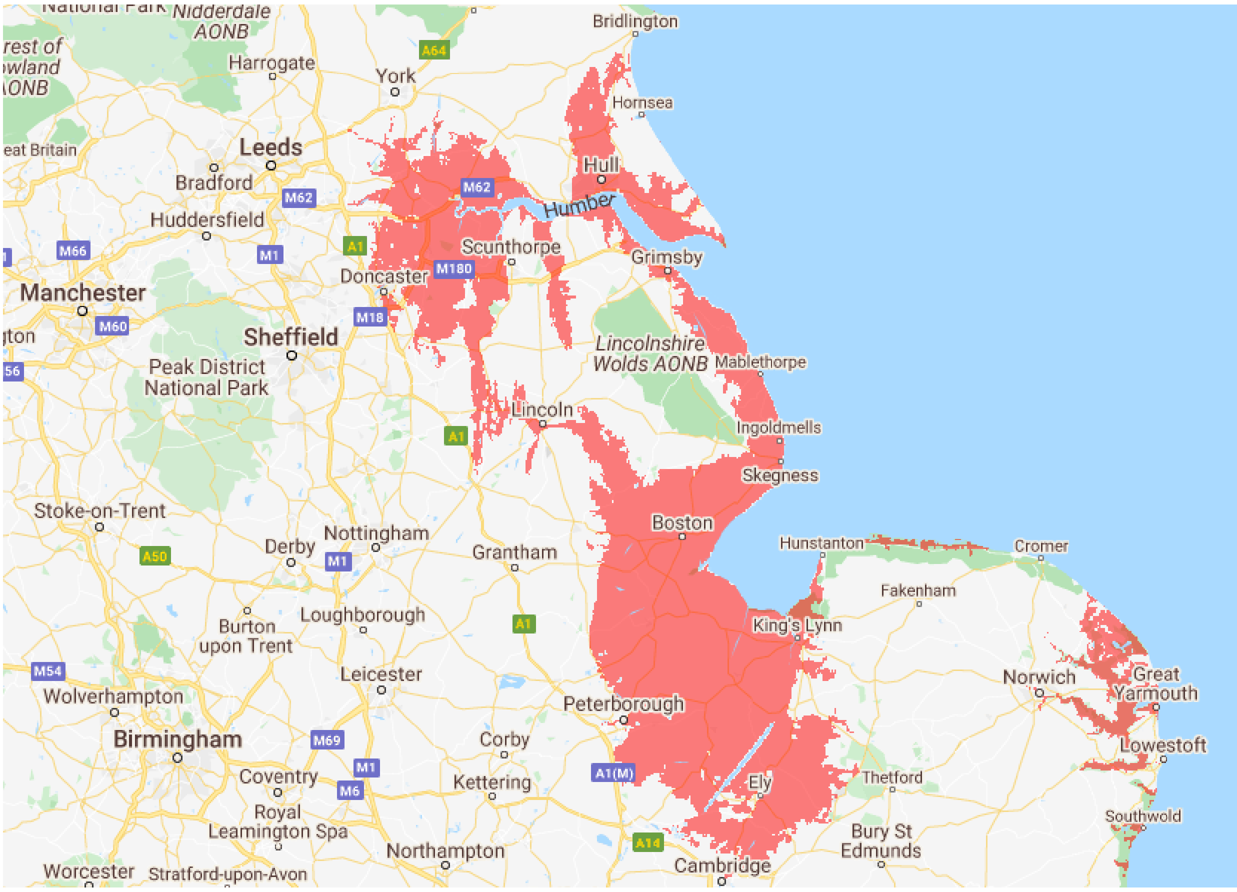


Figure 68: The extent land at risk of being affected by annual flooding and sea-level rise by 2050

Source: based on *CoastalDEM* model data (2020).

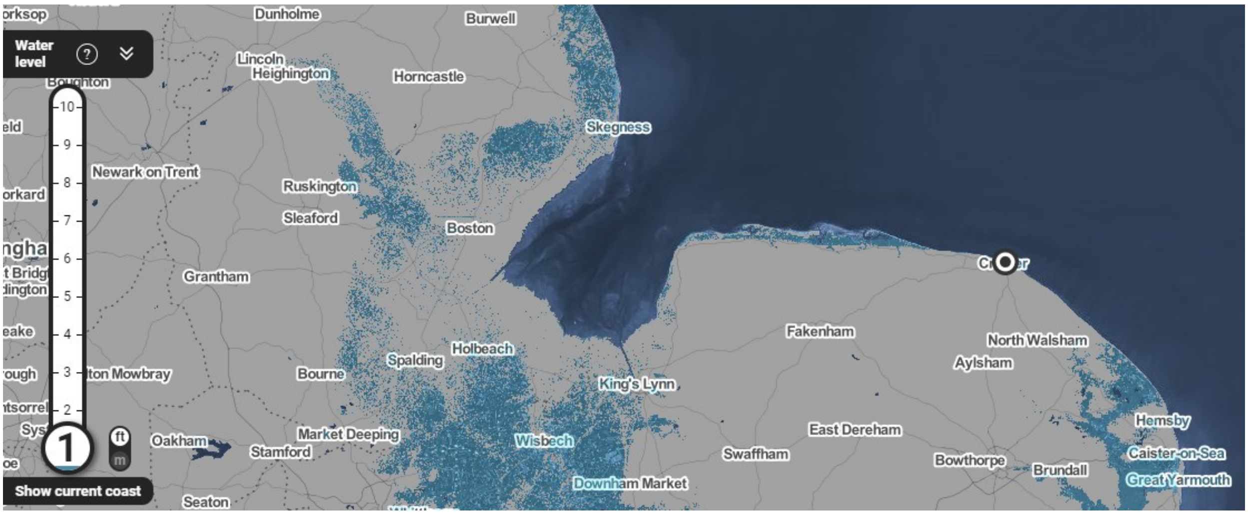


Figure 69: Climate Central CoastalDEM projected 1 metre sea-level rise on the Lincolnshire fens

Figure 70: Climate Central CoastalDEM projected 2 metre sea-level rise on the Lincolnshire fens

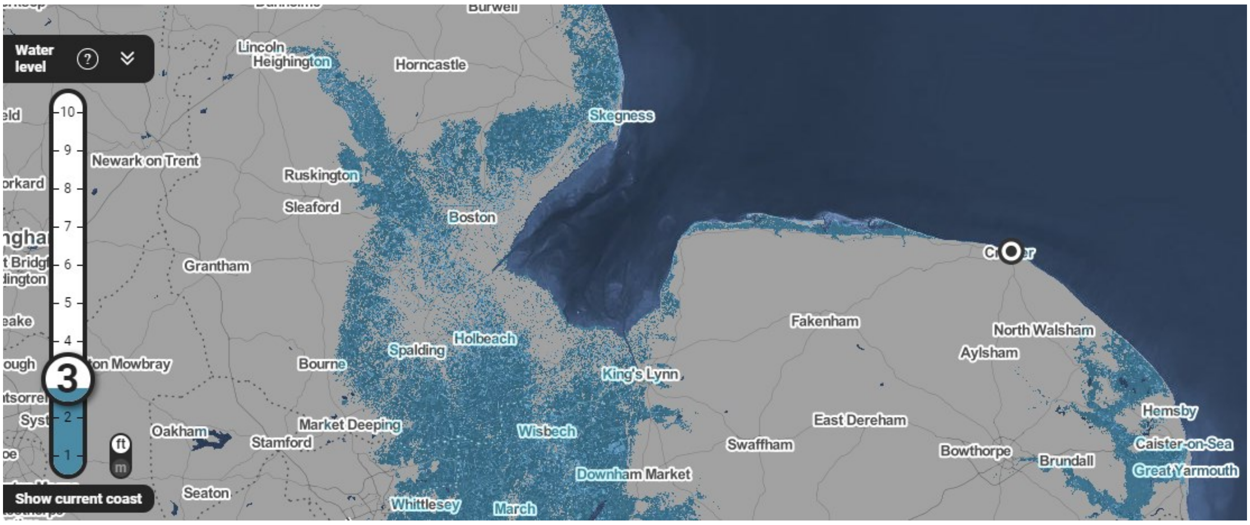


Figure 71: Climate Central CoastalDEM projected 3 metre sea-level rise on the Lincolnshire fens

Figure 72: Climate Central CoastalDEM projected 5 metre sea-level rise on the Lincolnshire fens

Figure 73: Climate Central CoastalDEM projected 10 metre sea-level rise on the Lincolnshire fens

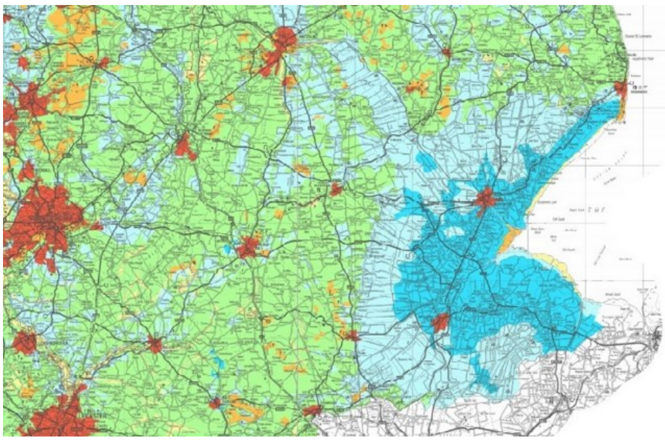


Figure 74: Natural England's (2020) map of Grade 1 (royal blue) and Grade 2 (light blue) Best and Most Versatile food producing land in the Lincolnshire fens (for a more detailed version, see appendix 8.22)

Source: Natural England (2020).

Sea-level rise	*Current*	*Low-Medium*		*High*		*Extreme*	
Adaptation level	Current	Current	Enhanced	Current	Enhanced	Current	Enhanced
Best and Most Versatile agricultural land area (acres)	321,230	444,780 (37%)	395,360 (25%)	444,780 (39%)	420,070 (31%)	444,780 (39%)	420,070 (31%)

Table 16: Current and future impacts of sea-level rise on the UK's Best and Most Versatile food producing land area (acres)

Source: adapted from Edwards (2017).

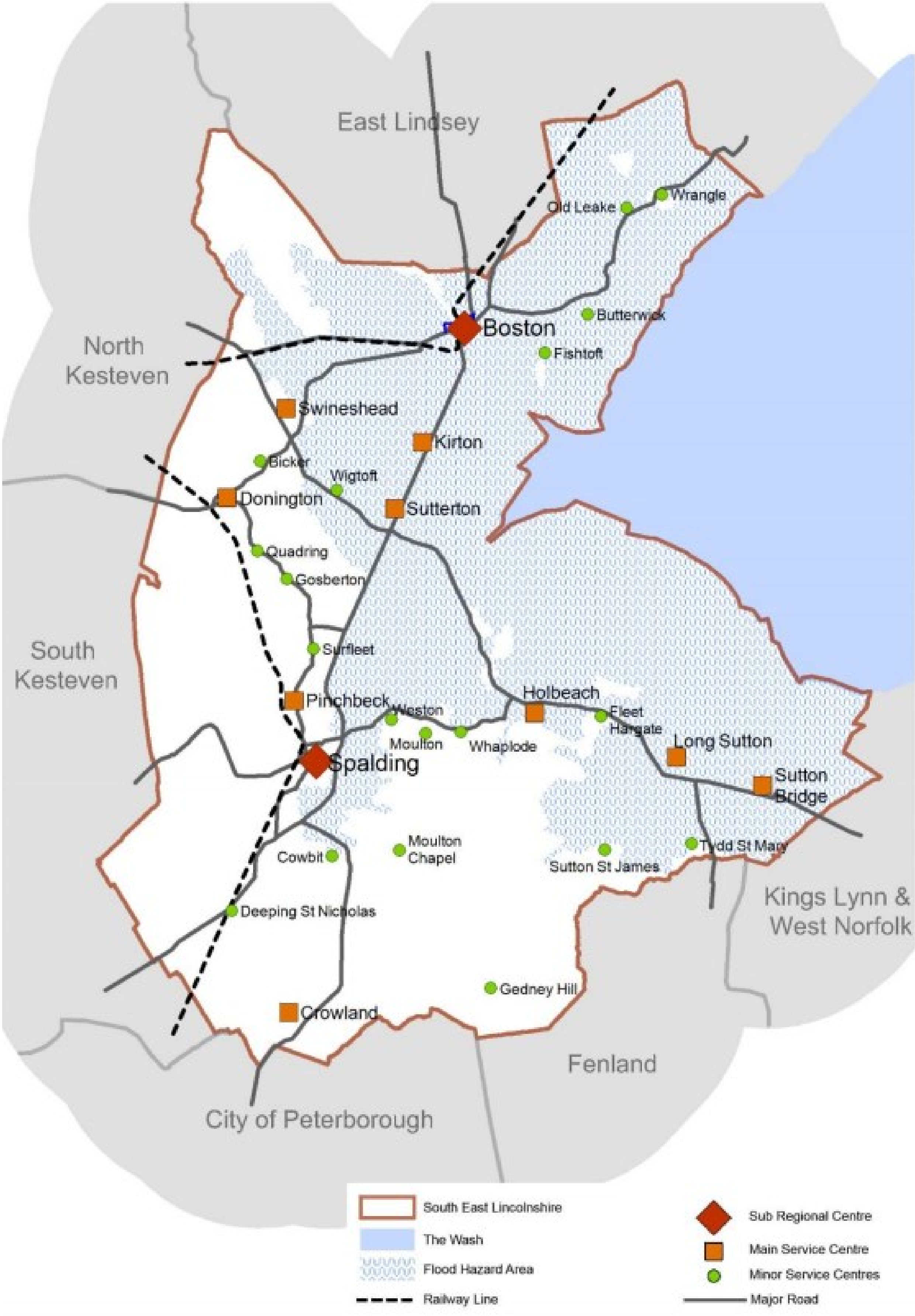


Figure 75: South East Lincolnshire regional authority analysis of the extent of current flood risk

Source: SEL-JPU (2019).

Figure 76: Government Flood Warning analysis of the extent Fenland flood risk from rivers or the sea

High Medium Low Very low

Source: UK Government Flood Warning Information Service (2020).

Figure 77: Environmental Agency Coastal evacuation routes in Lincolnshire

Blue shaded area represents area identified at risk of flooding by the Environmental Agency

Source: Environmental Agency (2020).

4.3 Results from the scenario analysis case studies: the impacts of climate change on the UK's main imported food commodities [RQ4]

Scenario analysis has long been part of trying to understand plausible outcomes for the future, certainly since Malthus (1798) predicted scenarios for population growth and food demand. Reilly and Willenbockel (2010) suggest there have been at least 30 analyses of global food supply and demand undertaken from 1950 to 2010. Since 2010, several studies have tended to develop scenario axes based on two dimensions of uncertainty, such as the Millennium Ecosystem Assessment scenarios shown in figure 81. The four scenarios present contrasting options for international cooperation and trade (global or regional) along with contrasting options for ecosystem management (pro-active versus reactive). This four-scenario approach was also utilised by a number of other significant studies, including by the Royal Institute of International Affairs (Ambler-Edwards *et al*., 2009), the University of Cambridge in collaboration with the Institute of Manufacturing (Livesey *et al*., 2010), the World Economic Forum (2017) and, most recently, by Benton (2019c). These models are shown in figures 6, 82, 83, and 84 respectively.

A considerable number of more recent analyses are increasingly suggesting significant yield reductions across a range of important global food commodities. It would appear that wheat, maize and barley are particularly sensitive to temperature change. Lobell and Field (2007), for example, put the annual combined losses of these three crops at 40mt per year since 2002, due to increases in temperature alone. Some climate change model projections suggest, however, that the threat of global crop yield reductions caused by higher temperatures and less soil moisture / precipitation will largely be offset by rising CO_2 concentrations (Easterling and Apps, 2005; Fuhrer, 2009; Lobell and Gourdji, 2012; Rötter and Höhn, 2015). Long *et al.* (2006) disagrees, seriously doubting whether rising CO_2 will fully offset the losses caused by climate change and Fernando *et al*. (2012) warn that rising atmospheric CO_2 concentrations affects the mineral nutrient and protein concentration of wheat. Rising CO_2 levels also raises additional human health concerns, due to it lowering zinc, iron and protein concentrations and raising the starch and sugar content in crop such as wheat, rice and soyabeans (Elbehri, 2015). Extrapolating lab-based calculations into field trials, where many more variables exist, creates considerable uncertainty. Many studies recognise the uncertainty associated with such predictions and call for improvements in model capabilities as well as for local air quality and emission control strategies. Further studies model the impacts of increasing mean surface ozone concentrations which reduces the yield of many crops (Morgan *et al*., 2006; Fuhrer, 2009; Avnery *et al*., 2011; Hollaway *et al*., 2012). Morgan *et al*. (2006) predicts surface ozone concentrations will increase by 23 per cent by 2050 which, Hollaway *et al.* (2012) argue, could reduce wheat, rice, and potato yields by 42.3–95.2 per cent, and maize and soyabean by 59.2–85.9 per cent. The total crop production losses from increased ozone levels are estimated by Avnery *et al*. (2011) at 79–121mt per annum. Another study considers 2.5 million yield records between 1961–2008, and observes 24–39 per cent of maize, rice, wheat and soyabean growing regions show yields as either never improving, stagnating or collapsing (Ray *et al*., 2012). Collectively, these four commodities provide around 66 per cent of global calories; relying on such a small range of food commodities means increasing vulnerability to climate change (Panko, 2017; Tutwiler, 2017). Even though the overall picture suggests annual yield increases of 1.6, 1.0, 0.9, and 1.3 per cent, respectively, these are far below the 2.4 per cent growth required annually to meet projected demand by 2050 (Ray *et al*., 2013). Similar findings are also reported by subsequent studies (Fischer *et al*., 2014; Rötter and Höhn, 2015; Lunt *et al*., 2016; FAO, 2017d), although Lobell and Tebaldi (2014) expect maize yields to be more severely impacted, with a more concentrated growing region and the crop more sensitive to temperature increases. The FAO (2017d) also raise concern about the level of yield growth since the 1990s (figure 75), as they argue the additional quantities of food required to feed a growing population needs to come from yield increases rather than expanding the land area required. During this time the global average yields of maize, rice, and wheat have been slightly more than 1 per cent, whereas soyabeans and sugarcane have been below 1 per cent. Figure 78 shows that where these growth rates need to improve for each of the four commodities by 2050 (maize by 67 per cent, rice by 42 per cent, wheat by 38 per cent, and soyabean by 55 per cent). Beyond

2050, the FAO expects even larger yield reductions caused by climate change that will impact the low- and middle-income countries in particular (FAO, 2017d). These are shown in figures 79 and 80.

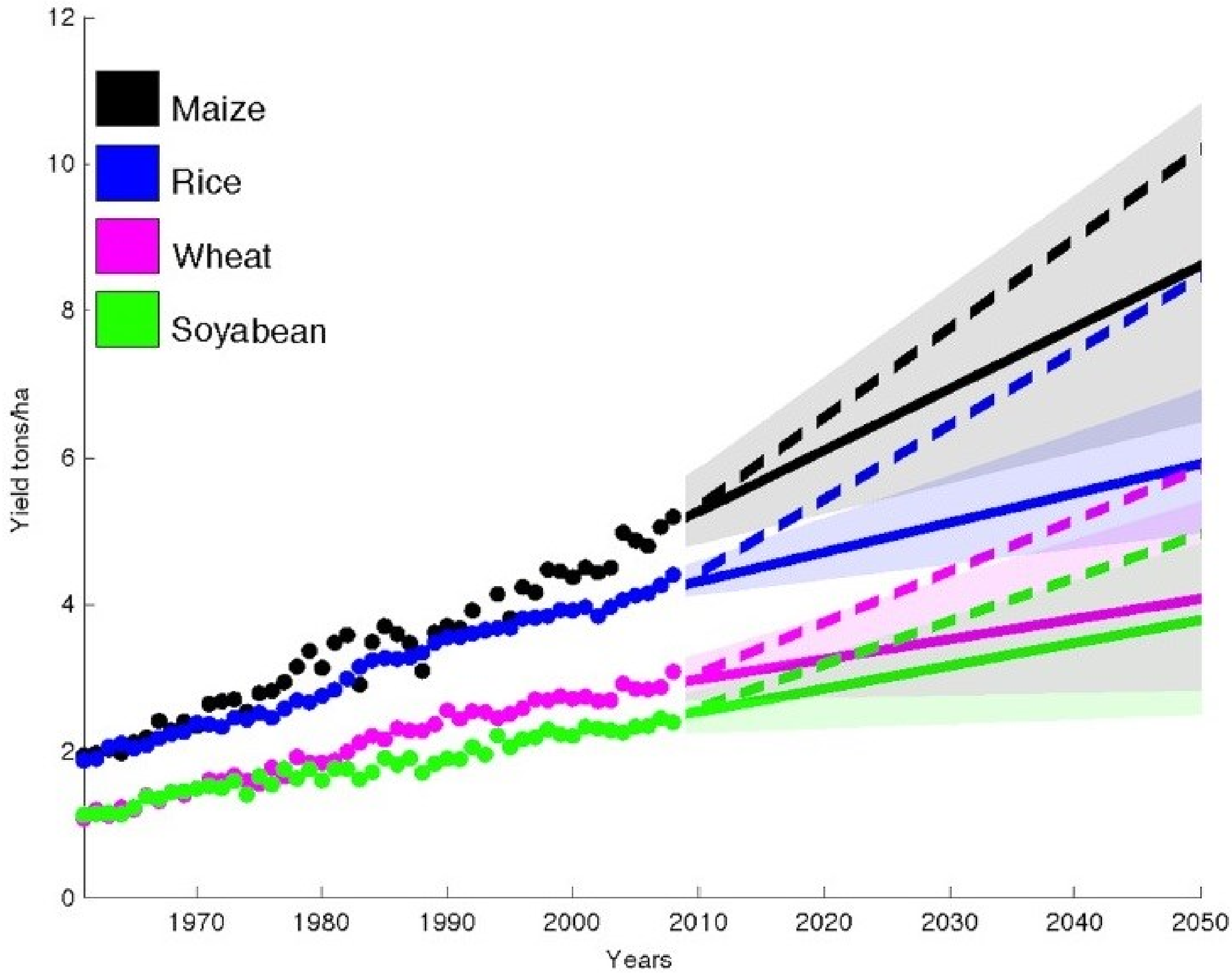


Figure 78: Global crop yield increase projections to 2050

Observed area-weighted global yield 1961–2008 shown using closed circles and projections to 2050 using solid lines for maize, rice, wheat, and soybean

Shading shows the 90 per cent confidence region derived

Dashed line shows the trend of the 2.4 per cent yield improvement required each year to double production in these crops by 2050 without bringing additional land under cultivation starting in the base year of 2008

Source: adapted from Ray *et al*. (2013).

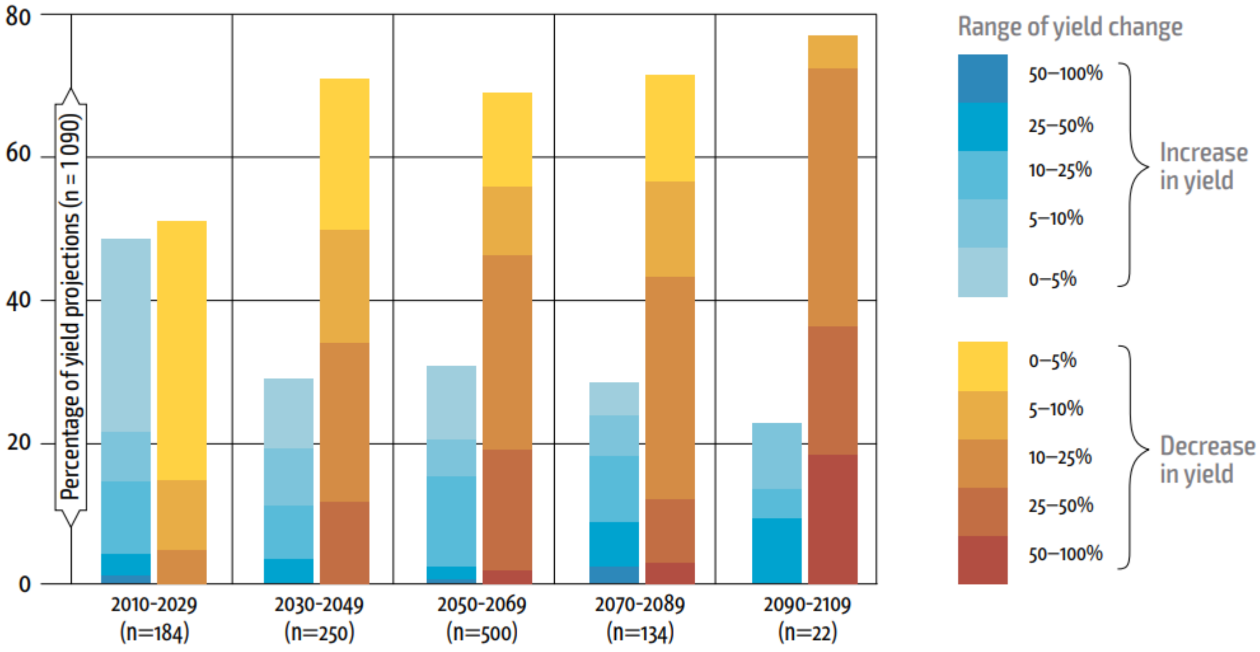


Figure 79: Projected changes in crop yields owing to climate change

Source: Porter *et al*. (2014) cited in FAO (2017d).

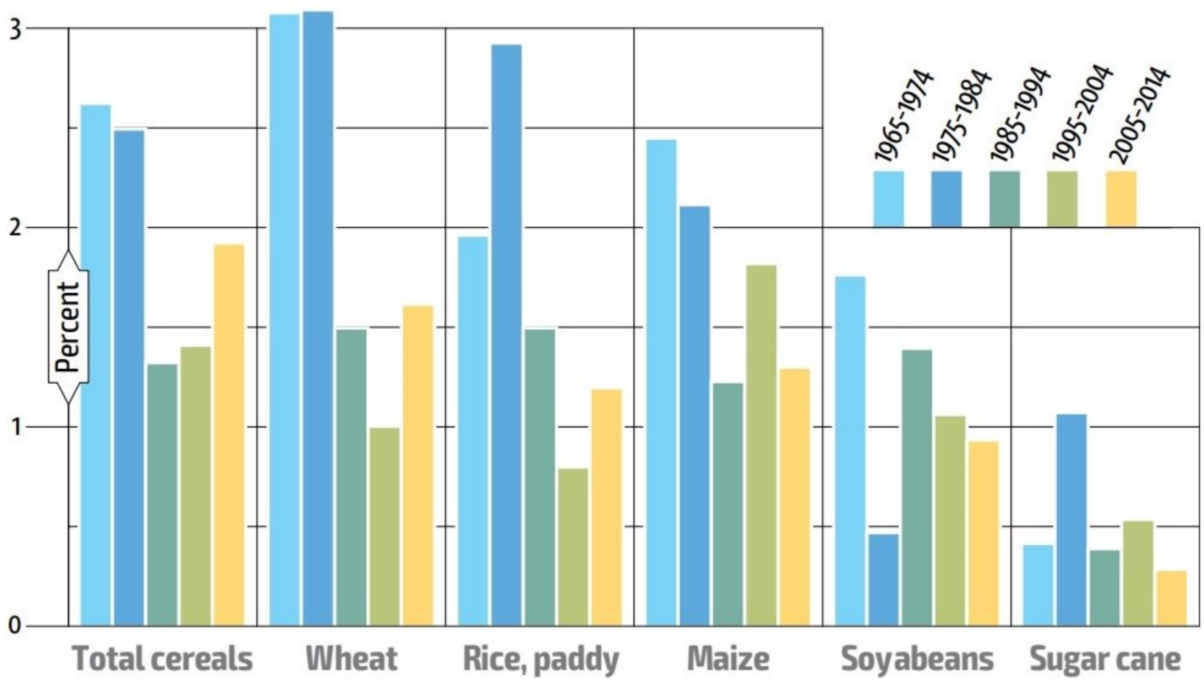


Figure 80: Average annual growth rates for selected crop yields

Source: FAO (2017d).

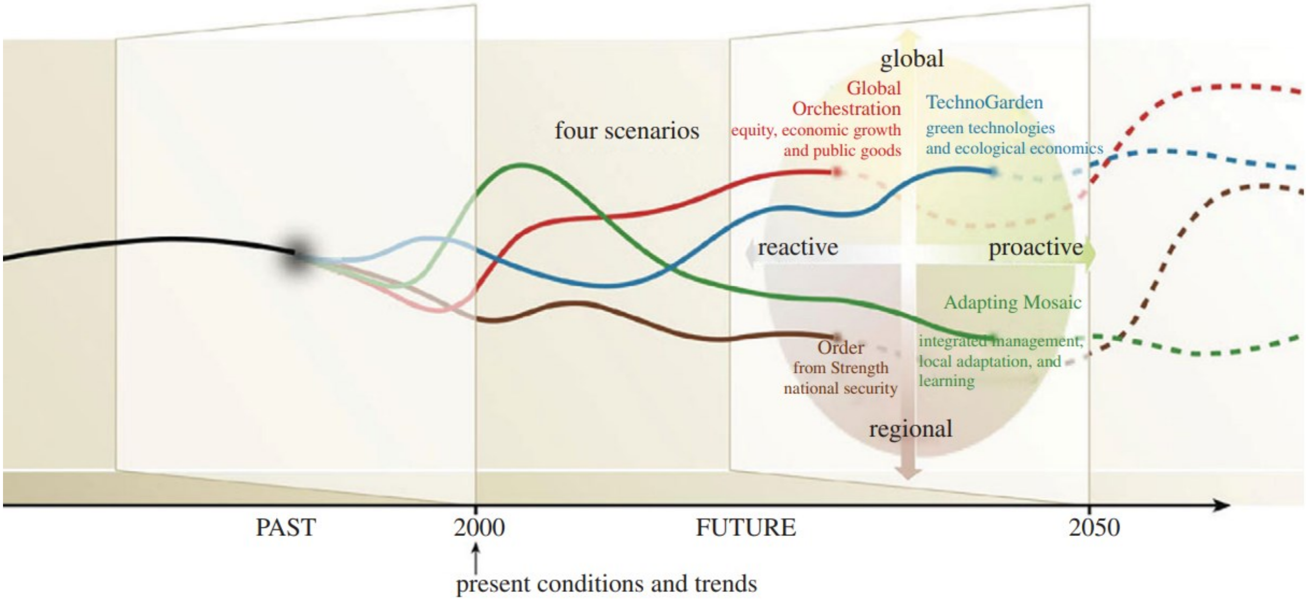


Figure 81: Axes of the Millennium Ecosystem Assessment scenarios

Source: Carpenter *et al.* (2005), cited in Reilly and Willenbockel, (2010).

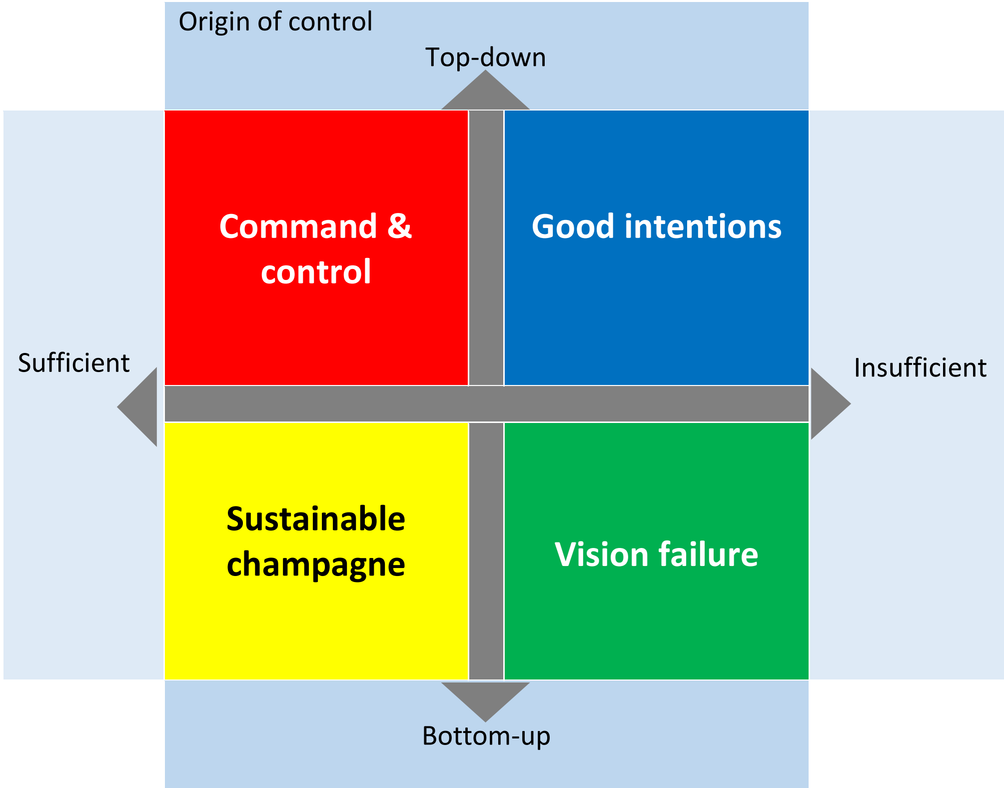


Figure 82: Four scenarios based on impetus for change and resource availability

Source: adapted from Livesey *et al*. (2010).

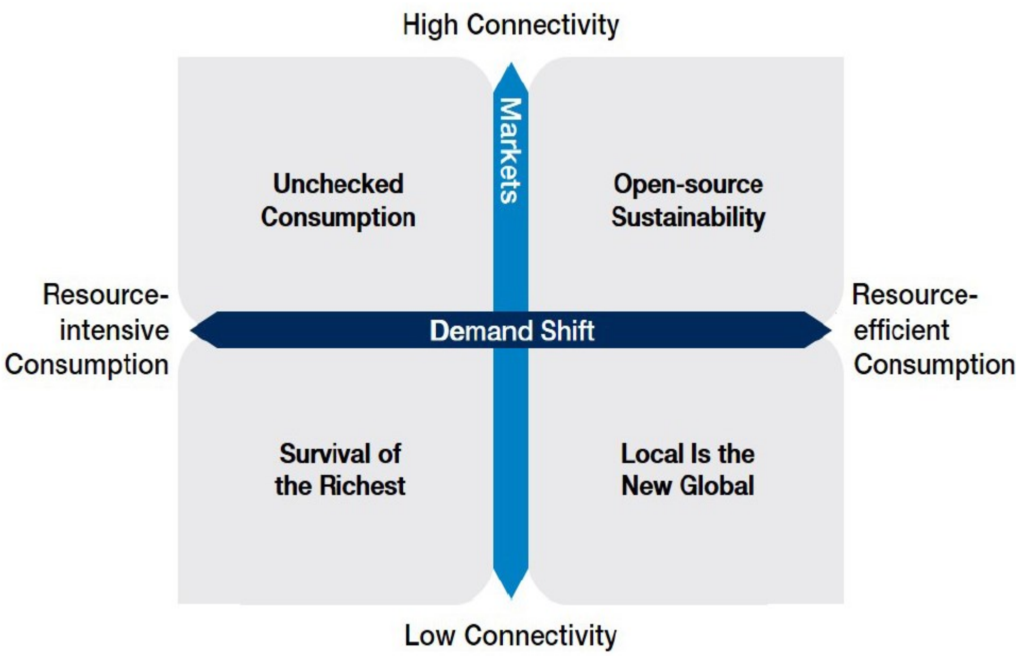


Figure 83: Four potential future worlds

Source: The World Economic Forum (2017).

The UK currently imports around half of all food consumed, which de Ruiter *et al*. (2016) estimate results in two-thirds of the land requirement being located overseas. Following Brexit, it is possible that the source of these imports may shift from EU countries with a high Environmental Performance (EPI) ranking to countries with lower standards (figure 84).

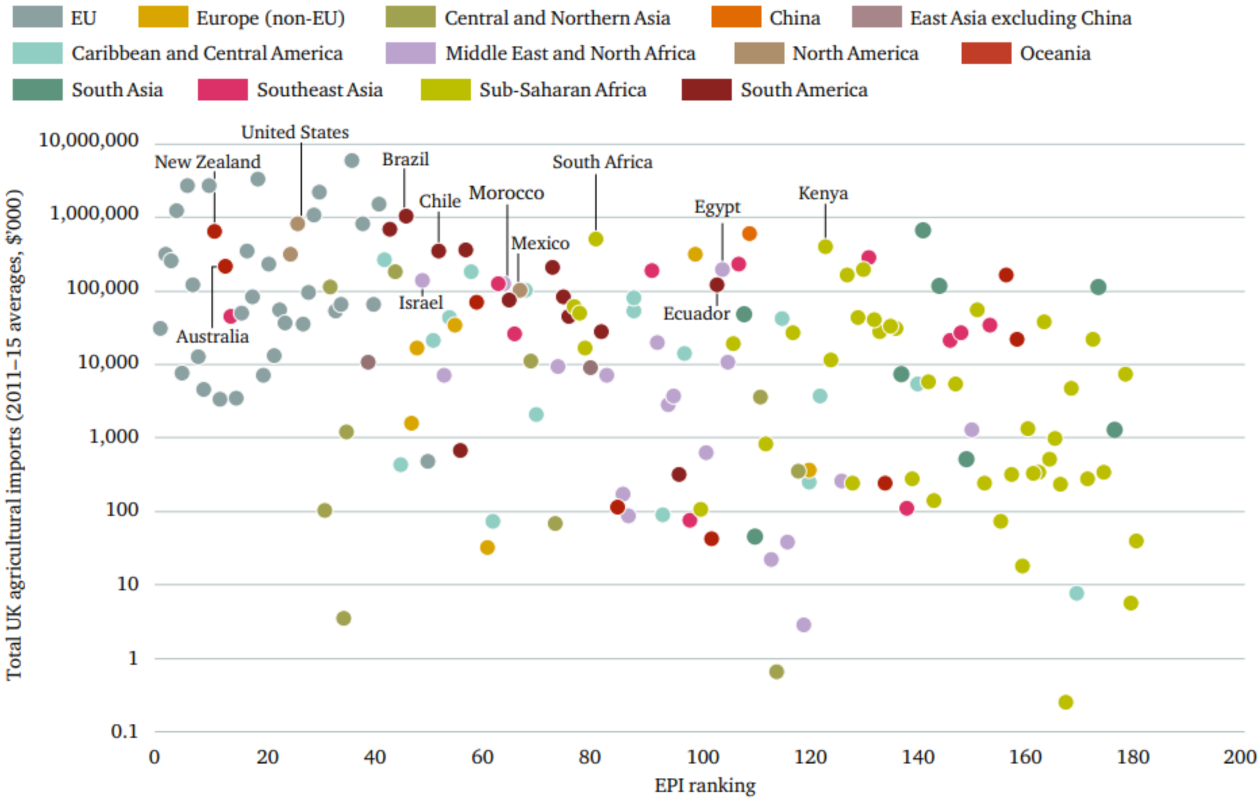


Figure 84: UK imports from EU suppliers with the highest environmental rankings

The Environmental Performance Index (EPI) is a method of quantifying the environmental performance of a state's policies

Source: Benton *et al*. (2019).

4.3.1 Grains

Cereal grains are the principal component of human diets around the world and have been for thousands of years. Wheat, rice, and maize alone provide two-thirds of all human energy requirements (Cassman, 1999) and over 30 per cent of the food calories for 4.5 billion consumers (Shiferaw *et al*., 2012). Cereals are grown under four, main production systems: irrigated, multi-cropped, continuous systems such as rice in lowland Asia which account for 25 per cent of global rice production; irrigated rice and wheat double-cropped systems in India, Pakistan, Nepal, and southern China; rain-fed maize production in the North American plains supply 40 per cent of global maize supplies; and rain-fed systems in Europe that produce

20 per cent of global wheat supplies (Cassman, 1999). The role of existing and potential future diets is also invariably linked to cereal production. For example, Krishna Bahadur *et al*. (2018) estimate that current global cereal production is 2.5 times more than would be needed if everyone adopted the USA's dietary guidelines. Furthermore, Benton (2019c) suggests global fruit and vegetable production supplies only 20 per cent of what would also be needed. The main systems in which cereals are grown have arguably been the foundation of human food supply for the past 30 years (Cassman, 1999). The intensified crop management systems that have brought about previous yield improvements comprise four main components: improved germplasms; higher fertiliser usage; multiple cropping on the same land within one season; and irrigation (Cassman, 1999). These inputs often mean that grain production systems are increasingly reliant upon fossil-based inputs (D'Silva, 2017; Wang *et al*., 2018). Proponents of sustainable intensification see further improvements in these components as vital in meeting future food demand (Areal *et al*., 2018; FAO, 2018b), although the exploitable gap between crop yields and genetic potential is closing (Cassman, 1999; Król *et al.*, 2018; Kumar *et al.*, 2018). Sustainable intensification is also dependent upon improvements in soil quality as well as precise management of all production factors to limit environmental damage. The likely causes of long-term yield declines in rice and cereal yields, include depletion of soil potassium levels (Ladha *et al.,* 2003), climate change induced temperature changes from 1990 onwards (Brisson *et al.,* 2010; Hernandez *et al.,* 2010; Welch *et al.,* 2010; Butler and Huybers, 2012; Sánchez *et al.*, 2014; Valizadeh *et al.,* 2014; Butler and Huybers, 2015) and more frequent extreme weather events (Trnka *et al.*, 2014; Trnka *et al.*, 2015; Butler *et al.,* 2018). Asseng *et al*. (2015), for example, estimate that global wheat production will fall by 6 per cent for every additional 1°C of temperature increase. The meta-analysis by Al-Hadeethi *et al*. (2019) confirms that, although rising levels of atmospheric CO_2 has some yield benefits, grain quality decreases to such an extent that it compromises human health. Long-term yield stagnation has largely occurred within developed nations, including the UK, France and Germany (Lin and Huybers, 2012). Such observations have led to concern that production of cereals will be insufficient to meet population demands for food by 2050 (Gilland, 2002), especially given that over 30 per cent of the USA's grain production is diverted away from human foods into biofuel production and animal feed. Recent import trends are shown in figure 85.

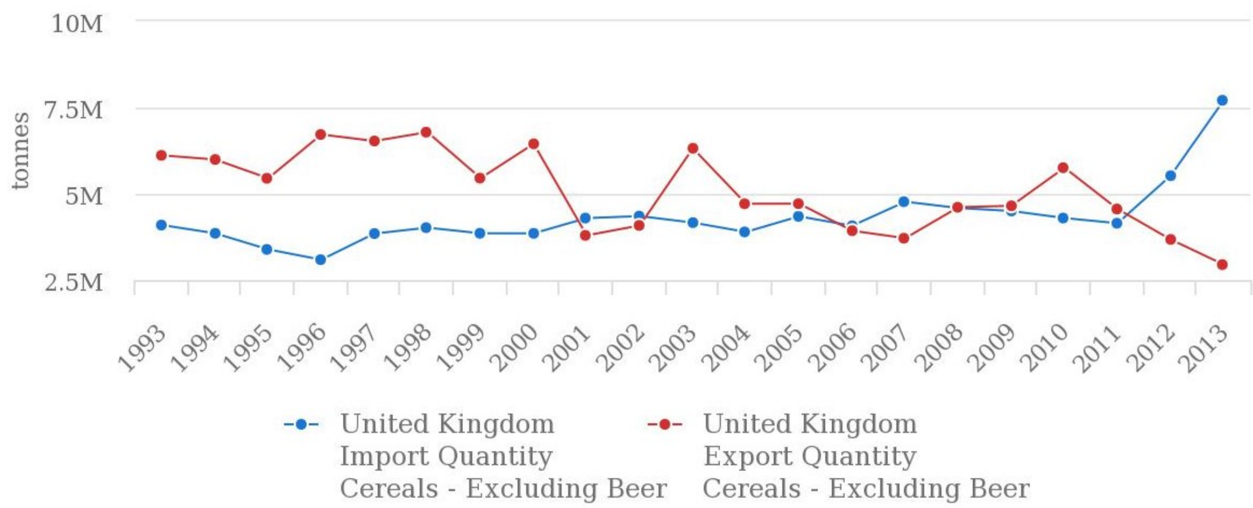


Figure 85: Cereal import and export trends in the United Kingdom 1993-2013

Source: FAOSTAT (2020).

Maize has the highest production of all cereals with 1,207mt predicted for the 2020 global harvest, up from 817mt a decade ago (FAO, 2020). The top three maize-producing countries in the world, the USA, China, and Brazil, produce around 80 per cent of the global crop (Ranum *et al.*, 2014). It is an important food staple as well as being used for animal feed and industrial applications such as bioethanol fuels, starch, sweeteners, beverages, glue, and industrial alcohol. Critics of industrialised maize production argue that such systems are highly unsustainable, with potentially global consequences. D'Silva (2017) lists burning forests, hunger, soil degradation, and the '*massive*' fertiliser input requirements. Climate change and increasing weather variability brings additional challenges for Maize, including rises in abiotic and biotic stresses. Maize is heat intolerant. Should temperatures increase to over 30°C, yields drop away very quickly as higher night temperatures disrupt the pollination process (Lobell *et al*., 2013; Hatfield, 2016). As production is increasingly unable to meet demand, especially with the USA consuming 40 per cent of its crop for fuel production (Ranum *et al.*, 2014), the market is becoming increasingly volatile and prices have risen substantially (Shiferaw *et al*., 2012). Given its role in ensuring food security, Kent *et al.* (2017) estimate the probability of climate-induced, multiple breadbasket failure increases by 6 per cent each decade. With each degree Celsius of warming, the global yield of maize drops by 7 per cent (Zhao *et al*., 2017). Tigchelaar *et al*. (2018) estimate that probability of simultaneous production losses increases by 7 per cent for 2°C of warming, but this rises to 86 per cent with a 4°C warming. This rising instability poses a potentially devastating impact for the 800 million people living in extreme poverty who are most vulnerable to food price spikes. This volatility is especially the case in years of limited water availability where rainfed production systems are used (Muchow and Sinclair, 1991). In rainfed systems, changes to rainfall patterns is also reducing yields (Murray-Tortarolo and Jaramillo, 2018; Murray-Tortarolo *et al.*, 2018), particularly in the USA where increasing climate sensitivity is coupled with a growing specialisation in maize production (Ortiz-Bobea and Tack, 2018). Although improved crop breeding continues to bring about productivity gains (Oszvald *et al.*, 2018; Allier *et al.*, 2019), the rate of improvement is currently insufficient to counter the negative impacts of climate change. This has led to calls for long-term, concerted and vigorous measures from both the public and private sectors, along with sustained governmental commitment and policy support, to avoid hunger and food insecurity for millions of poor consumers (Shiferaw *et al*., 2012; Snapp *et al.*, 2018). The majority of maize grown for human food is produced in hot, arid climates where C4 photosynthesis takes place i.e. where plants are able to maintain low oxygen levels in their leaves by keeping the stomata closed to prevent water loss. In climates where C4 photosynthesis is not possible, such as the UK, maize is primarily grown for animal feed and increasingly as an energy crop for anaerobic digesters to produce biogas for fuel. According to DEFRA (2020), there were 558,446 acres of maize grown in the UK during 2019. This is a dramatic increase over the past 40 years when the area was less than 20,000 acres. Using such a large area of arable land to grow food for cattle and biogas has been controversial. The UK Soil Association, for example, instigated a major campaign to raise awareness to the damage the crop was doing to soil structures, and potential consequences in terms of food supply (Farnworth and Melchett, 2014). At the time, farmers were subsidised to grow biogas in addition to the subsidies from the EU Common Agricultural Policy; in total, over £33 million. The Soil Association argued that biogas production was not environmentally sustainable and policy should not encourage diverting land away from food production. Two years later, the UK government reduced the subsidy for biogas maize by fifty per cent (Melchett, 2016). Recent import trends are shown in figure 86.

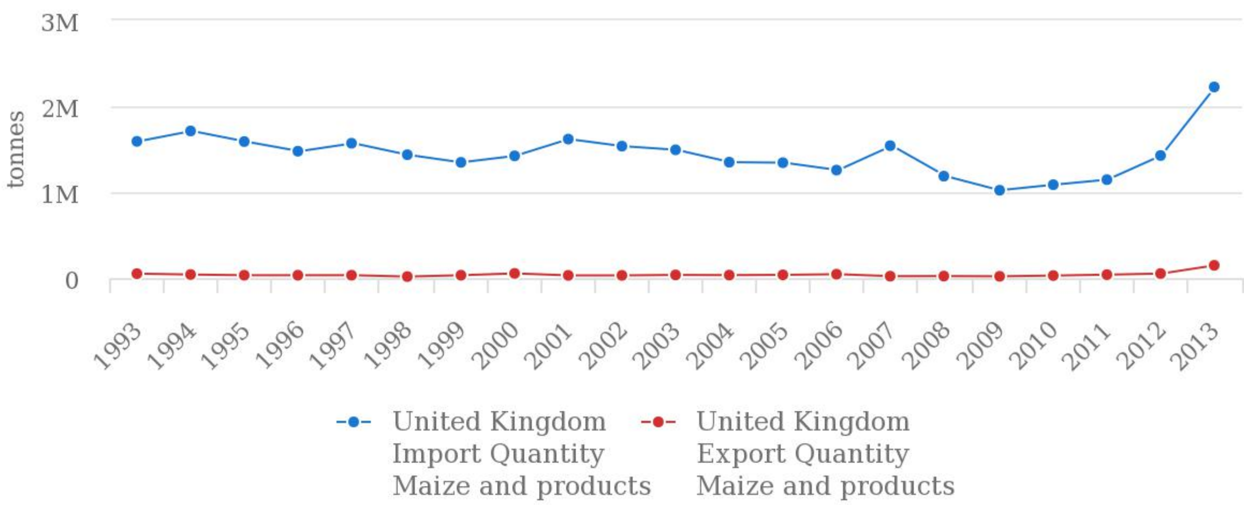


Figure 86: Maize import and export trends in the United Kingdom 1993-2013

Source: FAOSTAT (2020).

Rice is the second largest cereal crop after maize at around 700mt annually, compared to 685mt a decade ago (FAO, 2020). As a staple food for more than half of the world's population, the crop is critical in ensuring food security, with demand growing at 0.8 per cent per annum. By 2035, Seck *et al.* (2012) estimate population growth will create demand for an additional 116mt, with Africa alone needing an additional 30mt. This rising demand also causes increasing pressure on demand for land, and concern that increasing competition will draw land away from other crop production sectors such as wheat (Chang *et al*., 2015). Other studies raise concern over the environmental sustainability of rice production: Sabiha *et al*. (2016) attributed up to 69 per cent of environmental damage was caused by the cultivation of high yielding rice varieties; and work by Kritee *et al.* (2018) calculates global rice cultivation is responsible for 2.5 per cent of current anthropogenic warming. Rice production is also impacted by climate change: with each degree Celsius of warming, the global yield of rice drops by 3 per cent (Zhao *et al*., 2017); the further benefits of additional CO_2 may decline as temperatures warm beyond optimum photosynthetic levels (Easterling and Apps, 2005); higher temperatures reduce water availability; and, shorter growing seasons reduce yields by up to 24 per cent (van Oort and Zwart, 2018). Zhu *et al.* (2018) also found that increasing CO_2 levels will cause declines in the protein, micronutrients, and vitamin content (B1, B2, B5, and B9) of rice with potential health consequences for the poorest 600m rice-dependent populations. Yields vary widely depending on availability of irrigation; all of China's production is irrigated, whereas more than 50 per cent of India's and most of Africa's crop is rainfed (Seck *et al.,* 2012). As such, Chapagain and Hoekstra (2011) argue that rice is one of the largest water consumers in the world. Recent import trends are shown in figure 87.

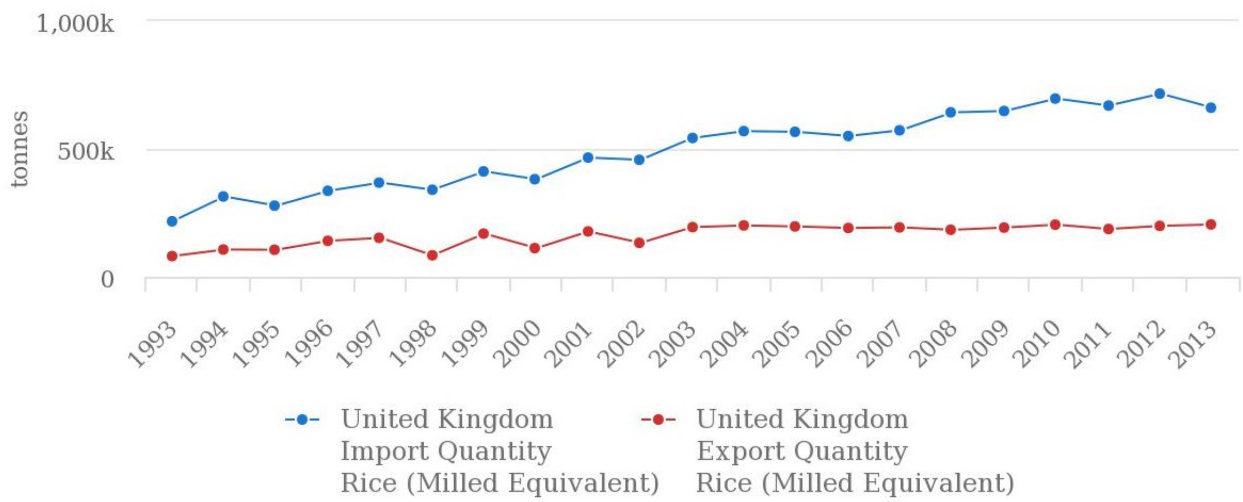


Figure 87: Milled rice import and export trends in the United Kingdom 1993-2013

Source: FAOSTAT (2020).

Global wheat production is forecast to reach 769mt for the 2020 harvest (International Grains Council, 2020). When measured by area, wheat is the most widely grown crop in the world, accounting for 11 per cent of total crop production (G20, 2018) and providing 20 per cent of the daily protein requirements and food calories for 4.5bn people (Shiferaw *et al.*, 2013; FAO, 2020). Production levels do not always meet demand, which causes market instability; by 2050, population growth is predicted to increase demand by 60 per cent, especially in the developing regions. Changing consumer tastes and the associated environmental, economic, and political issues risk increasing the demand for wheat in unsustainable ways (Roeder *et al*., 2011). Current annual yield rises are below 1 per cent, lower than the 1.6 per cent minimum required to meet this demand growth (Trnka *et al.*, 2015). Agronomic improvements offer some potential for further improvement in yields (Ladha *et al.*, 2016), but limitations associated with genetic improvements, including being unable to control locations and linkage relationships, an inability to predict outcomes, and societal opposition remain (Blechl and Jones, 2009). To address this threat to global food security, the G20 instigated the '*Wheat Initiative*' to coordinate and stimulate research efforts. The G20 is, however, not without its critics, especially when their initiative to boost food production and relieve poverty required African nations to change seed, land and tax laws in favour of large global businesses over small farmers, was seen as a new wave of colonialism. Röder *et al.* (2014), however, suggests global demand could be met if northern hemisphere producers exploit the potential benefits for climate change by increasing production and narrowing their yield gaps. Nonetheless, current production is threatened by climate change, particularly through increasing temperature effects on growth and development; with each degree Celsius of warming, the global yield of wheat drops by 6 per cent (Porter and Gawith, 1999; Zhao *et al*., 2017). The expected increase in the frequency of adverse weather events is also expected to reduce yields (Trnka *et al.,* 2015), especially given its vulnerability to droughts (Simelton *et al.,* 2012). Rising atmospheric CO_2 concentrations also affects the mineral nutrient and protein concentration of wheat (Fernando *et al.*, 2012). The increasing use of fertiliser in wheat production is also a concern. These contain substances and chemicals including methane, carbon dioxide, ammonia and nitrogen, the emissions from which contribute to greenhouse gases. Global food production currently uses 100mt of fertiliser annually and, as their environmental impacts are not costed into food prices, there is currently no real incentive to reduce reliance on this fertiliser (Röder *et al.*, 2014). In the case of one of the 12m loaves sold in the UK every day, Goucher *et al.* (2017) estimate fertiliser accounts for 43 per cent of all GHG emissions associated with the product. The UK produced 16.3mt of wheat in 2019, with additional, high protein wheat being imported from Germany and Canada (DEFRA, 2019d). In many respects, a similar picture emerges with barley production. Total production amounted to 141mt in 2019 (FAO, 2020), making it the fourth largest cereal. It is predominantly used as flour for human consumption, for animal feeds and as malt in alcoholic drinks. UK production is around 8.2mt (DEFRA, 2020). In addition to the risk factors identified for wheat, Yawson *et al.* (2017) predict that the UK may face large deficits in domestic feed barley production, which will also impact future meat supplies. They also question where future imports of barley or meat to address the deficits will come from. Xie *et al*. (2018) used climate models and scenarios to consider future risks to UK barley production; their research foresees barley's vulnerability to the threats of climate change-induced heat and drought resulting in higher beer prices. On a more positive note, Newton *et al.* (2011) see future potential for barley through the exploitation of the health benefits of whole grain and beta-glucans, its ability to adapt to multiple biotic and abiotic stresses, and overall resilience.

Soyabean is an important protein source and also grown for oils, flour, meal and milk (DEFRA, 2006e). Global production is currently around 346mt annually, significantly up from 230mt a decade ago (FAO, 2020). It is found in two-thirds of manufactured foods in the UK, the range of which is phenomenal: as an emulsifier in chocolate; breakfast cereals; gluten-free flour; high-fructose corn syrup in processed foods; ice cream; meat substitutes such as tofu; salad dressings; soya flour to extend the shelf-life of many products and improve the colour of pastry; soya proteins for biscuits, sweets, diet drinks, pasta and a variety of frozen foods; spreads; substitutes for those with intolerances or allergies such as soya drinks; and vegetable fats. It is also increasingly used in biofuels (Knoope *et al*., 2019). Despite its versatility as a source of protein, especially in plant-based diets, around 75 per cent (by weight) is fed to livestock (Fraanje and Garnett, 2020). Garnett *et al*. (2014) estimate that soya intake in the UK is between 1-3.5g per day. Being a non-perishable commodity makes it ideal for global trading. The UK imports approximately 3.2mt of soya and soya products annually (UK Roundtable on Sustainable Soya, 2019). Most comes from South America, either directly or through the Netherlands, with the remainder from the USA. A further 0.6mt of additional soya is imported indirectly 'embedded' in products. The main soya exporting countries are shown in figure 88. Collectively, the USA, Brazil, and Argentina account for about 82 per cent of global production (USDA, 2020).

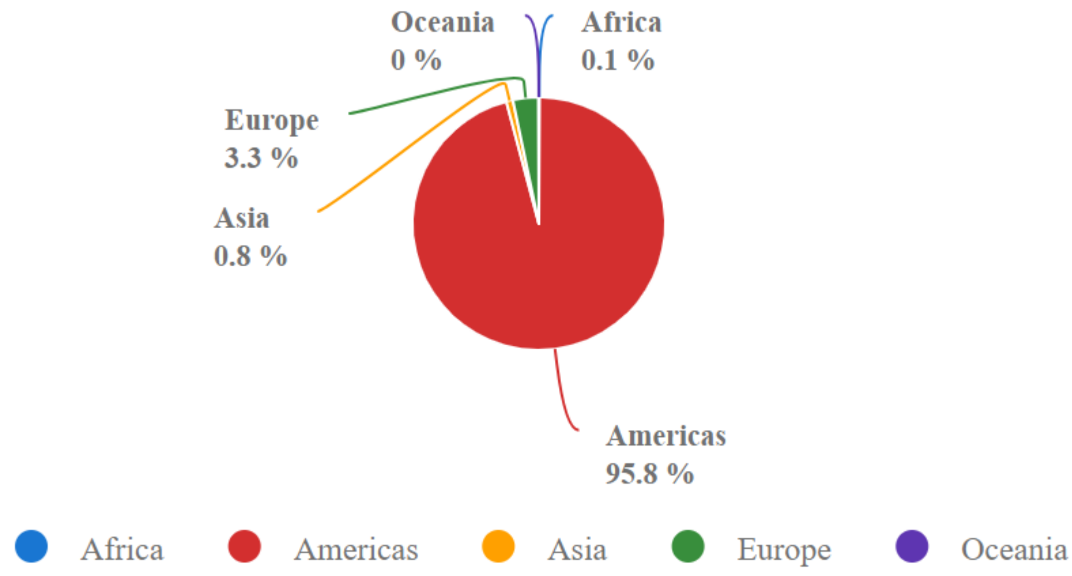


Figure 88: Exports of soyabeans by region 1993-2013

Source: FAOSTAT (2020).

Soya is also leguminous, so it is able to fix its own nitrogen and so can be grown on poorer soils. Despite its popularity with those consumers seeking a more sustainable, plant-based diet, soya is however associated with a number of environmental concerns (Patthanaissaranukool and Polprasert, 2016). Since the introduction in 1996 of glyphosate-tolerant genetically modified (GM) soya has led to the expansion of the crop into previously degraded land (Fraanje and Garnett, 2020). At the same time, however, Bøhn and Millstone (2019) argue this has introduced thousands of additional tonnes of glyphosate into the food chain. The number of applications per season has doubled (from two to four), with the latter application now occurring later in the season and during the full-flowering stage of the plant. This not only increases the environmental burden of the crop, but also results in an estimated 2,500-10,000t of glyphosate entering the global food chain every year. Furthermore, Bøhn and Millstone (2019) argue that flaws in the current testing regime creates knowledge gaps and seriously underestimates the health risks to consumers. Wang and Serventi (2019) appraise the large volumes of wastewater used in soya processing. As the area in South America devoted to growing soya has increased from 1m acres in 1961 to 348m acres in 2017 (FAO, 2020), it has become increasingly associated with direct and indirect land-use change, loss of natural vegetation, and especially deforestation of the Brazilian Amazon, the Brazilian Cerrado, and the Gran Chaco region in Argentina and Paraguay (Garrett and Rausch, 2016; Sauer, 2018; West *et al*., 2018; Fraanje and Garnett, 2020). Much of this soya is exported to China and Europe, where it is primarily used to feed animals, raising additional concerns about the sustainability of meat and dairy supply chains (Taelman *et al*., 2015). Efforts to decouple soya production from deforestation, such as the Brazilian Soy Moratorium of 2006 and other certification schemes, are estimated to cover only 0.2 to 6 per cent of soya sold worldwide (Kastens *et al*., 2017; Fraanje and Garnett, 2020). Since 2012, overall deforestation rates in the Amazon has risen again, but the extent to which they are linked to soya production remains unclear (Garrett *et al*., 2016; Garrett *et al*., 2018). The election of a far-right, populist president in 2019 has also raised concerns in terms of the future of the Amazon in the consumer press (Sandy, 2019). Other environmental concerns associated with soya production include the impacts of growing biofuels on water availability (Knoope *et al*., 2019). Finally, the role of soya within international trade remains contentious. Barth (2019) is critical of the USA 'Farm Bill' subsidy programme, in the way that it seemingly perpetuates support for producing low margin commodities frequently grown in vast industrial-scale monocultures that are associated with detrimental environmental and public health consequences. Such production systems ensure surplus commodities most years, ensuring prices remain low and thereby perpetuate the need for subsidies. Roe *et al*. (2019) recommends campaigns directly targeting consumers in the EU and China to reduce consumption of deforesting products such as soya and meat would offer the greatest emissions impact. Sun *et al*. (2018) argue that importing such foods can also damage the domestic environment and ecology. This argument is counter to the widely held belief that importing countries gain environmental benefits while displacing environmental costs to the exporting country. The authors cite the example of cornfields in Mexico and South America being converted to grow vegetables, demanding more nitrogen inputs, due to the influxes of cheap USA grains.

4.3.2 Potatoes

Potatoes are the world's third most important staple food with 350mt being grown annually (Reay, 2019) to provide an important source of starch (Birch *et al.*, 2012). They are now produced on all continents except Antarctica and have expanded dramatically in developing countries within the last two decades. In the UK, potatoes feature on the PHE's Eatwell Guide and are considered as nationally important staple foods. Early work by Hijmans (2003) used a simulation model to predict the impacts of climate change on potato yields around the globe. It suggested that higher temperatures of between 1°C and 1.4°C would bring about yield decreases of 18 to 32 per cent (without adaptation) and by 9 to 18 per cent (with adaptation). These effects would lead to changes in the time of planting, the use of later-maturing varieties, and shift potato production geographically. In many of these regions, changes in potato yield are likely to be relatively small, and sometimes positive. At lower latitudes where shifting planting time or location would be less feasible, climate change would have a greater negative effect on potato production. Further research assesses the ecological and financial sustainability of resource-use efficiencies (Steyn *et al*., 2016) and the socio-economic considerations of GM potatoes (Gillund *et al*., 2016). A number of studies assess specific impacts on UK production. Yakovleva (2009) uses a case study on these effects on the potato supply chain and evaluates options to ensure sustainability. This finds that potato producers are the most vulnerable part of the supply chain and recommends improving genetic variability, quality and water management. Knox *et al.* (2011, p.82) use scenario analysis for production in Norfolk, Lincolnshire, and Suffolk, warning that irrigation needs may exceed current capacity for around half of future years and the economic risks expected from flooding. Their report to the UK Potato Council recommends wide-ranging adaptations, including 'earlier planting and harvest dates, better adapted varieties, less dependence on soils with low water holding capacities, moving the production to regions with suitable agroclimate and water availability, and the uptake of GM technology'. Research by Cranfield University (2015) studies the potential and wide-ranging impacts of extreme weather events such as coastal and inland flooding on potato production, including to yields, resources, operations (including markets), supply, and processing. The frequency of extreme weather events is also analysed by Adesina and Thomas (2020), who note the 2006, 2012, and 2018, potato growing seasons were all affected, especially in regions such as the Lincolnshire Fens. Higher temperatures are a particular concern, with studies attempting to ascertain whether potatoes can withstand high temperatures in realistic conditions (Lehretz *et al.*, 2019) and the impacts of drought. This is seen as a particular risk in the UK, where few producers use irrigation and higher temperatures will increase evapotranspiration by 20-30 per cent (Adesina and Thomas, 2020). Reay (2019) warns the viability of rain-fed potatoes could shrink to 5 per cent of its current extent as droughts intensify with climate change, unless adaptations such as disease and drought-resistant varieties, investments in irrigation, soil management and greater nutrient efficiency are made. At the same time, Hess *et al*. (2016) estimate that with consumers switching preferences away from British grown potatoes to Italian pasta and Indian rice, this has resulted in an increase in blue water scarcity and a transfer of burdens from the UK to Italy and India (Hess *et al*., 2016).

4.3.3 Fish proteins

Fish presents similar challenges within current food-based dietary guidelines (Clonan *et al*., 2011; Clonan and Holdsworth, 2012; Johnston *et al*., 2014a; Dötsch-Klerk *et al*., 2016; Fischer and Garnett 2016), especially as it is not adequately addressed within the sustainable diet literature (Farmery *et al*., 2017). Furthermore, to continue eating fish at the current recommended intake levels will invariably exceed the current and future availability of fish stocks (Dötsch-Klerk *et al*., 2016; WWF, 2019a; WWF, 2019b). Climate change will continue to disrupt marine ecosystems, so there is a need to improve fisheries governance, in areas such as the high seas (HLPE, 2014b; Alberro, 2018; Cheung *et al*., 2019) and even the EU, where politicians have ignored scientific advice over fish stocks for decades (The Economist, 2014c; 2014d).

Although fish have been exploited since at least Palæolithic times, archæological evidence suggests quantities peaked during the Roman Empire, but then declined during the middle ages (Scearce, 2009). By the 1300s, however, England had established distribution networks which enabled cart traffic from the coastal fisheries to cover the interior markets. But reports of hyper abundance and the rapaciousness of many natural resources are described by Hoffmann (2005) as myths. The decline in quantities of freshwater fish available for consumption in the UK coincides with the sudden development of commercial sea fishing. Archæologists now believe this began around the year 1000, as advances in isotopic sampling techniques now reveal fish coming from farther away with the development of long-distance trade. In Southampton, for example, the point at which marine species remains outnumber fresh water species has been dated quite precisely to the year 1030 (Boissoneault, 2019). Zooarchæological evidence has also been used to demonstrate that changes in UK populations of natural herring and cod occurred as early as 600, predating the expansion of England's sea fisheries by at least 400 years, with the similar date of 1000 marking the greatest shortfall in availability (Barrett *et al*., 2004; Barrett, 2016a; Barrett, 2016b; Barrett, 2019). By the 1300s, population levels remained high, but further strains were also starting to appear in food supply. Malnutrition is thought to have developed gradually during this period which lowered resistance to disease. The competition for resources led to a greater incidence of warfare, at the same time as increasingly lower temperatures depressed crop yields (Grove, 2004; Matthews and Briffa, 2005). The Great Famine of 1315 and outbreaks of the Black Death (plague) in 1348 and 1420 caused rapid declines of more than 50 per cent of the population, with the resultant profound impacts on the economy and society lasting for many years (Virgili, 2020). Perhaps rather obviously, traditional historiography sees this period as characterised by a long period of instability and economic recession. Goldberg (2004), however, argues that despite the disruption and friction, those remaining found themselves better off, with greater resource availability and higher wages for labour. The resultant responses by government to impose price and wage controls triggered the Peasants' Revolt of 1381. Furthermore, Brenner (1976) cites the influence of feudal control over rents causing subsistence survival and hereditary sub-division of peasant farms as limiting both the economies of scale and productivity of the food system. The above scenarios led Bois (1998) to question whether the appearance of the plague was accidental or part of a much wider process.

Marine fishing became an increasingly profitable enterprise for British fishermen throughout the mid to late Middle Ages. Tittler (1977) describes the annual summer to autumn harvests of local herring, followed by spring and early summer catches of cod and ling off the Icelandic coast. Holm *et al.* (2019) estimate a 15-fold increase in the amount of cod caught in the North Atlantic around 1500. When the Tudor warship Mary Rose sank off the coast of southern England in 1545, it was full-freighted and in the midst of conflict with the French fleet in the battle of the Solent. A study by Hutchinson *et al.* (2015), employing DNA and stable isotope analyses on the cod stored in the ship's larder not only provides evidence of the continuation of the Icelandic fishing activities, but also reveals evidence of cod sourced from Newfoundland in eastern Canada. The English Newfoundland fishery had been established in 1502, with round trips taking between three to six months. This suggests that demand for fish was exceeding national supplies, and that globalised fisheries were already well established. Despite the increased levels of trade and competition from government-subsidised fleets such as the Dutch, the trade became synonymous with the nation's strong maritime tradition that laid the foundations for sea-borne colonial expansion (Rappaport, 2017).

Fish is the largest source of animal protein globally and is arguably one of the most important foods in the history of humanity. The current annual amount of fish used is around 179mt, of which 156mt is consumed directly by humans (FAO, 2020). This latest FAO data is taken from the year 2018, which set new records in terms of total production, trade and consumption: fish capture has increased by 14 per cent since the base year 1990; aquaculture correspondingly increased by 527 per cent; and consumption during the same time by 122 per cent. Average annual growth rates across both sectors are significant at around 8.8 per cent (Kumar, 2014). Fish provides 17 per cent of the total animal protein and 6 per cent of all protein consumed by humans (McMichael and Butler, 2005; Purvis, 2009; van Hoof *et al.*, 2019). Behind this growth, however, is a plethora of scientific studies and public concerns about both the current sustainability of this critical food source and the prognosis for its future (Hollingsworth, 2017). Collectively, these studies provide depth to a complex narrative; one which is full of major concerns such as: fish, human health, and marine ecosystems being on a collision course (Brunner *et al*., 2009); where longstanding concerns over the tragedy of the commons remains (Hadjimichael *et al.*, 2014; Iizuk and Katz, 2015; Costello *et al*., 2016; Webster, 2016); where claims that humankind has set sail on the wrong course, with every chance this will harm the very source of human prosperity (McMichael and Butler, 2005; Greenpeace, 2012c; Roberts, 2014); and predictions of a climate change-led perfect storm with the potential to drive the marine web, and the fisheries which depend on it, into collapse (Nellemann *et al.*, 2008; Barange and Perry, 2009; de Silva and Soto, 2009; Pickering *et al.*, 2011; Blanchard *et al*., 2012; Cheung *et al.*, 2013; Cheung *et al.*, 2016; Dahlke *et al.,* 2018; Gaines *et al.,* 2018; Le Bris *et al.*, 2018; Moore *et al.*, 2018; Ullah *et al.,* 2018; Plagányi, 2019; Thiault *et al*., 2019). The meridional overturning circulation is slowing, with serious potential consequences for fisheries (Easterling *et al*., 2007), warming oceans threaten fish species (Cheung *et al.*, 2013), and ocean acidification has already decreased seawater pH by 0.1 units with further reductions of 0.3-0.5 pH units predicted, with disastrous consequences for shell-borne organisms, tropical coral reefs, and cold water corals (Barange and Perry, 2009; Cooley *et al.*, 2012; Heinrich and Krause, 2016).

From the perspective of marine fisheries there are numerous specific concerns. The oceans were once seen as inexhaustible providers (Delgado *et al.*, 2003) of low cost or uncosted environmental goods and services (Botsford *et al.,* 2009; Bostock *et al.*, 2010), but evidence of over-exploitation and unsustainability has been mounting for decades (Ye *et al.*, 2013). The global fishing fleet increased from 1.7 million vessels in 1950 to 3.7 in 2015, and is expected to reach nearly 5m by 2050, as developing countries continue their transition into motorised vessels (Rousseau *et al.,* 2019). Estimates suggest this is 3-4 times the number of boats than the annual catch requires (Pauly, 2009; McClanaha *et al.*, 2015). At present, Europe dominates the global fishing effort, followed by Asia (Anticamara *et al*., 2011). Monitoring and recording the activities of these vessels is challenging, especially given concerns over the accuracy of catch data (Cawthorn and Mariani, 2017) and evidence of under-reporting (Pauly and Zeller, 2016). Further studies report concerns over the incentive-driven, free market where industrialised fishing techniques have been increasingly practiced by these vessels since the 1950s (Pauly, 2009; Anticamara *et al*., 2011; Gladek *et al*., 2016; Pauly and Zeller, 2016), exhausting fish stocks first in the Northern Hemisphere, before moving to the Southern Hemisphere, deeper waters, and developing-nation coastal waters. Kroodsma *et al.* (2018) used the automatic identification system installed on all industrial fishing vessels to track their fishing activity in over 50 per cent of the world's oceans. A similar approach by Tickler *et al.* (2018) records vessels from Taiwan, South Korea, Spain, and China travelling up to 2,500 miles to start their fishing activities. The techniques used by the wealthy countries who dominate industrial fishing (McCauley *et al.,* 2019) have contributed to the annual decline in fishcatch of around 1 per cent, reports of population collapse of some species (Easterling *et al*., 2007; Pauly and Zeller, 2016), and the total exploitation of over 90 per cent of the world's marine fisheries since the 1980s (Pauley *et al*., 2002; Delgado *et al*., 2003; Pitcher and Lam, 2015; Gladek *et al*., 2016). Österblom *et al*. (2015) observes that just thirteen corporations control 11-16 per cent of the global marine catch (9-13mt) and 19-40 per cent of the largest, most valuable stocks, and ecosystem-critical species. This domination extends through all segments of fish production, operating through extensive global networks that dominate. Pauly (2009) also highlights the damaging political power that companies like the Japanese Mitsubishi use to gain access to the few remaining plentiful stocks of tuna. In the UK, local extinctions have included Bluefin Tuna and Angel Shark; the once common Skate is now also virtually extinct (Purvis, 2009; Harvey, 2013). Sardines were also once abundant in UK waters and Herring was found in great shoals. Globally, many species are no longer counted in terms of monitoring fish stocks, as being so low they are no longer fished commercially. Press reports suggest some species are deliberately overfished to free up resources for other species, thereby enabling them to grow faster (Roberts, 2014). This is based on the theory that the maximum sustainable yield is reached when stocks are reduced by 50 per cent, or even as much as 80 per cent (Colloca *et al.,* 2013). From a biological perspective, these industrialised techniques remove mass and energy that is then no longer available to the higher trophic levels (Coll *et al*., 2008) and threatens the bioeconomic sustainability of many species (Pelletier *et al*., 2009; Yamazaki *et al.*, 2015; Dueri *et al.*, 2016; Martinet *et al.*, 2016; Tickler *et al.*, 2018). Wider human activities also contribute to deterioration of the ocean environment. Oils, fuels, polychlorinated biphenyls from plasticisers and fire retardants, polymers from plastic that gets into the ocean, and other persistent organic pollutants concentrate in the surface of the ocean (Radford, 2013). This layer is also critical to life in the sea, containing fats, fatty acids, proteins, floating eggs and millions of micro-organisms. The close proximity of the two mean that pollutants get into the food chain. Industrialised fishing also catches immature species (Vasilakopoulos *et al.*, 2011) and is responsible for the unnecessary killing of wildlife such as dolphins and seabirds (Clover, 2004; Pauly, 2009; Roberts, 2014). Despite the improvements in scale and technology Radford (2013) reports that, for every hour of fishing, fishing vessels catch 1 per cent of what they did 120 years ago. The total catch is, however, at least twice that needed to maintain sustainability (Coll *et al.*, 2008).

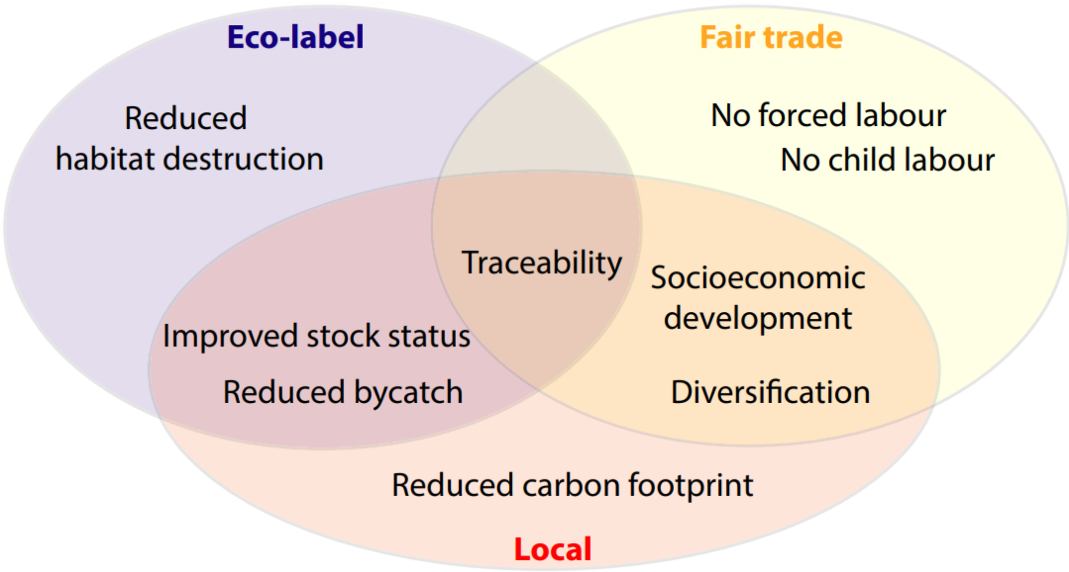


Figure 89: Classification of seafood sustainability initiatives with example goals

Source: McClenachan *et al.* (2016).

Aquaculture in both coastal and inland areas has been on a very different trajectory during this same time. It is arguably the fastest growing, global food-producing sector; by 2014 it accounted for more than 50 per cent of the world's fish (Belton *et al*., 2018; FAO, 2020). Volumetrically, 90 per cent of commercial aquaculture occurs in developing countries, where it is a source of protein, employment, income, and foreign exchange (Hishamunda *et al*., 2009). Here again, however, current practices and future prognosis particularly in terms of sustainability have been the subject of much academic debate. In particular, there are a number of key environmental concerns (Tisdell, 1999; Samuel-Fitwi *et al.*, 2012). Firstly, although species requirements do vary, most systems require wild fish to be rendered as fishmeal and fish oil for their food, with feed-to-edible product ratios of 3kgs of forage fish to produce 1kg of edible farmed fish seen as typical. With sole, however, Clover (2004) suggests a ratio nearer to 16:1 and, as the fish feed industry accounts for 36 per cent of the global marine catch, this is seen as representing poor sustainability efficiency (Tacon, 2006; Olsen and Hasan, 2012; Natale *et al.*, 2013). Studies call for the animal and fish feed industries to reduce their reliance on wild marine fish so as to not compromise the future of aquaculture, price volatility, or worsen food insecurity (Merino *et al.*, 2012; Bartolino *et al.*, 2014; Hixson *et al*., 2014; Troell *et al*., 2014; Carter, 2015; Lam *et al.*, 2016; Andrews, 2017; Froehlich *et al.,* 2018a; Froehlich *et al*., 2018b). Current innovative solutions include GM plant-based feeds, but these may well be resisted by the consumer (Kristofersson and Anderson, 2006; Lazard *et al*., 2014; Schweisfurth, 2017). The increasing use of grain, soyabeans, lupins, and blended vegetable oils in fish feeds is also problematic, as these are lower in long-chain fatty acids (especially n-3 PUFAs) compared to wild-caught fish feeds, suggesting the health benefits of farmed fish are reduced (McMichael and Butler, 2005). Secondly, there are many environmental concerns associated with pollution from aquaculture (Papatryphon *et al*., 2005; Barange and Perry, 2009; Duarte *et al*., 2009; Pauly, 2009; Olesen *et al.*, 2011; Worm and Branch, 2012; Worm, 2016). These include waste from faecal matter and unused feed around the farmed area (Mungkung *et al.*, 2013), increased eutrophication potential (d'Orbcastel *et al*., 2009) and the increasing routine use of antibiotics, antifoulants, and pesticides (Orsini, 2016; Edwards, 2017; Schweisfurth, 2017; McVeigh, 2019; Yamamuro *et al*., 2019). Reverter *et al*. (2020) meta-analysis raise the prospect of those countries most affected by climate change at greatest risk from AMR and calls for immediate and urgent action. Also of particular concern must be the recent finding that Neonicotinoids may be used in fish farms to control fish lice (Macaskill and Leake, 2020). Kaiser (2005, p.195) found parasitic lice from fish farms caused '*a moving cloud of infection*' that passed onto other species, causing increased mortality in wild species such as salmon (Krkošek *et al.*, 2005; Hilborn, 2006). Paterson (2017), for example, raises concern over increasing mortality rates on Scottish salmon farms; the disposal of 10m salmon (or 22,480 tonnes) in 2016 suggests mortality rates of 25 per cent, and a doubling in just three years. Schweisfurth (2017) also reports on the decline of wild salmon and sea trout stocks due to parasitisation, suggesting some Scottish rivers are now close to extinction. Thirdly is the association between aquaculture and habitat destruction (Kumar, 2014) which can be both localised and far-reaching. Further concerns include water quality being affected by discharges to surface water, abstractions, the removal of sediments, and the replacement of stream structures such as weirs. Fourthly, escaping salmonids, for example, have been found to impact wild fish stocks by spreading disease, occupying their habitats, and interbreeding which risks losing genetic integrity (Eagle *et al*., 2004; Papatryphon *et al*., 2005; Standal and Utne, 2007; Olesen *et al*., 2011; Orsini, 2016; Schweisfurth, 2017; Gibbens, 2018). This concern is further exacerbated when the farmed salmon is genetically modified, such as with the 'AquaAdvantage®' salmon now being farmed in Canada since approval in 2016 (Goubau, 2011; Thompson, 2017).

For the responsible consumer wanting to purchase sustainably sourced fish for the mainly, well-publicised health benefits that it brings, there is also need for clearer information. Exposure to a regular array of mixed messages is unlikely to help them make the right, well-informed choices. Dietary guidelines, such as the USA's 2010 iteration, advocate the doubling of fish intake but, given the future prognosis on the availability of fish, the sustainability of such advice has to be questioned (Love *et al.*, 2015; Farmery *et al*., 2017). Studies using LCA of fishing systems show variable results, even within single species (Pelletier *et al.*, 2009; Mungkung *et al.*, 2013; Denham *et al.,* 2015), with reports suggesting that the carbon emissions of lobster and shrimp are higher than chicken, pork, and sometimes even beef (Bryce, 2018). More fish is good for health, but too much is bad for the biosphere's health, and therefore ultimately human health too. Furthermore, using market power to make the right choices may in fact unintentionally harm the health of consumers in developing countries. Even within the UK, consumer decisions are far from straightforward. Whitmarsh and Palmieri (2011), for example, discuss the challenges of marketing Scottish salmon to consumers ever more concerned with environmental performance. When faced with messages advocating the need to eat less fish altogether instead of more sustainable fish (Esteban, 2011), or that eating a tuna role at a sushi restaurant should be considered no more environmentally benign than driving a Hummer or harpooning a Manatee (Pauly, 2009), it is perhaps unsurprising that such beliefs do not correlate with responsible purchasing or consumption behaviour (Verbeke *et al.*, 2007). Reports of the failure of metrics such as ecological footprint / sustainability index add more uncertainty (Roth *et al.*, 2000; Volpe *et al*., 2013), as does the absence of environmental accounting for organic aquaculture (Georgakopoulos and Thomson, 2005). Furthermore, marketing techniques such as renaming unfamiliar species (e.g. shark into rock; slimehead into orange roughy; Patagonian toothfish into Chilean seabass) simply add further confusion (Pauly, 2009). From a health perspective, consumers have a real dilemma choosing between increasing consumption to improve health or being more sustainable by eating less fish (Mitchell, 2011). Fish represents one of the only significant sources of long-chain omega 3 fatty acids, but aquaculture-produced sources may be increasingly limited (Buttriss, 2010; McMichael and Butler, 2005; Byelashov and Griffin, 2014; Moomaw *et al*., 2017). The use of prebiotics, non-digestive food ingredients that stimulate growth through the colon, also pose an additional risk consideration given the current lack of evidence on their effects (Ringø *et al*., 2010).

4.3.4 Animal proteins

The role of livestock within sustainable food systems is undoubtedly one of the most contentious and divisive. Protein is fundamental to human health, but current meat consumption levels and production practices are creating huge challenges for resources, the climate, and public health (Djekic, 2015; Forum for the Future, 2019). Although earlier reports had raised concerns over increasing demand for livestock (Delgado *et al*., 1999) and its correlation with human population (Tran Thi Dan *et al*., 2003), it was the FAO's (2006a) 'livestock's long shadow' report that first brought together the evidence on livestock's significant contribution to environmental problems and suggested the need for urgent policy reform (Ilea, 2008; Koneswaran and Nierenberg, 2008; Josling *et al*., 2019). It called for urgent redress of the problem areas, including land degradation, loss of biodiversity, water shortages, air and water pollution and climate change, through cross-cutting policy frameworks. As such, it has become one of the most cited in both the scientific and consumer-focused literature, especially the initial estimate that livestock were responsible for 18 per cent of global GHG emissions (FAO, 2006b); later studies provide estimates of 14.5 per cent (Bailey *et al*., 2014; Eisler *et al*., 2014; Rojas-Downing *et al*., 2017) and 23 per cent (Reisinger and

Clark, 2018). In terms of the total carbon amount that the global livestock sector is already responsible for, studies variously estimate quantities of 5.6–7.5 (Herrero *et al*., 2016), 7.1 (Wellesley *et al*., 2015; Grossi *et al*., 2019), and 9.8–16.9 gigatonnes of CO_2e released each year (Vermeulen *et al*., 2012). These figures are a significant proportion of the total industrial emissions of CO_2: for example, in 2018 Jackson *et al*. (2019) puts this at 37 gigatonnes. The current production and consumption of livestock products is impacting planetary life support systems and creating one of the most important ecological challenges facing humanity (Eisler *et al*., 2014; Arcari, 2017; Mottet *et al*., 2017; Greenpeace, 2018b; Vigo, 2018; Bowles *et al*., 2019). The demand projections from the FAO (2006) are shown in figure 90. These projections are based on growing populations, increasing affluence, changing dietary preferences, and globalisation boosting the trade in livestock inputs and products. They also suggest that meat will more than double from 229mt in 2001 to 465mt by 2050; milk will similarly increase from 580mt to 1,043mt; such increases are reflected in later studies (Rojas-Downing *et al*., 2017; Röös *et al*., 2017a).

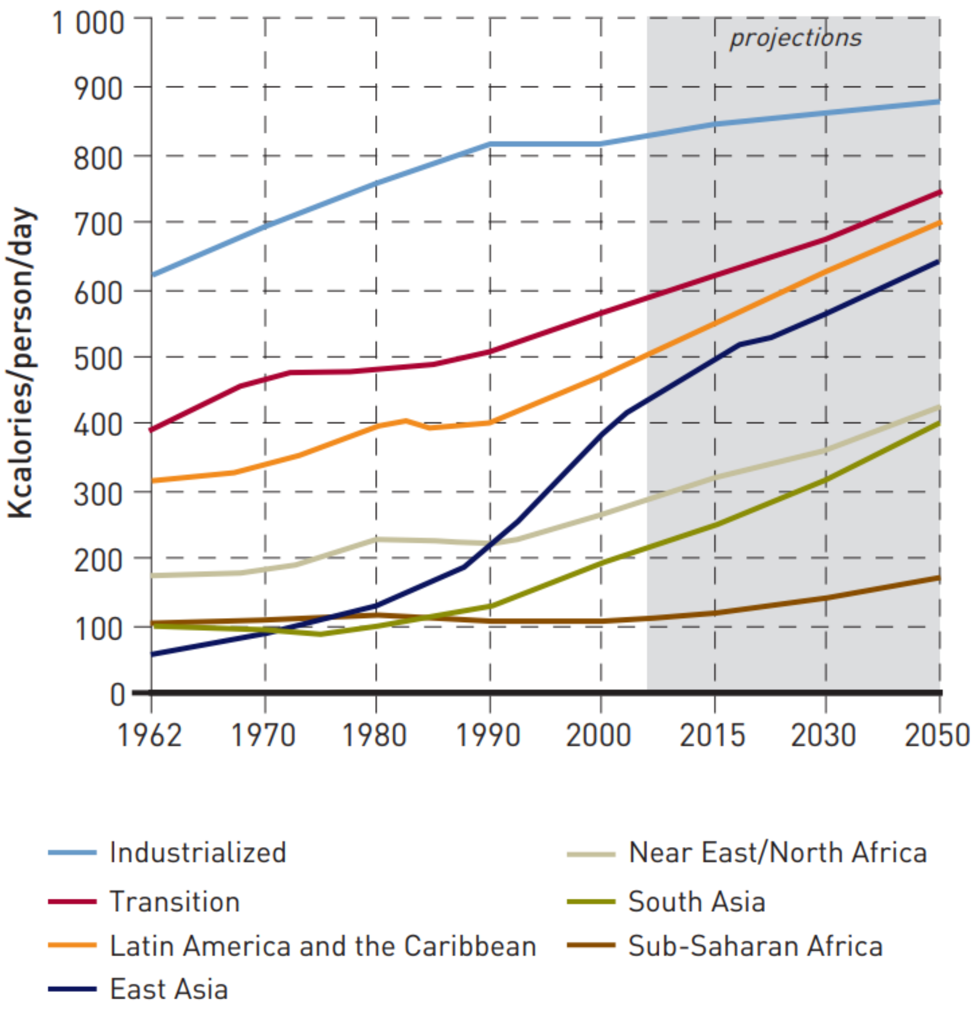


Figure 90: Historical and projected food consumption of livestock products

For past, three-year averages centred on the indicated year. Livestock products include meats, eggs, milk, and dairy products (excluding butter)

Source: FAO (2006).

In the case of the UK (figure 92), Benton (2020) suggests that livestock provide 18 per cent of calories and 37 per cent of dietary protein, but use more than 80 per cent of farmland and produce more than half of the GHGs. The growth in consumption is despite systems such as ruminant agriculture been seen as increasingly unsustainable, even though much of the UK's grassland is unsuitable for much else (Wathes *et al*., 2013). Recent recommendations include a reduction in the consumption of livestock products, due to the increasing evidence associated with their environmental impacts (WWF, 2008b; Perignon *et al*., 2016; Ponsioen and van der Werf, 2017; Bankman, 2018; Scott, 2018; Fanzo and Herrero, 2019; Hawkins, 2019). The WHO (2018b) also advocate the need for healthy diets that are sustainably produced and consumed. More detailed analyses suggest that the scale and type of the livestock system produces significantly different levels of GHG emissions (Clonan and Holdsworth, 2012; de Carvalho *et al*., 2013; Clonan *et al.*, 2015; Hyland *et al*. 2017; Barré *et al*., 2018; Benton, 2020). From the consumers' perspective, Macdiarmid *et al*. (2016) found a general lack of consumer awareness about consumption and climate change, followed by an unwillingness to adapt their behaviour accordingly. Yet, the need to address the consequences of livestock consumption is becoming increasingly urgent. Bryngelsson *et al*. (2016), for example, argue the only way that the EU can meet its climate targets is by reducing ruminant meat consumption by more than 50 per cent. Exactly how this can be achieved remains uncertain (Macdiarmid *et al*., 2012), although Macdiarmid *et al*. (2016) suggest that such dietary recommendations would need to consider the cultural, social, and personal values associated with eating meat.

Grossi *et al*. (2019) provide a recent breakdown of sources of GHG emissions for livestock (figure 91). It shows feed production and processing contributing 45 per cent, enteric fermentation 39 per cent, manure storage 10 per cent, and 6 per cent for the processing and transport. Figure 93 shows the GHG incidences that enteric fermentation and manure storage have across the main global livestock species. Livestock production is associated with particularly harmful greenhouse gases: for example, 65 per cent of human-related nitrous oxide, which has 296 times the Global Warming Potential (GWP) of CO_2, mostly from manure (FAO, 2006a; 2006b); 37 per cent of all human-induced methane is produced by ruminants (23 times as warming as CO_2) (Wolf *et al*., 2011; Wolf *et al*., 2017; Lynch *et al*., 2020); and, 64 per cent of ammonia which causes acid rain (FAO, 2006; Eisler *et al*., 2014; Hansen, 2019). The 500L of methane gas emitted daily by every cow equates to 50 per cent more GHG emissions than 1 billion vehicles on the road at present (Barclays, 2019). Dietary and management options can reduce methane emissions without lowering production (Grainger and Beauchemin, 2011) and biogas used to provide renewable energy (FAO, 2006). Should livestock numbers continue to grow on the current trajectory, it may cause humanity to overshoot its safe operating space (Pelletier and Tyedmers, 2010), with the cumulative emissions accounting for one third of the remaining carbon budget under the 1.5°C Paris Agreement (Livestock Global Alliance, 2016; Forum for the Future, 2017b). Macroeconomic policies to ensure both sustainable production and consumption practices are urgently required as part of the transition to sustainable food systems and ensuring humanity operates within its safe operating space (Buckwell and Nadeau, 2018; Bowles *et al*., 2019). Djekic (2015) argues the environmental impacts of producing livestock comprise three dimensions: the consumption of natural resources, climate change, and environmental pollution.

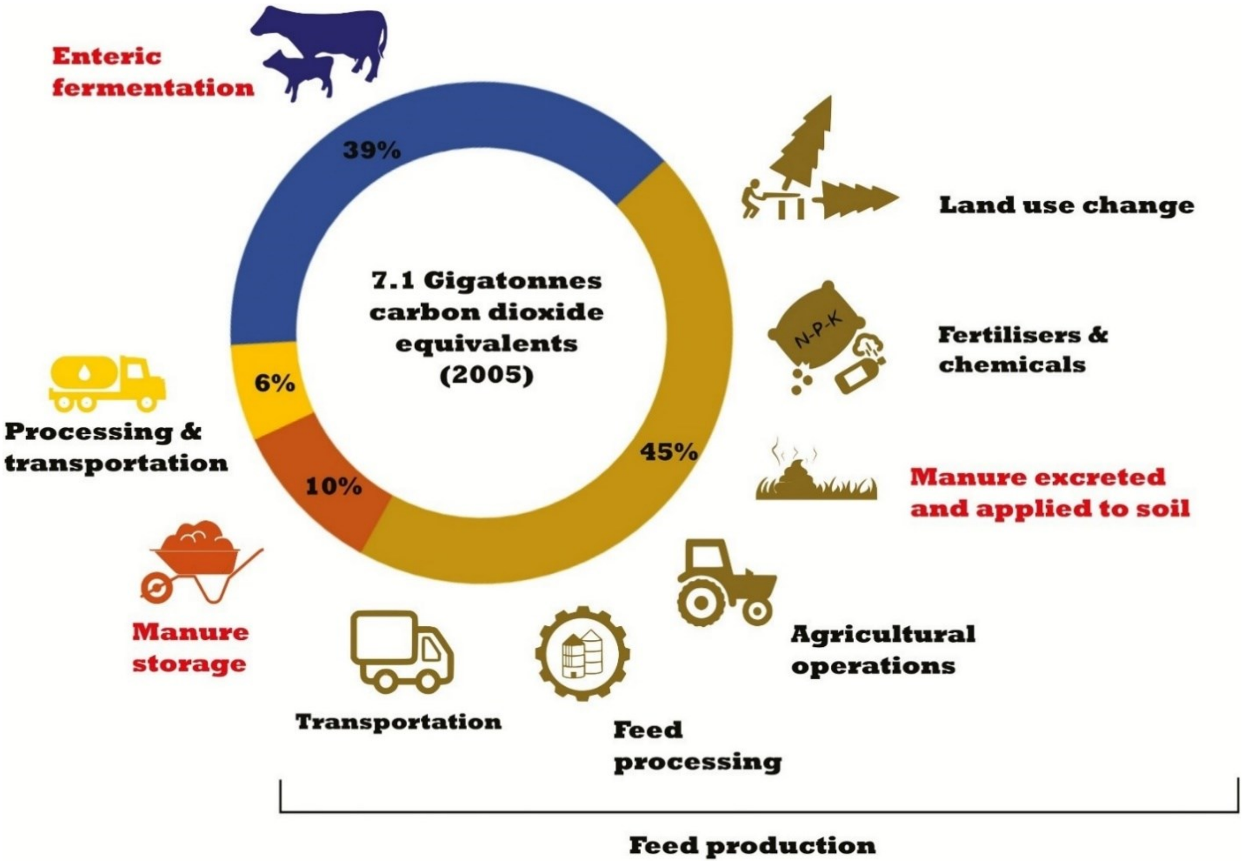


Figure 91: Livestock emissions by source

Direct livestock emissions are shown in red

Source: adapted from Gerber *et al*. (2013) cited in Grossi *et al*. (2019).

In terms of consuming natural resources, land-use and associated changes are especially significant. Livestock production already accounts for 70 per cent of all agricultural land-use, at around 6 billion acres (Mottet *et al*., 2017; Fraanje and Garnett, 2020) or 30 per cent of the earth's entire land surface (FAO, 2006a). It is also the single largest anthropogenic user of land by a considerable margin (Herrero and Thornton, 2013). Most of this is down to pasture, where grazing continues to degrade the land, despite increasing trends towards intensification and industrialisation (Pollan, 2006; Bailey *et al*., 2014; Gladek *et al*., 2016; Röös *et al*., 2016; Soder and Muller, 2016; D'Silva, 2017; Garnett *et al*., 2017; Greenpeace, 2019b; Mozaffarian, 2019; zu Ermgassen and Yoh, 2019). Should the USA switch to grass-fed only beef systems, Hayek and Garrett (2018) estimate this would require 30 per cent more cattle and the present area of grassland could only accommodate 27 per cent of the current national herd. Land-use change, especially with deforestation, also has a dramatic impact (Peters *et al*., 2014; Wellesley *et al*., 2015; Global

Forest Alliance, 2016; Greenpeace, 2018b; Phillips *et al*., 2019; Spring, 2020). For example, between 1990 and 2005, 71 per cent of deforestation in South America was caused by demand for additional pastures; industrial livestock production systems such as Concentrated Animal Feedlot Operations (or Confined Animal Feeding Operations) and ranching are also replacing sustainable farming practiced by small farmers, communities, and indigenous peoples (Fiala, 2008b; Global Forest Alliance, 2016; Rotz *et al*., 2019). To produce 1kg of meat requires around 2.8kg of human-edible feed in ruminant systems and 3.2kg in monogastric systems (Mottet *et al*., 2017), so a further 33 per cent of arable land is used for animal feed, meaning livestock are actually consuming human-edible biomass (Van Zanten *et al*., 2018; Karlsson and Roos, 2019). On a global scale, estimates suggest animal feeds consumes 1 billion tonnes cereal grains, enough to feed up to 3.5 billion humans (Herrero *et al*., 2013; Eisler *et al*., 2014; Davis and D'Odorico, 2015; Breewood and Garnett, 2020). Given the pressures of consumption growth ultimately increasing demand for land, there is an urgent need to find a solution to this complex issue. For example, increasing efficiency reduces land-use, but invariably creates higher inputs usage, waste, and pollution levels. The concentration into industrialised units, however, may keep the additional damage more localised and easier to regulate (Davis *et al*., 2015; Garnett, 2015; Garnett, 2017). Research is also underway to find alternative sources of feedstock, such as the industrial production of microbial proteins (Pikaar *et al*., 2018).

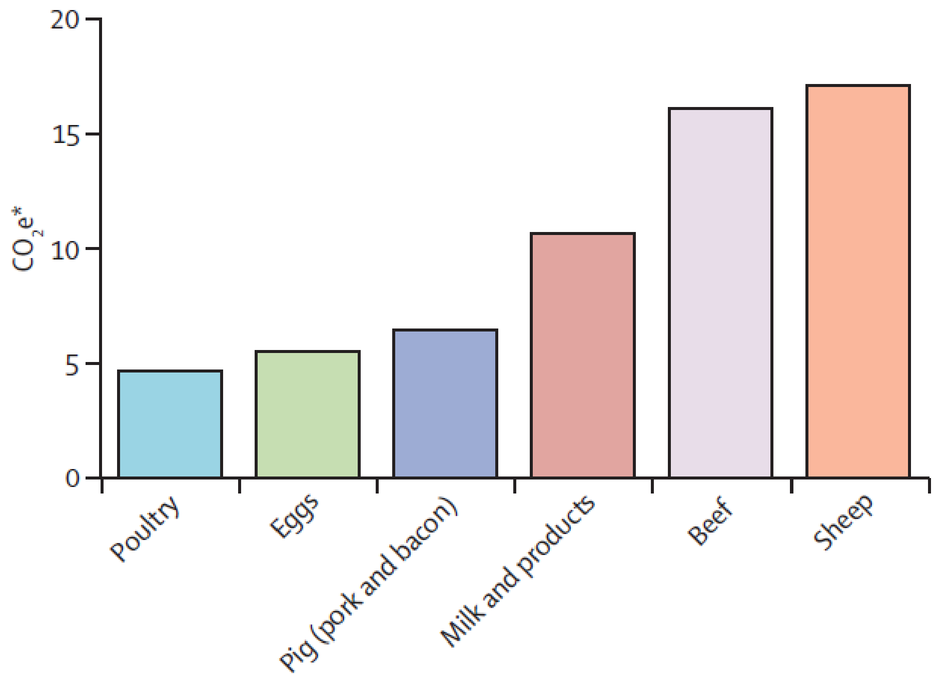


Figure 92: Estimates of total greenhouse-gas emissions for livestock products in the UK

**Tonnes of CO2e per tonne of carcass weight, 20,000 eggs (about 1 tonne), or 10m³ milk (about 1 tonne dry matter equivalent)*

Source: Friel *et al.* (2009).

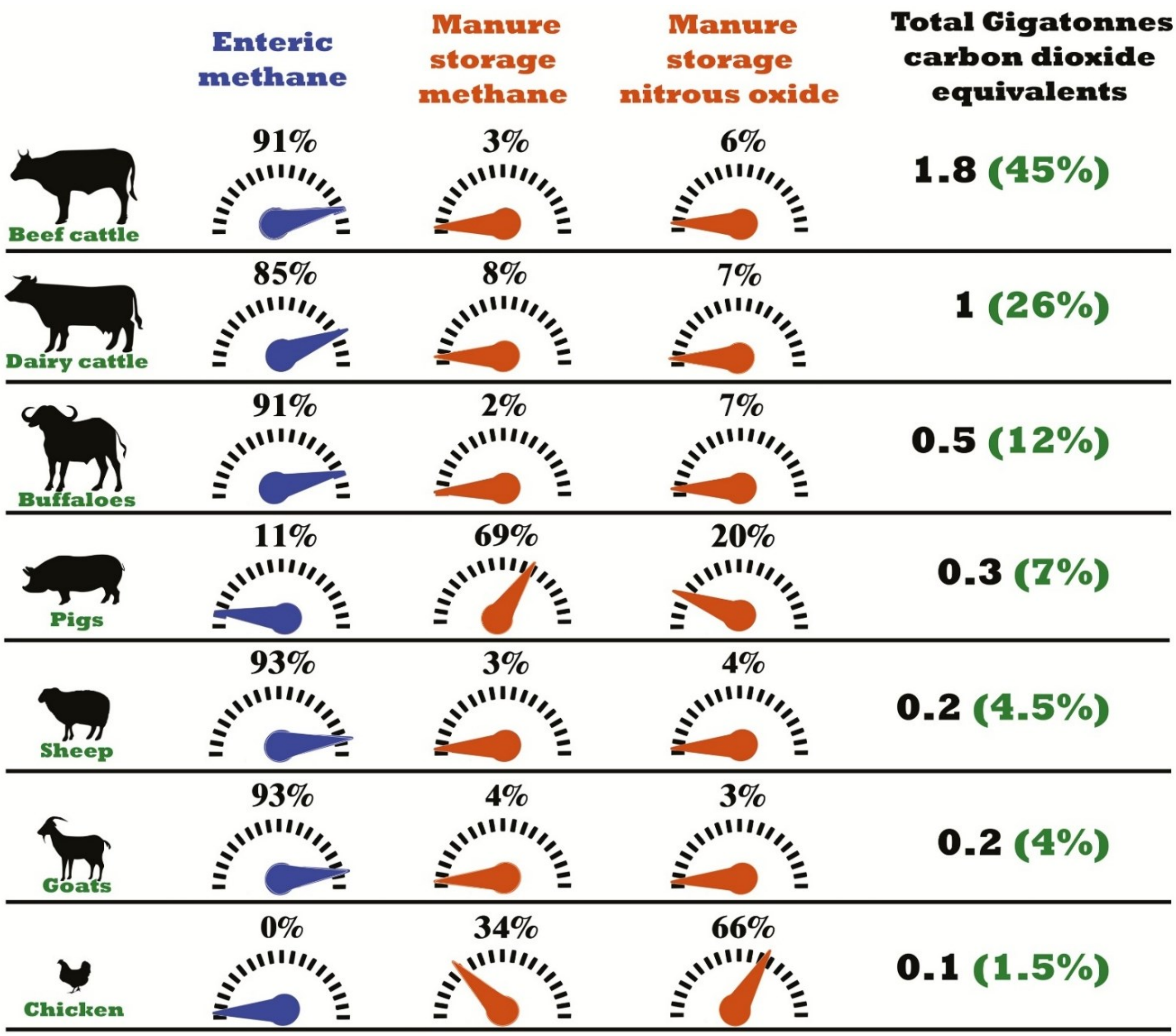


Figure 93: Greenhouse gases incidence of enteric fermentation and manure storage by animal type, expressed as gigatonnes of carbon dioxide equivalents

Source: FAO data cited in Grossi *et al*. (2019).

The existing literature provides a wealth of detail on the various livestock systems, including the problems associated with ruminants (O'Mara, 2012; Broom *et al*., 2013; Eisler *et al*., 2014; Niman, 2014; Mottet *et al*., 2017; Bowles *et al*., 2019; Costain, 2019; Jordan, 2019; Salami *et al*., 2019) as well as the environmental consequences of different production systems for beef (Richards and Padilla, 2007; Nguyen *et al*., 2010; Opio *et al*., 2013; Eshel *et al*., 2018) and lamb (Worsley, 2018). Dairy systems within broader processes of social-environmental change also receive comprehensive coverage too (Lassen *et al*., 2008; Forum for the Future, 2012; Van Middelaar *et al*., 2013; Dairy 2020 (Forum for the Future, 2014); Glenk *et al*., 2014; Gollnow *et al*., 2014; Herzog *et al*., 2018; Clay *et al*., 2019; FAO, 2019c). The various attributes of the monogasts has received less attention to date (Jensen, 1996; de Vries and de Boer, 2010;

Vardoulakis and Heaviside, 2012; Lara and Rostagno, 2013; Röös *et al*., 2013; Mottet *et al*., 2017; Young, 2017), although poultry systems are covered by Westgren (1999), Wang *et al*. (2010), MacLeod *et al*. (2013), the Sustainable Food Trust (2017a), Bennett *et al*. (2018), Rigod and Tovar (2019), and Rocchi *et al*. (2019); similarly, the various pork systems used globally (Taylor, 2006; Wognum, 2008; Leat and Revoredo-Giha, 2013; MacLeod *et al*., 2013; Sonesson *et al*., 2016; Rudolph *et al*., 2018). Further analysis on GHG emissions of production systems in a range of different countries to date includes Australia (Peters *et al*., 2010; Arcari, 2017), Brazil (de Oliveira Silva *et al*., 2015; Gibbs *et al*., 2015; National Research Council, 2015; Hajjar *et al*., 2019), Italy (Farchi *et al*., 2017), Norway (Austgulen *et al*., 2018), and Sweden (Cederberg *et al*., 2009; Hellstrand, 2013; Röös *et al*., 2014; Röös *et al*., 2016; Sonesson *et al*., 2016; Röös, 2017).

The environmental impacts from consuming meat and dairy produce are also integral to the debate on the drivers of climate change (Bailey *et al*., 2014). The sheer scale and speed of growth of the global livestock sector has both caused problems that will invariably become worse with climate change, and risks influencing the climate directly (Nardone *et al*., 2010; Herrero and Thornton, 2013; Havlík *et al*., 2015; Garnett *et al*., 2017). Of particular concern are the consequences of pollution on water and air quality (Mekonnen and Hoekstra, 2012; Hunt *et al*., 2014; McKenna, 2017; Harris *et al*., 2019), and the vast quantities of GHG emissions released into the atmosphere. Examples of pollution include from animal wastes, antibiotics and hormones (Wellesley *et al*., 2015), chemicals from tanneries, fertilisers and pesticides used for feed crops, and sediments from eroded pastures; these can then contribute to eutrophication (Payen *et al*., 2020), 'dead' sea zones in coastal areas, and the degradation of coral reefs. In the UK, antibiotic growth promoters were first permitted for use in 1953, following which AMR in livestock occurred almost immediately as Fleming (1945) had warned (Nunan, 2017). Across the world today, Nunan also argues that 110 countries have few or no regulations covering their use on livestock. China alone is estimated to generate 243mt of waste faeces every year; it also consumes over 50 per cent of global antibiotics (FAIRR, 2018). Climate change also threatens feed quality, water availability, milk production, disease incidence including zoonosis, and affects reproductive performance (Eisler *et al*., 2014; Greger, 2017; Rojas-Downing *et al*., 2017; FCRN, 2018k). Livestock are also one of the main threats to biodiversity, which arises from their impacts on climate, air, water, and land (Shiva, 2019a). As they account for 20 per cent of the total terrestrial animal biomass and use 30 per cent of the land surface, much of this will have caused habitat loss in the natural ecosystem there previously (Bernués, 2017; Hansen, 2019). This invariably leads to a number of consequences, including land degradation, pollution, sedimentation of coastal areas, facilitating invasive species, and species endemism (i.e. the ecological state of a species being unique to a defined geographic location) (Röös *et al*., 2014; Stoll-Kleemann and O'Riordan, 2015; Wirsenius *et al*., 2017). The tools available for measuring and benchmarking emissions is also studied extensively (IDF, 2010; de Boer *et al*., 2011; Flachowsky and Kamphues, 2012; Lebacq *et* *al*., 2012; Roy *et al*., 2012; Weiss and Leip, 2012; Gerber *et al*., 2013; MacLeod *et al*., 2013; O'Brien *et al*., 2013; Opio *et al*., 2013; Röös *et al*., 2013; Vellinga *et al*., 2013; Liedke, 2014; Djekic and Tomasevic, 2016; DeWeerdt, 2017; Layman, 2018; McAuliffe *et al*., 2018; Eme *et al*., 2019).

The role of livestock protein within a healthy diet is also the topic of much debate. Garnett *et al*. (2017) recognises its various virtues: as a popular protein with consumers; with high nutrient density; and a culturally significant food. Piazza *et al*. (2015) evaluates the traditional rationalisation of meat consumption, especially those consumers who believe that eating meat is natural, normal, necessary, and nice. Lang *et al*. (2010) sees a battle for hearts and minds over the place of meat within culture, whereas Sutton and Dibb (2013) suggest placing more value on meat. It may also provide income, livelihoods, and food security, as well as traditionally being used to transfer nutrients from grassland onto crops through waste manures. Increasing consumption of meat and dairy products was also seen as an indicator of both progress (Lang, 2017f) and affluence (Godfray *et al*., 2018). Despite these contributions, however, Thornton (2010) argues that future demand will be moderated by socio-economic factors including human health concerns and changing socio-cultural values. Anthropogenic CO_2 emissions from livestock are contributing to the increasingly adverse health consequences of climate change, threatening the availability of food in many countries (McMichael *et al*., 2007) and widening the disparity in protein intakes with disproportionate impacts for those on plant-based diets (Medek *et al*., 2017). Garnett (2015) considers consumer behaviour when it comes to buying meat and develops a scenario model to better understand the complex beliefs and ideologies that underpin their decisions, as well as the polarisation that exists. This allows typologies to be extended (figure 94): proponents of intensive and efficient systems could see artificial meat as a logical way forward (Gaffney *et al*., 2019); proponents might, however, see this artificial meat as a threat to health and move more towards what they see as higher quality, grass-fed beef using ecological leftovers; for those who see eating meat as morally wrong (Graça *et al*., 2014), consuming animals fed on ecological leftovers would still be unacceptable whereas artificial meat may be more acceptable. Consumer choices are also influenced by sensory-based associations and conceptual interpretations of social situations (de Boer and Aiking, 2017; Chiles and Fitzgerald, 2018; Eker *et al*., 2019), as well as targeted, persuasive messages regarding meat (Apostolidis and McLeay, 2016; Palomo-Vélez *et al*., 2018), all of which would need bridging frames to encourage dietary reductions in meat. The role of meat within the diet has long been debated by those in the health professions community; the meta-analysis by Chen *et al*. (2013) found a clear correlation between the consumption of red and processed meat and an increased risk of strokes, especially ischemic stroke; various other systematic reviews have established clear links between levels of meat consumption, CVD and cancer risk (Rayner and Scarborough, 2017). Today, many countries issue advice to lower meat consumption to reduce this risk accordingly through their dietary guidelines, although few have yet to factor-in the additional benefits from a planetary perspective. Clonan *et al*. (2015, p.2446) also calls for health professionals to help increase the public's awareness of the environmental impact of eating red and processed meat and for policymakers 'to ensure that dietary guidelines integrate the nutritional, animal welfare and environmental components of sustainable diets'. Eme *et al*. (2019) compared 52 previous methodological approaches towards assessing sustainable diets to design a proposed framework to guide such dietary transitions.

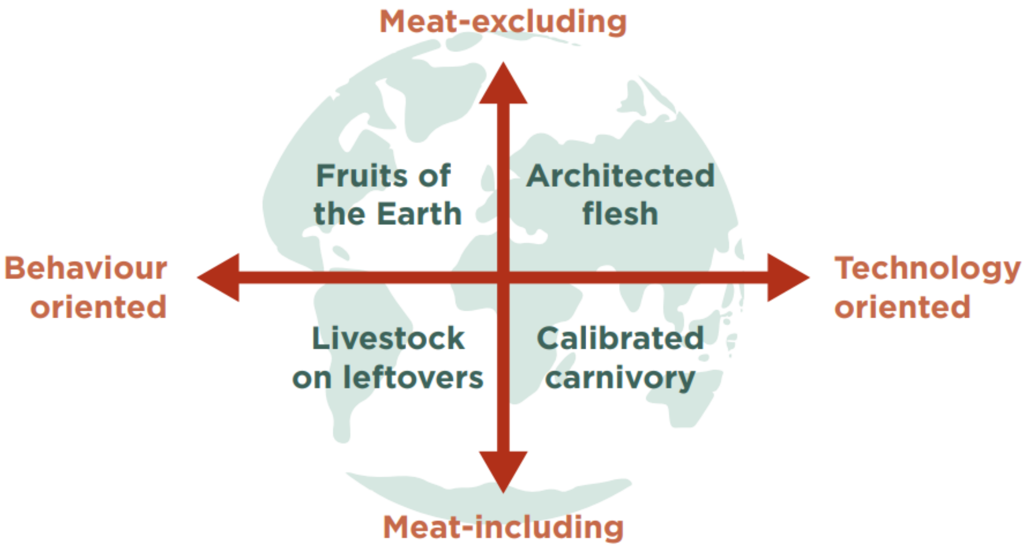


Figure 94: Four scenarios for future animal protein production

Source: Garnett (2015).

Further studies add to the knowledge base by making specific dietary and behavioural recommendations concerning the consumption of livestock products. Hoolohan *et al*. (2013) illustrates how British consumer choices could help reduce the average, daily, food-related GHG emissions from 8.8 kg CO_2e person^{-1} day^{-1}. Here specifics include removing meat from the diet (35 per cent reduction), moving from carbon-intensive meats such as lamb and beef to less carbon-intensive options such as pork and chicken (18 per cent reduction), eliminating all avoidable waste (12 per cent reduction), and not consuming foods grown in hot-houses or air-freighted (5 per cent reduction). They conclude that such actions would easily bring down food-related GHG emissions by 25 per cent which, if adopted by the whole population, would be equivalent to 50mt CO_2e year^{-1} or 71 per cent of emissions from all cars. The UK-based CSO Eating Better identifies key drivers that provide opportunities to encourage dietary shift (table 17) and calls upon governments, public health bodies, business, researchers and CSOs to work together to address the interlinked issues of climate change, public health, and fair and human access to food worldwide (Dibb and Fitzpatrick, 2014; Dibb and de Llaguno, 2018).

Driver	*Opportunities*
1. Habits	Non-meat or lower-meat choices to be good value, accessible and desirable tasty choices
2. Cultural significance of meat eating	Opportunity to draw on traditional diets based on low meat/plant-based eating e.g. Mediterranean diet, Asian and Middle Eastern cuisines
3. Price/cost	Lower meat diets can save money and enable 'better' meat choices within the same budget
4. Convenience	Food companies and the food service sector to offer more non-meat and lower meat meal alternatives. Education to increase cooking skills for plant-based eating
5. Interest in health	Promotion of strong public health messages on health benefits of lower meat and plant-based diets. Myth busting information provision on nutritional adequacy of lower/non meat eating e.g. protein and iron. Reducing meat, rather than eliminating it completely to offer nutritional reassurance
6. Awareness of the environmental impacts	Awareness raising campaigns, information, education and better labelling (where appropriate)
7. Concern for animal welfare	Opportunities to link animal welfare concerns to wider environmental and health concerns to encourage less and better meat eating. Greater provision and promotion of meat produced to higher animal welfare standards
8. Interest in provenance and traceability	Opportunity to connect people with where their food comes from and the people that produce it, and offer higher quality/taste, environmental, welfare standards and better returns to producers/local economy. Food retailers and caterers, to include 'local' distinctiveness as part of 'better' meat offer
9. Knowledge about alternatives to meat	Growth in meat replacement and meat alternative market provides opportunities to help consumers transition to a lower meat diet
10. Food scares	Opportunity to raise awareness of 'better' meat choices or meat alternatives

Table 17: Ten drivers to provide opportunities to encourage dietary shift

Source: Eating Better (Dibb and Fitzpatrick, 2014).

The literature also considers the alternative sources of protein for meat (Pluhar, 2009; Ercin *et al*., 2012; Wellesley *et al*., 2015; Bianchi *et al*., 2018; Buckwell and Nadeau, 2018; Rödl, 2018; Shepon *et al*., 2018; Baggini, 2019; Mozaffarian, 2019; Sexton *et al*., 2019; Tubb and Seba, 2019; Tuomisto, 2019; WEF, 2019d) as well as edible insects (Premalatha *et al.*, 2011; Verbeke, 2015; FAO, 2016j; Proteinsect, 2016; Weinbren, 2018; FCRN, 2019a). Writing in *The Ecologist*, the Indian environmental activist and food sovereignty advocate Vandana Shiva condemns industrialised food systems in general and fake foods such as GM soya-based alternative meats in particular, seeing them as the big food companies attempting to further the industrialisation of food that will invariably further destroy the planet, human health and ultimately bring about mass extinction. She is equally dismissive of the role of the Eat Forum, suggesting it is trying to impose a '*monoculture diet of chemically grown, hyperindustrially processed food on the world*' in partnership with '*the junk food industry and Big Agriculture*' to build '*on a century and a half of food imperialism and food colonisation*' that will '*accelerate the rush to collapse*' (Shiva, 2019c). The roles of market investors and speculators also have a significant part in influencing future diets. US-based investment advisors StreetAuthority (2015) warn of future losses, unless the meat industry lobby convince the USDA to omit the expert committee's new recommendations or water them down enough to render them ineffective (GRAIN, 2017). Similarly, the Paraguayan-based CSO Global Forest Coalition evaluates the free trade model used within the livestock sector and observes an industry attitude that their food business should not be the business of consumers (Malig and Hall, 2017). Organisations such as the FAIRR Initiative (Farm Animal Investment Risk & Return), however, provide alternative advice to those investors wanting to avoid intensive livestock production stocks (Food Service Footprint, 2018g; FAIRR, 2019; FAIRR, 2019b). They highlight companies who supply global brands including McDonald’s, Tesco, Nestlé and Walmart: most don’t measure their GHG emissions; none have a comprehensive policy to stop deforestation (Greenpeace, 2018d); or are committed to phasing out the routine use of antibiotics. Although McDonald’s has pledged to reduce antibiotics use in their beef supply chain, its suppliers do not have a policy to avoid the routine use of antibiotics.

Given that global livestock numbers are responsible for roughly the same amount of emissions as all transport in the world, they are a critical element in any policies to reduce the impact of climate change. Furthermore, as reducing emissions alone will not be enough to avoid the worsening effects of climate change (Garnett, 2009; Bailey *et al*., 2014; Wellesley *et al*., 2015; Canadell and Jackson, 2019), policies are urgently needed to bring about changes in consumption behaviour. GRAIN (2018) suggest that total global emissions must rapidly decline from 51 gigatons to 13 gigatons (figure 95). Governments and environmental groups, however, are mostly reluctant to pursue policies to shift this behaviour for fear of backlash (Bailey *et al*., 2014). At best, some consumers consider the environmental impacts after taste, price, health and food safety when choosing food. Lang (2017f) argues that meat is a test case to see how and whether policymakers will be able align the food system with sustainability goals. For those with low or even no awareness, then environmental impacts do not feature at all. One recent multi-country online survey found consumers in Brazil, China and India showed higher levels of awareness, consideration, and willingness to modify their behaviour when buying meat and dairy products (Bailey *et al*., 2014; Clonan *et al*., 2016). To mitigate against GHG emissions within the food sector, there are three major policy choices (Hedenus *et al*., 2014). These comprise productivity improvements in the livestock sector, such as policy measures that include full cost pricing, regulatory frameworks for limiting inputs and scale, specified discharge levels, and planning restrictions to reduce conflict with urban populations. Secondly, a range of specific, dedicated technical mitigation measures to be used. This offers considerable scope, given estimates that livestock accounts for up to half of the technical mitigation potential of the agriculture, forestry and land-use sectors (Herrero *et al*., 2016). Examples would include better feed conversion and feeds that increase soil carbon sequestration versus carbon emission (Hermansen and Kristensen, 2011;

Garnett *et al*., 2017; Dass *et al*., 2018). Finally, and most significantly to this thesis are policies to bring about human dietary change.

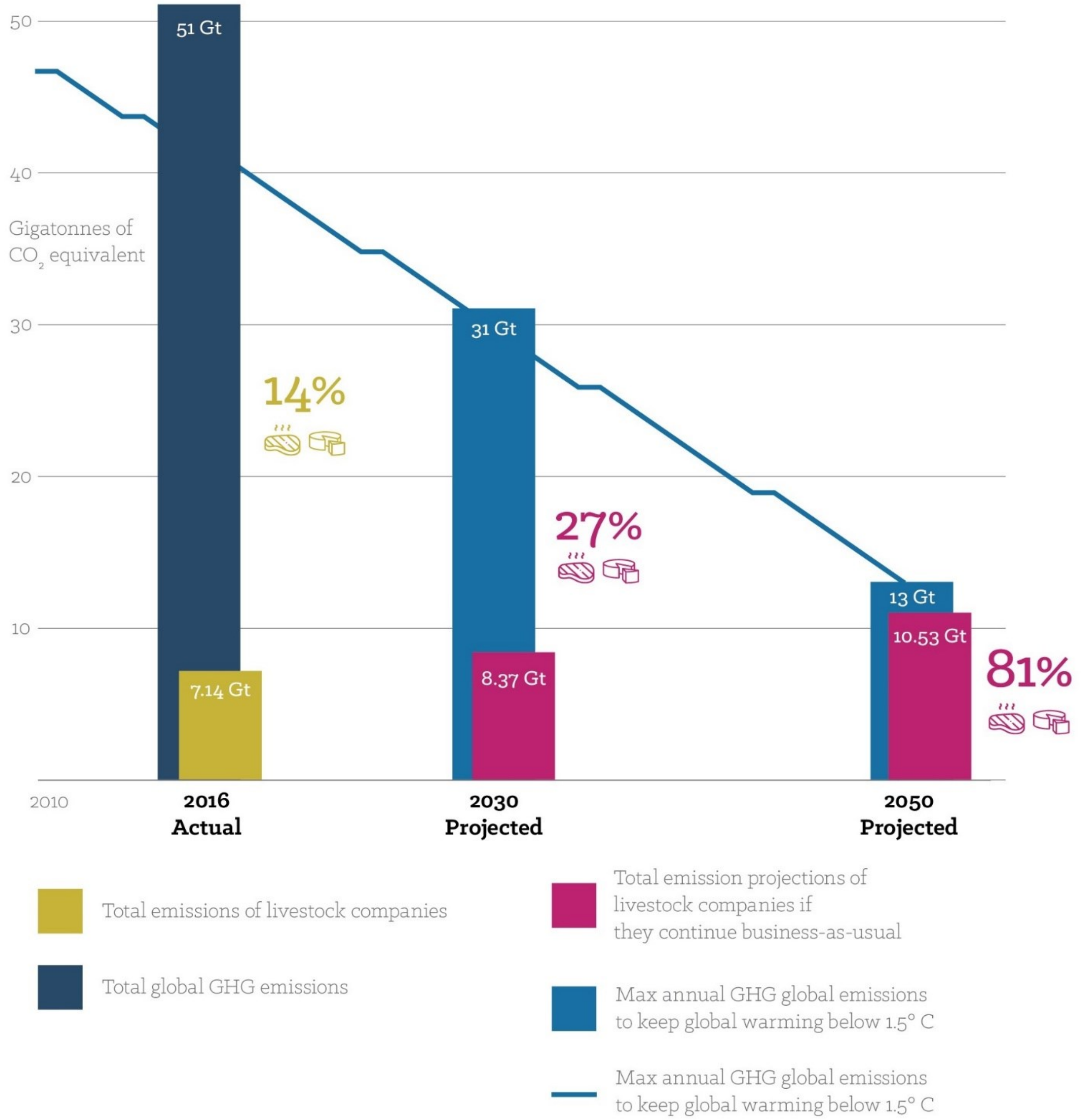


Figure 95: Estimated global GHG targets to keep within a 1.5°C rise in temperature compared to emissions from global meat and dairy production based on business-as-usual growth projections

Source: GRAIN (2018).

4.3.5 Fruit and vegetables

The UK consumes around 11mt of vegetables annually (Frankowska *et al*., 2019). Much of this is imported along with fresh fruit, especially those crops that cannot be grown here out of season. A similar disconnect can be found with the dependency in the UK on imported fruit and vegetables, where a switch to higher consumption levels would have very significant impacts on the additional carbon costs associated with air freight, out of season supplies, waste, and perishability (Clonan and Holdsworth, 2012). These imports equate to 7.5mt of fruit and vegetables (Tones, 2019) or around 51 per cent of the total consumed and, valued at €10.3bn in 2016, was the largest food import category by value, creating a €9.2bn trade deficit. This includes non-indigenous items such as exotic fruits that cannot be grown in the UK. Figure 96 shows the monetary value of these fruit and vegetable imports from 2013 to 2018; figure 97 similarly shows the tonnages of both fruit and vegetables to 2017, as well as indicating the degree of self-sufficiency. Over the last 30 years the number of acres planted to vegetables in the UK has decreased by 26 per cent (Landworkers' Alliance, 2017a). DEFRA (2020) latest estimates record vegetable imports at £2.5bn in 2018, a 2.8 per cent increase on the previous year with volumes up by 4.4 per cent to 2.3mt. Fruit imports cost a further £3.8bn in 2018. In addition, the Sustainable Food Trust (2019b) estimate a further 4.5mt of domestic production is lost to aesthetic grading including, for example, up to 50 per cent of all carrots produced.

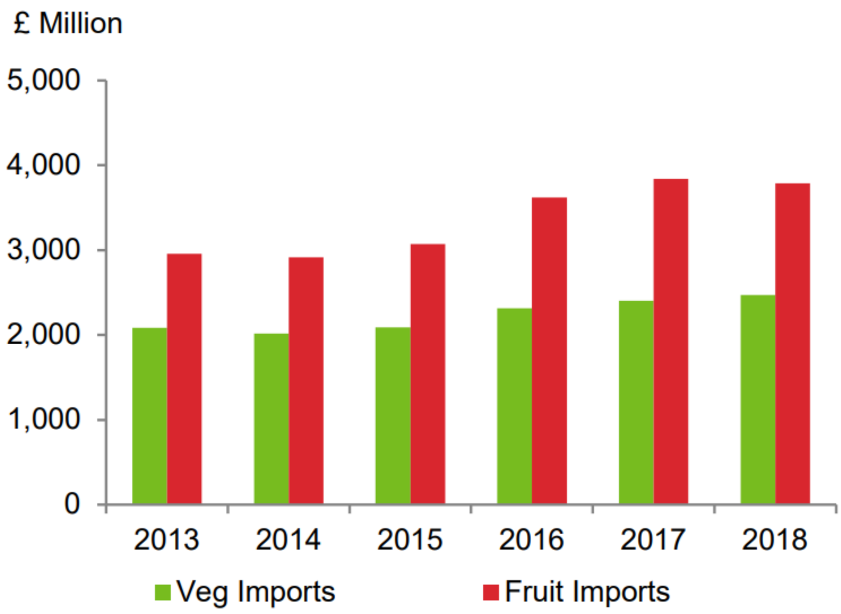


Figure 96: Imports of fruit and vegetables by value

Source: DEFRA (2019n).

Imports to the UK come primarily from the EU: one recent estimate suggests around 76 per cent of vegetable imports and 41 per cent of fruit; furthermore 40 per cent of them come from countries that are already water-stressed (Frankowska *et al*., 2019). The UK now only produces 31 per cent of the apples it consumes; the remainder comes from the EU, South Africa, and New Zealand (DEFRA, 2020). Figure 97 provides a more detailed breakdown of the location of fruit imports for 2013 to 2017, whereas figure 98 provides percentages from the major vegetable importers. The UK only produces around 20 per cent of its tomatoes, so is increasingly sourcing them from Morocco, where imports have increased from 7,148 tonnes in 2007 to 49,334 tonnes in 2017 (HMRC, 2020) as well as the more traditional markets in The Netherlands and Spain. Spain, Egypt and South Africa similarly supply the bulk of the oranges. Much of Spain's strawberry production, for example, is located next to the Doñana national park, a world heritage site, where it currently uses up to half the water this wildlife-rich wetland needs to survive (Leahy, 2015). Such challenges are set to increase the demand on water (Hess and Sutcliffe, 2018), worsening the risks of extreme weather events and climate change on fresh produce production (Moretti *et al*., 2010; Reganold *et al*., 2010; Kirezieva *et al*., 2015; Parajuli *et al*., 2019), and increasing the need to ensure the environmental sustainability of production (Kamp and Østergård, 2016; Angevin *et al*., 2017; Garofalo *et al*., 2017; Lazzarinia *et al*., 2017; Iocola *et al*., 2018; Walters and Stoelzle Midden, 2018; Frankowska *et al*., 2019; Parajuli *et al*., 2019). As with other supply chains, the fruit and vegetable sector continues to be further impacted by the increasing concentration and power of the food retailers (Maruyama and Hirogaki, 2007); the sector has also been associated with labour shortages and low wages (Fairtrade International, 2014; Navarrete *et al*., 2014; 2015), especially with the uncertainty of leaving the EU (Landworkers' Alliance, 2017b). Imports from outside the EU are tariff-free under existing EU trade agreements and so, under a 'no deal' scenario, such trade agreements would no longer apply (Tones, 2019).

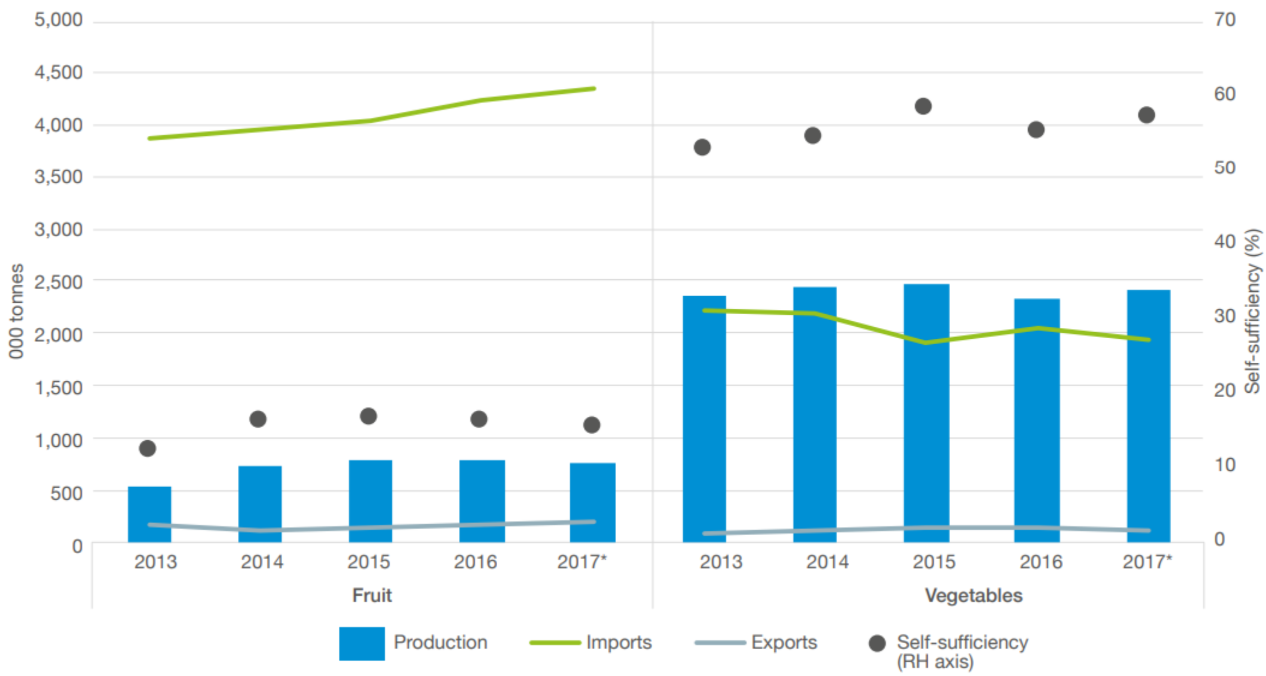


Figure 97: UK fruit and vegetable supplies by tonnage

**2017 production figure is provisional ~ Fresh/chilled vegetables, excluding potatoes*

Consumption figures used for self-sufficiency calculation were derived using production + imports – exports

Source: DEFRA, HMRC cited in Tones (2019).

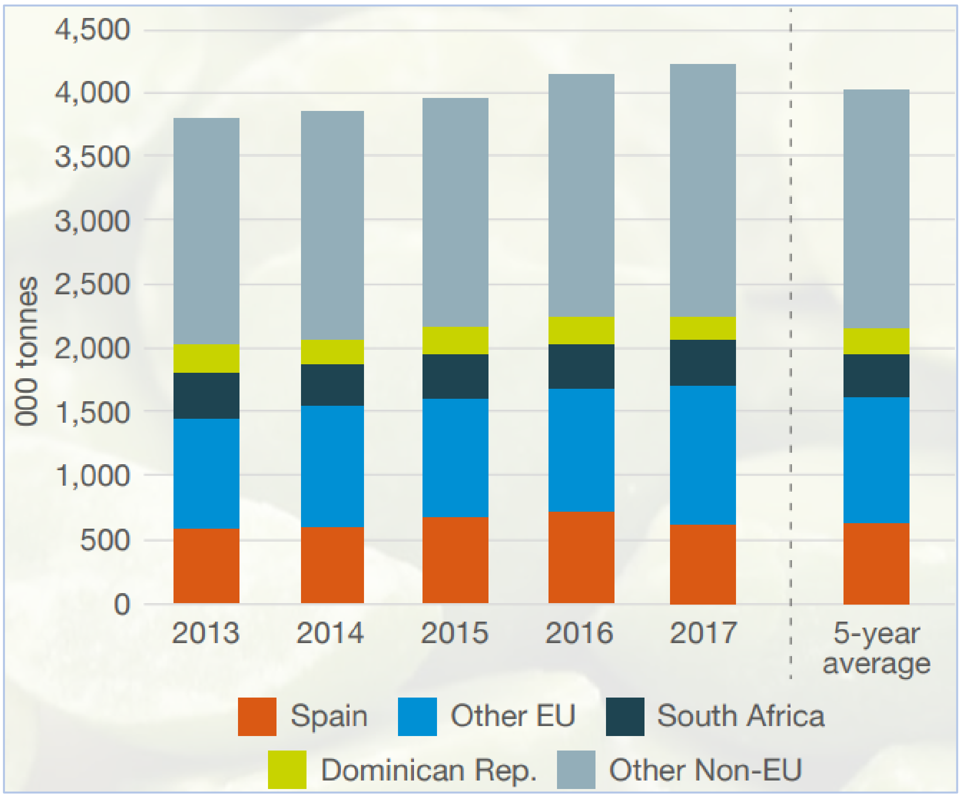


Figure 98: UK fruit imports 2017

Source: HMRC cited in Tones (2019).

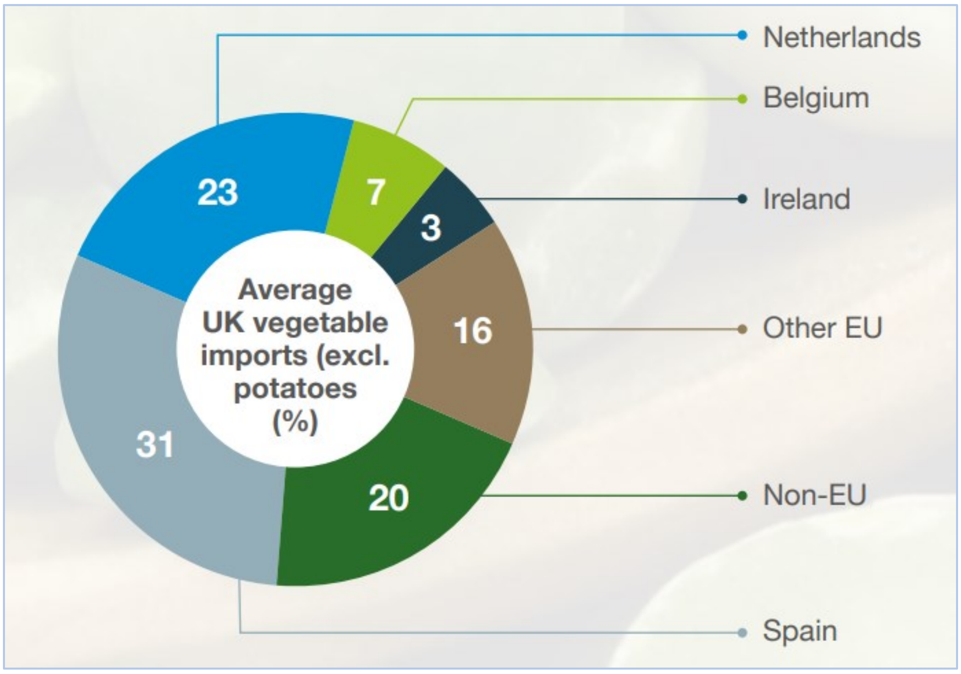


Figure 99: Average UK vegetable imports (excluding potatoes), 2013–2017

Source: HMRC cited in Tones (2019).

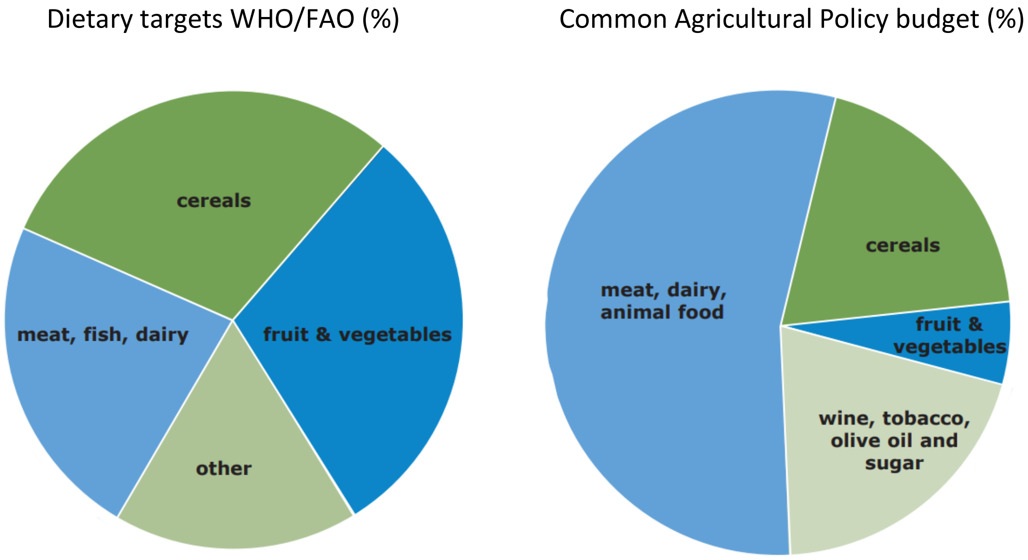


Figure 100: CAP expenditure versus nutritional health

Source: Birt *et al.* (2007).

4.4 Chapter summary

This chapter provides the results obtained from each of the three methods employed. The umbrella review synthesises the extent of existing evidence on future options for UK sustainable diets, health, and policy to address research questions one and two. Results from modelling predictions illustrate how climate change will impact the UK's ability to produce healthy food in one area of the UK to address research question three. Finally, results from the scenario analysis case studies show the impacts of climate change on the UK's main imported food commodities such as grains, potatoes, fish protein, animal protein, fruit, and vegetables.

5. Discussion

5.1 Introduction

This chapter interprets the empirical findings in terms of the research aims, objectives, and how this contributes to the wider literature. The original purpose of this thesis was to synthesise the challenges from the food– environment–health nexus, the anticipated impacts of climate change on this nexus, and identify the dietary behaviours that need to be adopted to reduce the impacts on human health. This synthesis would then be used to help train and enable UK health professionals to bring about the changes necessary in the move towards more sustainable diets. It starts from a premise over two decades ago that changing policy and food practices was a formidable but urgent challenge for both humanity and the environment on which it depends. Two decades on, *The Lancet* is warning that civilisation is facing an accelerating crisis as food security cannot be balanced within existing planetary resources; the scientific consensus on the potentially catastrophic global impact and gigantean scale of climate change has grown; more recently, when civilisation should be coming together to address this formidable global challenge, many nations have instead chosen a path of nationalism in their continued fixation with growing their share of these planetary resources. With this better understanding facilitated by an increasing knowledge base, the urgency is becoming ever more acute.

5.2 What constitutes a healthy diet, how sustainable are current UK diets, and the potential benefits of changes in dietary behaviour towards healthier eating? [RQ1]

The umbrella review adds considerable insight into the first research question. The topic has attracted many systematic reviews, accounting for around 40 per cent of all the studies included in this umbrella review, so the range of issues and possible interventions is very wide. Sustainable diets, health promotion and nudge theory have been particularly well-served by systematic reviews; less so for policy interventions to improve healthy diets. Reviews also recommend promoting healthier diets through a combination of food pricing and taxation policies. These reviews add important detail to the debate which, although such detail may not in itself be new, the review process does show where the current consensus lies. Collectively, they also make a compelling and overwhelming case for dietary change. The chance to reduce GHGs and land-use by half, along with the environmental and health benefits this would also bring would negate many of the less attractive sustainability options, such as sustainable intensification (Mahon *et al*., 2017). Increasing consumer awareness of the environmental impacts of their dietary choices remains a challenge, especially given the norm that most have not had to previously consider where their food has come from or the effects that this may have. Publication bias and the perceived weaknesses associated with nutrition science remain limiting factors, as well. Getting the message into all six food environments including schools and hospitals remains a challenge too. Some UK hospitals, for example, remain unable to adhere to the PHE Eatwell Guide because of contractual obligations with their current catering suppliers.

Diets that promote greater health benefits with fewer negative impacts on the environment have generated wide ranging discussion on the policy requirements to implement such changes. Consumer awareness of the benefits of dietary change is generally low, however, as is their current willingness to change. Here again the umbrella review identifies remaining gaps in the scientific knowledge, including how to motivate consumers to bring about the behavioural change needed to reduce their meat consumption, inequality, and the necessary improvements in health research (Haby *et al*., 2016; Lennox *et al*., 2018; Cerri *et al*., 2019; El Bilali (2019). Diets based on organic and local do not always produce lower GHGe and direct comparison can be difficult. But buying local does reduce the environmental costs of transport, ensuring that it will assume greater importance in the future as food systems have to cover their full environmental costs. An early study by Caspi *et al*. (2012) recognised the potential for local environments to be altered to bring about improvements in dietary health, although later studies found limited evidence for associations between local food environments and obesity (Cobb *et al*., 2015; Mackenbach *et al*., 2019), and Zenk *et al*. (2015) similarly find geographic disparities in these environments and dietary intake among some populations.

Numerous reviews evaluate strategies to reduce meat consumption or modify behaviour. Early studies called for caps on demand (Garnett, 2010) and on reducing per capita meat consumption (Porritt, 2010; Porritt, 2017). Chen *et al*. (2013) finds that the consumption of red and / or processed meat increases the risk of stroke, in particular, ischemic stroke. Other suitable interventions to reduce meat consumption are also featured, such as reducing portion sizes, providing meat alternatives, or changing the sensory properties of meat and meat alternatives at the point of purchase (Bianchi *et al*., 2018). Beef production is especially problematic in terms of its GHG emissions and current levels of consumption are climatically unsustainable. Production systems do vary, but with less overall impact than was previously thought: non-grass fed systems are more GHG emissions efficient but, grass-fed beef has lower carbon footprints (Lynch, 2019). Writing in *The Lancet*, Harwatt *et al*. (2020) suggest CO_2 emissions will need to be limited to 420b tonnes, with a further 720b tonnes removed from the atmosphere to limit global warming to 1·5°C; the business-as-usual trajectory would see livestock emissions accounting for 49 per cent of the emissions budget by 2030. If meat and dairy continues on the business-as-usual trajectory, it will account for 27 per cent of all emissions by 2030 and 81 per cent by 2050. Disagreement on policy direction still exists, however. The *Animal* journal recently published an opinion piece by Haniotis (2019) who argues that beef has assumed the disproportionate burden of proof on climate action; a similar article in the *Animal Frontiers* journal by Varijakshapanicker *et al*. (2019) appears to complain that too much of the sustainability discourse is placed on the environment, when 'equally important' factors include the need to ensure food and nutritional security in a culturally acceptable manner that ensures its accessibility, affordability, and safety. Harguess *et al*. (2020) evaluates strategies to reduce meat consumption and advocates modifications of the food environment such as increasing the number of meatless meals on restaurant menus. Several find low consumer awareness of the environmental impacts of meat is resulting in a low willingness to change (Hartmann and Siegrist, 2017; Sanchez-Sabate *et al*., 2019) even when faced with potentially undesirable health effects (Valli *et al*., 2019). Sanchez-Sabate and Sabaté (2019) find that where consumers are aware of the environmental concerns of consuming meat, they are more likely to be female, young, simply meat-reducer (not vegan/vegetarian), ecology-oriented, and living in Europe and Asia rather than in the USA. Allwood *et al*. (2019) makes specific recommendations: reduce beef and lamb consumption; buy locally sourced but not air-freighted; use less frozen and processed meals; and, insist farmers use less fertiliser.

Fish consumption is similarly problematic with many of the studies suggesting an imminent crisis. From the year 2000, studies and reports refer to a tipping point, beyond which stocks might collapse and millions of humans starve (Clover, 2004; Brunner *et al*., 2009; Pauly, 2009; Clover, 2012; Pauly and Froese, 2012; Levitt and Thomas, 2014; Thurstan and Roberts, 2014). Financial subsidises distort the industry (Sumaila *et al.*, 2007; Pauly, 2009; Sovacool, 2009; Sumaila *et al.,* 2010; Österblom *et al*., 2015; Gibbens, 2018; Sala *et al*., 2018; Tickler *et al.,* 2018; Costello *et al.,* 2019; Sumaila *et al*., 2019) and reduce the total biomass of commercially important species (Heymans *et al.*, 2011). Governance mechanisms have failed to deliver effective fisheries management (Garcia and Rosenberg, 2010; Greenpeace, 2012c; GRID-Arendal, 2012; Kalfagianni and Pattberg, 2013; Hadjimichael *et al.*, 2014; Malone *et al.,* 2014; Bremer *et al*., 2015; Bush and Mol, 2015; Iizuk and Katz, 2015; Costello *et al*., 2016; Webster, 2016; ISSF, 2018; Pinsky *et al*., 2018), especially the EU Common Fisheries Policy (Purvis, 2009; Froese *et al.*, 2012; Fernandes and Cook, 2013; Belschner, 2014; Säwe and Hultman, 2014; Belschner *et al.*, 2019). The UK catch equates to 32 per cent of its Exclusive Economic Zone (EEZ), the assumed jurisdiction over marine resources within the 200 mile radius from shore (Forse *et al*., 2019). The remaining 700,000 tonnes is taken by other EU states, Norway and the Faroe Islands; the UK also lands a further 92,000 tonnes annually from EU waters. Despite the extra-ordinary decline UK fishing productivity brought about by industrialised fishing, down 94 per cent over last 130 years (Thurstan *et al.*, 2010), perceptions of the CFP’s relative unfairness was a key focus influencing the Brexit decision (Billiet, 2019). At the same time, further studies conclude that fisheries certification will not arrest the decline in fish stocks (Lacquet and Pauly, 2007; Gulbrandsen, 2009; Hallstein and Villas-Boas, 2013; Kvalvik *et al.*, 2014; Madin and Macreadie, 2015; Hadjimichael and Hegland, 2016; Terazono, 2016; Smith, 2017). Calculating fish stocks is also problematic (Vassallo *et al*., 2007; Khalilian *et al.*, 2010; Branch, 2012; Froese *et al.*, 2012; Fernandes and Cook, 2013; Pritcher and Cheung, 2013; Belschner, 2014; Byelashov and Griffin, 2014; Vasilakopoulos *et al*., 2016; Belschner *et al.,* 2019).

The supply and availability of fruit and vegetables is critical to any nutritional policy, and particularly with the urgent need to switch to a sustainable diet. In the UK, the 5-A-Day campaign was launched in 2003 with the aim of reaching 5 portions a day for the whole of the UK population by 2015. Analysis of sales data by the National Farmers Union (2016) suggests actual consumption is around 3 portions a day; Beckenham (2009) had previously estimated 3.9 portions per day for all households, but only 3.5 for low-income households. The challenge was further exacerbated in 2014, with recommendations from the NHS that this moves to 7 portions per day. The Landworkers' Alliance (2017a), for example, calculated this would require 2.4mt of additional fresh produce which would equate to a 66 per cent growth in UK production. Finally, studies identify the urgent need for systematic public policy to target the constraints to producing and consuming fruits and vegetables, including increasing consumer education on healthy diets (Mason-D'Croz *et al*., 2019), otherwise global food systems will not be able to produce enough fruit and vegetables to meet the nutritional needs of the world's population (Bahadur KC *et al*., 2018).

Learning from best practice elsewhere is also complex due to the variability of national diets. Evidence on the health benefits of the Nordic diet is inconclusive; although the Indian diet is high in fruit and vegetable consumption, it varies significantly between regions and often has high levels of dietary fat and sugar; only the Mediterranean diet is associated with lower risk of type-2 diabetes and coronary heart disease. Vegan and vegetarian diets have lower overall health risks, and simply increasing fruit and vegetable consumption results in obesity reduction. More recently, the benefits of a worldwide healthy diet have gained some traction, with Wellesley *et al*. (2015) estimating has the potential to reduce emissions by 25 per cent by 2050 and a study observing when countries reduced their animal product consumption when switching to nationally recommended diets (Scherer *et al*., 2019). At the same time, Willett *et al*. (2019) suggest reductions in the consumption of red meat greater than 50 per cent will be required. Poppy *et al*. (2019) consider the trade of meat into the UK after Brexit, especially as the world's fifth largest importer, but concludes that any shortfall from the EU could be made up by other nations. There is also a need to establish international norms for healthy and sustainable diets in conjunction with bodies such as the WHO, FAO and IPCC, and continue to build the evidence base to help guide policymakers.

The price and affordability of current diets is also a common theme throughout the reviews. Here variables such as socio-economic status and inequalities in diet were also associated with specific consequences (Mayén *et al*., 2014; Mekonnen *et al*., 2020). Living in a socioeconomically-deprived area is associated with a number of obesogenic dietary behaviours (Giskes *et al*., 2011). Fleischhacker *et al*. (2011) found a connection between access to fast food and the prevalence of such outlets in low-income areas with higher concentrations of ethnic minority groups; Jia *et al*. (2019) similarly find an association with more fast-food consumption. Later reviews call for robust and psychometrically-sound measures and more sophisticated study designs to further understand this disparity (Lytle and Sokol, 2017), along with availability measures and accessibility measures (Bivoltsis *et al*., 2018). Early reviews considered the impacts of increasing food prices forcing consumers to switch to lower cost foods with higher disease risks (Andreyeva *et al*., 2010; Lee *et al*., 2011; Cornelsen *et al*., 2015; Lewis and Lee, 2016) and ultimately further increased socio-economic disparities (Green *et al*., 2013; Darmon and Drewnowski, 2015; Lara Silva and Sanjuan, 2019) especially during times of economic crisis (Rajmil *et al*., 2014). Furthermore, promoting healthier diets through food pricing policies should be a goal of public health and policy efforts, and can reduce consumption of unhealthy foods (Dangour *et al*., 2013; Rao *et al*., 2013). Here, subsidies to promote fruit and vegetable consumption could potentially reduce the rate of NCDs (Black *et al*., 2012) but need to be of a magnitude of 10-20 per cent lower in price before they become effective (Niebylski *et al*., 2015; Wood *et al*., 2019). Price and availability are also important determinants of food choice and are therefore critical in addressing the current obesity epidemic. Birt *et al*. (2007) argue that these two factors were partly regulated by the EU CAP and that there has long been a disconnect between global nutritional health recommendations and CAP expenditure. Further studies also record concern regarding having access to sufficient quantities to be able to adhere to recommendations such as the WHO's minimum target of 400 g/person per day (Siegel *et al*., 2014; Mason-D'Croz *et al*., 2019) and national dietary guidelines (National Farmers Union, 2016).

The reviews on dietary change also offer benefits in lowering diet related GHG emissions. Hallström *et al*. (2015) estimated that for areas with affluent diet, dietary change could reduce up to 50 per cent of the GHG emissions and land use demand associated with current diets. Further examples include the environmental and health benefits of changing to more sustainable dietary patterns (Aleksandrowicz *et al*., 2016) such as vegan, vegetarian and omnivorous diets, with the vegan diet having the lowest land use and water use and the least environmental impact, especially when local products are used (Dinu *et al*., 2016; Chai *et al*., 2019). Furthermore, adhering to sustainable diets promotes greater health and has a less negative impact on the environment than current average dietary intakes (Nelson *et al*., 2016; Albrecht *et al*., 2018; Harris *et al*., 2020). Reinhardt *et al*. (2020), however, found that diets adhering to the USA national dietary guidelines lead to similar or increased GHG emissions, energy use, and water use when compared to the current US diet.

5.3 How effective is the existing regulatory framework and what should a new policy framework comprise to ensure both risk minimisation and the security of sustainable, healthy food in the UK? [RQ2]

The evidence clearly indicates that UK food security is in a perilous state and certainly not where any developed nation would wish to be. Warnings that civilisation is in an accelerating crisis which threatens human existence because we can no longer provide a healthy diet while balancing planetary resources cannot be ignored; neither can claims that UK policy lacks overarching agenda that aligns healthy eating and environmental protection to deliver sustainable diets (Langdon and Mwatsama, 2018). Although previous scenario analyses have considered policy options ranging from increasing self-sufficiency through to increasing reliance on global imports (Benton, 2020), the evidence considered within this thesis would certainly not advocate the latter. The irony of a global pandemic starting mid-way through the writing of this thesis further reinforces the view, as global institutions such as the World Bank (Espitia *et al*., 2020a; 2020b) and the IFPRI (Laborde *et al*., 2020) raise concerns that trade reactions to COVID-19 further risk turning a health crisis into a food crisis. Altman (2020) likewise observes that COVID-19 and the public health response are causing the largest and fastest decline in international flows in modern history. At the same time, the disruption to UK supplies caused shortages (Murray, 2020), panic buying, and further exacerbated food inequalities (Rayner, 2020). At the very time when we require our government to show leadership and clarity of vision, the evidence would suggest the opposite. When DEFRA and PHE were recently asked about setting up an expert committee on food and nutrition to assist during the COVID-19 crisis, DEFRA said that PHE was responsible; PHE in turn said the matter was for ministers; clearly both thought the responsibility wasn't theirs. This is after the UK climate minister went on record in 2018 to state it is not the government's job to advise people on a climate-friendly diet (Harrabin, 2018). Simultaneously, the food and consumer media is awash with concerns about the potential impacts on UK food standards as the UK government embarks on a trade deal with the USA. Whatever the outcome, the recent recommendation to government from the RSA-FFCC (2019b) that it should not use trade deals to off-shore climate and environmental commitments to countries with fewer resources or weaker environmental standards remains fundamental. It is also the focus of a current Greenpeace campaign. Further calls for proactive government leadership include: the resources and scale capacities needed to change diets; to incentivise business; to provide soft interventions to nudge consumers to more sustainable diets; to provide a clear rationale for interventionist taxes (Weis, 2015; Wellesley *et al*., 2015; Springmann *et al*., 2018a; *The Lancet*, 2018e; Baggini, 2019); to help increase consumer awareness on the links between livestock, diet and climate change; and, the public expects leadership whereas inaction risks signalling unimportance. Wellesley also argues that the market is failing with insufficient incentives for business to reduce supply. The issue is further complicated by so-called trade-offs. Here beef is the oft-cited example, as emissions from intensive systems are often lower than grass-fed systems but is associated with a host of other concerns (McMichael *et al.*, 2007; Wellesley *et al*., 2015; Young, 2018; Mozaffarian, 2019). To overcome potential confusion, trusted experts will be needed, especially to engage with the mainstream media. Finally, ensure that this receives cross-departmental support within government.

The review demonstrates the wealth of literature available to help inform policy development. The interdisciplinarity of the problem, the growing imbalance of power, finance and governance remain challenging and more effort is needed to ensure that all stakeholders and interested parties are contributing towards the same ends. Neither is the problem necessarily a new one, as the unsustainability of food systems has contributed to the fall of civilisations throughout history. But the gravity and enormity of the task has been growing now since at least the 1960s; some would argue even earlier; and its current scale is unprecedented. Not only do food systems impact mortality, morbidity and environmental degradation; coupled with the insatiable need for growth, they also compromise the ability of future generations to meet their own needs, and threaten attainability of the SDGs and the Paris Climate Agreement. Numerous scientific studies have been referring to the need for an urgent solution for at least the past two decades. Today, attention is very much focused on resolving the multitude of challenges as quickly as possible; beyond 2030 is generally regarded as being too late to significantly alter the course of the trajectory towards the impending existential threat (RSA FFCC, 2017; Porritt, 2020).

The reviews highlight the importance of using a combination of strategies to deliver the best improvements, so healthy diets should be used in conjunction with other strategies such as lifestyle improvements. Health promotion interventions such as health education, nutrition education, dietary change strategies and environmental modification are considered across a range of settings, including schools, workplaces, restaurants and retailers. Such strategies are especially important within the six obesogenic environments for the young: namely, schools, retailers, television, the internet, in the home, and those promotional campaigns targeted at them. Others include food taxes and subsidies to improve diets and health (Thow *et al*., 2014; Alagiyawanna *et al*., 2015; Walls *et al*., 2018), as well as the more recent focus on public food procurement (Stefani *et al*., 2017). Legislative options include multi-component interventions to assist in dietary reformulation and to limit access to unhealthy foods such as those which are ultra-processed or contain Trans-Fatty Acids. The simultaneous use of taxes and subsidies offer the dual benefit of reducing GHGe and ensuring healthier diets. Care is needed, however, given the complexities of the GHGe of some foods, especially when healthier and nutrient-dense foods can be associated with higher GHGs than foods providing poorer nutrition, higher sugar consumption, or lower micro-nutrient uptake. Similarly, taxes on items such as carbonated drinks and foods containing saturated fat were associated with beneficial dietary change (Eyles *et al*., 2012; Afshin *et al*., 2017). The success of such interventions can, however, be undermined by publication bias with little data on either the longer-term effects or cost-effectiveness (Appleton *et al*., 2016). The umbrella review also identifies various specific needs: for smart governance systems (Candel, 2014); to better understand what food insecurity looks like (McKay *et al*., 2019); for food to become a public good and guaranteeing universal access (Bes-Rastrollo *et al*., 2013; Vandergeten *et al*., 2016; Vivero-Pol, 2017; Zaçe *et al*., 2020); to target inequalities in food insecurity for vulnerable groups such as children; for interdisciplinary approaches and stakeholder engagement to address the challenges; and, for science-informed policy decisions.

Finally, recommendations for how food policy should be developed to ensure UK food security and specific proposals for UK health professionals that will enable them to deliver evidence-based information to inform and bring about the behavioural change needed in the transition to more sustainable and healthy diets. Here examples include extending better labelling of healthier foods to include sustainable diets as well (Crockett *et al*., 2010; Cecchini and Warin, 2016; Clune *et al*., 2017; Chau *et al*., 2018; Christoph and An, 2018; Croker *et al*., 2020). This would empower consumers to make healthier food choices. It needs to be done with care, however, to ensure the use of consistent health and nutritional information without undermining public health nutrition, especially should consumers buy more environmentally friendly foods that may be less nutritious. Interpretive labels such as traffic lighting have been found to be more effective across the retail, hospitality and takeaway settings and therefore offer greater potential for nudging consumers towards behavioural change. These also need to be used in conjunction with clearer guidance and standardisation on portion sizes and definitions such as small, medium and large. Once again, such policies also need to be supported through better education.

5.4 How will climate change impact the UK's ability to produce healthy food? [RQ3]

The third research question also sought to establish the latest scientific consensus on the policy changes needed to enable domestic food production to adapt to climate change. Here the umbrella review helps provide a definitive prognosis on the increasing environmental and climate change-related issues across four areas. The first is the increasing scale of the risk to global food security along with a wide range of possible future scenarios that this increasing risk may bring. The second area relates to the state of readiness of the current UK food system and its likely ability to be able to adapt to an increasing scale of change. Here again the consensus is a cause for concern. The UK has not had a clear food policy for many decades; instead, it has chosen a free-market approach which has exploited global sourcing in favour of preserving domestic food production; much of the necessary infrastructure has either been dismantled or has fallen by the wayside. Successive UK governments have become accustomed to a system that they believed negated the need for market intervention. Furthermore, increasingly powerful commercial interests were best-placed to provide food for the UK and sometimes even help decide health policy too. The net result of this free-market approach has led to a policy vacuum, whereby government either no longer sees the need for robust food policy, or they remain reassured by the continued availability of food on supermarket shelves. But the scientific consensus and even the evidence commissioned either by them, or provided by their own auditors, clearly presents a very different prognosis for the future. The current status quo cannot possibly accommodate the many and varied risks the UK food system now faces. In fact, the current comparative metrics provide grim reading for the UK. Poor diets, growing food inequalities and spiralling health costs all suggest both a failure of the market and an urgent need to change. The UK urgently needs clearer policy direction that links climate risk and vulnerability assessment effects of healthy food supplies. The continued decline in domestic food production is increasing food insecurity in the UK and needs urgent intervention to reverse, especially given the increasing risk of insecurity with food imports caused by increasingly volatile markets. The UK needs to produce more of its own food, especially foods that are suited to UK growing conditions e.g. fruit and vegetables, across all regions, shorter supply chains as part of a national drive to contribute to global targets such as the SDGs Lang (2020) had earlier suggested returning to the 80% self-sufficiency of the 1980s. Thirdly, a similar free-market approach and increasingly deregulated planning environment has dramatically increased competition for land in the UK. This has increasingly seen land best reserved for food production being used for a whole variety of other purposes, including fuel and house building. Increasing use of land to grow animal feeds such as maize have also accelerated rates of soil degradation. The umbrella review, however, suggests that land used to produce food needs much greater levels of protection from other potential uses and to further reduce the degradation caused by land-use change. The UK urgently needs to devise a policy that protects the land currently used for food production as well as preserving its other functional uses, such as water, carbon storage, rewilding, biodiversity, etc. Similarly, the UK needs to reduce the amount of land used for animal production, especially where it is intensively produced, as well as carefully monitoring and regulating the amount and effects of biofuel production. Finally, by making better use of its own, domestic food-producing capabilities, the UK can reduce its dependency on the resources of other countries at a time of increasing shortages and pressures on such resources. This is the only realistic way that the UK can meet its existing international commitments to carbon emissions reductions.

Despite the initial enthusiasm following the launch of the Climate Change Act of 2008, the target of reducing 80 per cent of all GHG emissions by 2050 is now seen as insufficient and the timescale too slow; the latest analysis by the Committee on Climate Change (2019f) also finds poor performance in nearly all policy areas. As a matter of urgency, the Government needs to ensure the timely delivery of existing policy commitments; look to improve ambition and timeliness by further challenging and incentivising stakeholders; and invest in domestic production capacity in a controlled and strategic manner. This latter commitment should be both focused on foods that the UK has a natural capacity to grow now, and those that may become more attractive as our climate changes. Farmers should be better awarded for their contribution towards supplying healthy foods and environmentally beneficial methods of production. Reduce dependency on imports to those products and raw materials that cannot be grown here, such as exotic fruits and hard wheat. Improving the ambition and speed of response is even more critical, given the post-Paris Agreement consensus of the need to reduce temperature increases to 1.5°C rather than 2°C. Other policy options include employing punitive taxes to discourage commodity imports for animal feed production in particular (e.g. fishmeal, maize, soya, and palm oil) as well of those destined for food manufacture and, where appropriate, on those products for direct human sale (e.g. ultra-processed foods containing maize, soya, and palm oil). Government should provide incentives at a regional and local level for alternative supply chains to develop. To address the environmental and health externalities of food they should use a combination of price controls and other financial tools. They also need to respond to calls from the ASC to undertake more research into the likely effects of flooding on UK food production to better inform policy direction. As for biofuels, government should abandon current ambitions and incentives for any form of bioenergy that requires land-use, given the rises anticipated would use an additional 1.8bn acres globally, with potentially catastrophic impacts on ecosystems. This should be part of a wider, overall move to change and improve land management policies for sustainable food production in ways that enhances the biodiversity of ecosystems. Although sustainable intensification offers clear benefits, it should only be able to proceed under clearly defined circumstances i.e. that the prerequisites of enhancing the biodiversity of ecosystems remains the over-riding priority. If this is not the case, then the risk becomes repeating mistakes already experienced in the UK i.e. protect the areas that need protecting (e.g. national parks and areas of natural beauty) but the vast majority of the remaining land can carry on with maximising production without full regard for the longer-term consequences. Rather than becoming increasingly isolated, the UK should look to fully engage with and even lead by example in international co-operations that are working to address climate change, such as the 10-year action agenda by the UN Convention on Biodiversity later this year (van Havre and Ogwal, 2020). This global activity could possibly include using the ability to trace historical emissions back to the 90 industrial producers mainly responsible and target them for future regulative control.

The initial prognosis for food production in the UK is reasonably positive. As crop yields are determined by both growing season temperatures and precipitation, the general assumption based on global modelling projections suggest growing conditions in the UK could improve marginally towards 2050. Furthermore, the UK could potentially contribute more food in the global drive to offset the significant falls in yields expected for many developing nations in the southern hemisphere, where the climate change prognosis is much more severe. This initial UK prognosis, however, does not fully take into consideration the caveats that are also accorded to it. Much of the UK's crop producing areas are currently located in the lower-lying alluvial soils mostly associated with coastal areas and river plains. Using meteorological predictive modelling to understand how climate change will impact domestic production on one important food growing region – the Lincolnshire Fens, one of the regions most at risk from climate change, raises a number of specific challenges.

The soils in Lincolnshire can be broadly classified into three types: soils overlaying limestone; soils overlaying chalk; and deep, alluvial clay and peat soils associated with historical river flood plains and areas reclaimed from the sea. It is these deeper soils that provide the right conditions for vegetable and potato production. The detailed study by Edwards (2017) identified a number of areas around the UK where sea-level rise could temporarily or permanently impact current production including, for example, the Lincolnshire Fens. This current thesis used the *CoastalDEM* model, specifically designed to identify areas at particular risk, to further investigate the impacts on this region under various future scenarios. The results indicate that, even at relatively modest levels of sea level rise (30-115cm) the area affected would be wide ranging and, by 2050, even assuming moderate cuts to existing GHG emissions, the model suggests around half of Lincolnshire's land area will be affected (figures 69-74) including almost all of its 'Best and Most Versatile' food producing land (i.e. those predominantly located in coastal areas, including reclaimed salt marshes and numerous river plains). This land has national importance in terms of domestic food security. Sayers *et al*. (2015) estimates over 320,000 acres of best arable land is at risk of flooding, whereas LCC (2019) suggest a total figure of 960,000 acres (including fenlands in neighbouring counties). The NFU (2018) estimate this area currently produces 37 per cent of English vegetables, 27 per cent of the potatoes, and 3 per cent of the fruit. Mitigating against such risks is especially difficult and may prove prohibitively expensive.

The geography and history of the area means much of the land is at or below current sea level, where it is protected by 60 miles of coastal sea walls, 96 miles of fluvial embankments, and a further 3,800 miles of watercourse drainage (NFU, 2019). The area also contains three vital shipping ports identified by DEFRA as critical to existing food imports, especially meat, fresh vegetables, palm oil, and sugar; the extent of the threat is deemed so severe, that DEFRA recommend other ports develop contingency plans and the food industry reduce its current dependency on EU refining, processing and consolidation centres. Despite this, although the Committee on Climate Change list a range of concerns for the coastal impacts of climate change, the lists makes little reference to expected impacts on agriculture and none on food systems. They do claim, however, that the government's current approach towards flooding and coastal erosion is unfit for purpose and they need to wake up to the real challenges ahead. The Environment Agency are similarly critical; they estimate the coastal erosion and sea-flooding schemes will require expenditure of more than £1bn a year over the next 50 years (Wall, 2019); the government has allocated £1.2bn for 2015 to 2021 i.e. 20 per cent of the amount needed per annum. Clearly, priorities will need to be identified but sparsely populated, rural food-producing areas may be deemed low priority. This may also be reflected in the local authority publications, almost all of which fail to prioritise protecting food producing land as a priority in flood defence planning, as well as in the attitudes of local businesses who had done little to mitigate and did not see a need to relocate (Evans, 2012). Those businesses who acknowledged the forthcoming risks believed additional barriers and defences would be put in place to protect the area. The current food sector plan for the area does at least acknowledge the risk to the food commodities mentioned earlier, and also raises the additional concern for the 70 per cent of the nation's fish processing capacity along with its associated vegetable freezing and processing facilities (which accounts for 12 per cent of national capacity) within one of these vulnerable ports (LLEP, 2019).

Implementing policy at a local authority level is particularly challenging, given the fragmented nature and differing types of government, including county councils, district councils, unitary authorities, metropolitan districts and boroughs. In the case of the Fens, then these cut across several local authority responsibilities. Early publications by Lincolnshire County Council make no mention of climate change, flooding risk, or sustainability (LRO, 2007); the LRO (2011) makes first reference to specific concerns regarding flood defences and makes the case for ensuring that high value, Grade 1 farmland is recognised as a priority in district flood defence planning. That said, however, the issue is more about the problems of supply caused by the 2010 spring and early summer drought, rather than longer-term concerns. In response to the government's Planning Policy Guidance 25 (PPG 25), which delegated flooding risk to local authorities in 2001, Lincolnshire's first Strategic Flood Risk Assessment was published (North and North East Lincolnshire, 2011). A review of policy the following year was produced in response to concerns raised by the Adaptation Sub-Committee in their biennial report to the Committee on Climate Change that very little, tangible action was occurring at local authority level. This policy review acknowledges the vulnerability to rising sea levels and flood risk with large areas at, or even below, existing sea level; it concludes by calling for immediate action to limit the impact of climate change and to prepare for unavoidable changes that must occur (LRO, 2012). A DEFRA-commissioned study (Evans, 2012) also looked to elicit attitudes and behaviours of the food industry and, in particular, what steps were being undertaken to safeguard food security. Responses from fenland food producers demonstrated a good awareness of the Climate Change Act, but little evidence of adaptation or mitigation. Examples of those adapting included buying sandbags in the case of floods; none believed their businesses would need to relocate because of flooding; others thought scenarios suggesting large parts of the region would be under water within 30 years were unlikely to happen; others accepted the scenarios, but believed flood barriers would be erected and sea defences put in place to protect such areas; few businesses had considered disruption to their supply chains caused by flooding; many were uncertain as to whether they had signed-up to the flood warning service and few had checked the environment agency maps for context. This data on the attitudes and behaviours of managers within the food industry was used to inform the food sector plan 2014-2020 that followed (Collison, 2014) and the later addendum (Collison, 2017). These see flood risk as a major weakness for the food businesses within this area. It details specific risks caused by both fluvial and estuarine flooding and includes major clusters such as the fish processing facilities in Grimsby, the associated vegetable freezing and processing facilities, fresh produce and horticultural distribution facilities, and large swathes of highly-productive, food producing land. The plan also lists threats such as flooding discouraging future investment and reducing scales within the food sector. It also predicts increases in winter rainfall (14 per cent extra by 2050) and reduced summer rainfall (17 per cent less by 2050) as necessitating additional storage capacity. It also refers to further work needing to be done to assess the cost of flooding and the crop failures that this would cause, as well as considering growth potential, especially in replacing imports of intensively-grown food crops. The East Lindsey region followed suit with their strategic flood risk assessment in 2017 (ELDC, 2017) and the areas came together in a Local Enterprise Partnership to explore future economic growth (LLEP, 2019). This sets out the areas importance to national food security: specifically, 12 per cent of the England's food and processing capacity, including foods such as ready meals, soups and pizzas; 70 per cent of its fish processing; 25 per cent of vegetable production; 19 per cent of sugar beet production; and 18 per cent of the country's poultry. It argues in favour of the regions international reputation, as well as its contribution to the local economy (24 per cent of jobs compared to 13 per cent nationally and 2 per cent of its economic output compared to 7 per cent nationally). Responses to flooding are also considered in the Local Plan to 2032 for North East Lincolnshire Council (2018) and South East Lincolnshire to 2036 (SEL-JPU, 2019). They describe how much of the land area was originally reclaimed from the sea by a vast network of drainage systems, coastal defences, and interconnected tidal rivers with pumping stations and sluices. The risk of flooding is seen as not only threatening whole settlements, but also inundating valuable soils with saline water which would negate food production for many years. In a Foresight report for the UK Government Office for Science, Edwards (2017) estimates that 321,230 acres of Best and Most Versatile food producing land is currently at risk from sea-level rise; this will eventually increase to 444,780 acres when such levels become more extreme (table 16). The three future scenarios to 2100 used here are 30cm sea-level rise (low–medium) with strong mitigation, 60cm sea-level rise (high) based on the current trajectory of GHG emissions, and 2.5m sea-level rise (extreme) to simulate the impacts of melting ice sheets on the speed of climate change. The figures in the enhanced column give an indication of the anticipated effects of mitigation measures to reducing flood probability, exposure, and vulnerability. For comparison purposes, figure 75 shows one regional authority analysis of the extent of current flood risk, figure 76 the Government's Flood Warning Information Service analysis of Fenland flood risks, and the coastal evacuation routes introduced by the Environmental Agency in 2015 (figure 77).

5.5 How will climate change impact the UK's main imported food commodities and what will this mean for major UK food supplies? [RQ4]

The literature is currently inconclusive as to the longer-term prognosis for the impacts of climate change on the major, global commodities. The problem here is the extent to which yield reductions will be off-set by higher rates of atmospheric CO_2 concentration. Yields are invariably determined by growing season temperatures and precipitation; together, these two factors are ordinarily responsible for yield ranges of around 30 per cent between successive years (Lobell and Field, 2007). With climate change progressively increasing temperatures, the general consensus is that warmer temperatures of 2–3°C will diminish crop yields in the tropical latitudes, especially when accompanied by increasing precipitation, but be more positive in high-latitude regions (Easterling and Apps, 2005; Lobell *et al*., 2011; Elbehri, 2015). The prognosis for Africa is particularly severe: the IPCC warn that many of the crops grown at present will be unable to survive temperature increases by 2050 (Appropriate Technology, 2016; Palazzo *et al*., 2017). By using climate change models and world food trade system scenarios, some studies suggest that climate change will not bring about a net decline in global yields therefore the world should be able to feed itself in 2050 (Parry *et al*., 2004; Lobell and Gourdji, 2012). Such optimism does come with caveats, such as although the developed world would need to increase production to compensate for losses in those developing countries more severely impacted by climate change (Parry *et al*., 2004), or that climate change threatens sustaining global productivity growth at the rates needed to meet demand to 2050 (Lobell and Gourdji, 2012). Benton (2016) also argues that the productionist approach of greater quantities of cheaper food facilitated through international trade is unlikely to provide either sustainable diets, equity, or food security. Benzie *et al.* (2017) sees the EU as increasingly exposed to the risks of climate change impacts outside of its borders through an increasing reliance on trade. Ingram *et al*. (2019) similarly argues the UK's food system is more vulnerable to disruption due to both importing half the food needed and the present diet that demands a wide range of foods to be available all year round. Such disruptions include increasingly extreme weather, currency fluctuations, and changes in trading arrangements; fruit and vegetables imports from water-scarce countries such as Spain, South America and South Africa are seen as especially vulnerable (Salmoral *et al*., 2018). Whatever the actual outcome, it does seem ironic that global efforts to reduce the rate of increase and ultimately reverse the levels of atmospheric CO_2, may in time further reduce yield projections and affect their nutritional quality, too. Further uncertainty surrounds predicting the impacts of future ozone levels; estimates of yield reductions vary widely – from 24 to 95 per cent. Whatever the actual amount, it can only be assumed at this stage that future ozone levels will significantly lower yields and therefore reduce the total amounts of maize, rice, wheat, and soyabean available. Even where yields are increasing, the rates are insufficient to meet the global demand increases caused by population growth. Collectively, these four commodities provide two thirds of global calories so any reduction in the quantities available would cause serious and potentially catastrophic consequences for many developing and import-dependent countries alike.

The umbrella review also adds to the consensus to the fourth research question on the substantial risks that climate change poses to the future availability of imported food. It reaffirms the position that the overall prognosis for global food supplies will be characterised by a combination of climate-induced yield reductions, greater risks from trade disruptions and possible conflicts, higher food prices and longer-term threats to availability. These growing threats to global food security will transpire at a time of both increasing demand driven by population growth and heightened uncertainty in the marketplace. The impacts of climate change on food systems has, rather unsurprisingly perhaps, been explored more extensively through the systematic review process, producing 16 relevant reviews to date. One of the earliest to meet the inclusion criteria for this umbrella review is also one of the most significant; it looked at 1700 studies into the global effects of climate change on crop yields, with the meta-analysis finding that yields for wheat, rice, and maize are at particular risk at temperature increases of 2°C (Challinor *et al*., 2014). One earlier review had already found increasing CO_2 concentrations were likely to decrease the protein concentration of many plant foods (Taub *et al*., 2008). Later systematic reviews soon added to the knowledge base: the effects on yields in Europe is more positive, especially in Northern Europe where yields could be higher by 2050, whereas in southern Europe yield reductions of 11 per cent were predicted (Knox *et al*., 2016); the meta-analysis by German *et al*. (2017) suggested the link between yields and the negative externalities caused by a range of measures including efficiencies in energy-use, water-use, nutrient-use, pollination, abundance or effectiveness of natural predators, and soil biodiversity; in those areas where yield is more effected, this would further impact quality and ultimately nutritional health especially in fruit, vegetables, nuts, legumes, and seeds (Scheelbeek *et al*., 2017; Scheelbeek *et al*., 2018; Alae-Carew *et al*., 2020); Knapp and van der Heijden (2018) found that although organic production systems promoted biodiversity and environmental benefits, yields were 15 per cent lower and Wickramasinghe *et al*. (2013) claim that organic and locally produced foods do not always produce fewer GHGEs; whereas Escarcha *et al*. (2018) saw gaps in the research for large parts of the world and Le Mouël and Forslund (2017) recommended scenarios that both increased yields and involved dietary change. Further systematic reviews call for improved model reporting and methodological improvements in order to better predict future global food demand (Flies *et al*., 2018), better assess climate risk and vulnerability (Jurgilevich *et al*., 2017), adaptation strategies (Pearce *et al*., 2016), the need for greater knowledge (Wirehn, 2018) and the need to examine adaptation and mitigation policies together (Landauer *et al*., 2015). One of the latest meta-analyses finds that those countries most at risk from climate change will also face the highest AMR risks affecting both aquaculture and human health (Reverter *et al*., 2020) which requires global antibiotic policies to effectively restrict (Tang *et al*., 2019). Many countries will be forced to limit food exports to ensure their own domestic food security, and thereby further exacerbating the availability of food supplies. The scientific evidence adds further weight to the existing EAC warning to government of the significant risk to existing food security, especially the current sourcing of fruit and vegetable imports from countries at a higher risk of being impacted by climate change. The evidence also confirms the risks to food security are also further exacerbated by Brexit and a 'no-deal' trade outcome with the EU.

To understand the significance of these impacts in more detail, the research also uses scenario analysis to develop case studies on the impacts of climate change on selected food commodities - grains, potatoes, fish, meat, and fruit and vegetables - are of particular importance to the UK. These cases primarily demonstrate a disconnect between what modern food systems demand and what future diets should look like. Here estimates suggest that the current global cereal production provides 2.5 times more cereals, but less than one-fifth of the fruit and vegetables needed should everyone adopt the USA's dietary guidelines. Many systems are heavily dependent on both fossil-based inputs and water availability; yield growth is plateauing and may well fall further with increasing temperatures. This in turn is expected to mean that supply will be unable to keep up with the projected increases in demand caused by population growth. The sustainable intensification techniques currently advocated in some circles may well be restricted by failing soil fertility. Perhaps the biggest limitation, however, is the current practice of feeding around a third of all grain to cattle. As the population increases and many become more affluent, the increasing consumption of animal products will further exacerbate this problem, with even more serious deterioration in the environmental degradation that this causes. Maize is the largest cereal market globally, but critics are concerned about highly unsustainable associations including deforestation, high water needs, soil degradation, and fertiliser usage. It is also highly threatened by increasing temperature changes, where rapidly reducing yields could have devastating impacts on millions of the world's poorest consumers who rely on this as a staple crop. In the UK it is grown as a cattle feed and increasingly for bio-gas generation, both of which have led to rapid declines in soil biodiversity. Rice production causes similar concerns from a sustainability perspective: yield increases cannot keep up with rising demand; this demand is creating additional pressure on land resources; and the crop is also highly susceptible to temperature increases. Wheat provides daily calories for 4.5 million people, but increasingly cannot be grown in sustainable ways and again demand is outstripping yield growth. The crop is particularly susceptible to drought and heat diminishes important quality characteristics. Soya production has increased by 50 per cent within the last decade, fuelled by genetic modification and dependency on multiple applications of glyphosate. Around three quarters of all production is again fed to livestock; it is also used in biofuels. Despite its multitude of possible food uses and being found in two-thirds of UK processed foods, it remains a highly controversial component within plant-based diets. Of the 3.2mt imported as raw material into the UK, the majority comes from South America where its rapid growth is synonymous with land-use change, industrial-scale monocultures and deforestation. Although responsible certification schemes are in operation, they cover only a minute proportion of the total crop sold. Climate change is also expected to bring about yield reductions in potatoes, as well as forcing significant changes to where and how the crop is grown. Know *et al.* (2011) predict UK production in areas such as the Lincolnshire Fens will be impacted in around half of all future seasons, either by water shortages or flooding, whereas at present only around one third of all harvest years are impacted (Adesina and Thomas, 2020). The ability for the UK crop to withstand climate change remains a gap within the current literature.

The case studies in meat and fish are associated with a huge array of sustainability issues. In the case of fish, the problems are invariably down to systematically overfishing and environmental degradation. Consumption is increasing by nearly 10 per cent per annum which, although this may be good from a dietary perspective, is responsible for many additional concerns. The case study into both fish capture and aquaculture makes for dire reading, with much of the scientific language framed with terms including collision course, harming human prosperity, a climate-led perfect storm into total collapse, and a tragedy of the commons. Poor political governance, including under the CFP, has had a significant part to play, especially when increasingly sophisticated, industrial-scale vessels have been allowed to catch amounts far beyond those deemed essential by scientists to enable stocks to recover. Without time to recover, scientist warn global fish stocks could be tipped into collapse by 2050 or even earlier, causing millions to starve. Once again, these practices are controlled by a diminishingly small circle of global corporations, based in wealthy countries but extracting fish from the other countries' waters. Many UK fish species have either long-since disappeared or are no longer economically viable. Although the UK has established a limited number of protected zones, the latest reports suggest even these were fished for over 3000 hours in 2019, by industrial 'super-trawlers' from Russia, The Netherlands and Poland (Carrington, 2020b; Drummond, 2020; Webster, 2020). Brexit may facilitate taking back control of British waters, but it is unlikely to bring about much of a change in the amount of fishing being done by UK vessels. One estimate suggests fishing activity is down by 94 per cent since the 1880s. British aquaculture, albeit undertaken by Norwegian companies, has a similarly long list of woes although, to be fair, these are common throughout this rapidly growing industrial sector. The main concern is the environmental cost, measured in terms of pollution, eutrophication, increasing dependency of antibiotics and other chemicals to control disease (and in the future this may potentially include neonicotinoids). The one meta-analysis into aquaculture raises concern regarding AMR and calls for urgent action. Fish farms also cause increased mortality in native species when they are exposed to unnaturally high levels of lice. The use of wild fish as a feedstock and cereal-based feed-stocks reducing the nutritional value of farmed fish both raise additional concerns; the farms also cause habitat destruction and water quality problems; GM escapes also threaten native species. In all, the limited number of LCA studies reveal that such rearing systems have high carbon footprints, with some higher than meat. Fish may be good for health, but in damaging the biosphere, it ultimately risks damaging human health, too. There is much to be done before aquaculture can become truly sustainable. The same can be said about achieving SDG 14. Various studies call for fish consumption to be curtailed, until such times that it can be deemed more sustainable (Grigorakis, 2010; Olesen *et al.*, 2011; Pinto de Moura *et al*., 2012; Bovenkerk and Meijboom, 2012; Kalshoven and Meijboom, 2013; Regnier and Schubert, 2013; Röcklinsberg, 2014; Säwe and Hultman, 2014).

Despite its previous rich history, the UK now only produces a fraction of the fruit and vegetables that it once did, which is a major obstacle when these are the major components within sustainable diets. At the same time, consumption of fruit and vegetables is woefully inadequate, averaging well below the target set in 2003 and is now around half of the NHS's 2014 recommendation of 7 portions per day. Of course, this average masks huge inequalities but, once again, the current COVID-19 pandemic has shown just how extreme these inequalities can become (BMJ, 2020; Laborde *et al*., 2020). The declining levels of production is down to a variety of factors, including poor producer margins that have in turn led to lower investments in production technologies and food retailers sourcing year-round supplies from the global market. Although figures vary depending on source, one recent estimate suggested 76 per cent of all vegetables and 41 per cent of all fruits are imported, mostly from the EU and a wide range of other countries such as South Africa, Morocco, Egypt and New Zealand. All these countries have their own particular challenges as they face adapting to future climate change. Critics argue that at best, the UK is exporting its environmental burdens and importing scarce resources such as water from countries where these resources are needed for domestic consumption; at worst, Lang (2020) argues this is the result of a neo-colonial and post-imperial model of food supply, whereby the UK expects other countries to feed it. UK consumers also eat the fruits from the labour of others, completely unaware of the consequence such consumption may be causing: Cherry tomatoes from Morocco have been associated with slave labour (Fairfood International, 2014); avocados from Chile, where some plantations have installed illegal pipes and wells diverting water from rivers to irrigate their crops, violating the water rights of those who live there; and strawberries from Spain, where diminishing water tables continue to threaten ecosystems in the neighbouring national park. When a UK food producer plans a radical departure from the norm, such as with the proposed Nocton mega-dairy a decade ago, the public reaction based on environmental and animal welfare grounds became a national media story that became so vociferous, the company withdrew its application. But when five young people died after inhaling fumes in a chicken plant in Bangkok which supplies large fast-food restaurant chains in the UK (*Bangkok Post*, 2017), the story doesn't even make the UK media. As with all these overseas products, the supply chain is so long that consumers rarely get to see the consequences of their purchasing actions or appreciate the many complexities involved along the way.

5.6 What should health professionals be doing to inform and enable the behavioural changes needed in the transition to more sustainable and healthy diets? [RQ5]

The impetus for this thesis comes from working alongside health professionals. They are incredibly committed and adept practitioners, dedicated to improving the lives of those they seek to help. Many have a detailed knowledge garnered over many years on the various attributes of food, coupled with a strong conviction regarding what constitutes a healthy and nutritious diet. When discussing the various health-enhancing properties of popular choices such as salmon, pomegranates and avocado, for example, there is a tendency not to consider details such as where food comes from, its resource requirements, environmental impacts, and consequences of getting it to UK consumers. Several studies call for health professionals to be more proactively involved in the dietary transition process. Gill and Scott (2009, p.1953) suggested health professionals should '*reach beyond conventional professional boundaries to collaborate with policymakers and scientists concerned with the study, development, and implementation of policies and technologies to mitigate climate change*'. Most, however, have no training or background in this area and there are few, readily available resources to assist. The umbrella review is especially useful in helping develop a framework for health professionals to enable them to contribute to the behavioural changes needed. Although most nutritionists and dietitians will have had little or no training in sustainable diets or ecological public health, most will be familiar with methodological approaches that include systematic and umbrella reviews to determine both the latest evidence and approaches towards remedying treatment. Knowledge on the rationale behind sustainable diets needs to be embedded into further and higher education for all health professionals, with ongoing training and support to assist all those working within this new and quickly emerging aspect of healthcare. The earlier research questions address both the public health interventions required to reduce the health impacts of climate change, and the policies needed to enable transformational dietary change. Consumers will need help to understand the need for change, guidance on the best ways to engage with such changes, and specific guidance on how to ensure their diets become more sustainable. Using the data garnered from the initial literature and the umbrella review, figure 101 synthesises this information into a simple healthy and sustainable diet framework for UK health professionals.

Systematic reviews are used extensively to understand the impacts of climate change on human health. Nichols *et al*. (2009) UK based review identified an urgent need for mitigation and adaptation strategies to be evidence-based. Further reviews link food sovereignty and health equity (Weiler *et al*., 2015) and the possible impacts on health inequalities (Haby *et al.*, 2016). Health promotion and marketing have been the focus of many review, covering the effects of retailer promotion on healthy food choices and eating practices (Escaron *et al*., 2013; Hartmann-Boyce *et al*., 2018; Blake *et al*., 2019; Hollis-Hansen *et al*., 2019; Houghtaling *et al*., 2019) and obesity interventions (Adam and Jensen, 2016). Interestingly, Jung *et al*. (2015) find dietitians and nutritionists are more likely to have a stigma with obesity. Other reviews consider interventions to promote healthy eating (Hendry *et al*., 2013; McDermott *et al*., 2015), the effects of increased vegetable and fruit consumption (Mytton *et al*. (2014), the value of eating norms and empowering nutrition in promoting healthy changes to dietary behaviour (Brandstetter *et al*., 2015; Robinson *et al*., 2014), the impact of health-related claims on dietary choices (Kaur *et al*., 2017; Smith-Taillie *et al*., 2017), the effectiveness of social (Chau *et al*., 2018; Abril and Dempsey, 2019) and digital (Hedin *et al*., 2019) campaigns in healthy eating behaviours, and health and food marketing (Silchenko *et al*., 2019) including to children (Smith *et al*., 2019). Nudge theory is also recommended in a further 10 studies (Arno and Thomas, 2016; Bucher *et al*., 2016; Wilson *et al*., 2016; Vecchio and Cavallo, 2019) including applications such as in school (Thapa and Lyford, 2014; Horne *et al*., 2020; Marcano-Olivier *et al*., 2020), increasing fruit and vegetable choice (Broers *et al*., 2017); to improve health (Tørris and Mobekk, 2019), and towards products with a lower environmental footprint (Ferrari *et al.*, 2019). Finally, a range of further reviews add to the knowledge base, ranging from the public health interventions needed to reduce the health impacts of climate change (Bouzid *et al*., 2013), the lifestyle-related changes that would be required (Quam *et al*., 2017) to UK households (Porter *et al*., 2014), the role of CSOs (Poutiainen *et al*., 2013), and the educational approaches needed to support the health professions (Vaitkeviciute *et al*., 2015; Lopez-Medina *et al*., 2019) through to the increasing concern over the association between climate change and mental health (Vins *et al*., 2015), and the association between Glyphosate herbicides and non-hodgkin lymphoma risk (Zhang *et al*., 2019).

One of the most pressing and immediate challenges stems from the strategic drift or policy vacuum mentioned previously; the UK does not currently have any sustainable dietary guidelines; the Eatwell Guide has a chequered history and needs to be science-based and free from commercial influences. But excellent examples of sustainable dietary guidelines are beginning to emerge elsewhere (e.g. Sweden and The Netherlands both launched theirs in 2015). Both these share similar approaches, by providing a clear rationale for consumers to switch their diets: to more plant-based foods and smaller portions of meat; to sustainably-sourced fish; to seasonal fruit and vegetables or those that store well; eating fewer sweets, cakes, cookies and snacks; minimising waste; and more 'eco-smart' food choices. The Dutch guidelines also attempt to quantify the daily amounts involved (e.g. 200 grams of vegetables, 200 grams of fruit, and 90 grams of wholegrains each day). The UK urgently needs to replace its Eatwell Guide with sustainable dietary guidelines; these need to be science-based, independent, and reviewed regularly. They also need to be enshrined in law and overseen by the British Standards Institute, with their own Publicly Available Specification to ensure integrity and approach. Food policy can then address the current disconnect between recommendations and the availability of sustainable sources as with the case of fish. Health professionals can then prioritise support that encourages behavioural change. Such initiatives would need to start with primary schools and extend right up to Further- and Higher-Education, covering planetary resources, environmental impacts of consumption, and health promoting behaviours. The school food environment is also critical in improving targeted dietary behaviours (Bourke *et al*., 2014; Olstad *et al*., 2017; Colley *et al*., 2019; Ronto *et al*., 2020). Here reviews recommend using best practice to design policies that help improve childhood dietary habits and health (Micha *et al*., 2018) and reduce the impact of highly available, competitive foods (Sildén, 2018) such as food takeaways near schools (Turbutt *et al*., 2019). Further reviews find such best practice includes multi-strategy interventions involving schools and families (Meiklejohn *et al*., 2016) and the need for more robust methods to monitor the school food environment to further understand obesogenic school environments (O'Halloran *et al*., 2020). Effective interventions to prevent childhood obesity included banning sugary drinks in schools and increasing the availability and accessibility of fruits and vegetables (Pineda *et al*., 2019), healthier choices in school cafeterias (Gordon *et al*., 2018), and the regional variations in the access to convenience stores (Xin *et al*., 2019). Health professionals can then contribute to the areas identified within the umbrella review as needing further research; to better understand consumer and industry responses to reducing price promotions, the effects of commodity prices on nutrition and health, and other public health interventions. Such market interventions are urgently needed now as part of wide-ranging policies to change behaviour before the costs of curing the health and environmental burdens become unaffordable.

The commercial food industry is seen as one of the main sources of diet-related risk through its influence within the six key obesogenic environments (Sonntag *et al*., 2015), where conflicts of interest abound, but where health promotion policy possibilities exist (Cullerton *et al*., 2019; Mah *et al*., 2019), but where retailer instrumental, structural and discursive power means positive public health impacts of supermarket power were rarely identified (Pulker *et al*., 2018) and healthy interventions at the point-of-sale were of uncertain benefit (Liberato *et al*., 2014). Maynard *et al*. (2020) similarly reviews the sustainability indicators in the food service sector and Bandy *et al*. (2019) uses commercial sales data to assess dietary change. Trade and investment agreements also pose significant health risks (Thow *et al*. 2010; Barlow *et al*., 2017). The anomaly that healthier and nutrient dense foods invariably have higher GHGe than foods with poorer, nutritionally suboptimal diets that are high in sugar is a common concern (Mandal, 2016; Payne *et al*., 2016) as is the associate link with cancer (Makarem *et al*., 2018). Reviews into healthy eating interventions in the home have been largely inconclusive (Snuggs *et al*., 2019), although home cooking was associated with potential dietary benefits (Mills *et al*., 2017) where parental influence (Johnson *et al*., 2018; Perez-Cueto, 2019) and support (Bourke *et al*., 2014) were both seen as critical elements within a holistic approach. Environmental and social responsibility labelling schemes are of more value to food consumers than previously thought, although care is needed to ensure this does not negatively impact on public health nutrition by leading some consumers to choose environmentally friendly products that might be less nutritious (Tobi *et al*., 2019). The systematic reviews also contribute to the measurement (Kirkpatrick *et al*., 2014; Jones *et al*., 2016; Hallström *et al*., 2018; Wrieden *et al*.

2019) and modelling of sustainable diets (Grieger *et al*., 2017), sedentary behaviour (Pearson and Biddle, 2011) and weight management (Atallah *et al*., 2014; Turton *et al*., 2016; Nour *et al*., 2018; Oostenbach *et al*., 2019), the benefits to public health from reducing GHG emissions (Gao *et al*., 2018), and a plethora of studies into dietary change interventions (Hyseni *et al*., 2017; Pember and Knowlden, 2017; Halford *et al*., 2018) and future dietary patterns (Green *et al*., 2016; Alae-Carew *et al*., 2019).

The third stage of the framework should ideally feature the UK's sustainable dietary guidelines. Unfortunately, however, no such definitive blueprint currently exists. The existing PHE Eatwell Guide has been heavily criticised previously for the unhelpful and misleading intervention from the commercial food sector (Cobiac *et al*., 2016); the 2016 edition is still perceived to have similar shortcomings and still does not fully incorporate sustainable diets at its core; and in 2018 the EAC urged further revision to include foods with lower environmental footprints and clear recommendations to help consumers choose healthy and sustainable diets. Its recommendations were informed by an external reference group that included the British Retail Consortium (i.e. the big food retailers and food manufacturers), the Food & Drink Federation (the main food processing companies, including those promoting ultra-processed foods), the Association of Convenience Stores (a government lobbying group), and the Agriculture & Horticulture Development Board (the levy board representing food producers). The Royal College of Nursing were also included, but they failed to attend most meetings. After the new Guide was published, one manufacturer even ran a series of media adverts telling consumers that it was great to have their Flora vegetable spread accepted onto the guide (see appendix 8.16). As an alternative, the Eat-Lancet planetary health plate (see appendix 8.6) could be used if it is adopted. Here, once again however, the jury remains out as to whether this diet fully meets all the necessary dietary requirements, and the policy literature clarifies the role of big agri-food companies in recommending plant-based foods that require high levels of food processing. Lang (2020) also advocates the need to enshrine such guidelines by the British Standards Institution with their own Publicly Available Specification.

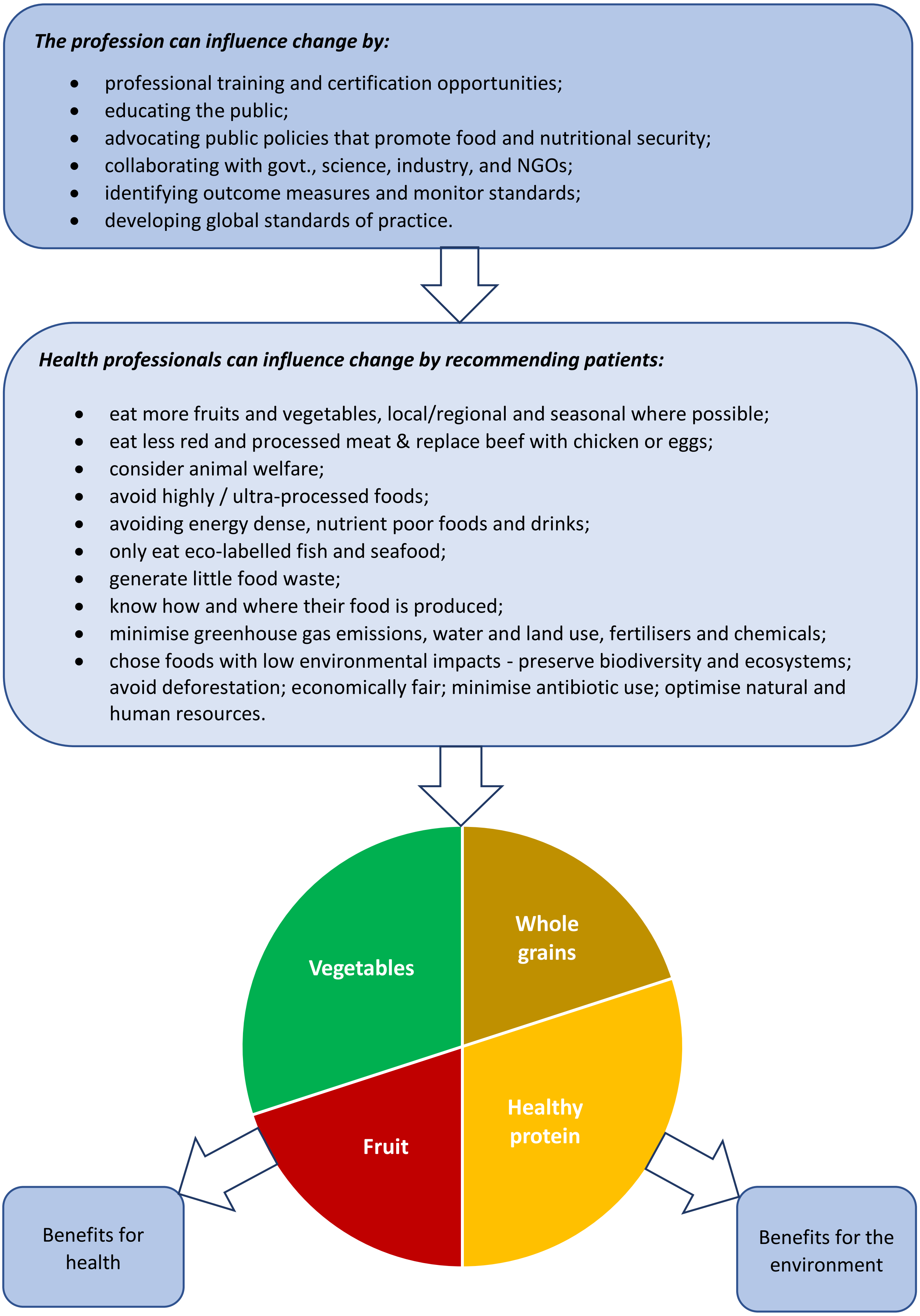


Figure 101: A healthy and sustainable diet framework for UK health professionals

For the time being, stage three of the framework is purely a hypothetical representation of what a future UK based, healthy and sustainable diet plate might look like

Professional bodies such as the WHO, the International Union for Health Promotion and Education, the European Public Health Association, the UK Health Alliance on Climate Change, the British Medical Association, the UK's Climate and Health Council, the British Nutrition Foundation, and the Food Standards Agency are also central to enabling health professionals to lead by example (Gill and Stott, 2009; Dixon, 2015; British Medical Association, 2016; FSA, 2016; *The Lancet,* 2016c; Galea, 2017; EUPHA, 2017; UKHACC, 2020). Lang (2017c) also acknowledges other recent initiatives, such as the International Panel of Experts on Food (IPES-Food), the EAT-Lancet Commission, the Global Alliance coalition, and funders such as the Wellcome Trust. The UKHACC (2020) recommendations on climate change are further detailed in appendix 8.12.

6. Conclusions, recommendations, and reflections

6.1 Introduction

This final chapter considers the conclusions along with the significance and implications of the findings for each of the five research questions. It also considers the main contributions made to the existing knowledge, particularly the extent to which it addresses the gaps previously identified. Finally, the chapter considers the limitations of this thesis and areas for further research.

6.2 Overview of findings: significance and implications

The main findings and their implications are grouped into five areas. The first is the scale of the scientific consensus and enormity of evidence calling for change. The world now feels a very different place to the one that has delivered our food over the past four decades. The scientific evidence is increasingly focused on an overwhelming consensus that human behaviour is creating conditions that will, at best, drastically and permanently curtail humanity's potential and, at worst, lead to its extinction. As the UK tries to find its position in the world outside of the EU, the global political landscape also looks very different. The rise of right-wing populism and increasingly nationalistic stances taken by some countries are reshaping the cultural, political and economic landscape, generating fear and uncertainty, and causing many to question the benefits and equity of globalisation. CSOs and social movements such as Extinction Rebellion and Black Lives Matter add further pressure for global change. The post-imperial default policy, whereby the UK relies on food imports, is no longer fit for purpose, increasingly seen as morally corrupt (Lang, 2020), and has left the country vulnerable to the most appalling human catastrophes such as COVID-19 (Horton, 2020). Oceans and land are critical natural and national assets that need both nurturing and protecting, and yet the UK has some of the most depleted resources which are unable to support sufficient food production. The prevailing government perspective sees food security as a combination of both local food production and international trade (Houses of Parliament, 2020). Research shows the UK is currently using 5-6 times its own land area to produce food, that 70 per cent of this land and 64 per cent of the GHG emissions is located overseas, especially in countries where climate change will be much more severe. Fifteen years ago DEFRA warned about the increasing risks of crop failure affecting UK imports and called for policymakers to adapt accordingly; a message repeated more recently by the Adaptation Sub-Committee, further demonstrating that current food policy is as unsustainable as it is indefensible.

The second area of findings and implications relate to inherent weaknesses in the neoliberal market. Much of the evidence links anthropogenic climate change to capitalism and the growth treadmill that it requires. Alternative sustainable approaches that are urgently needed; and protectionist reactions are increasingly predicted as the global crisis starts to affect more nations. At the same time, however, continuing to put politics ahead of health or the planet will become increasingly unacceptable. The laissez-faire approach that has increasingly dominated UK food policy for over 40 years has undoubtedly delivered cheap food. The increasing propensity to liberalise world markets has brought huge societal rewards for many; so much so, that the virtues of the free market have now almost become a given. Even the limited regulations imposed by the UK's membership of the EU was seen as restricting access to the free market beyond. The mere suggestion that this growth might not last, that it was storing-up potential problems for the future, or that it might even threaten the very survival of future generations, could be easily dismissed when supermarkets offered ever-more choice of foods from around the world. The growing magnitude of these distant suggestions have, however, been gathering pace for some time, fuelled-on by the growing scientific consensus. Today, few consumers doubt the reality of climate change; many are beginning to accept the need for change; and the CSOs are focusing attention on the urgency such change now requires. As the door opens on the legacy of cheap food, the enormity of the task ahead is huge: our diets are now the major cause of mortality, morbidity and disease; many ecosystems have declined to such an extent that their very survival is now at risk; environmental damage risks pushing temperature increases to levels beyond which we would be unable to regain control; and the food security taken as a certainty for so long is brought into sharp focus when supermarket shelves empty within a couple of days of disruption. The evidence for change is clear and overwhelming: what is lacking, however, is the political will to change. Until that political will is galvanised into change, the business-as-usual default position will continue, but the evidence suggests that this trajectory is the quickest route towards existential crisis. To galvanise political will needs electoral focus: not just by the dedicated few sitting on the fringes, but vast swathes of the electorate who see their lives and the future for their children in serious peril. The CSOs along with a relatively small number of environmental journalists continue to ensure that these issues remain in the news. The absence of a national food strategy and general lack of consumer awareness of the need to change consumption behaviour continues to exacerbate the UK situation.

The third area of findings and implications relate to the urgency to find a solution. COVID-19 has already infected 168 million people across 222 countries (30th May 2021) and provides further evidence of the link between planetary and human health. If ever there was a point in history that galvanised a need for urgent change on a global scale, this must be it. This is certainly not a new finding; many studies over the past two decades make similar recommendations. Nor is it a fact lost on UK governments: their very own Stern Review in 2006 referred to this overwhelming scientific evidence and the need for decisive and urgent action; Carney has reminded them that the responsibility for responding to climate change remains with them; and yet, the present Government still does not seem fully aware or conversant of the risks. The relative lack of progress over this time, coupled with the increasing knowledge that science has delivered at the same time, has fundamentally shifted many assumptions. It is clear from this thesis that the world is not currently on track to achieve either the SDGs or the Paris Agreement. More recent studies are increasingly focused on 2030 as the date, beyond which, there is a high probability that the existential threat will become unstoppable. The tipping points that climate scientists predict, in particular the collapse of global ice sheets and the melting of permafrost, will trigger an acceleration in temperature rises that will be both impossible to reverse, and therefore be impossible for vast swathes of humanity to endure. Furthermore, the biodiversity of the ecosystems which support all life systems will be irreparably damaged. These factors have significantly changed recommendations within the literature, which is now focused on the few remaining years left to prevent the stoppable becoming unstoppable. Globally, more effort is urgently required to go further and faster, otherwise the consequences of this inaction further compounds the seriousness of the problems ahead. Current modelling trajectories are continuing to predict average temperature increases of around 3.5-4°C on the medium to high emissions path. The tipping point, beyond which climate change is expected to become irreversible, is thought to be between 2-3°C. To continue on this trajectory will quickly result in higher food prices; meta-analyses predict significant yield declines which will exacerbate supplies even further; putting further pressures on water stress thereby forcing many increasingly vulnerable countries to export less. The world must ensure that the 1.5°C target is realised; it cannot allow nationalism or political disunity to stand in the way of achieving this goal; nor can those countries on a faster track towards lowering emissions do so alone. The developed nations must also help the developing nations to achieve the same goal within the same timescale. Despite the poor and clearly inadequate progress to date, the evidence undoubtedly suggests that the threats from climate change can be avoided by 2050, and importantly, that current food production has sufficient capacity to meet the nutritional needs of the population in 2050, providing that the radical social adaptations required start now. Lack of progress over the past two decades in the UK is of particular concern.

The fourth area of findings and implications relate to the obstacles that remain and continue to inhibit possible solutions. Even today, the general impression in various UK governmental departments is that responsibility isn’t within their brief and, without a national food strategy, collectively the government is failing to take responsibility on the assumption that the neoliberal marketplace can resolve. Little wonder then that auditors find the government failing to deliver on 24 out of 25 areas. Concerns over the credibility of the Committee on Climate Change have to be resolved and its independence guaranteed. The threat from climate change is so great that it needs to have one department with specific overall responsibility. Even the government’s slow response to the COVID-19 public health crisis could be seen as further evidence for both the urgent need for them to have robust plans and mechanisms in place to respond to future shocks to food security. The Committee on Climate Change provided clarity in 2017 on the three main risks to UK and, in doing so, identified the urgent priorities: from flooding; temperature increases affecting domestic food production; and threats to imported food supplies caused by climate change reducing availability and disrupting trade. The Government's own auditors, however, warn that it is ignoring the advice on food security from the Committee on Climate Change; specifically, importing over 40 per cent of its food, including from countries classified as highly and moderately climate vulnerable. They also warned this risk would be even greater should the UK leave the EU which provides over 40 per cent of current supplies. Although the academic discourse has made very significant gains over this time; the political discourse has not. Even today, the general impression by the various governmental departments is that responsibility isn't within their brief and, without a national food strategy, the government is failing to act on the assumption that the neoliberal market place can resolve without any need to intervene.

For at least the past 40 years, the lack of a national food strategy has inadvertently allowed strategic drift with the UK's food security. The previous imperialist approach to sourcing food from around the world seemed to morph quite readily into the neo-liberal markets that globalisation provided, driven by an abundance of affordable fossil fuels making the global trade in commodities a possibility. Lang (2020) continues to call for a national food strategy that addresses the fundamental questions of how to use our land, the policy requirements to ensure food is affordable to all, defines a good diet, determines what a sustainable food systems should look like and, most importantly of all, designing exactly what form the transformational shift should take in the move from the current, high risk neo-colonial import-dependency model to a truly sustainable food system that delivers healthy diets to all. Until such a strategy is in place, all further land-use change should cease until such times that it can be done in a planned and co-ordinated manner. Other nations should be encouraged to do the same; any notion that Africa, for example, could be 'tapped' to provide palm oil for the world's cattle and processed foods market should be abhorrent, given the extent of the challenge facing nations in the southern hemisphere as they adapt to changing climates. This national food strategy would also be instrumental in shaping food policy once the UK fully leaves the EU, as well as steering the country towards achieving the SDGs and Paris Agreement commitments. It would also ensure co-ordination between government departments, so often seen as disjointed. The latest PostNote from the Houses of Parliament (2020) does at least acknowledge that some experts are proposing such a notion but falls short of really advocating it. The much-anticipated National Food Strategy scheduled for publication later in the summer of 2021 is eagerly awaited. If it is singularly focused on the clear scientific consensus, there will be genuine jubilation from scientists and many health professionals alike; if however, the powerful food lobby continues to insist that the market economy is best able to tackle the challenges and that the business-as-usual will soon return, the future prognosis will be grim. The challenge of getting the politicians to act upon the recommendations remains a further hurdle. Fears that Brexit and now COVID-19 will further distract government from the emphasis and trajectory urgently needed remains. After Brexit, food imports could switch from high Environmental Performance Index EU countries to ones with much lower ratings, posing a whole new array of safety concerns, whereas the UK should only be trading with those nations that are fully complying with international commitments on climate change. The UK also urgently needs a new governance system to replace those once undertaken by the EU.

The final area of contribution this thesis makes has implications for policy. Since Lang (1999) highlighted the intricacies globalisation was inflicting on UK food policy, continued developments in the scientific discourse have enabled a much more detailed understanding of this 'formidable' problem. Unfortunately, there has been little adjustment in policy and food practices in the intervening period. While the fixation on the ability of neoliberal markets to cure-all ills remains, our diet-related health worsens as the existential threat to ecosystems continues to build. With both this greater understanding of the science and Lang's (2020) latest blueprint of the critical infrastructural components for a national food strategy, the UK could soon be on its way towards a sustainable and more secure food system. The umbrella review also provides a clear blueprint for what any successful National Food Strategy must include. It needs to have science-informed ecological public health at its core; it needs effective governance to successfully manage issues such as power, accountability, leadership, and provide longevity beyond changing governmental priorities. It needs to be fully funded, so that Research & Development can support regional development. It also must effectively promote better nutrition and healthier foods through pricing policies that, for example, increase local fruit and vegetable consumption. It must also restrict antibiotic usage, curtail the use of therapeutic antibiotics in farm animals, and prevent similar such products entering the UK food chain thereby risking the health of UK consumers. Such a strategy needs to be part of a wider, more comprehensive effort that enables the social impacts of climate change to be tackled much faster; health policies similarly need to do more to effectively prevent obesity across all ages. Here such policies will need to incentivise and control (where necessary) food retail and hospitality, target educational policies to change dietary behaviour, and health promotion to help educate consumers about portion sizes. Pricing policies are needed to tax unhealthy choices (at suggested levels of 20%) and subsidies to ensure healthy and sustainable food is available to all income groups. Public health strategies also need to be targeted at retailers, so that their relative power can be used to bring about more positive public health benefits. The review also addresses gaps within the knowledge base by calling for more research to understand potential impacts, into the drivers behind current diets, to better understand which interventions are more effective in changing dietary behaviour, and which retailer interventions should be encouraged. The health profession will need to play an important role, and this will involve a detailed understanding of the rationale for, and main components of, a sustainable diet. The initial framework proposed in this thesis could be used to inform the debate, to improve understanding across the profession, and ultimately be used to advise and educate patients and wider consumer groups alike.

6.3 The main contribution made by this thesis, recommendations, and limitations

This thesis makes four original contributions to the research field. Firstly, the research provides an umbrella review of the latest evidence on how climate change will impact the UK's ability to both produce and import healthy food and develops recommendations for a new policy framework to ensure the sustainability and security of UK food. The umbrella review is one of only a handful done to date. It is believed to be both the first to consider the policy issues connected to food security and the first specifically written to guide health professionals through the complex narratives surrounding sustainable diets. The size of the sample studied is particularly significant for two reasons: firstly, the interdisciplinarity of food policy means that this encompasses a wide range of inter-related topics; and secondly, systematic reviews and meta-analyses are themselves becoming much more widely used as tools of analysis across these disciplines. The technique is also especially useful for identifying where further systematic reviews and meta-analyses need to be undertaken. The umbrella search using three additional databases produced a significantly difference dataset to that from the initial literature search. So collectively, the six databases used provided useful complementarity. The main strength of this thesis is that it uses a methodological approach that has been increasingly used within the medical profession over the past few decades, so many health professionals will be comfortable with, and have confidence in the approach, even though the concept of sustainable diets may be new to them. Furthermore, the umbrella review provides an overview of the many variables that contribute to the interdisciplinarity of food policy mentioned previously; it also provides both methodological familiarity and a narrative for the required next steps for those nutritionists and dietitians working within the health professions sector.

Secondly, it uses commodity case studies to further analyse the likely impacts on the future availability of both food grown in the UK and areas critical to food imports. Here the lack of consensus on the impacts of climate change on the import regions is complex and there is currently a lack of available data to be able to determine precise impacts. There is some scope for crops to move geographically as temperatures change but, thus far, few studies have considered this aspect. This is then linked to the wider literature and considers possible future constraints such as, for example, the increasing vulnerability of some supplying nations as they struggle to cope with climate change, and the possible impacts on availability and prices caused by the increasing prevalence of nationalism.

Thirdly, it uses climate modelling to quantify the impact of flooding to vegetable and potato production in one important UK growing region, the Lincolnshire Fens, by way of example. The results show that even relatively small levels of sea-level rise risk impacting the majority of Lincolnshire's vegetable and potato capacity. Should this be the case, ceteris paribus, the UK's self-sufficiency in vegetables would be further impacted by around 0.6 – 0.9mt of vegetable production per annum based on the loss of production of the Lincolnshire Fens alone, thereby further exacerbating the country's dependency on the increasingly volatile imports option. This thesis also highlights a gap in the scientific literature, between current estimates of climate change under predicted emissions scenarios, and the greater uncertainty surrounding the post-tipping point estimates. Although local authorities have assessed the likely impact on local populations and the physical location of some business, the assessment does not appear to cover farms or land used for food production. The findings lead to recommendations that local authorities need to better co-ordinate the planning and acknowledge the issue within their local plans; policymakers also need to do more to better understand the impacts of sea-level rise in particular, on vulnerable parts of the UK where there is no national strategy in terms of flood defence or the protection of national food production capacity. The case for the UK growing more of what it possibly can do, as an insurance against what might well turn into chaos within global markets, has never been stronger. At the same time, the moral arguments against using the resources of others, whose needs will be much more adversely affected by climate change than our own, must also have a bearing. Similarly, the UK must assume responsibility for all carbon emissions, included on imported goods. Further research is needed to understand the cost-benefit analysis of flood mitigation and adaptation in these areas; however, it is entirely possible that in the foreseeable future vegetable production will no longer be possible in the Lincolnshire fens.

Finally, it synthesises the latest findings on what constitutes a healthy diet and provides a framework for UK health professionals that will enable them to deliver evidence-based information to inform and bring about the behavioural change needed in the transition to more sustainable and healthy diets. This includes using the framework for the training of, and dissemination by, UK health professionals that will enable them to deliver evidence-based information to inform and bring about the behavioural change needed in the transition to more sustainable and healthy diets. There is a need for health professionals, especially dietitians and nutritionists, to receive formal training in sustainable diets; currently, few options are available. The framework proposed here could be further developed in order to be used for training within the professional community and also form the basis of educating patients and the wider community. The weakness in the current model is the lack of a definitive sustainable diet recommendation. The original intention to use either the latest PHE Eatwell Guide or the EAT-Lancet planetary health diet had to be abandoned due to the further work that needs to be done on both before they could be included and effectively endorsed. It was beyond the scope of this thesis to determine which currently provides the better fit; this requires specific medical and nutritional examination. The final stage of the model is therefore included for illustrative purposes only. Once the sustainable diet element of the framework is established, the intention would be to formally register the outline protocol and the review with the Prosperi register and ultimately publish the framework within an international journal in order to receive peer feedback and reach a wider audience as possible. This would also enable potential collaborators to be identified, thereby addressing one of the weaknesses with the current thesis. The weakness of the current status of nutrition science also remains a limiting factor, especially in arriving at a clear consensus of the key components of a healthy diet. Similar ambiguities also exist as to how healthy diets become sustainable. Further obstacles can be found within the medical profession, many of whom may not have received medical training on diets for health, and in the process of generating the PHE Eatwell Guide. Both of these need to be addressed as a matter of urgency. Similarly, the potential for a more sustainable diet such as the EAT-Lancet planetary health diet needs further evaluation to determine the full extent of possible benefits. Again, this would need to be fully endorsed by the medical profession and then suitable specifications drawn-up by the BSI.

Several limitations in the research have been identified. The first relates to the recommendation that umbrella reviews are best performed by teams with specialist skills. Given the requirements of this thesis, this wasn't possible and, as Perez-Cueto (2019) demonstrates, should not necessarily preclude later journal publication. The second limitation is that a formal meta-analysis was not possible as originally intended. It is noted, however, that this limitation is common to other such reviews where the heterogeneous nature of the studies' settings, designs and outcome measures means a narrative synthesis is more appropriate. The final limitation is the lack of an applicable sustainable diet that is covered in detail in relation to the framework for health professions. This thesis also identifies gaps throughout the analysis. Of particular importance is the lack of data on marine fishing, aquaculture and sustainable intensification, all of which require significant further study.

Finally, to address the continued lack of political engagement demonstrated by successive UK governments, this thesis ends with a specific recommendation. One possible solution to reverse the political disinterest that has seemingly held back meaningful progress over the past two decades would be initiatives to engage widespread consumer interest, in the assumption that this voter-power will convince government of the need to engage. This could be done using main-stream television to highlight the growing plight of food supply. Food has always been a popular genre for TV programmes, but what is needed here is a Professor for Public Engagement role i.e. someone with the right scientific expertise and credentials to engage a mainstream media audience, much in the same way that Brian Cox has done for Astronomy, Bettany Hughes has done for history, and Alice Roberts has done for archæology. On the latter example, the TV programme 'Time Team' helped turn archæology into mainstream TV for the best part of two decades, with around 20m viewers per annum. If done effectively, this medium could be used to inform and educate the general public about the numerous challenges and available options. In the case of extolling the virtues of rewilding, for example, the ongoing story of the Knepp Estate project in West Sussex would be a point in case, especially given the potential of the stork reintroduction programme and the nesting success in 2020 to capture the nation's attention.

7. References

- Abadie, L.M., de Murieta, E.S. and Galarraga, I. (2016). Climate risk assessment under uncertainty: an application to main European coastal cities, *Frontiers in Marine Science*, Vol. 3, doi: 10.3389/fmars.2016.00265.
- Abbade, E.B. (2015). Environmental impacts of food supply and obesogenic severity worldwide, *British Food Journal*, Vol. 117, Iss. 12, pp.2863-2879, https://doi.org/10.1108/BFJ-12-2014-0404 [accessed 11th April 2019].
- Abbas, F., Hammad, H.M., Fahad, S., Cerdà, A., Rizwan, M., Farhad, W., Ehsan, S. and Bakhat, H.F. (2017). Agroforestry: a sustainable environmental practice for carbon sequestration under the climate change scenarios: a review, *Environmental Science and Pollution Research International*, Vol. 24, No. 12, pp.11177-11191, https://doi-org.ezproxy.mmu.ac.uk/10.1007/s11356-017-8687-0 [accessed 11th April 2019].
- Abdullah, A. (2019). Identifying agriculture land acquisitions for alleviating future food security concerns, *Food Science and Technology*, Vol. 39, No.2, pp.301-307, doi: 10.1590/fst.24917.
- Abel, G.J., Brottrager, M., Cuaresma, J.C. and Muttarak, R. (2019). Climate, conflict and forced migration, *Global Environmental Change*, Vol. 54, pp.239-249, https://doi.org/10.1016/j.gloenvcha.2018.12.003 [accessed 11th April 2019].
- Abeykoon, A.H., Engler-Stringer, R. and Muhajarine, N. (2017). Health-related outcomes of new grocery store interventions: a systematic review, *Public Health Nutrition*, Vol. 20, No. 12, pp.2236-2248. doi: 10.1017/S1368980017000933.
- Abraham, B., Araya, H., Berhe, T., Edwards, S., Gujja, B., Khadka, R.B., Koma, Y.S., Sen, D., Sharif, A., Styger, E., Uphoff, N. and Verma, A. (2014). The system of crop intensification: reports from the field on improving agricultural production, food security, and resilience to climate change for multiple crops, *Agriculture and Food Security*, Vol. 3, No. 4, doi:10.1186/2048-7010-3-4.
- Abril, E.P. and Dempsey, P.R. (2019). Outcomes of healthy eating ad campaigns: a systematic review, *Progress in Cardiovascular Diseases,* vol. 62, no. 1, pp. 39-43, https://doi.org/10.1016/j.pcad.2018.12.008 [accessed 11th April 2019].
- Abrol, D.P. (2012). Climate change and pollinators. In: *Pollination Biology* (ed.) D.P. Abrol, pp.479-508, Dordrecht, Netherlands: Springer.
- Abson, D., Fraser, D.G. and Benton, T. (2013). Landscape diversity and the resilience of agricultural returns: a portfolio analysis of land-use patterns and economic returns from lowland agriculture, *Agriculture & Food Security*, Vol. 2, No. 2, https://doi.org/10.1186/2048-7010-2-2 [accessed 11th April 2019].

- Abu Hatab, A., Cavinato, M.E.R. and Lagerkvist, C.J. (2019). Urbanization, livestock systems and food security in developing countries: a systematic review of the literature, *Food Security*, Vol. 11, No. 2, pp.279-299, https://doi.org/10.1007/s12571-019-00906-1 [accessed 15th April 2020].
- Accorsi, R. and Manzini, R. (eds)(2019). *Sustainable food supply chains: planning, design, and control through interdisciplinary methodologies*, 1st Edition, Cambridge, USA: Academic Press, ISBN: 9780128134115.
- Acevedo, M.F., Harvey, D.R. and Palis, F.R. (2018). Food security and the environment: interdisciplinary research to increase productivity while exercising environmental conservation, *Global Food Security*, Vol. 16, pp.127-132, https://doi.org/10.1016/j.gfs.2018.01.001 [accessed 11th April 2019].
- Achuthan, K., Zainudin, F., Roan, J. and Fujiyama, T. (2015). *Resilience of the food supply to port flooding on East Coast*, Synthesis Report, Defra research project report F00454, London, UK: University College London, Department of Civil, Environmental and Geomatic Engineering.
- Ackerman, F. and Munitz, C. (2016). Debating climate economics: a reply to Richard Tol's response on climate damage modelling, *Energy Research & Social Science*, Vol. 17, pp.167-168, doi: 10.1016/j.erss.2016.04.008.
- Ackers, K. (2017). What does food sustainability really mean? *Food Rush*, 30th January, https://www.thefoodrush.com/articles/what-does-food-sustainability-really-mean/ [accessed 11th April 2019].
- Acunzo, D.J., Escher, G., Ottersen, O.P., Whittington, J.D., Gillet, P., Stenseth, N.C. and Negrutiu, I. (2018). Framing planetary health: arguing for resource-centred science, *The Lancet*, Vol 2, pp.e101-e102, doi: 10.1016/S2542-5196(18)30023-8.
- Adab, P. (2018). Obesity crisis can't be solved by schools - major new study, *The Conversation*, 7th February, https://theconversation.com/obesity-crisis-cant-be-solved-by-schools-major-new-study-91265 [accessed 11th April 2019].
- Adam, A. and Jensen, J.D. (2016). What is the effectiveness of obesity related interventions at retail grocery stores and supermarkets? A systematic review, *BMC Public Health*, Vol. 16, No. 1, pp.1-18, doi: 10.1186/s12889-016-3985-x.
- Adams, M. (2019). The climate crisis has arrived – so stop feeling guilty and start imagining your future, *The Conversation*, 7th February, https://theconversation.com/the-climate-crisis-has-arrived-so-stop-feeling-guilty-and-start-imagining-your-future-111139 [accessed 11th April 2019].
- Adams, R.M. (1989). Global climate change and agriculture: an economic perspective, *American Journal of Agricultural Economics*, Vol. 71, No. 5, pp.1272-1279, doi: 10.2307/1243120.
- Adedeji, O., Reuben, O. and Olufemi Olatoye, O. (2014). Global climate change, *Journal of Geoscience and Environment Protection*, Vol. 2, pp.114-122, http://dx.doi.org/10.4236/gep.2014.22016 [accessed 11th April 2019].

- Adesina, O.S. and Thomas, B. (2020). Potential impacts of climate change on UK potato production, *International Journal of Environment and Climate Change*, Vol. 10, No. 4, pp.39-52, https://doi.org/10.9734/ijecc/2020/v10i430194.
- Adger, W.N. (2016). Place, well-being, and fairness shape priorities for adaptation to climate change, *Global Environmental Change*, Vol. 38, A1-A3, https://doi.org/10.1016/j.gloenvcha.2016.03.009 [accessed 11th April 2019].
- Adger, W.N., Pulhin, J.M. and Barnett, J. (2014). Human security. In: *Climate change 2014: impacts, adaptation, and vulnerability*, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White, eds.). Cambridge University Press, Cambridge, UK, pp. 755-791.
- Adhikari, P., Araya, H., Aruna, G., Balamatti, A., Banerjee, S., Baskaran, P., Barah, B.C., Behera, D., Berhe, T., Boruah, P., Dhar, S., Edwards, S., Fulford, M., Gujja, B., Ibrahim, H., Kabir, H., Kassam, A., Khadka, R.B., Koma, Y.S., Natarajan, U.S., Perez, R., Sen, D., Asif Sharif, A., Singh, G., Styger, E., Thakur, A.K., Tiwari, A., Uphoff, N. and Verma, A. (2018). System of crop intensification for more productive, resource-conserving, climate-resilient, and sustainable agriculture: experience with diverse crops in varying agroecologies, *International Journal of Agricultural Sustainability*, Vol. 16, No. 1, pp.1-28, doi: 10.1080/14735903.2017.1402504 [accessed 11th April 2019].
- Adom, D., Kamil Hussein, E. and Joe, A-A. (2018). Theoretical and conceptual framework: mandatory ingredients of a quality research, *International Journal of Scientific Research*, Vol. 7, No. 1, pp.438-441.
- Adorno, J. (2018). Species worldwide in decline as result of human activity, *Aljazeera News*, https://www.aljazeera.com/news/2018/03/species-worldwide-decline-result-human-activity-180323201750584.html [accessed 11th April 2019].
- Adrian, F. (2012). Dynamics of food security in recent decades, *Annals of Faculty of Economics,* Vol. 1, No. 2, pp.192-196, Oradea, Romania: University of Oradea, Faculty of Economics.
- Afshin, A., Peñalvo, J.L., Del Gobbo, L., Silva, J., Michaelson, M., O'Flaherty, M., Capewell, S., Spiegelman, D., Danaei, G. and Mozaffarian, D. (2017). The prospective impact of food pricing on improving dietary consumption: a systematic review and meta-analysis, *PloS One,* Vol. 12, No. 3, pp. e0172277, doi: 10.1371/journal.pone.0172277.
- Afshin, A., Peñalvo, J.L., Del Gobbo, L., Silva, J., Michaelson, M., O'Flaherty, M., Capewell, S., Spiegelman, D., Danaei, G. and Mozaffarian, D. (2017). The prospective impact of food pricing on improving dietary consumption: a systematic review and meta-analysis, *PLoS One*, Vo. 12, No. 3, pp.e0172277, doi:10.1371/journal.pone.0172277 [accessed 11th April 2019].

- Afshin, A., Sur, P., Fay, K. *et al.* (2019). Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017, *The Lancet*, Vol. 393, pp.1958-1972, https://doi.org/10.1016/S0140-6736(19)30041-8 [accessed 11th April 2019].
- Aggarwal, P., Vyas, S., Thornton, P. and Campbell, B.M. (2019). How much does climate change add to the challenge of feeding the planet this century? *Environmental Research Letters*, Vol. 14, No. 4, 043001, doi: 10.1088/1748-9326/aafa3e.
- Agovino, M., Casaccia, M., Ciommi, M., Ferrara, M. and Marchesano, K. (2019). Agriculture, climate change and sustainability: the case of EU-28, *Ecological Indicators*, Vol. 105; pp.525-543, https://doi.org/10.1016/j.ecolind.2018.04.064 [accessed 11th April 2019].
- Agrawala, S., Carraro, M., Kingsmill, N., Lanzi, E., Mullan, M. and Prudent-Richard, G. (2011). *Private sector engagement in adaptation to climate change: approaches to managing climate risks*, OECD Environment Working Paper 39, Paris, France: Organisation for Economic Co-operation and Development.
- Agriculture and Agri-Food Canada (2019). *Food policy for Canada*, https://www.canada.ca/content/dam/aafc-aac/documents/20190614-en.pdf [accessed 11th June 2019].
- Agri-Food Strategy Board for Northern Ireland (2013a). *Going for growth: a strategic action plan for the Northern Ireland*, Belfast, UK: Department of Agriculture, Environment and Rural Affairs, https://www.daera-ni.gov.uk/articles/going-growth-strategic-action-plan [accessed 11th April 2019].
- Agri-Food Strategy Board for Northern Ireland (2013b). *Going for growth: investing in success*, Belfast, UK: Department of Agriculture, Environment and Rural Affairs, https://www.daera-ni.gov.uk/sites/default/files/publications/dard/going-for-growth.pdf [accessed 11th April 2019].
- AHDB (2012). *Down to earth - The beef and sheep roadmap*, Kenilworth, Warwickshire: Agriculture and Horticulture Development Board, http://beefandlamb.ahdb.org.uk/research/climate-change/climate-change-generic/roadmap-3-down-to-earth/ [accessed 11th April 2019].
- AHDB (2013). *Understanding the nutrition and health claims regulations for lamb*, Kenilworth, UK: Agriculture and Horticulture Development Board, http://beefandlamb.ahdb.org.uk/wp-content/uploads/2013/05/Lamb-health-claims-document.pdf [accessed 11th April 2019].
- AHDB (2017). *Understanding the nutrition and health claims regulations for beef*, Kenilworth, UK: Agriculture and Horticulture Development Board, http://beefandlamb.ahdb.org.uk/wp-content/uploads/2017/11/AHDB-health-claims-for-beef.pdf [accessed 11th April 2019].
- AHDB (2018). *Landscapes without Livestock: visualising the impacts of a reduction in beef and sheep farming on some of England's most cherished landscapes*, Kenilworth, UK: Warwickshire: Agriculture and Horticulture Development Board.

- AHDB (2019). *AHDB response to Eat Lancet Commission report*, Kenilworth, UK: Agriculture and Horticulture Development Board, https://ahdb.org.uk/news/ahdb-response-to-eat-lancet-commission-report [accessed 11th April 2019].
- Ainsworth, E.A. and Ort, D.R. (2010). How do we improve crop production in a warming world, *Plant Physiology*, Vol. 154, pp.526-530, www.plantphysiol.org/cgi/doi/10.1104/pp.110.161349 [accessed 11th April 2019].
- Ainsworth, E.A., Leakey, A.D.B., Ort, D.R. and Long, S.P. (2008). FACE-ing the facts: inconsistencies and interdependence among field, chamber and modeling studies of elevated [CO_2] impacts on crop yield and food supply, *New Phytologist*, Vol. 179, No. 1, pp.5-9, https://doi.org/10.1111/j.1469-8137.2008.02500.x [accessed 11th April 2019].
- Ainsworth, E.A., Yendrek, C.R., Sitch, S., Collins, W.J. and Emberson, L.D. (2012). The effects of tropospheric ozone on net primary productivity and implications for climate change, *Annual Review of Plant Biology*, Vol. 63, pp.637-661, doi: 10.1146/annurev-arplant-042110-103829.
- Akenji, L. and Chen, H. (2017). *A framework for shaping sustainable lifestyles: determinants and strategies*, Nairobi, Kenya: United Nations Environment Programme, www.unep.org [accessed 11th April 2019].
- Åkesson, A., Andersen, L.F., Kristjansdottir, Á.G., Roos, E., Trolle, E., Voutilainen, E. and Wirfält, E. (2013). Health effects associated with foods characteristic of the Nordic diet: a systematic literature review, *Food & Nutrition Research*, Vol. 57, doi:10.3402/fnr.v57i0.22790.
- Akpan, N. (2020). New coronavirus can spread between humans—but it started in a wildlife market, *National Geographic*, 21st January, https://www.nationalgeographic.com/science/2020/01/new-coronavirus-spreading-between-humans-how-it-started/ [accessed 11th April 2019].
- Akram-Lodhi, H. (2015). Land grabs, the agrarian question and the corporate food regime, *Canadian Food Studies*, Vol. 2, No. 2, pp.233-241, doi: 10.15353/cfs-rcea.v2i2.94.
- Alae-Carew, C., Bird, F.A., Choudhury, S., Harris, F., Aleksandrowicz, L., Milner, J., Joy, E.J., Agrawal, S., Dangour, A.D. and Green, R. (2019). Future diets in India: a systematic review of food consumption projection studies, *Global Food Security*, Vol. 23, pp.182-190, doi: 10.1016/j.gfs.2019.05.006.
- Alae-Carew, C., Nicoleau, S., Bird, F.A., Hawkins, P., Tuomisto, H.L., Haines, A., Dangour, A.D. and Scheelbeek, P.F.D. (2020). The impact of environmental changes on the yield and nutritional quality of fruits, nuts and seeds: a systematic review, *Environmental Research* Letters, Vol. 15, No. 2, pp. 023002, doi:10.1088/1748-9326/ab5cc0.
- Alagiyawanna, A.M.A.A.P., Townsend, N., Mytton, O., Scarborough, P., Roberts, N. and Rayner, M. (2015). Studying the consumption and health outcomes of fiscal interventions (taxes and subsidies) on food and beverages in countries of different income classifications: a systematic review, *BMC Public Health*, Vol. 15, No. 887, doi:10.1186/s12889-015-2201-8.

- Alamar, M.C., Psichas, A., Spence, M. and Willcock, S. (2017). *The carbon footprint of high-protein foods: perceptions and impact of consumer-facing information in the UK*, Global Food Security (GFS) programme, www.foodsecurity.ac.uk [accessed 11th April 2019].
- Al-Amin, A.Q. and Ahmed, F. (2016). Food security challenge of climate change: an analysis for policy selection, *Futures*, Vol. 83, pp.50-63, https://doi.org/10.1016/j.futures.2016.04.002 [accessed 11th April 2019].
- Alberro, H. (2018). Climate change conflicts are here – and 'scallop wars' are just the beginning, *The Conversation*, 10th September, http://theconversation.com/climate-change-conflicts-are-here-and-scallop-wars-are-just-the-beginning-102928 [accessed 11th April 2019].
- Alberti, J., Balaguera, A., Brodhag, C. and Fullana-i-Palmer, P. (2017). Towards life cycle sustainability assessment of cities: a review of background knowledge, *Science of the Total Environment*, Vol. 609, pp.1049-1063, https://doi-org.ezproxy.mmu.ac.uk/10.1016/j.scitotenv.2017.07.179 [accessed 11th April 2019].
- Albrecht, T.R., Crootof, A. and Scott, C.A. (2018). The Water-Energy-Food Nexus: a systematic review of methods for nexus assessment, *Environmental Research Letters*, Vol. 13, No. 4, 043002, doi: 10.1088/1748-9326/aaa9c6.
- Alcamo, J. (2001). *Scenarios as tools for international environmental assessments*, European Environment Agency, Luxembourg: Office for Official Publications of the European Communities.
- Alders, R.G and Kock, R. (2017). What's food and nutrition security got to do with wildlife conservation? *Australian Zoologist*, Vol. 39, No. 1, pp.120-126, https://doi.org/10.7882/AZ.2016.040 [accessed 11th April 2019].
- Alders, R.G. (2016). Peak food and our quest for an ethical and ecologically sustainable human diet, *Proceedings of the Australian Poultry Science Symposium*, Sydney, Australia, Volume 27, pp.9-13.
- Aleixandre-Benavent, R., Aleixandre-Tudo, J.L., Castello-Cogollos, L. and Aleixandre, J.L. (2017). Trends in scientific research on climate change in agriculture and forestry subject areas (2005–2014), *Journal of Cleaner Production*, Vol 147, pp.406-418, https://doi.org/10.1016/j.jclepro.2017.01.112 [accessed 11th April 2019].
- Aleksandrowicz, L., Green, R., Joy, E.J.M., Smith, P. and Haines, A. (2016). The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: a systematic review, *PLoS One*, Vol. 11, No. 11, e0165797, doi:10.1371/journal. pone.0165797.
- Aleksandrowicz, L., Haines, A. and Green, R. (2015). Sustainable diet studies show co-benefits for greenhouse gas emissions and public health, *Advances in Nutrition*, Vol. 6, Iss. 3, pp.282–283, https://doi.org/10.3945/an.115.008466 [accessed 11th April 2019].
- Alemu, M.M. (2016). Sustainable land management, *Journal of Environmental Protection*, Vol. 7, pp.502-506, http://dx.doi.org/10.4236/jep.2016.74045 [accessed 11th April 2019].

- Alexander, P., Brown, C., Arneth, A., Dias, C., Finnigan, J., Moran, D. and Rounsevell, M.D.A. (2017). Could consumption of insects, cultured meat or imitation meat reduce global agricultural land use? *Global Food Security*, Vol 15, pp.22-32, https://doi.org/10.1016/j.gfs.2017.04.001 [accessed 11th April 2019].
- Alexander, P., Brown, C., Arneth, A., Finnigan, J. and Rounsevell, M.D.A. (2016). Human appropriation of land for food: the role of diet, *Global Environmental Change*, Vol. 41, pp.88-98, https://doi.org/10.1016/j.gloenvcha.2016.09.005 [accessed 11th April 2019].
- Alexander, P., Brown, C., Arneth, A., Finnigan, J., Moran, D. and Rounsevell, M.D.A. (2017). Losses, inefficiencies and waste in the global food system, *Agricultural Systems*, Vol. 153, pp.190-200, https://doi.org/10.1016/j.agsy.2017.01.014 [accessed 11th April 2019].
- Alexander, P., Reddy, A., Brown, C., Henry, R.C. and Rounsevell, M.D.A. (2019). Transforming agricultural land use through marginal gains in the food system, *Global Environmental Change,* Vol. 57, 101932, https://doi.org/10.1016/j.gloenvcha.2019.101932 [accessed 11th April 2019].
- Alexander, P., Rounsevell, M.D.A., Dislich, C., Dodson, J.R., Engström, K. and Moran, D. (2015). Drivers for global agricultural land-use change - the nexus of diet, population, yield and bioenergy, *Global Environmental Change*, Vol. 35, pp.138-147, https://doi.org/10.1016/j.gloenvcha.2015.08.011 [accessed 11th April 2019].
- Alexandratos, N. (2011). World food and agriculture to 2030/2050 revisited. Highlights and views four years later. In: *Looking ahead in world food and agriculture: perspectives to 2050* (ed) P. Conforti, pp.11-56, Rome, Italy: Food and Agriculture Organization of the United Nations.
- Alexandratos, N. and Bruinsma, J. (2012). *World agriculture towards 2030/2050: the 2012 revision*, ESA Working paper No. 12-03, Rome: Food and Agriculture Organization of the United Nations, http://large.stanford.edu/courses/2014/ph240/yuan2/docs/ap106e.pdf [accessed 11th April 2019].
- Al-Hadeethi, I., Li, Y., Odhafa, A.K.H., Al-Hadeethi, H., Seneweera, S. and Lam, S.K. (2019). Assessment of grain quality in terms of functional group response to elevated [CO_2], water, and nitrogen using a meta-analysis: grain protein, zinc, and iron under future climate, *Ecology and Evolution*, Vol. 9, No. 13, pp.7425-7437, doi: 10.1002/ece3.5210.
- Alison, B.P., Conaré, D., Meter, K., Di Battista, A. and Johnston, C. (2019). *Sustainable food system assessment: lessons from global practice*, Abingdon, UK: Routledge, https://doi.org/10.4324/9780429439896 [accessed 11th April 2019].
- Allain, J. (2018). The right to safe food: can the international food system deliver to the United Kingdom? *International Journal of Human Rights*, Vol. 22, No. 3, pp.350-369, https://doi.org/10.1080/13642987.2017.1371139 [accessed 11th April 2019].
- Allan, J.A. (1998). Virtual water: a strategic resource global solutions to regional deficits, *Ground Water*, Vol. 36, No. 4, pp.545-546, doi: 10.1111/j.1745-6584.1998.tb02825.x.

- Allen T., Prosperi, P. and Cogill, B. (2014). *Metrics of sustainable diets and food systems*, Workshop Report, Bioversity International & CIHEAM-IAMM, Montpellier, France, www.bioversityinternational.org [accessed 11th April 2019].
- Allen, M., Cain, M., Lynch, J. and Frame, D. (2018). Climate metrics for ruminant livestock, www.oxfordmartin.ox.ac.uk/publications/view/2601 [accessed 11th April 2019].
- Allen, M.R., Fuglestvedt, J.S., Shine, K.P., Reisinger, A., Pierrehumbert, R.T. and Forster, P.M. (2016). New use of global warming potentials to compare cumulative and shortlived climate pollutants, *Nature Climate Change*, Vol. 6, No. 8, pp.773-776, https://doi.org/10.1038/nclimate2998 [accessed 11th April 2019].
- Allen, M.R., Shine, K.P., Fuglestvedt, J.S., Millar, R.J., Cain, M., Frame, D.J. and Macey, A.H. (2018). A solution to the misrepresentations of CO_2-equivalent emissions of shortlived climate pollutants under ambitious mitigation, *Climate and Atmospheric Science*, Vol. 1, No. 1, 16, https://doi.org/10.1038/s41612-018-0026-8 [accessed 11th April 2019].
- Allen, P. (2010). Realizing justice in local food systems, *Cambridge Journal of Regions, Economy and Society*, Vol. 3, No. 2, pp.295-308, https://doi.org/10.1093/cjres/rsq015 [accessed 11th April 2019].
- Allen, S. and de Brauw, A. (2017). Nutrition sensitive value chains: theory, progress, and open questions, *Global Food Security*, https://doi.org/10.1016/j.gfs.2017.07.002 [accessed 11th April 2019].
- Allen, T. and Prosperi, P. (2016). Modeling sustainable food systems, *Environmental Management*, Vol. 57, pp.956-975, doi:10.1007/s00267-016-0664-8.
- Allès, B., Péneau, S., Kesse-Guyot, E., Baudry, J., Hercberg, S. and Mejean, C. (2017). Food choice motives including sustainability during purchasing are associated with a healthy dietary pattern in French adults, *Nutrition Journal*, Vol. 16, No. 16, p.58, doi: 10.1186/s12937-017-0279-9.
- Allier, A., Teyssèdre, S., Lehermeier, C., Claustres, B., Maltese, S., Melkior, S., Moreau, L. and Charcosset, A. (2019). Assessment of breeding programs sustainability: application of phenotypic and genomic indicators to a North European grain maize program, *Theoretical and Applied Genetics*, Vol. 132, No. 5, pp.1321-1334, https://doi.org/10.1007/s00122-019-03280-w [accessed 11th April 2020].
- Allievi, F., Vinnari, M. and Luukkanen, J. (2015). Meat consumption and production – analysis of efficiency, sufficiency and consistency of global trends, *Journal of Cleaner Production*, Vol. 92, pp.142-151, https://doi.org/10.1016/j.jclepro.2014.12.075 [accessed 11th April 2019].
- Allouche, J. (2011). The sustainability and resilience of global water and food systems: political analysis of the interplay between security, resource scarcity, political systems and global trade, *Food Policy*, Vol. 36, Suppl. 1, pp.S3-S8, https://doi.org/10.1016/j.foodpol.2010.11.013 [accessed 11th April 2019].

- Allwood, J.M., Dunant, C.F., Lupton, R.C., Cleaver, C.J., Serrenho, A.C.H., Azevedo, J.M.C., Horton, P.M., Clare, C., Low, H., Horrocks, I., Murray, J. c, Lin, J., Cullen, J.M., Ward, M., Salamati, M., Felin, T., Ibell, T., Zho, W. and Hawkins, W. (2019). *Absolute Zero*, UK Fires (a collaboration between the Universities of Cambridge, Oxford, Nottingham, Bath and Imperial College London), Cambridge, UK: University of Cambridge, doi: 10.17863/CAM.46075.
- Almås, R., Campbell, H. and Marsden, T. (eds)(2012). *Rethinking agricultural policy regimes: Food security, climate change and the future resilience of global agriculture*, Bingley, UK: Emerald Group Publishing Limited.
- Alonso, E.B., Cockx, L. and Swinnen, J. (2018a). Culture and food security, *Global Food Security*, Vol. 17, pp.113-127, https://doi.org/10.1016/j.gfs.2018.02.002 [accessed 11th April 2019].
- Alpro (2018). *The future of food & drink*, Birmingham, UK: Alpro.
- Alston, M. and Whittenbury, K. (2013). Does climatic crisis in Australia's food bowl create a basis for change in agricultural gender relations? *Agriculture and Human Values*, Vol. 30, No. 1, pp.115-128, doi: 10.1007/s10460-012-9382-x.
- Altieri, M.A. (1995). *Agroecology: the science of sustainable agriculture*, 2nd Edition, London, UK: CRC Press, ISBN 0-8133-1717-7.
- Altman, S.A. (2020). Will COVID-19 have a lasting impact on globalization? *Harvard Business Review*, 20th May, https://hbr.org/2020/05/will-COVID-19-have-a-lasting-impact-on-globalization [accessed 15th June, 2020].
- Alvarez, M. (2015). *What do we mean by Sustainable Communties*, January, London: Nesta Impact Investments, https://www.nesta.org.uk/blog/sowhat-exactly-do-we-mean-by-sustainable-communities/ [accessed 11th April 2019].
- Alvarez, S.A., Baltenweck, I., Iannotti, L. and Dominguez-Salas, P. (2019). First ever global scientific eating plan forgets the world’s poor, *The Conversation*, 27th February, https://theconversation.com/first-ever-global-scientific-eating-plan-forgets-the-worlds-poor-112238 [accessed 11th April 2019].
- Ambler-Edwards, S., Bailey, K., Kiff, A., Lang, T., Lee, R., Marsden, T., Simons, D. and Tibbs, H. (2009). *Food futures - rethinking UK strategy*, A Chatham House Report, London, UK: Chatham House Royal Institute of International Affairs, ISBN 978 1 86203 211 8.
- Ambler-Edwards, S., Bailey, K., Kiff, A., Lang, T., Lee, R., Marsden, T., Simons, D. and Tibbs, H. (2008). *Thinking About the Future of Food: The Chatham House Food Supply Scenarios,* Briefing Paper, Chatham House Food Supply Project CH BP 08/03, May, London, UK: Chatham House Royal Institute of International Affairs.
- Amel, E., Manning, C., Scott, B., and Koger, S. (2017). Beyond the roots of human inaction: fostering collective effort toward ecosystem conservation, *Science*, Vol. 356, pp.275-279, doi: 10.1126/science.aal1931.

- American Heart Association (2015). *The American Heart Association's Diet and Lifestyle Recommendations*, http://www.heart.org/HEARTORG/HealthyLiving/Diet-and-Lifestyle-Recommendations_UCM_305855_Article.jsp [accessed 11th April 2019].
- American Psychological Association (2019). Climate change conversations can be difficult for both skeptics, environmentalists - reinforcing trust in science, focusing on perseverance may shift views, *Science Daily*, 10th August, www.sciencedaily.com/releases/2019/08/190810151936.htm [accessed 11th August 2019].
- Amos, J. (2018). Thwaites Glacier - biggest ever Antarctic field campaign, *BBC News*, 30th April, https://www.bbc.co.uk/news/science-environment-43936372 [accessed 11th April 2019].
- Amos, N. and Sullivan, R. (2014). The *business benchmark on farm animal welfare 2014 report*, Business Benchmark on Farm Animal Welfare (BBFAW), Godalming, UK: Compassion in World Farming, https://www.compassioninfoodbusiness.com/our-work/what-we-offer/business-benchmark-on-farm-animal-welfare/ [accessed 11th April 2019].
- Amos, N. and Sullivan, R. (2016). The *business benchmark on farm animal welfare 2016 report*, Business Benchmark on Farm Animal Welfare (BBFAW), Godalming, UK: Compassion in World Farming, https://www.bbfaw.com [accessed 11th April 2019].
- AMS (2018). *Explaining Extreme Events in 2018 from a Climate Perspective,* 8th Edition, Boston, USA: American Meteorological Society, https://www.ametsoc.org/ams/index.cfm/publications/bulletin-of-the-american-meteorological-society-bams/explaining-extreme-events-from-a-climate-perspective/ [accessed 11th April 2019].
- Amundson, R., Berhe, A.A., Hopmans, J.W., Olson, C., Sztein, A.E. and Sparks, D.L. (2015). Soil and human security in the 21st century, *Science*, Vol. 348, No. 6235, 1261071, http://science.sciencemag.org/content/348/6235/1261071 [accessed 11th April 2019].
- An, R., Ji, M. and Zhang, S. (2018). Global warming and obesity: a systematic review, *Obesity Reviews*, Vol. 19, No. 2, pp.150-163, doi: 10.1111/obr.12624.
- Anandhi, A., Steiner, J.L. and Bailey, N. (2016). A system's approach to assess the exposure of agricultural production to climate change and variability, Climatic Change, Vol. 136, No. 3-4, pp.647-659, doi: 10.1007/s10584-016-1636-y.
- Anastasiou, K., Miller, M. and Dickinson, K. (2019). The relationship between food label use and dietary intake in adults: a systematic review, *Appetite*, Vol. 138, pp.280-291, https://doi.org/10.1016/j.appet.2019.03.025.
- Anderson, J.A., Gipmans, M., Hurst, S., Layton, R., Nehra, N., Picket, J., Shah, D.M., Lívio, T., Souza, P.O. and Tripathi, L. (2016). Emerging agricultural biotechnologies for sustainable agriculture and food security, *Journal of Agricultural and Food Chemistry*, Vol. 64, No. 2, pp.383-393, doi: 10.1021/acs.jafc.5b04543.

- Anderson, K. (2010). Globalization's effects on world agricultural trade, 1960–2050, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.3007-3021, https://doi.org/10.1098/rstb.2010.0131 [accessed 11th April 2019].
- Anderson, K. (2016). Climate change: a tale of Parisian triumph and tragedy, *Uppsala University lecture in climate change leadership*, 31st August, Manchester, UK: University of Manchester Tyndall Centre.
- Anderson, K. and Bows, A. (2011). Beyond 'dangerous' climate change: emission scenarios for a new world, *Series A, Mathematical, Physical, and Engineering Sciences*, Vol. 1934, pp.20-44, https://doi.org/10.1098/rsta.2010.0290 [accessed 11th April 2019].
- Andersson, R., Algers, B., Bergström, L., Lundström, K., Nybrant, T. and Sjödén, P.O. (2005). Food 21: a research program looking for measures and tools to increase food chain sustainability, *Ambio*, Vol. 34, pp.275-282, doi: 10.1639/0044-7447(2005)034[0275:farpfm]2.0.co;2.
- Andrews, K. (2019). Does Lancet want to hand control of our diets to the state, *The Spectator*, 18th January, https://blogs.spectator.co.uk/2019/01/does-lancet-want-to-hand-control-of-our-diets-to-the-state/ [accessed 11th April 2019].
- Andrews, S. (2017). The vegetarian carnivore - can we really feed plants to salmon, *Sustainable Food Trust*, 9th February, https://sustainablefoodtrust.org/articles/the-vegetarian-carnivore-can-we-really-feed-plants-to-salmon/ [accessed 11th April 2019].
- Andreyeva, T., Long, M.W. and Brownell, K.D. (2010). The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food, *American Journal of Public Health*, Vol. 100, No. 2, pp.216-222, doi: 10.2105/AJPH.2008.151415.
- Angevin, F., Fortino, G., Bockstaller, C., Pelzer, E. and Messéan, A. (2017). Assessing the sustainability of crop production systems: toward a common framework? *Crop Protection*, Vol. 97, pp.18-27, https://doi.org/10.1016/j.cropro.2016.11.018 [accessed 11th April 2020].
- Anstey, C. (2009). *The drive for sustainable food production, supply and consumption*, Utrecht, The Netherlands: Initiatief Duurzame Handel (Dutch Sustainable Trade Initiative). http://www.bibalex.org/Search4Dev/files/431940/460337.pdf [accessed 11th April 2019].
- Antal, M. (2018). Post-growth strategies can be more feasible than techno-fixes: focus on working time, *The Anthropocene Review*, Vol. 5, No. 3, pp.230-236, https://doi.org/10.1177/2053019618794212 [accessed 11th April 2019].
- Antelo, L.T., Carla Lopes, C., Amaya Franco-Uría, A. and Alonso, A.A. (2012). Fish discards management: pollution levels and best available removal techniques, *Marine Pollution Bulletin*, Vol. 64, pp.1277-1290, http://dx.doi.org/10.1016/j.marpolbul.2012.04.005 [accessed 11th April 2019].
- Anthony, A. (2019). How diet became the latest front in the culture wars, *The Guardian*, 17th March, https://www.theguardian.com/environment/2019/mar/17/how-diet-latest-front-culture-wars-eat-less-meat-lancet [accessed 11th April 2019].

- Anthony, K.W., von Deimling, T.S., Nitze, I., Frolking, S., Emond, A., Daanen, R., Anthony, P., Lindgren, P., Jones, B. and Grosse, G. (2018). 21st-century modeled permafrost carbon emissions accelerated by abrupt thaw beneath lakes, *Nature Communications*, Vol. 9, No. 1, doi: 10.1038/s41467-018-05738-9.
- Anticamara, J.A., Watson, R., Gelchu, A. and Pauly, D. (2011). Global fishing effort (1950–2010): trends, gaps, and implications, *Fisheries Research*, Vol. 107, No.1-3, pp.131-136, doi:10.1016/j.fishres.2010.10.016.
- Antle, J.M. and Capalbo, S.M. (2010). Adaptation of agricultural and food systems to climate change: an economic and policy perspective, *Applied Economic Perspectives and Policy*, Vol. 32, No. 3, pp.386-416, doi:10.1093/aepp/ppq01.
- Antonelli, M. and Dembska, K. (2018). *Tracking progress and identifying solutions for a healthier long-term future*, https://newfood.attach.io/Sy4ilujsQ [accessed 11th April 2019].
- Apostolidis, C. and McLeay, F. (2016). Should we stop meating like this? Reducing meat consumption through substitution, *Food Policy*, Vol. 65, pp.74-89, https://doi.org/10.1016/j.foodpol.2016.11.002.
- Appleby, M.C. (2005). The relationship between food prices and animal welfare, *Journal of Animal Science*, Vol. 83, pp.E9-E12, https://doi.org/10.2527/2005.8313_supplE9x [accessed 11th April 2019].
- Appleton, J. (2019). *Cooking for bureaucrats why the policy of food reformulation is hard to stomach*, IEA Discussion Paper No. 98, London, UK: Institute of Economic Affairs, https://Cooking for bureaucrats why the policy of food reformulation is hard to stomachiea.org.uk/publications/cooking-for-bureaucrats/ [accessed 11th April 2019].
- Appleton, K. (2014). *The psychology of food intake and portion control*, London, UK: The Institute of Food Science and Technology, https://www.ifst.org/resources/information-statements/psychology-food-intake-and-portion-control [accessed 11th April 2019].
- Appleton, K.M., Hemingway, A., Saulais, L., Dinnella, C., Monteleone, E., Depezay, L., Morizet, D., Armando Perez-Cueto, F.J., Bevan, A. and Hartwell, H. (2016). Increasing vegetable intakes: rationale and systematic review of published interventions, *European Journal of Nutrition*, Vol. 55, Iss. 3, pp.869-896, doi: 10.1007/s00394-015-1130-8.
- Appropriate Technology (2016). The climate is changing. Food and agriculture must too, 2016, *Appropriate Technology*, Vol. 43, No. 4, pp. 15, https://www.bioversityinternational.org/news/detail/the-climate-is-changing-food-and-agriculture-must-too/ [accessed 11th April 2019].
- Araujo Enciso, S.R., Fellmann, T., Dominguez, I.P. and Santini, F. (2016). Abolishing biofuel policies - possible impacts on agricultural price levels, price variability and global food security, *Food Policy*, Vol. 61, pp.9-26, http://dx.doi.org/10.1016/j.foodpol.2016.01.007 [accessed 11th April 2019].
- Araus, J.L. and Kefauver, S.C. (2018). Breeding to adapt agriculture to climate change: affordable phenotyping solutions, *Current Opinion in Plant Biology*, Vol. 45, pp.237-247, https://doi.org/10.1016/j.pbi.2018.05.003 [accessed 11th April 2019].

- Arbuthnott, K.G. and Hajat, S. (2017). The health effects of hotter summers and heat waves in the population of the United Kingdom: a review of the evidence, *Environmental Health*, Vol. 16, pp.119, https://doi.org/10.1186/s12940-017-0322-5 [accessed 11th April 2019].
- Arcari, P. (2017). Normalised, human-centric discourses of meat and animals in climate change, sustainability and food security literature, *Agriculture and Human Values*, Vol. 34, No. 1, pp.69-86, doi: 10.1007/s10460-016-9697-0.
- Arce, A.N., Rodrigues, A.R., Yu, J., Colgan, T.J., Wurm, Y. and Gill, R.J. (2018). Foraging bumblebees acquire a preference for neonicotinoid-treated food with prolonged exposure, *Proceedings of the Royal Society B*, Vol. 285, No. 1885, p.20180655, https://doi.org/10.1098/rspb.2018.0655 [accessed 11th April 2019].
- Archer, E. and Lavie, C.J. (2019). Healthy diets and sustainable food systems, *The Lancet*, Vol. 394, No. 10194, pp.214-215, doi: 10.1016/S0140-6736(19)31130-4.
- Areal, F.J., Jones, P.J., Mortimer, S.R. and Wilson, P. (2018). Measuring sustainable intensification: combining composite indicators and efficiency analysis to account for positive externalities in cereal production, *Land Use Policy*, Vol. 75, pp.314-326, https://doi.org/10.1016/j.landusepol.2018.04.001 [accessed 11th April 2019].
- Arezki, R., El Aynaoui, K. and Nyarko, Y. (2016). Food price volatility and its consequences, *Oxford Economic Papers*, Vol. 68, No. 3, pp.655-664, doi: 10.1093/oep/gpw019.
- Arias-Maldonado, M. (2013). Rethinking sustainability in the Anthropocene, *Environmental Politics*, Vol. 22, No. 3, pp.428-446, http://dx.doi.org/10.1080/09644016.2013.765161 [accessed 11th April 2019].
- Armanda, D.T., Guinée, J.B. and Tukker, A. (2019). The second green revolution: innovative urban agriculture's contribution to food security and sustainability – a review, *Global Food Security*, Vol. 22, pp.13-24, https://doi.org/10.1016/j.gfs.2019.08.002 [accessed 11th April 2020].
- Armstrong McKay, D.I., Dearing, J.A., Dyke, J.G., Poppy, G.M. and Firbank, L.G. (2019). To what extent has sustainable intensification in England been achieved? *Science of the Total Environment*, Vol. 648, pp.1560-1569, https://doi.org/10.1016/j.scitotenv.2018.08.207 [accessed 11th April 2019].
- Armstrong, M. and Holmes, I. (2010). *An indicator of sustainability for marine fin-fish stocks around the UK, 1990 – 2008,* Lowestoft, UK: Centre for Environment, Fisheries and Aquaculture Science.
- Arnell, N.W., Cannell, M.G.R., Hulme, M., Kovats, R.S., Mitchell, J.F.B., Nicholls, R.J., Parry, M.L., Livermore, M.T.J. and White, A. (2002). The consequences of CO_2 stabilisation for the impacts of climate change, *Climatic Change*, Vol. 53, No. 413, pp.201-223, https://doi.org/10.1023/A:1015277014327 [accessed 11th April 2019].
- Arnell, N.W., Livermore, M.J.L., Kovats, S., Levy, P.E., Nicholls, R., Parry, M.L. and Gaffin, S.R. (2004). Climate and socio-economic scenarios for global-scale climate change impacts assessments: characterising the SRES storylines, *Global Environmental Change*, Vol. 14, pp.3-20. doi:10.1016/j.gloenvcha.2003.10.004.

- Arno, A. and Thomas, S. (2016). The efficacy of nudge theory strategies in influencing adult dietary behaviour: a systematic review and meta-analysis, *BMC Public Health*, Vol. 16, No. 676, doi:10.1186/s12889-016-3272-x.
- Arnott, D. (2018). Brexit's impact on farming policy will take Britain back to the 1920s – but that's not necessarily a bad thing, *The Conversation*, 2nd July, https://theconversation.com/brexits-impact-on-farming-policy-will-take-britain-back-to-the-1920s-but-thats-not-necessarily-a-bad-thing-80028 [accessed 11th April 2019].
- Arnoult, M.H., Jones, P.J., Tranter, R.B., Tiffin, R., Traill, W.B. and Tzanopoulos, J. (2010). Modelling the likely impact of healthy eating guidelines on agricultural production and land use in England and Wales, *Land Use Policy*, Vol. 27, Iss. 4, pp.1046-1055, https://doi.org/10.1016/j.landusepol.2010.02.001 [accessed 11th April 2019].
- Aromataris, E. and Munn, Z. (2017). Chapter 1: JBI systematic reviews. In: Aromataris, E. and Munn, Z. (eds). *Joanna Briggs Institute Reviewer's Manual*, Adelaide, Australia: The Joanna Briggs Institute, https://reviewersmanual.joannabriggs.org/ [accessed 15th January 2020].
- Aromataris, E. and Riitano, D. (2014). Systematic reviews: constructing a search strategy and searching for evidence, *American Journal of Nursing*, Vol. 114, pp.49-56, doi: 10.1097/01.NAJ.0000446779.99522.f6.
- Aromataris, E., Fernande, R., Godfrey, C., Holly, C., Khalil, H. and Tungpunkom, P. (2014). *Methodology for JBI umbrella reviews*, The Joanna Briggs Institute; University of Adelaide.
- Aromataris, E., Fernandez, R., Godfrey, C., Holly, C., Khalil, H. and Tungpunkom, P. (2015). Summarizing systematic reviews: methodological development, conduct and reporting of an umbrella review approach, *International Journal of Evidence-Based Healthcare*, Vol. 13, No. 3, doi: 10.1097/XEB.0000000000000055.
- Arpad, T. (2019). Willing to pay to save the planet? Evaluating support for increased spending on sustainable development and environmentally friendly policies in five countries, *PLoS One*, Vol. 14, No. 5, e0216571, https://doi.org/10.1371/journal.pone.0216571 [accessed 15th April 2019].
- Arratia, R. (2019). Footprint trends: time for radical sustainability, *Food Service Footprint*, 24th January, https://www.foodservicefootprint.com/footprint-trends-time-for-radical-sustainability/ [accessed 11th April 2019].
- Arsenault, C. (2014). Only 60 years of farming left if soil degradation continues, *Scientific American*, 5th December, https://www.scientificamerican.com/article/only-60-years-of-farming-left-if-soil-degradation-continues/ [accessed 11th April 2019].
- ASC (2013). *Managing the land in a changing climate*, Adaptation Sub-Committee Progress Report, London, UK: Committee on Climate Change, https://www.theccc.org.uk/wp-content/uploads/2013/07/ASC-2013-Book-singles_2.pdf [accessed 11th April 2019].

- ASC (2016). *UK Climate Change Risk Assessment 2017 Synthesis Report: priorities for the next five years*, London, UK: Adaptation Sub-Committee of the Committee on Climate Change, https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Synthesis-Report-Committee-on-Climate-Change.pdf [accessed 11th April 2019].
- Asgari, N., Hassani, A., Jones, D. and Nguye, H.H. (2014). Sustainability ranking of the UK major ports - methodology and case study, *Transportation Research*, Part E, Vol. 78, pp.19-39, https://doi.org/10.1016/j.tre.2015.01.014 [accessed 11th April 2019].
- Ash, T. (2020). EM investors can no longer ignore climate change: the benign consensus for 2020 leaves too much out of the equation, *Financial Times*, 17th January, https://www.ft.com/content/e62bbb32-127e-4a37-8aba-30eda73d2e95 [accessed 17th January 2020].
- Asiedu, R. and Sartie, A. (2010). Crops that feed the World 1. Yams: Yams for income and food security, *Food Security*, Vol. 2, No.4, pp.305-315, doi: 10.1007/s12571-010-0085-0.
- Assadourian, E. (2010). Transforming cultures: from consumerism to sustainability, *Journal of Macromarketing*, Vol. 30, No. 2, pp.186-191, doi: 10.1177/0276146710361932.
- Asseng, S., Ewert, F., Martre, P., Rötter, R.P., Lobell, D.B., Cammarano, D., Kimball, B.A., Ottman, M.J., Wall, G.W., White, J.W., Reynolds, M.P., Alderman, P.D., Prasad, P.V.V., Aggarwal, P.K. Anothai, J., Basso, B., Biernath, C., Challinor, A.J., De Sanctis, G., Doltra, J., Fereres, E., Garcia-Vila, M., Gayler, S., Hoogenboom, G., Hunt, L.A., Izaurralde, R.C., Jabloun, M., Jones, C.D., Kersebaum, K.C., Koehler, A-K., Müller, C., Naresh Kumar, S., Nendel, C., O'Leary, G., Olesen, J.E., Palosuo, T., Priesack, E., Eyshi Rezaei, E., Ruane, A.C., Semenov, M.A., Shcherbak, I., Stockle, C., Stratonovitch, P., Streck, T., Supit, I., Tao, F., Thorburn, P.J., Waha, K., Wang, E., Wallach, D., Wolf, J., Zhao, Z., and Zhu, Y. (2015). Rising temperatures reduce global wheat production, *Nature Climate Change*, Vol. 5, No. 2, pp.143-147, doi:10.1038/nclimate2470.
- Aston, L.M., Smith, J.N. and Powles, J.W. (2012). Impact of a reduced red and processed meat dietary pattern on disease risks and greenhouse gas emissions in the UK: a modelling study, *BMJ Open*, Vol. 2, e001072. doi:10.1136/bmjopen-2012-001072.
- Atallah, R., Filion, K.B., Wakil, S.M., Genest, J., Joseph, L., Poirier, P., Rinfret, S., Schiffrin, E.L. and Eisenberg, M.L. (2015). Long-term effects of 4 popular diets on weight loss and cardiovascular risk factors: a systematic review of randomized controlled trials, *Cardiovascular Quality and Outcomes*, Vol. 7, No. 6, pp.815-827, doi:10.1161/CIRCOUTCOMES.113.000723.
- Audsley, E., Angus, A., Chatterton, J., Graves, A., Morris, J., Murphy-Bokern, D., Pearn, K., Sandars, D. and Williams, A. (2010). *Food, land and greenhouse gases: the effect of changes in UK food consumption on land requirements and greenhouse gas emissions*, Report for the Committee on Climate Change December, Cranfield, UK: Cranfield University.

- Audsley, E., Brander, M., Chatterton, J., Murphy-Bokern, D., Webster, C., and Williams, A. (2010). *How low can we go? An assessment of Greenhouse Gas Emissions from the UK food system and the scope for reduction by 2050*, Godalming, UK: World Wide Fund for Nature.
- Auestad, N. and Fulgoni, V.L. (2015). Reply to L Aleksandrowicz *et al*., *Advances in Nutrition*, Vol. 6, Iss. 3, pp.283-284, https://doi.org/10.3945/an.115.008573 [accessed 15th April 2019].
- Auestad, N. and Fulgoni, V.L. (2015). What current literature tells us about sustainable diets: emerging research linking dietary patterns, environmental sustainability, and economics, *American Society for Nutrition Advances in Nutrition*, Vol. 6, pp.19-36, doi:10.3945/an.114.005694.
- Austgulen, M., Skuland, S., Schjøll, A. and Alfnes, F. (2018). Consumer readiness to reduce meat consumption for the purpose of environmental sustainability: insights from Norway, *Sustainability*, Vol. 10, No. 9, pp.3058, https://doi.org/10.3390/su10093058 [accessed 11th April 2020].
- Avadí, A. and Fréon, P. (2015). A set of sustainability performance indicators for seafood - direct human consumption products from Peruvian anchoveta fisheries and freshwater aquaculture, *Ecological Indicators*, Vol. 48, pp.518-532, https://doi.org/10.1016/j.ecolind.2014.09.006 [accessed 11th April 2019].
- Avnery, S., Mauzerall, D.L., Liu, J. and Horowitz, L.W. (2011). Global crop yield reductions due to surface ozone exposure: 1. Year 2000 crop production losses and economic damage, *Atmospheric Environment*, Vol. 45, pp.2284-2296, https://doi.org/10.1016/j.atmosenv.2010.11.045 [accessed 11th April 2019].
- Azevedo, J. and Marques, M. (2017). Climate literacy: a systematic review and model integration, *International Journal of Global Warming*, Vol. 12, No. 3-4, pp.414-430, doi: 10.1504/IJGW.2017.084789.
- Azhar, B., Saadun, N., Prideaux, M. and Lindenmayer, D.B. (2017). The global palm oil sector must change to save biodiversity and improve food security in the tropics, *Journal of Environmental Management*, Vol. 203, Partt 1, pp.457-466, doi: 10.1016/j.jenvman.2017.08.021.
- Azzini, E., Maiani, G., Turrini, A., Intorre, F., Lo Feudo, G., Capone, R., Bottalico, F., El Bilali, H. and Polito, A. (2018). The health-nutrition dimension: a methodological approach to assess the nutritional sustainability of typical agro-food products and the Mediterranean diet: sustainability of typical agro-food products and Med diet, *Journal of the Science of Food and Agriculture*, Vol. 98, Iss. 10, pp.3684-3705, doi: 10.1002/jsfa.8877.
- Backhaus, J., Breukers, S., Mont, O., Paukovic, M. and Mourik, R. (2017). *Sustainable lifestyles - today's facts and tomorrow's trends*, D1.1 Sustainable lifestyles baseline report, Amersterdam, The Netherlands: Energy research Centre of the Netherlands.
- Baer-Nawrocka, A. and Sadowski, A. (2019). Food security and food self-sufficiency around the world: a typology of countries, *PLoS One*, Vol. 14, No. 3, e0213448, https://doi.org/10.1371/journal.pone.0213448 [accessed 11th April 2019].

- Baggini, J. (2019). A tax on red meat? That won't save the planet – or do much to improve our health: The problems associated with the production of red meat are far too complicated for a simplistic sin levy, *The Guardian*, 29th May, https://www.theguardian.com/commentisfree/2019/may/29/tax-red-meat-save-the-planet-improve-health-sin-levy [accessed 11th April 2019].
- Bähr, C.C. (2015). Greenhouse gas taxes on meat products - a legal perspective, *Transnational Environmental Law,* Vol. 4, Iss. 01, pp.153-179, doi: 10.1017/S2047102515000011.
- Bai, X. (2017). Sustainability: China's path to ecotopia, *Nature*, Vol. 550, No. 7674, pp.37-38, doi:10.1038/550037a.
- Bai, X., Huang, Y., Ren, W., Coyne, M., Jacinthe, P-A., Tao, B. and Hui, D. (2019). Responses of soil carbon sequestration to climate-smart agriculture practices: a meta-analysis, *Global Change Biology*, Vol. 25, No. 8, pp.2591-2606, doi: 10.1111/gcb.14658.
- Bai, Z., Caspari, T., Gonzalez, M.R., Batjes, N.H., Mäder, P., Bünemann, E.K., Goede, R., Brussaard, L., Xu, M., Sofia, C., SantosFerreira, S., Reintam, E., Fan, H., Mihelič, R., Glavan, M. and Tóth, Z. (2018a). Effects of agricultural management practices on soil quality: a review of long-term experiments for Europe and China, *Agriculture, Ecosystems & Environment*, Vol. 265, pp.1-7, doi:10.1016/J.AGEE.2018.05.028.
- Bai, Z., Lee, M.R.F., Ma, L., Ledgard, S., Oenema, O., Velthof, G.L., Ma, W., Guo, M., Zhao, Z., Wei, S., Li, S., Liu, X., Havlík, P., Luo, J., Hu, C. and Zhang, F. (2018b). Global environmental costs of China's thirst for milk, *Global Change Biology*, Vol. 24 No. 5, pp.2198-2211, doi: 10.1111/gcb.14047.
- Bailey, R. (2011). *Growing a better future: food justice in a resource-constrained world*, Oxfam Policy and Practice, Oxford, UK: Oxfam, https://policy-practice.oxfam.org.uk/publications/growing-a-better-future-food-justice-in-a-resource-constrained-world-132373 [accessed 11th April 2019].
- Bailey, R. and Wellesley, L. (2017). *Chokepoints and vulnerabilities in global food trade*, London, UK: Chatham House Royal Institute of International Affairs, https://www.chathamhouse.org/publication/chokepoints-vulnerabilities-global-food-trade [accessed 11th April 2019].
- Bailey, R., Benton, T., Challinor, A., Elliott, J., Gustafson, D., Hiller, B., Jones, A., Lewis, K., Meacham, T., Rivington, M., Tiffin, R. and Wuebbles, D. (2015a). Climate change - a risk assessment. In: D King, D Schrag, Z Dadi, Q Ye and A Ghosh, (eds), chap. 20, 113-119, UK Foreign and Commonwealth Office.
- Bailey, R., Benton, T., Challinor, A., Elliott, J., Gustafson, D., Hiller, B., Jones, A., Lewis, K., Meacham, T., Rivington, M., Tiffin, R. and Wuebbles, D. (2015b). *Extreme weather and resilience of the global food system*, Final Project Report from the UKUS Taskforce on Extreme Weather and Global Food System Resilience, UK: The Global Food Security Programme, https://www.foodsecurity.ac.uk/publications/extreme-weather-resilience-global-food-system.pdf, [accessed 11th April 2019].

- Bailey, R., Froggatt, A. and Wellesley, L. (2014). *Livestock – climate change's forgotten sector: global public opinion on meat and dairy consumption*, Chatham House with FCRN, Ipsos MORI, and the Avatar Alliance, December, https://www.chathamhouse.org/publication/livestock-climate-change-forgotten-sector-global-public-opinion-meat-and-dairy [accessed 11th April 2019].
- Bailey, R., Lee, B. and Benton, T. (2018). *Breaking the vicious circle: food, climate & nutrition*, London, UK: Hoffmann Centre for Sustainable Resource Economy, https://hoffmanncentre.chathamhouse.org/article/breaking-the-vicious-cycle-food-climate-nutrition/ [accessed 11th April 2019].
- Bajželj, B. and Richards, K.S. (2014). The positive feedback loop between the impacts of climate change and agricultural expansion and relocation, *Land*, Vol. 3, pp.898-916, doi:10.3390/land3030898.
- Bajželj, B., Richards, K.S., Allwood, J.M., Smith, S., Dennis, J.S., Curmi, E. and Gilligan, C.A. (2014). The importance of food demand management for climate mitigation, *Nature Climate Change*, Vol. 4, No. 10, pp.924-929, doi: 10.1038/nclimate2353.
- Bakker, L. and Svenning, J-C. (eds)(2018). Trophic rewilding: consequences for ecosystems under global change, *Philosophical Transactions of the Royal Society B*, Vol. 373, No. 1761, https://doi.org/10.1098/rstb.2017.0432 [accessed 11th April 2019].
- Balbus, J.M. and Malina, C. (2017). Identifying vulnerable subpopulations for climate change health effects in the United States, *Journal of Occupational and Environmental Medicine*, Vol. 51, No. 1, pp.33-37, doi: 10.1097/JOM.0b013e318193e12e.
- Baldos, U., Hertel, T. and Moore, F. (2018). The biophysical and economic geographies of global climate impacts on agriculture, *Working Paper Series*, Vol. 24779, doi: 10.3386/w24779.
- Baldos, U.L.C. and Hertel, T.W. (2014). Global food security in 2050 - the role of agricultural productivity and climate change, *Australian Journal of Agricultural and Resource Economics*, Vol. 58, No. 4, pp.554-570, doi: 10.1111/1467-8489.12048.
- Baldwin, R. (1995). Does sustainability require growth? In: *Economics of sustainable development* (eds) Goldin, I. and Winters, L.A., Cambridge, UK: Organisation for Economic Co-operation and Development and Centre for Economic Policy Research, ISBN 0521469570.
- Bale, J.S., Masters, G.J., Hodkinson, I.D., Awmack, C., Bezemer, T.M. and Brown, V.K. (2002). Herbivory in global climate change research: direct effects of rising temperature on insect herbivores, *Global Change Biology*, Vol. 8, pp.1-16, https://doi.org/10.1046/j.1365-2486.2002.00451.x [accessed 11th April 2019].
- Balfour, M.C. (1891). Legends of the Lincolnshire Cars, *Folklore*, Vol. II, pp.149-56.
- Balgopal, M.M., Klein, J.A., Brown, C.S., McMeeking, L.B.S, Morgan, J.A. and Frasier, W.M. (2014). Linking biophysical, socioeconomic, and political effects of climate change on agro-ecosystems, *Journal of Geoscience Education*, Vol. 62, pp.343-352, doi: 1089-9995/2014/62(3)/343/10.

- Ball, J. (2009). Defra sustainability move to have major impact on industry, *The Grocer*, 19th September, p.4, https://www.thegrocer.co.uk/home/topics/defra-sustainability-move-to-have-major-impact-on-industry/203500.article [accessed 11th April 2019].
- Ball, P. and Jolly, M. (2016). *Sustainable manufacturing for the future*, The journey to 2050: research on the vision and pathways for sustainability in the food and drink industry in Great Britain, Coca-Cola Enterprises Great Britain and Cranfield University.
- Balmford, A., Amano, T., Bartlett, H., Chadwick, D., Collins, A., Edwards, D., Field, R., Garnsworthy, P., Green, R., Smith, P., Waters, H., Whitmore, A., Broom, D.M., Chara, J., Finch, T., Garnett, E., Gathorne-Hardy, A., Hernandez-Medrano, J., Herrero, M., Hua, F., Latawiec, A., Misselbrook, T., Phalan, B., Simmons, B.I., Takahashi, T., Vause, J., zu Ermgassen, E.Z., and Eisner, R. (2018). The environmental costs and benefits of high-yield farming, *Nature Sustainability*, Vol. 1, No. 9, pp. 477-485, doi: 10.1038/s41893-018-0138-5.
- Balmford, A., Green, R. and Phalan, B. (2012). What conservationists need to know about farming, *Proceedings of the Royal Society B: Biological Sciences*, rspb20120515 doi:10.1098/rspb.2012.0515.
- Balmford, A., Green, R. and Phalan, B. (2015). Land for food and land for nature? *Daedalus*, Vol. 144, pp.57-75, https://doi.org/10.1162/DAED_a_00354 [accessed 11th April 2019].
- Balmford, A., Green, R.E. and Scharlemann, J.P.W. (2005). Sparing land for nature: exploring the potential impact of changes in agricultural yield on the area needed for crop production, *Global Change Biology*, Vol. 11, No. 10, pp.1594–1605, https://doi.org/10.1111/j.1365-2486.2005.001035.x [accessed 11th April 2019].
- Bamber, J. and Oppenheimer, J. (2019). Climate change - sea-level rise could displace millions of people within two generations, *The Conversation*, 20th May, https://theconversation.com/climate-change-sea-level-rise-could-displace-millions-of-people-within-two-generations-116753 [accessed 11th April 2019].
- Bamber, J.L., Oppenheimer, M., Kopp, R.E., Aspinall, W.P. and Cooke, R.M. (2019). Ice sheet contributions to future sea-level rise from structured expert judgment, *Proceedings of the National Academy of Sciences*, May, 201817205, doi: 10.1073/pnas.1817205116.
- Bamford, V. (2014). Tea players warn of pressure on crops, *The Grocer*, 15th February, p.16, https://www.thegrocer.co.uk/prices-and-promotions/tea-players-warn-of-pressures-on-crops/354530.article [accessed 11th April 2019].
- Bandara, J.S. and Cai, Y. (2014). The impact of climate change on food crop productivity, food prices and food security in South Asia, *Economic Analysis and Policy*, Vol. 44, No. 4, pp.451-465, doi: 10.1016/j.eap.2014.09.005.
- Bandy, L., Adhikari, V., Jebb, S. and Rayner, M. (2019). The use of commercial food purchase data for public health nutrition research: a systematic review, *PLoS One,* Vol. 14, No. 1, pp. e0210192, doi: http://dx.doi.org/10.1371/journal.pone.0210192.

- *Bangkok Post* (2017). Toxic gases blamed as 5 die after factory fall in Bang Na, *Bangkok Post*, 24th June, https://www.bangkokpost.com/thailand/general/1274503/toxic-gases-blamed-as-5-die-after-factory-fall-in-bang-na [accessed 15th April, 2019].
- *Bank of England* (2019). A framework for assessing financial impacts of physical climate change: a practitioner's aide for the general insurance sector, London, UK: Bank of England, https://www.bankofengland.co.uk/prudential-regulation/publication/2019/a-framework-for-assessing-financial-impacts-of-physical-climate-change [accessed 11th April 2019].
- Bankman, J. (2018). *Chronic disease, changing diets, and sustainability - the globaliziation of western-style eating and its implications*, Brighter Green Discussion Paper, www.brightergreen.org [accessed 11th April 2019].
- Bansal, P. and DesJardine, M.R. (2014). Business sustainability: it is about time, *Strategic Organization*, Vol. 12, p.70, https://doi.org/10.1177/1476127013520265 [accessed 11th April 2019].
- BANT (2019). BANT cautiously welcomes EAT-Lancet Commission on healthy diets from sustainable food systems but has reservations, *British Association for Nutrition and Lifestyle Medicine*, 17th January, https://bant.org.uk/2019/01/17/bant-cautiously-welcomes-eat-lancet-commission-on-healthy-diets-from-sustainable-food-systems-but-has-reservations/ [accessed 11th April 2019].
- Banta, J.E., Lee, J.W., Hodgkin, G., Yi, Z., Fanica, A. and Sabate, J. (2018). The global influence of the Seventh-Day Adventist Church on diet, *Religions*, Vol. 9, No. 251, doi:10.3390/rel9090251.
- Barange, M. and Perry, R.I. (2009). Physical and ecological impacts of climate change relevant to marine and inland capture fisheries and aquaculture. In: *Climate Change Implications for Fisheries and Aquaculture: Overview of Current Scientific Knowledge*, (ed.) Cochrane, K., De Young, C., Soto, D., and Bahri, T. pp.7–106. Rome, Italy: Food and Agriculture Organization of the United Nations.
- Barange, M., Cheung, W.W.L., Merino, G. and Perry, I.R. (2010). Modelling the potential impacts of climate change and human activities on the sustainability of marine resources, *Current Opinion in Environmental Sustainability*, Vol. 2, pp.326-333, doi: 10.1016/j.cosust.2010.10.002.
- Barba, F., Putnik, P. and Kovacevic, D.B. (eds.)(2020). *Agri-food industry strategies for healthy diets and sustainability: new challenges in nutrition and public health*, Cambridge, UK: Academic Press,
- Barbieri, P., Pellerin, S. and Nesme, T. (2017). Many shades of gray - the context-dependent performance of organic agriculture, *Scientific Reports*, Vol. 7, pp.13761, doi:10.1038/s41598-017-14271-6.
- Barclay, C. (2012). *Food Security – UK Policy*, Standard Note: SN/SC/4985, Science and Environment Section, London, UK: Library of the House of Commons.
- Barclays (2019). Winds of change - the next environmental debate, 11th February, https://www.investmentbank.barclays.com/our-insights/the-cattle-industry-on-climate-change.html [accessed 11th April 2019].

- Barilla (2016). *Fixing food - towards a more sustainable food system*, Economist Intelligence
- Barilla Center for Food and Nutrition Foundation (2018). *An index on food and sustainability*, http://foodsustainability.eiu.com/ [accessed 11th April 2019].
- Barilla Center for Food and Nutrition Foundation (2018). *Fixing food 2018: best practices towards the sustainable development goals*, http://foodsustainability.eiu.com/wp-content/uploads/sites/34/2019/05/FixingFood2018-2.pdf [accessed 11th April 2019].
- Barilla Group (2017). *Good for you, good for the planet*, http://www.goodforyougoodfortheplanet.org/ [accessed 11th April 2019].
- Barkemeyer, R., Givry, P. and Figge, F. (2017). Trends and patterns in sustainability-related media coverage: a classification of issue-level attention, *Environment and Planning C: Politics and Space*, Vol. 36, Iss. 5, pp.937-962, https://doi.org/10.1177/2399654417732337 [accessed 11th April 2019].
- Barkemeyer, R., Holt, D., Preuss, L. and Tsang, S. (2014). What happened to the development in sustainable development - business guidelines two decades after Brundtland, *Sustainable Development*, Vol. 22, pp.15-32, doi: 10.1002/sd.521.
- Barkham, P. (2018). EU in 'state of denial' over destructive impact of farming on wildlife, *The Guardian*, 23rd March, https://www.theguardian.com/environment/2018/mar/23/eu-in-state-of-denial-over-destructive-impact-of-farming-on-wildlife [accessed 11th April 2019].
- Barling, D. (2007). Food supply chain governance and public health externalities: upstream policy interventions and the UK state, *Journal of Agricultural and Environmental Ethics*, Vol. 20, pp.285-300, doi: 10.1007/s10806-007-9034-0.
- Barling, D. (2017). ‘Dig for Brexit’ comments reveal the UK government digging a food security hole for itself, *The Conversation*, 19th October, https://theconversation.com/dig-for-brexit-comments-reveal-the-uk-government-digging-a-food-security-hole-for-itself-85798 [accessed 11th April 2019].
- Barling, D. (2018). Food supply after Brexit, *Food Science and Technology: Journal of the Institute of Food Science and Technology*, 20th February, Vol. 32, No. 1, p.17, https://fstjournal.org/features/32-1/food-supply-after-brexit [accessed 11th April 2019].
- Barling, D. and Lang, T. (2003). The politics of UK food policy: an overview, *The Political Quarterly*, Vol. 74, pp.4-7, doi:10.1111/1467-923X.00506.
- Barling, D., Lang, T. and Caraher, M. (2002). Joined-up food policy - the trials of governance, public policy and the food system, *Social Policy & Administration*, Vol. 36, No. 6, pp.556-574, doi: 10.1111/1467-9515.t01-1-00304.
- Barling, D., Lang, T. and Sharpe, R. (2008b). Addressing the challenges of UK national food security, *Living Earth*, Vol. 234, Spring, pp.22-27, http://openaccess.city.ac.uk/12920/ [accessed 11th April 2019].
- Barling, D., Sharpe, R. and Lang, T. (2008a). *Rethinking Britain’s food security*, research report for the Soil Association, London, UK: City University London Centre for Food Policy.

- Barlow, P., McKee, M., Basu, S. and Stuckler, D. (2017). The health impact of trade and investment agreements: a quantitative systematic review and network co-citation analysis, *Globalization and Health*, Vol. 13, No. 1, doi: 10.1186/s12992-017-0240-x.
- Barlow, P., Reeves, A., McKee, M., Galea, G. and Stuckler, D. (2016). Unhealthy diets, obesity and time discounting: a systematic literature review and network analysis, *Obesity Reviews*, Vol. 17, No. 9, pp.810-819, doi: 10.1111/obr.12431.
- Barnes, A.P. and McVittie, A. (2006). *Measuring the Sustainability of the UK Food Chain*, Land Economy Working Paper Series Number 18, Edinburgh, UK: Scottish Agricultural College.
- Barnes, F.A. and King, C.A.M. (1953). The Lincolnshire coastline and the 1953 storm flood, *Geography*, Vol. 38, No. 3, July, pp.141-160.
- Barnett, J. and Adger, W.N. (2007). Climate change, human security and violent conflict, *Political Geography*, Vol. 26, pp.639-655, https://doi.org/10.1016/j.polgeo.2007.03.003 [accessed 11th April 2019].
- Barnett, R. (2008). Let them eat cake, *The Lancet*, Vol. 371, Iss. 9616, 15-21st March, pp.889-890, https://doi.org/10.1016/S0140-6736(08)60398-0 [accessed 11th April 2019].
- Barnett, T. (2001). Detection of anthropogenic climate change in the world's oceans, *Science*, Vol. 292, No. 5515, pp.270-274, doi: 10.1126/science.1058304.
- Barnier, M. (2017). *Task force for the preparation and conduct of the negotiations with the United Kingdom under Article 50 TEU*, Brussels, Belgium: European Commission.
- Baron, G.L., Raine, N.E., Brown, M.J.F. (2017). General and species-specific impacts of a neonicotinoid insecticide on the ovary development and feeding of wild bumblebee queens, *Proceedings of the Royal Society B*, Vol. 284, 20170123, http://dx.doi.org/10.1098/rspb.2017.0123 [accessed 11th April 2019].
- Bar-On, Y.M., Phillips, R. and Milo, R. (2018). The biomass distribution on Earth, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 25, pp.6506-6511, www.pnas.org/cgi/doi/10.1073/pnas.1711842115 [accessed 11th April 2019].
- Baroni, L., Cenci, L., Tettamanti, M. and Berati, M. (2007). Evaluating the environmental impact of various dietary patterns combined with different food production systems, *European Journal of Clinical Nutrition*, Vol. 61, pp.279-286, doi:10.1038/sj.ejcn.1602522.
- Barons, M.J. and Aspinall, W. (2020). Anticipated impacts of Brexit scenarios on UK food prices and implications for policies on poverty and health: a structured expert judgement approach, *BMJ Open*, Vol. 10, Iss. 3, e032376, doi:10.1136/bmjopen-2019-032376.
- Barré, T., Perignon, M., Gazan, R., Vieux, F., Micard, V., Amiot, M. and Darmon, N. (2018). Integrating nutrient bioavailability and co-production links when identifying sustainable diets: how low should we reduce meat consumption? *PLoS One*, Vol. 13, No. 2, p.e0191767.

- Barrett, A. (2018a). How capitalism without growth could build a more stable economy, *The Conversation*, 26th February, https://theconversation.com/how-capitalism-without-growth-could-build-a-more-stable-economy-91779 [accessed 11th April 2019].
- Barrett, A.B. (2018b). Stability of zero-growth economics analysed with a Minskyan Model, Ecological Economics, *Ecological Economics*, Vol. 146, pp.228-239, http://dx.doi.org/10.1016/j.ecolecon.2017.10.014 [accessed 11th April 2019].
- Barrett, C.B. (2010). Measuring food insecurity, *Science*, Vol. 327, pp.825-828, doi: 10.1126/science.1182768.
- Barrett, C.B. (2016). Meeting the global food security challenge - obstacles and opportunities ahead, *Global Food Security*, Vol. 11, pp.1-4, http://dx.doi.org/10.1016/j.gfs.2016.11.001 [accessed 11th April 2019].
- Barrett, C.B. (ed) (2013). *Food security and sociopolitical stability*, Oxford, UK: Oxford University Press.
- Barrett, J.H. (2016). Medieval sea fishing AD 500–1550: chronology, causes and consequences. In: Barrett, J.H. and Orton, D.C. (eds). *Cod and herring: the archaeology and history of medieval sea fishing*, Oxford, UK: Oxbow Books, ISBN 978-1-78570-240-2.
- Barrett, J.H. (2016). Studying medieval sea fishing and fish trade: how and why, *Cod & Herring: The Archaeology & History of Medieval Sea Fishing*, doi: 10.1093/oxfordhb/9780198744719.013.5.
- Barrett, J.H. (2019). An environmental (pre)history of European fishing - past and future archaeological contributions to sustainable fisheries, *Journal of Fish Biology*, Vol. 94, No. 6, pp.1033-1044, https://doi.org/10.1111/jfb.13929 [accessed 11th April 2019].
- Barrett, J.H., Locker, A.M. and Roberts, C.M. (2004). The origins of intensive marine fishing in medieval Europe: the English evidence, *Proceedings of the Royal Society B: Biological Sciences*, Vol. 271, pp. 2417-2421, https://doi.org/10.1098/rspb.2004.2885 [accessed 11th April 2019].
- Barrios, E. (2007). Soil biota, ecosystem services and land productivity, *Ecological Economics*, Vol. 64, pp.269-285, doi:10.1016/j.ecolecon.2007.03.004.
- Barron, A.R. (2018). Time to refine key climate policy models, *Nature Climate Change*, Vol. 8, pp.350-352, doi:10.1038/s41558-018-0132-y.
- Barth, B. (2019). Congress finally passed a new farm bill and it continues to pay homage to the cult of corn and soy, *Modern Farmer*, 7th January, https://modernfarmer.com/2019/01/congress-finally-passed-a-new-farm-bill-and-it-continues-to-pay-homage-to-the-cult-of-corn-and-soy/ [accessed 11th April 2019].
- Barth, H., Ulvenblad, P-O. and Ulvenblad, P. (2017). Towards a conceptual framework of sustainable business model innovation in the agri-food sector: a systematic literature review, *Sustainability*, Vol. 9, Iss. 9, 1620, doi: 10.3390/su9091620.

- Bartlett, H. and Garnett, T. (2016). *Metrics for sustainable healthy diets: why, what, how? A report of a meeting, and ideas about next steps*, London and Oxford, UK: Food Climate Research Ntework and The Food Foundation, https://fcrn.org.uk/sites/default/files/metrics_for_sustainable_healthy_diets_0.pdf
- Bartlett, H. and Garnett, T. (2016). *Metrics for sustainable healthy diets: a report of a meeting, and ideas about next steps*, Oxford, UK: University of Oxford Food Climate Research Network.
- Bartolino, V., Margonski, P., Lindegren, M., Linderholm, H.M., Cardinale, M., Rayner, D., Wennhage, H. and Casini, M. (2014). Forecasting fish stock dynamics under climate change: Baltic herring (Clupea harengus) as a case study, *Fisheries Oceanography*, Vol. 23, No. 3, pp.258-269, doi:10.1111/fog.12060.
- Barton, M., Kearney, J. and Stewart-Knox, B.J. (2011). Knowledge of food production methods informs attitudes toward food but not food choice in adults residing in socioeconomically deprived rural areas within the United Kingdom, *Journal of Nutrition Education and Behavior*, Vol. 43, No. 5, pp.374-378, doi: 10.1016/j.jneb.2009.12.010.
- Bash, K. and Donnelly, A. (2019). *Sustainable food systems for a healthier UK: a discussion paper*, Faculty of Public Health and The Soil Association, March, https://www.fph.org.uk/media/2409/sustainable-food-systems-for-a-healthier-uk-final.pdf [accessed 11th April 2019].
- Bastian, H., Glasziou, P. and Chalmers, I. (2010). Seventy-five trials and eleven systematic reviews a day: how will we ever keep up? *PLoS Medicine*, Vol. 7, e1000326, doi: 10.1371/journal.pmed.1000326.
- Bastian, J. and Zentes, J. (2013). Supply chain transparency as a key prerequisite for sustainable agri-food supply chain management, *International Review of Retail, Distribution & Consumer Research*, Vol. 23, No. 5, pp.553-570, doi: 10.1080/09593969.2013.834836.
- Basu, A. (2017). *How to conduct meta-analysis: a basic tutorial*, Cantebury, UK: University of Canterbury, 12th May, https://peerj.com/preprints/2978.pdf [accessed 15th April 2020].
- Bathiany, S., Dakos, V., Scheffer, M. and Lenton, T.M. (2018). Climate models predict increasing temperature variability in poor countries, *Science Advances*, Vol. 4, No. 5, eaar5809, doi: 10.1126/sciadv.aar5809.
- Båtstrand, S. (2015). More than markets: a comparative study of nine conservative parties on climate change, *Politics and Policy*, Vol. 43, pp.538-561, doi:10.1111/polp.12122.
- Bauer, J.M. and Reisch L.A. (2019). Behavioural insights and (un) healthy dietary choices: a review of current evidence, *Journal of Consumer Policy*, Vol. 42, pp.3-45, doi: 10.1007/s10603-018-9387-y.
- BBC (2019c). NFU warns flood defence for Fens 'inadequate', *BBC News*, 17th May, https://www.bbc.co.uk/news/uk-england-cambridgeshire-48298361 [accessed 20th October 2019].
- BBC (2020). Coronavirus confirmed as pandemic by World Health Organization, *BBC News*, 11th March, https://www.bbc.co.uk/news/world-51839944 [accessed 11th April 2020].
- Beaudoin, Y. and Pendleton, L. (2012). *Why value the oceans?* Discussion Paper, Geneva, Switzerland: UNEP/GRID Arundel/TEEB/UNEP Regional Seas Programme.

- Bebber, D.P. (2015). Range-expanding pests and pathogens in a warming world, *Annual Review of Phytopathology*, Vol. 53, pp.335-356, doi: 10.1146/annurev-phyto-080614-120207.
- Bebber, D.P., Ramotowski, M.A.T. and Gurr, S.J. (2013). Crop pests and pathogens move polewards in a warming world, *Nature Climate Change*, Vol. 3, pp.985-988, doi:10.1038/nclimate1990.
- Bebbington, A.J., Bebbington, D.H., Sauls, L.A., Rogan, J., Agrawal, S., Gamboa, C., Imhof, A., Johnson, K., Rosa, H., Royo, A., Toumbourou, T. and Verdum, R. (2018). Resource extraction and infrastructure threaten forest cover and community rights, *Proceedings of the National Academy of Sciences*, 201812505, doi: 10.1073/pnas.1812505115.
- Beckage, B., Gross, L.J., Lacasse, K., Carr, E., Metcalf, S.S., Winter, J.M., Howe, P.D., Fefferman, N., Travis, F.T., Zia, A., Kinzig, A. and Hoffman, F.M. (2018). Linking models of human behaviour and climate alters projected climate change, *Nature Climate Change*, doi: 10.1038/s41558-017-0031-7.
- Becken, S. and Mackey, B. (2017). Flying home for Christmas? Carbon offsets are important, but they won't fix plane pollution, *The Conversation*, 14th December, https://theconversation.com/flying-home-for-christmas-carbon-offsets-are-important-but-they-wont-fix-plane-pollution-89148 [accessed 11th April 2019].
- Beckenham, M. (2009). Horticulture. In: Bridge, J. and Johnson, N. (eds*). Feeding Britain*, London, UK: The Smith Institute, ISBN 1 905370 46 6, http://www.smith-institute.org.uk/wp-content/uploads/2015/10/FeedingBritain.pdf [accessed 15th April, 2019].
- Becker, A., Acciaro, M. and Asariotis, R. (2013). A note on climate change adaptation for seaports: a challenge for global ports, a challenge for global society, *Climatic Change*, Vol. 120, pp.683-695, https://doi.org/10.1007/s10584-013-0843-z [accessed 11th April 2019].
- Becker, L.A. and Oxman, A.D. (2011). Chapter 22: overviews of reviews. In: Higgins, J.P.T. and Green, S. (eds). *Cochrane handbook for systematic reviews of interventions*, Version 5.1.0 (updated March 2011), The Cochrane Collaboration, www.cochrane-handbook.org [accessed 15th April 2020].
- Beddington, J. (2009a). Food, energy, water and the climate: a perfect storm of global events? Speech given at 'Sustainable Development UK 09', QEII Conference Centre, 19th March, http://webarchive.nationalarchives.gov.uk/+/http://www.bis.gov.uk/go-science/government-chiefscientific-adviser/speeches-and-interviews [accessed 11th April 2019].
- Beddington, J. (2009b). World faces 'perfect storm' of problems by 2030, chief scientist to warn, *The Guardian*, http://www.guardian.co.uk/science/2009/mar/18/perfect-storm-john-beddington-energy-food-climate [accessed 11th April 2019].
- Beddington, J. (2010). Global food and farming futures, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, p.2767, https://doi.org/10.1098/rstb.2010.0181 [accessed 11th April 2019].
- Beddington, J. (2011). *The future of food and farming: challenges and choices for global sustainability*, London, UK: The Government Office for Science.

- Beddington, J., Asaduzzaman, M., Clark, M., Fernández, A., Guillou, M., Jahn, M., Erda, L., Mamo, T., Van Bo, N., Nobre, C.A., Scholes, R., Sharma, R. and Wakhungu, J. (2012). *Achieving food security in the face of climate change: final report from the Commission on Sustainable Agriculture and Climate Change*, Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), www.ccafs.cgiar.org/commission [accessed 11th April 2019].
- Beer, T., Lin, B.B. and McGill, A.E.J. (2016). Urbanisation, nutrition and food security - a climatological perspective. In: Basant Maheshwari, B., VijayP.Singh, V.P. and BhadranieThoradeniya, B. (eds) *Balanced Urban Development: Options and Strategies for Liveable Cities*, Water Science and Technology Library, Vol. 72, Springer, doi:10.1007/978-3-319-28112-4.
- Beevers, L. (2018). Will the weather get worse in 2018? What the experts say, *The Conversation*, 11th January, https://theconversation.com/will-the-weather-get-worse-in-2018-what-the-experts-say-89949 [accessed 11th April 2019].
- Behnke, N.L., Cronk, R., Shackelford, B.B., Cooper, B., Tu, R., Heller, L. and Bartram, J. (2020). Environmental health conditions in protracted displacement: a systematic scoping review, *Science of the Total Environment*, Vol. 726, No. 138234, doi: 10.1016/j.scitotenv.2020.138234.
- Behzadifar, M., Behzadifar, M., Abdi, S., Malekzadeh, R., Arab Salmani, M., Ghoreishinia, G., Falahi, E., Mirzaei, M., Shams Biranvand, N. and Sayehmiri, K. (2016). Prevalence of food insecurity in Iran: a systematic review and meta-analysis, *Archives of Iranian Medicine*, Vol. 19, No. 4, pp.288-294, https://search.proquest.com/docview/1778763712?accountid=13460.
- Belk, R.W. (1988). Possessions and the extended self, *Journal of Consumer Research*, Vol. 15, No. 2, pp.139-168, https://www.jstor.org/stable/2489522 [accessed 11th April 2019].
- Bell, A.R., Benton, T.G., Droppelmann, K., Mapemba, L., Pierson, O. and Ward, P.S. (2018). Transformative change through Payments for Ecosystem Services (PES): a conceptual framework and application to conservation agriculture in Malawi, *Global Sustainability*, Vol. 1, e4, pp.1-8, https://doi.org/10.1017/sus.2018.4 [accessed 11th April 2019].
- Bell, M.J., Cloy, J.M. and Rees, R.M. (2014). The true extent of agriculture's contribution to national greenhouse gas emissions, *Environmental Science and Policy*, Vol. 39, pp.1-12, http://dx.doi.org/10.1016/j.envsci.2014.02.001 [accessed 11th April 2019].
- Bell, M.L., Goldberg, R., Hogrefe, C., Kinney, P., Knowlton, K., Lynn, B., Rosenthal, J., Rosenzweig, C. and, J.A. (2007). Climate change, ambient ozone, and health in 50 U.S. cities, *Climate Change*, Vol. 82, pp.61-76, doi: 10.1007/s10584-006-9166-7.
- Beller E.M., Glasziou P.P., Altman D.G., Hopewell S., Bastian H., Chalmers I., Gøtzsche P.C., Lasserson T. and Tovey D. (2013). PRISMA for abstracts: reporting systematic reviews in journal and conference abstracts, *PLoS Medicine*, Vol. 10, e1001419, doi: 10.1371/journal.pmed.1001419.

- Bellora, C., Emlinger, C., Fouré, J. and Guimbard, H. (2017). *Research for AGRI Committee, EU – UK agricultural trade: state of play and possible impacts of Brexit*, Brussels, Belguim: European Parliament, Policy Department for Structural and Cohesion Policies.
- Belschner, T. (2014). Not so green after all: the EU's role in international fisheries management - the cases of NAFO and ICCAT, *Journal of European Public Policy*, doi: 10.1080/13501763.2014.989891.
- Belschner, T., Ferretti, J., Strehlow, H.V., Kraak, S.B.M., Döring, R., Kraus, G., Kempf, A. and Zimmermann, C. (2019). Evaluating fisheries systems: a comprehensive analytical framework and its application to the EU's Common Fisheries Policy, *Fish and Fisheries*, Vol. 20, pp.97-109, https://doi.org/10.1111/faf.12325 [accessed 11th November 2019].
- Belton, B., Little, D. and Bush, S. (2018). Let them eat carp: fish farms are helping to fight hunger, *The Conversation*, 8th March, https://theconversation.com/let-them-eat-carp-fish-farms-are-helping-to-fight-hunger-90421 [accessed 11th April 2019].
- Benavot, A. (2017). Education for people, prosperity and planet: can we meet the sustainability challenges? *European Journal of Education*, Vol. 52, No. 4, pp.399-403, https://doi.org/10.1111/ejed.12248 [accessed 11th April 2019].
- Bendjebbar, P., Bricas, N. and Giordano, T. (2019). Fo*od systems at risk. A scientific handout for the High Level Event of the Global Network against Food Crises: Food & Agriculture in times of crisis*, Brussels, 2nd-3rd April 2019, http://agritrop.cirad.fr/592016/ [accessed 15th April 2020].
- Béné, C., Arthur, R., Norbury, H., Allison, E.H., Beveridge, M.C., Bush, S., Campling, L., Leschen, W., Little, D., Squires, D., Thilsted, S.H., Troell, M. and Williams, M. (2016). Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence, *World Development*, Vol. 79, pp.177-196, https://doi.org/10.1016/j.worlddev.2015.11.007 [accessed 11th April 2019].
- Béné, C., Barange, M., Subasinghe, R., Pinstrup-Andersen, P., Merino, G., Hemre, G-I. and Williams, M. (2015). Feeding 9 billion by 2050 – putting fish back on the menu, *Food Security*, Vol. 7, pp.261-274, doi: 10.1007/s12571-015-0427-z.
- Béné, C., Oosterveer, P., Lamotte, L., Brouwer, I.D., de Haan, S., Prager, S.D., Talsma, E.F. and Khouryae, C.K. (2019). When food systems meet sustainability – current narratives and implications for actions, *World Development*, Vol. 113, pp.116-130, https://doi.org/10.1016/j.worlddev.2018.08.011 [accessed 11th April 2019].
- Bengtsson, M., Alfredsson, E., Cohen. M., Lorek, S. and Schroeder, P. (2018). Transforming systems of consumption and production for achieving the sustainable development goals: moving beyond efficiency, *Sustainability Science*, Vol. 13, No. 6, pp.1533-1547, doi:10.1007/s11625-018-0582-1.
- Beniston, M. (2010). Climate change and its impacts - growing stress factors for human societies, *International Review of the Red Cross*, Vol. 92, No. 879, pp.557-568, doi: https://doi-org.mmu.idm.oclc.org/10.1017/S1816383110000342 [accessed 11th April 2019].

- Bennema, F.P. and Rijnsdorp, A.D. (2015). Fish abundance, fisheries, fish trade and consumption in sixteenth-century Netherlands as described by Adriaen Coenen, *Fisheries Research*, Vol. 161, pp.384-399, https://doi.org/10.1016/j.fishres.2014.09.001 [accessed 11th April 2019].
- Bennett, C.E., Thomas, T., Williams, M., Zalasiewicz, J., Edgeworth, M., Miller, H., Coles, B., Foster, A., Burton, E.J. and Marume, U. (2018). The broiler chicken as a signal of a human reconfigured biosphere, *Royal Society Open Science*, Vol. 5, doi: 10.1098/rsos.180325.
- Bennett, E.M. (2017). Changing the agriculture and environment conversation, *Nature Ecology & Evolution*, Vol. 1, No. 18, doi: 10.1038/s41559-016-0018.
- Bennett, R., Zorbas, C., Huse, O., Peeters, A., Cameron, A.J., Sacks, G. and Backholer, K. (2020). Prevalence of healthy and unhealthy food and beverage price promotions and their potential influence on shopper purchasing behaviour: a systematic review of the literature, *Obesity Reviews*, Vol. 21, No. 1, e12948, doi: 10.1111/obr.12948.
- Bennett, W.L., Wilson, R.F., Zhang, A., Tseng, E., Knapp, E.A., Kharrazi, H., Stuart, E.A., Shogbesan, O., Bass, E.B. and Cheskin, L.J. (2018). Methods for evaluating natural experiments in obesity: a systematic review, *Annals of Internal Medicine*, Vol. 168, No. 11, pp.791-800, doi: 10.7326/M18-0309.
- Bennetzen, E.H., Smith, P. and Porter, J.R. (2016). Decoupling of greenhouse gas emissions from global agricultural production: 1970-2050, *Global Change Biology*, Vol. 22, No. 2, pp.763-781, doi: 10.1111/gcb.13120.
- Benoliel, J.Q. (1996). Grounded theory and nursing knowledge, *Qualitative Health Research*, Vol. 6, pp.406-428, https://doi.org/10.1177/104973239600600308 [accessed 15th April 2020].
- Benson, T., Minot, N., Pender, J., Robles, M. and von Braun, J. (2008). *Global food crisis: monitoring and assessing impact to inform policy responses*, Washington, USA: International Food Policy Research Institute.
- Benton, T. (2012). *Severe weather and UK food chain resilience*, Global Food Security Report, file:///C:/Users/User/Downloads/insight-issue-two-severe-weather-and-uk-food-resilience.pdf.
- Benton, T. (2019a). *A better UK food policy requires better government*, Chatham House, 10th January, https://www.chathamhouse.org/expert/comment/better-uk-food-policy-requires-better-government [accessed 11th April 2019].
- Benton, T. (2019b). *Food security, trade and its impacts*, Resource Trade Earth, https://resourcetrade.earth/stories/food-security-trade-and-its-impacts [accessed 11th April 2019].
- Benton, T. (2020). *Climate change and diets: a CCC discussion meeting*, London, UK: Committee on Climate Change, https://www.theccc.org.uk/wp-content/uploads/2020/01/Tim-Benton-2019-Climate-change-and-diets-a-CCC-discussion-meeting.pdf [accessed 23rd January 2020].
- Benton, T. and Bailey, R. (2019). The paradox of productivity: agricultural productivity promotes food system inefficiency, *Global Sustainability*, Vol. 2, e6, 1-8, doi: 10.1017/sus.2019.3.

- Benton, T., Gallani, B., Jones, C., Lewis, K., Tiffin, R. and Donohoe, T. (2012). *Severe weather and UK food chain resilience: detailed appendix to synthesis report*, Food Research Partnership: Resilience of the Uk Food System Subgroup, http://www.foodsecurity.ac.uk/assets/pdfs/frp-severe-weather-uk-food-chain-resilience.pdf [accessed 11th April 2019].
- Benton, T.G. (2016). The many faces of food security, *International Affairs*, Vol. 92, pp.1505-1515, doi: 10.1111/1468-2346.12755.
- Benton, T.G. (2019c). Using scenario analyses to address the future of food, *EFSA Journal*, Vol. 17, S1, e170703, https://doi.org/10.2903/j.efsa.2019.e170703 [accessed 11th April 2020].
- Benton, T.G., Bailey, R., Froggatt, A., King, R., Lee, B. and Wellesley, L. (2018). Designing sustainable landuse in a 1.5°C world: the complexities of projecting multiple ecosystem services from land, *Current Opinion in Environmental Sustainability*, Vol. 31, pp.88-95, https://doi.org/10.1007/s11625-018-0582-1 [accessed 11th April 2019].
- Benton, T.G., Froggatt, A. Wright, G. Thompson, C.E., and King, R. (2019). *Food politics and policies in post-Brexit Britain*, London, UK: Chatham House Royal Institute of International Affairs, https://www.chathamhouse.org/sites/default/files/publications/research/2019-01-10-BentonFroggattWrightThompsonKing.pdf [accessed 11th April 2019].
- Benton, T.G., Bieg, C., Harwatt, H., Pudasaini, R. and Wellesley, L. (2021). *Food system impacts on biodiversity loss: three levers for food system transformation in support of nature*, London, UK: Chatham House Royal Institute of International Affairs, https://www.chathamhouse.org/2021/02/food-system-impacts-biodiversity-loss [accessed 11th April 2021].
- Benzie, M., Carter, T., Groundstroem, F., Carlsen, H., Savvidou, G., Pirttioja, N., Taylor, R. and Dzebo, A. (2017). *Implications for the EU of cross-border climate change impacts*, EU FP7 Impressions Project Deliverable D3A.2, March, Wallingford, UK: NERC Centre for Ecology & Hydrology.
- Berlin, A., Kallstrom, H.N., Lindgren, A. and Olson, A. (2018). Scientific evidence for sustainable plant disease protection strategies for the main arable crops in Sweden: a systematic map protocol, *Environmental Evidence,* Vol. 7, No. 1, pp.1-8, doi: http://dx.doi.org/10.1186/s13750-018-0141-3.
- Bernabucci, U., Lacetera, N., Baumgard, L.H., Rhoads, R.P., Ronchi, B. and Nardone, A. (2010). Metabolic and hormonal acclimation to heat stress in domesticated ruminants, *Animal*, Vol. 4, pp.1167-1183, doi: 10.1017/S175173111000090X.
- Berners-Lee, M. (2011). *How bad are bananas? The carbon footprint of everything*, Vancouver, Canada: Greystone Books.
- Berners-Lee, M., Hoolohan, C., Cammack, H. and Hewitt, C.N. (2012). The relative greenhouse gas impacts of realistic dietary choices, *Energy Policy*, Vol. 43, pp.184-190, https://doi.org/10.1016/j.enpol.2011.12.054 [accessed 11th April 2019].

- Berners-Lee, M., Kennelly, C., Watson, R. and Hewitt, C.N. (2018). Current global food production is sufficient to meet human nutritional needs in 2050 provided there is radical societal adaptation, *Elementa: Science of the Anthropocene*, Vol. 6, No. 1, pp.52-, doi: http://doi.org/10.1525/elementa.310 [accessed 11th April 2019].
- Bernués, A. (2017). Animals on the land: ecosystem services and disservices of grazing livestock systems. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.67-92, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Berry, E.M. (2019). Sustainable food systems and the Mediterranean Diet, *Nutrients*, Vol. 11, No. 9, https://doi.org/10.3390/nu11092229.
- Berry, E.M., Dernini, S., Burlingame, B., Meybeck, A. and Conforti. P. (2015). Food security and sustainability: can one exist without the other? *Public Health Nutrition*, Vol. 18, Iss. 13, pp.2293-2302, doi:10.1017/S136898001500021X.
- Berry, H.L. (2009). Pearl in the oyster: climate change as a mental health opportunity, *Australian Psychologist*, Vol. 17, pp.453-456, doi: 10.1080/10398560903045328.
- Berry, H.L. and Peel, D. (2015). Worrying about climate change: is it responsible to promote public debate? *British Journal of Psychiatry International*, Vol. 12, pp.31-32, doi: https://doi.org/10.1192/S2056474000000234 [accessed 11th April 2019].
- Berry, H.L., Hogan, A., Owen, J., Rickwood, D. and Fragar, L. (2011). Climate change and farmers' mental health: risks and responses, *Asia-Pacific Journal of Public Health*, Vol. 23, S119-132, https://doi.org/10.1177/1010539510392556 [accessed 11th April 2019].
- Berry, H.L., Waite, T.D., Dear, K.B.G., Capon, A.G. and Murray, V. (2018). The case for systems thinking about climate change and mental health, *Nature Climate Change*, Vol. 8, pp.282-290, https://doi.org/10.1038/s41558-018-0102-4 [accessed 11th April 2019].
- Bes-Rastrollo, M., Schulze, M.B., Ruiz-Canela, M. and Martinez-Gonzalez, M.A. (2013). Financial conflicts of interest and reporting bias regarding the association between sugar-sweetened beverages and weight gain: a systematic review of systematic reviews, *PLoS Medicine*, Vol. 10, No. 12, e1001578, https://doi.org/10.1371/journal.pmed.1001578 [accessed 15th April 2020].
- Bestwick, C., Douglas, F., Allan, J., Macdiarmid, J., Ludbrook, A. and Carlisle, S. (2013). A perspective on the strategic approach to the complexity and challenges of behaviour change in relation to dietary health, *Nutrition Bulletin*, Vol. 38, No. 1, pp.50-56, doi:10.1111/nbu.12007.
- Bettencourt, L.M.A. and Kaur, J. (2011). Evolution and structure of sustainability science, *Proceedings of the National Academy of Sciences*, Vol. 108, No. 49, pp.19540-19545, doi: 10.1073/pnas.1102712108.
- Betts, R.A. and McNeall, D. (2018). How much CO_2 at 1.5 °C and 2 °C? *Nature Climate Change*, Vol. 8, No. 7, pp.546-548, doi: 10.1038/s41558-018-0199-5.

- Betts, R.A., Alfieri, L., Bradshaw, C., Caesar, J., Feyen, L., Friedlingstein, P., Gohar, L., Koutroulis, A., Lewis, K., Morfopoulos, C., Papadimitriou, L., Richardson, K.J., Tsanis, I. and Wyser, K. (2018). Changes in climate extremes, fresh water availability and vulnerability to food insecurity projected at 1.5°C and 2°C global warming with a higher-resolution global climate model, *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences,* Vol. 376, No.2119, 20160452, doi: 10.1098/rsta.2016.0452.
- Beumer, C., Figge, L. and Elliott, J. (2018). The sustainability of globalisation: including the 'social robustness criterion', *Journal of Cleaner Production*, Vol. 179, pp.704-715, doi: 10.1016/j.jclepro.2017.11.003.
- Beuret, N. (2018). Climate action must now focus on the global rich and their corporations, *The Conversation*, 17th December, https://theconversation.com/climate-action-must-now-focus-on-the-global-rich-and-their-corporations-108943 [accessed 11th April 2019].
- Beveridge, M.C., Thilsted, S.H., Phillips, M.J., Metian, M., Troell, M. and Hall, S.J. (2013). Meeting the food and nutrition needs of the poor: the role of fish and the opportunities and challenges emerging from the rise of aquaculture, *Journal of Fish Biology*, Vol. 83, pp.1067-1184, https://doi.org/10.1111/jfb.12187 [accessed 11th April 2019].
- Bhardwaj, P., Chatterjee, P., Demir, K., D. and Turut, O. (2018). When and how is corporate social responsibility profitable? *Journal of Business Research*, Vol. 84, pp.206-219, https://doi.org/10.1016/j.jbusres.2017.11.026 [accessed 11th April 2019].
- Bhunnoo, R. (2018). Feeding the world: a global challenge, *New Food*, 20th February, Vol. 21, No. 1, p.24, https://www.newfoodmagazine.com/article/64808/food-security-riaz-bhunnoo/ [accessed 11th April 2019].
- Bhunnoo, R. (2019). The need for a food-systems approach to policy making, *The Lancet*, Vol. 393, No. 10176, pp.1097-1098, https://doi.org/10.1016/S0140-6736(18)32754-5 [accessed 11th April 2019].
- Bianchi, F., Garnett, E., Dorsel, C., Aveyard, P. and Jebb, S.A. (2018). Restructuring physical micro-environments to reduce the demand for meat - a systematic review and qualitative comparative analysis, *Lancet Planet Health*, Vol. 2, pp.e384-397, doi:https://doi.org/10.1016/S2542-5196(18)30188-8 [accessed 11th April 2019].
- Bicalho, T., Bessou, C. and Pacca, S.A. (2016). Land-use change within EU sustainability criteria for biofuels: The case of oil palm expansion in the Brazilian Amazon, *Renewable Energy*, Vol. 89, pp.588-597, https://doi.org/10.1016/j.renene.2015.12.017 [accessed 11th April 2020].
- Biesbroek, G.R., Swart, R.J., Carter, T.R., Cowan, C., Henrichs, T., Mela, H., Morecroft, M.D. and Rey, D. (2010). Europe adapts to climate change: comparing National Adaptation Strategies, *Global Environmental Change*, Vol. 20, Iss. 3, pp.440-450, https://doi.org/10.1016/j.gloenvcha.2010.03.005 [accessed 11th April 2019].

- Biesbroek, R. and Candel, J.J.L. (2020). Mechanisms for policy (dis)integration: explaining food policy and climate change adaptation policy in the Netherlands, *Policy Sciences*, Vol. 53, No. 1, pp.61-84, https://doi.org/10.1007/s11077-019-09354-2 [accessed 11th April 2020].
- Biesbroek, S., Bueno-de-Mesquita, H.B., Peeters, P.H., Verschuren, W.M., van der Schouw, Y.T., Kramer, G.F., Tyszler, M. and Temme, E.H. (2014). Reducing our environmental footprint and improving our health - greenhouse gas emission and land use of usual diet and mortality in in EPIC-NL: a prospective cohort study, *Environmental Health*, Vol. 13, No. 1, pp.27, doi: 10.1186/1476-069X-13-27.
- Bijl, D.L., Bogaart, P.W., Dekker, S.C., Stehfest, E., de Vries, B.J.M. and van Vuuren, D.P. (2017). A physically-based model of long-term food demand, *Global Environmental Change*, Vol. 45, pp.47-62, https://doi.org/10.1016/j.gloenvcha.2017.04.003 [accessed 11th April 2019].
- Bijma, J., Pörtner, H-O., Yesson, C. and Rogers, A.D. (2013). Climate change and the oceans – What does the future hold, *Marine Pollution Bulletin*, Vol. 74, pp.495-505, http://dx.doi.org/10.1016/j.marpolbul.2013.07.022 [accessed 11th April 2019].
- Billen, G., Le Noe, J. and Garnier, J. (2018). Two contrasted future scenarios for the French agro-food system, *Science of the Total Environment*, Vol. 637, pp.695-705, doi: 10.1016/j.scitotenv.2018.05.043.
- Billiet, S. (2019). Brexit and fisheries: fish and chips aplenty? *The Political Quarterly*, Vol. 90, Iss. 4, pp.611-619.
- Bingham, I.J., Hoad, S., Lang, B., Philpott, H., Stobart, R., Thomas, J., Barnes, A., Ball, B.C., Knight, S.M. and Kightley, S.P. (2012). *Desk study to evaluate contributory causes of the current "yield plateau" in wheat and oilseed rape*, DEFRA R&D project IF01116, Kenilworth, UK: Home Grown Cereals Authority.
- Binkley, A. (2020). Appointments to Food Policy Advisory Council not expected for a few more months, *National Newswatch*, 15th January, https://www.nationalnewswatch.com/2020/01/15/appointments-to-food-policy-advisory-council-not-expected-for-a-few-more-months/#.XqRTAa2ZPBI [accessed 11th April 2020].
- Biodiversity International (2017). *Mainstreaming agrobiodiversity in sustainable food systems: scientific foundations for an agrobiodiversity index*, Rome, Italy: Bioversity International.
- Biodiversity International (2019). *Agrobiodiversity index report 2019: risk and resilience*, Rome, Italy: Biodiversity International, https://hdl.handle.net/10568/100820 [accessed 11th April 2019].
- Birch, P.R.J., Bryan, G., Fenton, B., Gilroy, E.M., Hein, I., Jones, J.T., Prashar, A., Taylor, M.A., Torrance, L. and Toth, I.K. (2012). Crops that feed the world 8 – Potato - are the trends of increased global production sustainable, *Food Security*, Vol. 4, pp.477-508, doi: 10.1007/s12571-012-0220-1.
- Bird, F.A., Pradhan, A., Bhavani, R.V. and Dangour, A.D. (2019). Interventions in agriculture for nutrition outcomes: a systematic review focused on South Asia, *Food Policy*, Vol. 82, pp.39-49, https://doi.org/10.1016/j.foodpol.2018.10.015 [accessed 11th April 2019].

- Birt, C., Maryon-Davis, A., Stewart, L., Parkin, C., Capewell, S. and Mwatsama, M. (2007). *A CAP on Health? The impact of the EU Common Agricultural Policy on public health*, London, UK: Faculty of Public Health ISBN: 1-900273-25-X.
- Bivoltsis, A., Cervigni, E., Trapp, G., Knuiman, M., Hooper, P. and Ambrosini, G.L. (2018). Food environments and dietary intakes among adults: does the type of spatial exposure measurement matter? A systematic review, *International Journal of Health Geographics*, Vol. 17, No. 1, 19, doi: 10.1186/s12942-018-0139-7.
- Bjørn, A. and Hauschild, M.Z. (2015). Introducing carrying capacity based normalisation in LCA: framework and development of midpoint level references, *International Journal of Life Cycle Assessment*, Vol. 20, pp.1005-1018, doi: 10.1007/s11367-015-0899-2.
- Bjørn, A., Diamond, M., Owsianiak, M., Verzat, B. and Hauschild, M.Z. (2015). Strengthening the link between Life Cycle Assessment and indicators for absolute sustainability to support development within planetary boundaries, *Environmental Science & Technology Letters*, Vol. 49, No. 11, pp.6370-6371, https://doi.org/10.1021/acs.est.5b02106 [accessed 11th April 2019].
- Black, A.P., Brimblecombe, J., Eyles, H., Morris, P., Vally, H. and O Dea, K. (2012). Food subsidy programs and the health and nutritional status of disadvantaged families in high income countries: a systematic review, *BMC Public Health,* Vol. 12, No. 1, pp.1099-1099, https://doi.org/10.1186/1471-2458-12-1099.
- Black, R., Adger, W.N., Arnell, N.W., Dercon, S., Geddes, A. and Thomas, D. (2011). The effect of environmental change on human migration, *Global Environmental Change*, Vol. 21, Supplement 1, pp.S3-S11, https://doi.org/10.1016/j.gloenvcha.2011.10.001 [accessed 11th April 2019].
- Blackstone, N.T., El-Abbadi, N.H., McCabe, M.S., Griffin, T.S. and Nelson, M.E. (2018). Linking sustainability to the healthy eating patterns of the Dietary Guidelines for Americans: a modelling study, *The Lancet Planetary Health*, Vol 2, Iss 8, pp.e344-e352, https://doi.org/10.1016/S2542-5196(18)30167-0 [accessed 11th April 2019].
- Blake, M.R., Backholer, K., Lancsar, E., Boelsen-Robinson, T., Mah, C., Brimblecombe, J., Zorbas, C., Billich, N. and Peeters, A. (2019). Investigating business outcomes of healthy food retail strategies: a systematic scoping review, *Obesity Reviews*, Vol. 20, No. 10, pp.1384-1399, doi: 10.1111/obr.12912.
- Blanchard, J.L. (2015). Climate change - a rewired food web, *Nature*, Vol. 527, 12th November 2015, pp.173-174, doi:10.1038/nature16311.
- Blanchard, J.L., Jennings, S., Holmes, R., Harle, J., Merino, G., Allen, J.I., Holt, J., Dulvy, N.K. and Barange, M. (2012). Potential consequences of climate change for primary production and fish production in large marine ecosystems, *Philosophical Transactions of the Royal Society B*, Vol. 367, pp.2979-2989, doi: 10.1098/rstb.2012.0231.
- Blay Palmer, A. and Donald, B. (2008). *Food fears: from industrial to sustainable food systems*, London, UK: Routledge.

- Blay-Palmer, A., Sonnino, R. and Custot, J. (2016). A food politics of the possible? Growing sustainable food systems through networks of knowledge, *Agriculture and Human Values*, Vol. 33, No. 1, pp.27-43, doi:10.1007/s10460-015-9592-0.
- Blechl, A.E. and Jones, H.D. (2009). Transgenic applications in wheat improvement. In: *Wheat science and trade* (ed) Carver, B.F., Wiley-Blackwell, pp.397-435.
- Blythman, J. (2015). *Swallow this: serving up the food industry's darkest secrets*, London: Fourth Estate.
- Blythman, J. (2019). Scrutinise the small print of Eat-Lancet, 29th January, https://wickedleeks.riverford.co.uk/opinion/veganism-meat/scrutinise-small-print-eat-lancet [accessed 11th April 2019].
- Blythman, J. (2019). Why we should resist the vegan putsch, *The Grocer*, 17th January, https://www.thegrocer.co.uk/stores/consumer-trends/why-we-should-resist-the-vegan-putsch/575625.article [accessed 11th April 2019].
- BMJ (2020). Public inquiry into UK's response to COVID-19, *British Medical Journal*, Vol. 369, No. 2052, doi: https://doi.org/10.1136/bmj.m2052 [accessed 15th June, 2020].
- Bodirsky, B.L., Rolinski, S., Biewald, A., Weindl, I., Popp, A. and Lotze-Campen, H. (2015). Global food demand scenarios for the 21st Century, *PLoS One*, Vol. 10, No. 11, pp.e0139201, https://doi.org/10.1371/journal.pone.0139201 [accessed 11th April 2019].
- Bohme, F., Bischoff, G., Zebitz, C.P., Rosenkranz, P. and Wallner, K. (2018). From field to food—will pesticide-contaminated pollen diet lead to a contamination of royal jelly? *Apidologie*, Vol. 49, No. 1, pp.112-119, doi:10.1007/s13592-017-0533-3.
- Bohnes, F.A., Hauschild, M.Z., Schlundt, J. and Laurent, A. (2019). Life cycle assessments of aquaculture systems: a critical review of reported findings with recommendations for policy and system development, *Reviews in Aquaculture*, Vol. 11, No. 4, pp.1061-1079, doi: 10.1111/raq.12280.
- Bois, G. (1998). Discussion: on the crisis of the Late Middle Ages, *The Medieval History Journal*, Vol. 1, No. 2, pp.311-321, https://doi.org/10.1177/097194589800100206 [accessed 11th April 2019].
- Boissoneault, L. (2019). The medieval practices that reshaped Europe's fish, *The Atlantic*, 21st May, https://www.theatlantic.com/science/archive/2019/05/medieval-people-were-already-ruining-fish/589837/ [accessed 11th April 2019].
- Böjeson, L., Mattias, H., Karl-Henrik, D., Ekvall, T. and Göran, F. (2005). Towards a user's guide to scenarios – a report on scenario types and scenario techniques, *Futures*, Vol. 38, No. 7, pp.723-739, doi: 10.1016/j.futures.2005.12.002.
- Böjeson, L., Mattias, H., Karl-Henrik, D., Ekvall, T. and Göran, F. (2006). Scenario types and techniques: towards a user's guide, Futures, Vol. 38, pp.723-739, doi:10.1016/j.futures.2005.12.002.

- Bollmann, M., Bosch, T., Colijn, F., Ebinghaus, R., Froese, R., Güssow, K., Khalilian, S., Krastel, S., Körtzinger, A., Langenbuch, M., Latif, M., Matthiessen, B., Melzner, F., Oschlies, A., Petersen, S., Proelß, A., Quaas, M., Reichenbach, J., Requate, T., Reusch, T., Rosenstiel, P., Schmidt, J.O., Schrottke, K., Sichelschmidt, H., Siebert, U., Soltwedel, R., Sommer, U., Stattegger, K., Sterr, H., Sturm, R., Treude, T., Vafeidis, A., van Bernem, C., van Beusekom, J., Voss, R., Visbeck, M., Wahl, M., Wallmann, K. and Weinberger, F. (2010). *World ocean review: living with the oceans*, Hamburg, Germany: Maribus gGmbH and Mareverlag.
- Bommarco, R., Vico, G. and Hallin, S. (2018). Exploiting ecosystem services in agriculture for increased food security, *Global Food Security*, Vol. 17, pp.57-63, https://doi.org/10.1016/j.gfs.2018.04.001 [accessed 11th April 2019].
- Bøn, T. and Millstone, E. (2019). The introduction of thousands of tonnes of glyphosate in the food chain-an evaluation of glyphosate tolerant soybeans, *Foods*, Vol. 11, No. 8, 12, pii: E669, doi: 10.3390/foods8120669.
- Bonanno, A. (2017). The contradictions of the neoliberal global agri-food system, *Global Environmental Politics*, Vol. 17, No. 4, pp.147-152, doi.org/10.1162/GLEP_a_00435.
- Bond-Lamberty, B., Bailey, V.L., Chen, M., Gough, C.M. and Vargas. R. (2018). Globally rising soil heterotrophic respiration over recent decades, *Nature*, Vol. 560, No. 7716, pp.80, doi: 10.1038/s41586-018-0358-x.
- Bongaarts, J. and O'Neill, B.C. (2018). Global warming policy: is population left out in the cold? *Science*, Vol. 361, pp.650-652, doi: 10.1126/science.aat8680.
- Borch, A. and Kjærnes, U. (2016). Food security and food insecurity in Europe - an analysis of the academic discourse (1975–2013), *Appetite*, Vol. 103, pp.137-147, http://dx.doi.org/10.1016/j.appet.2016.04.005 [accessed 11th April 2019].
- Börjeson, L., Höjer, M., Dreborg, K-H., Ekvall, T. and Finnveden, G. (2006). Scenario types and techniques: towards a user's guide, *Futures*, Vol. 38, pp.723-739, doi:10.1016/j.futures.2005.12.002.
- Borsato, E., Tarolli, P. and Marinello, F. (2018). Sustainable patterns of main agricultural products combining different footprint parameters, *Journal of Cleaner Production*, Vol. 179, pp.357-367, https://doi.org/10.1016/j.jclepro.2018.01.044 [accessed 11th April 2019].
- Borunda, A. (2019). The last five years were the hottest ever recorded: the planet is warming up, and there's no sign of stopping, *National Geographic*, 6th February, https://www.nationalgeographic.com/environment/2019/02/2018-fourth-warmest-year-ever-noaa-nasa-reports [accessed 11th April 2019].
- Borzekowski, D.L.G. and Pires, P.P. (2018). A six country study of young children's media exposure, logo recognition, and dietary preferences, *Journal of Children and Media*, Vol. 12, No. 2, pp.143-158, doi: 10.1080/17482798.2018.1425730.

- Boseley, S. (2018a). At last, a sound plan to tackle obesity: the food industry must not ruin it, *The Guardian*, 25th June, https://www.theguardian.com/society/2018/jun/25/obesity-food-industry-junk-food-ads-corporate-power [accessed 11th April 2019].
- Boseley, S. (2018b). Living near food outlets linked to higher rates of type 2 diabetes. People in cities with high density of ready-to-eat food outlets have 11% higher risk of developing the condition, research shows, *The Guardian*, 12th October, https://www.theguardian.com/society/2018/oct/12/living-near-food-outlets-linked-to-higher-rates-of-type-2-diabetes [accessed 11th April 2019].
- Boseley, S. (2018d). Ultra-processed products now half of all UK family food purchases. Health experts warn increasing popularity of industrially-made food will lead to negative effects such as obesity and poor health, *The Guardian*, 2nd February, https://amp.theguardian.com/science/2018/feb/02/ultra-processed-products-now-half-of-all-uk-family-food-purchases?__twitter_impression=true [accessed 11th April 2019].
- Boseley, S. (2019). Scientific conflict and big food companies, *The Lancet*, Vol. 393, No. 10170, pp.395-395, doi:https://doi.org/10.1016/S0140-6736(19)30109-6 [accessed 11th April 2019].
- Bostock, J., McAndrew, B., Richards, R., Jauncey, K., Telfer, T., Lorenzen, K., Little, D., Ross, L., Handisyde, N., Gatward, I. and Corner, R. (2010). Aquaculture: global status and trends, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2897-2912, https://doi.org/10.1098/rstb.2010.0170 [accessed 11th April 2019].
- Botsford, L.W., Brumbaugh, D.R., Grimes, C., Kellner, J.B., Largier, J., O'Farrell, M.R., Ralston, S., Soulanille, E. and Wespestad, V. (2009). Connectivity, sustainability, and yield - bridging the gap between conventional fisheries management and marine protected areas, *Philosophical Transactions of the Royal Society B*, Vol. 365, pp.2897-2912, doi:10.1098/rstb.2010.0170.
- Botta, M. (2016). Evolution of the slow living concept within the models of sustainable communities, *Futures*, Vol. 80, pp.3-16, https://doi.org/10.1016/j.futures.2015.12.004 [accessed 11th April 2019].
- Boulay, M., Bare, J., Benini, L., Berger, M., Lathuillière, M.J., Manzardo, A., Margni, M., Motoshita, M., Núñez, M., Pastor, A.V., Ridoutt, B., Oki, T., Worbe, S. and Pfister, S. (2018). The WULCA consensus characterization model for water scarcity footprints: assessing impacts of water consumption based on available water remaining (AWARE), *International Journal of Life Cycle Assessment*, Vol. 23, pp.368-378, https://doi.org/10.1007/s11367-017-1333-8 [accessed 11th April 2019].
- Bourke, M., Whittaker, P.J. and Verma, A. (2014). Are dietary interventions effective at increasing fruit and vegetable consumption among overweight children? A systematic review, *Journal of Epidemiology and Community Health*, Vol. 68, No. 5, pp.485-490, doi: 10.1136/jech-2013-203238.

- Bourlakis, M., Maglaras, G., Aktas, E., Gallear, D. and Fotopoulos, C. (2014). Firm size and sustainable performance in food supply chains – insights from Greek SMEs, *International Journal of Production Economics*, Vol. 152, pp.112-130, http://dx.doi.org/10.1016/j.ijpe.2013.12.029 [accessed 11th April 2019].
- Bouvard, V., Loomis, D., Guyton, K.Z., Grosse, Y., Ghissassi, F.E., Benbrahim-Tallaa, L., Guha, N., Mattock, H. and Straif, K. (2015). Carcinogenicity of consumption of red and processed meat, *The Lancet Oncology*, Vol. 16, No. 16, pp.1599-600, doi: 10.1016/S1470-2045(15)00444-1.
- Bouwman, A.F., Van Vuuren, D.P., Derwent, R.G. and Posch, M. (2002). A global analysis of acidification and eutrophication of terrestrial ecosystems, *Water, Air, and Soil Pollution*, Vol. No. 141, pp.349-382, https://doi.org/10.1023/A:1021398008726 [accessed 11th April 2019].
- Bouzid, M., Hooper, L. and Hunter, P.R. (2013). The effectiveness of public health interventions to reduce the health impact of climate change: a systematic review of systematic reviews, *PLoS One*, Vol. 8, No. 4, e62041, doi: 10.1371/journal.pone.0062041.
- Bovenkerk, B. and Meijboom, F.L.B. (2012). The moral status of fish - the importance and limitations of a fundamental discussion for practical ethical questions in fish farming, *Journal of Agricultural and Environmental Ethics*, Vol. 25, pp.843-860, doi: 10.1007/s10806-011-9365-8.
- Bowen, S. (2014). *Global Food Security – Importing Food to the UK - the food safety perspective*, London, UK: Food Standards Agency.
- Bowles, N., Alexander, S. and Hadjikakou, M. (2019). The livestock sector and planetary boundaries - a ‘limits to growth’ perspective with dietary implications, *Ecological Economics*, Vol. 160, pp.128-136, https://doi.org/10.1016/j.ecolecon.2019.01.033 [accessed 11th April 2019].
- Bowman, G., MacKay, R., Masrani, S. and McKiernan, P. (2012). Storytelling and the scenario process: understanding success and failure, *Technological Forecasting and Social Change*, doi: 10.1016/j.techfore.2012.04.009.
- Bowman, M. (2016). Campaign to halve Europe's food waste, *Sustainable Food Trust*, 27th October, https://sustainablefoodtrust.org/articles/campaign-halve-europes-food-waste/ [accessed 11th April 2019].
- Bows, A., Dawkins, E., Gough, C., Mander, S., McLachlan, C., Röder, M., Thom, L., Thornley, P. and Wood, R. (2012). *What's cooking? Adaptation and mitigation in the UK food system*, University of Manchester, UK: Sustainable Consumption Institute.
- Boyatzis, R. (1998). *Transforming qualitative information: thematic analysis and code development*, Thousand Oaks, USA: Sage Publications, Inc., ISBN: 978 0761909613.
- Boyce, D.G., Lewis, M.R. and Worm, B. (2010). Global phytoplankton decline over the past century, *Nature*, Vol. 466, pp.591-596, http://dx.doi.org.ezproxy.mmu.ac.uk/10.1038/nature09268 [accessed 11th April 2019].

- Boyd Orr, J. (1936). Food, *health and income: report on a survey of adequacy of diet in relation to income*, London, UK: MacMillan.
- Boyd, O. (2017). The ridiculous story of airline food and why so much ends up in landfill, *The Guardian*, 1st April, https://www.theguardian.com/sustainable-business/2017/apr/01/airline-food-waste-landfill-incineration-airports-recycling-iberia-qantas-united-virgin [accessed 11th April 2019].
- Boyd, P.W., Lennartz, S.T., Glover, D.M. and Doney, S.C. (2015). Biological ramifications of climate-change-mediated oceanic multi-stressors, *Nature Climate Change*, Vol. 5, pp.71-79, doi:10.1038/nclimate2441.
- Boyer, E., Lazarus, C., Messina-Gourlot, C., and Salomon, J. (2019). Health professionals are the cornerstone of public health security, *The Lancet*, Vol. 4, Iss. 6, pe276-e277, doi: https://doi.org/10.1016/S2468-2667(19)30088-X [accessed 11th April 2019].
- Boyland, E.J., Nolan, S., Kelly, B., Tudur-Smith, C., Jones, A., Halford, J.C.G. and Robinson, E. (2016). Advertising as a cue to consume: a systematic review and meta-analysis of the effects of acute exposure to unhealthy food and non-alcoholic beverage advertising on intake in children and adults, *American Journal of Clinical Nutrition*, Vol. 103, No. 2, pp.519-533, doi: 10.3945/ajcn.115.120022.
- Boyle, R.D. (2007). Tightening the food supply chain chain of custody, *Supply Chain Management Review*, Vol. 11, Iss. 6, p.40.
- Bozzola, M., Massetti, E., Mendelsohn, R. and Capitanio, F. (2018). A Ricardian analysis of the impact of climate change on Italian agriculture, *European Review of Agricultural Economics*, Vol. 45, Iss. 1, pp. 57-79, https://doi.org/10.1093/erae/jbx023 [accessed 11th April 2019].
- Brack, D. (2019). *Towards sustainable cocoa supply chains: regulatory option for the EU*, Moreton in Marsh, UK: Fern UK, https://www.fern.org/fileadmin/uploads/fern/Documents/2019/Fern-sustainable-cocoa-supply-chains-report.pdf [accessed 11th April 2019].
- Brack, D. and Bailey, R. (2013). *Ending global deforestation - policy options for consumer countries*, London, UK: Chatham House Royal Institute of International Affairs, https://www.chathamhouse.org/publications/papers/view/194247 [accessed 11th April 2019].
- Bradbear, C. and Friel, S. (2013). Integrating climate change, food prices and population health, *Food Policy*, Vol. 43, pp.56-66, http://dx.doi.org/10.1016/j.foodpol.2013.08.007 [accessed 11th April 2019].
- Bradbury, K.E., Murphy, N. and Key, T.J. (2019). Diet and colorectal cancer in UK Biobank: a prospective study, *International Journal of Epidemiology*, dyz064, https://doi.org/10.1093/ije/dyz064 [accessed 11th April 2019].
- Bradfield, R., Wright, G., Burt, G., Cairns, G. and Van Der Heijden, K. (2005). The origins and evolution of scenario techniques in long range business planning, *Futures*, Vol. 37, pp.795-812, doi:10.1016/j.futures.2005.01.003.
- Bradley, C. (2014). Food sector needs to help fight slavery, *The Grocer*, 8th November, p.22.

- Bradley, P. (2016). Environmental impacts of food retail: a framework method and case application, *Journal of Cleaner Production*, Vol. 113, pp.153-166, http://dx.doi.org/10.1016/j.jclepro.2015.09.085 [accessed 11th April 2019].
- Bradner, E. (2017). Trump's TPP withdrawal: 5 things to know, *CNN*, 23rd January, https://edition.cnn.com/2017/01/23/politics/trump-tpp-things-to-know/index.html [accessed 11th April 2019].
- Bradshaw, A.D. (1972). Some of the evolutionary consequences of being a plant, *Evolutionary Biology*, Vol. 5, 525-547.
- Braithwaite, J., Mannion, R., Matsuyama, Y., Shekelle, P.G., Whittaker, S., Al-Adawi, S., Ludlow, K., James, W., Ting, H.P., Herkes, J., Mcpherson, E., Churruca, K., Lamprell, G., Ellis, L.A., Boyling, C., Warwick, M., Pomare, C., Nicklin, W. and Hughes, C.F. (2018). The future of health systems to 2030: a roadmap for global progress and sustainability, *International Journal for Quality in Health Care*, Vol. 30, No.10, pp.823-831, doi: 10.1093/intqhc/mzy242.
- Brambila-Macias, J., Traill, W.B., Shankar, B., Capacci, S., Mazzocch, M., Perez-Cueto, F.J.A. and Verbeke, W. (2011). Policy interventions to promote healthy eating: a review of what works, what does not, and what is promising, *Food and Nutrition Bulletin*, Vol. 32, pp.365-375, doi: 10.1177/156482651103200408.
- Branca, F., Demaio, A., Udomkesmalee, E., Baker, P., Aguayo, V.M., Barquera, S., Dain, K., Keir, L., Lartey, A., Mugambi, G., Oenema, S., Piwoz, E., Richardson, R., Singh, S., Sullivan, L., Verburg, G., Fracassi, P., Mahy, L. and Neufeld, L.M. (2019). A new nutrition manifesto for a new nutrition reality, *The Lancet*, Vol. 395, No. 10217, doi:https://doi.org/10.1016/S0140-6736(19)32690-X.
- Branch, T.A. (2012). FAO's state of fisheries and aquaculture: correcting some misrepresentations by Pauly and Froese, *Marine Policy*, Vol. 36, pp.1191-1192, doi:10.1016/j.marpol.2012.02.026.
- Brandi, C., Cabani, T., Hosang, C., Schirmbeck, S., Westermann, L. and Wiese, H. (2015). Sustainability standards for palm oil: challenges for smallholder certification under the RSPO, *Journal of Environment and Development*, Vol. 24, No. 3, pp.292-314, doi: 10.1177/1070496515593775.
- Brandsma, P.J., van Broekhuizen, R. and Wiersum, J-A. (2002). *Desk study on consumer behaviour towards sustainable food products: national report – Netherlands*, SUS-CHAIN report no. 9.1, European Commission Fifth Framework Programme 1998-2002, Quality of Life and Management of Living Resources.
- Brandstetter, S., Rüter, J., Curbach, J. and Loss, J. (2015). A systematic review on empowerment for healthy nutrition in health promotion, *Public Health Nutrition*, Vol. 18, No. 17, pp. 3146-3154, doi: 10.1017/S1368980015000270.
- Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J. and von Wehrden, H. (2013). A review of transdisciplinary research in sustainability science, *Ecological Economics*, Vol. 92, pp.1-15, https://doi.org/10.1016/j.ecolecon.2013.04.008 [accessed 11th April 2019].

- Brauman, K.A., Richter, B.D., Postel, S., Malsy, M. and Flörke, M. (2016). Water depletion: an improved metric for incorporating seasonal and dry-year water scarcity into water risk assessments, *Elementa: Science in the Anthropocene*, Vol. 4, 000083, doi: http://doi.org/10.12952/journal.elementa.000083 [accessed 11th April 2019].
- Braun, V. and Clarke, V. (2019). Thematic analysis. In: Liamputtong, P. (ed) *Handbook of research methods in health social sciences*, pp.843-860, Hoboken, USA: Springer, doi:10.1007/978-981-10-5251-4_103.
- Breen, J.P., Donnellan, T. and Westhoff, P. (2010). Food for thought: EU climate change policy presents new challenges for agriculture Éléments de réflexion: La politique européenne en matière de changement climatique offre de nouveaux défis à l'agriculture Denkanstoß: Die EU-Politik zum Klimawandel ste", *EuroChoices*, Vol. 9, No. 3, pp.24-29, doi: 10.1111/j.1746-692X.2010.00161.x.
- Breewood, H. (2018). *Are modern plant-based diets and foods actually sustainable?* Food Climate Research Network, 15th April, https://fcrn.org.uk/fcrn-blogs/helen-breewood/are-modern-plant-based-diets-and-foods-actually-sustainable [accessed 11th April 2019].
- Breewood, H. (2018). *What is the nutrition transition*? Foodsource building blocks, Oxford, UK: University of Oxford Food Climate Research Network.
- Breewood, H. and Garnett, T. (2020). *What is feed-food competition?* Foodsource: building blocks, Food Climate Research Network, University of Oxford.
- Bremer, S., Millar, K., Wright, N. and Kaiser, M. (2015). Responsible techno-innovation in aquaculture, *Aquaculture*, Vol. 437, pp.370-381, http://dx.doi.org/10.1016/j.aquaculture.2014.12.031 [accessed 11th April 2019].
- Brenner, R. (1976). Agrarian class structure and economic development in pre-industrial Europe, *Past & Present*, Vol. 70, pp.30-75, www.jstor.org/stable/650345 [accessed 11th April 2019].
- Breuer, O., Schütz, V., Brinkmann, D. and Petersen, B. (2008). Integrated crisis management approach supported by private chain orientated information systems and public animal disease control measures, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands.
- Briggs, A.D.M., Kehlbacher, A., Tiffin, R., Garnett, T., Rayner, M. and Scarborough, P. (2013). Assessing the impact on chronic disease of incorporating the societal cost of greenhouse gases into the price of food: an econometric and comparative risk assessment modelling study, *BMJ Open*, Vol. 3, pp.e003543, doi:10.1136/bmjopen-2013-003543.
- Briggs, S., Kennel, C.F. and Victor, D.G. (2015). Planetary vital signs, *Nature Climate Change*, Vol. 5, No. 969, doi: 10.1038/nclimate2828.
- Brindley, C. and Oxborrow, L. (2014). Aligning the sustainable supply chain to green marketing needs: a case study, *Industrial Marketing Management*, Vol. 43, pp.45-55, http://dx.doi.org/10.1016/j.indmarman.2013.08.003 [accessed 11th April 2019].

- Brinsden, H. and Lang, T. (2015). *An introduction to public health advocacy - reflections on theory and practice*, London, UK: City University London, Centre for Food Policy: Food Research Collaboration.
- Brisley, R., Welstead, J., Hindle, R. and Paavola, J. (2012). *Socially just adaptation to climate change: an exploration of how far social justice is considered in local adaptations to climate change impacts across the UK*, York, UK: Joseph-Rowntree Foundation, https://www.jrf.org.uk/report/socially-just-adaptation-climate-change [accessed 11th April 2019].
- Brisson, N., Gate, P., Gouache, D., Charmet, G., Oury, F.X. and Huard, F. (2010). Why are wheat yields stagnating in Europe? A comprehensive data analysis for France, *Field Crops Research*, Vol. 119, No.1, pp.201-212, doi: 10.1016/j.fcr.2010.07.012.
- British Medical Association (2016). *Obesity and diet related illness in the UK*, London, UK: British Medical Association, https://www.bma.org.uk [accessed 11th April 2019].
- British Nutrition Foundation (2016). *Nutrition requirements*, London, UK: British Nutrition Foundation, http://www.nutrition.org.uk/attachments/article/234/Nutrition%20Requirements_Revised%20Oct%20 2016.pdf [accessed 11th April 2019].
- British Retail Consortium (2019). *Global standard for food safety*, Issue 8, London, UK: British Retail Consortium, http://www.brcglobalstandards.com/ [accessed 28th November 2019].
- British Standards Institution (2011). *Publically Available Specificiation (PAS 2050: 2011)*, London, UK: The British Standards Institution.
- British Standards Institution (2014). *Guide to protecting and defending food and drink from deliberate attack*, PAS 96:2014, London, UK: British Standards Institution.
- Britwum, K. and Yiannaka, A. (2019). Shaping food safety perceptions: the influence of informational nudges, *Journal of Behavioral and Experimental Economics*, Vol. 81, pp.139-151, https://doi.org/10.1016/j.socec.2019.06.007 [accessed 11th April 2019].
- Broecker, W.S. (1975). Climatic change: are we on the brink of a pronounced global warming? *Science*, 8th August, Vol. 189, Issue 4201, pp.460-463, doi: 10.1126/science.189.4201.460.
- Broers, V.J.V., De Breucker, C., Van den Broucke, S. and Luminet, O. (2017). A systematic review and meta-analysis of the effectiveness of nudging to increase fruit and vegetable choice, *European journal of public health,* Vol. 27, No. 5, pp.912-920, https://doi.org/10.1093/eurpub/ckx085.
- Brönnimann, S., Luterbacher, J., Ewen, T., Diaz, H.F., Stolarski, R.S. and Neu, U. (eds)(2008). *Climate Variability and Extremes during the Past 100 years*, New York, USA: Springer.
- Brons, A. (2018). Feeding the melting pot: inclusive sustainable diets in the multi-ethnic city, *Food Climate Research Network*, 27th November, https://fcrn.org.uk/fcrn-blogs/feeding-melting-pot-inclusive-sustainable-diets-multi-ethnic-city [accessed 11th April 2019].
- Bronselaer, B., Winton, M., Griffies, S.M., Hurlin, W.J., Rodgers, K.B., Sergienko, O.V., Stouffer, R.J. and Russell, J.L. (2018). Change in future climate due to Antarctic meltwater, *Nature*, Vol. 564, No. 10.1038, doi:s41586-018-0712-z.

- Brookes, G., Taheripour, F. and Tyner, W.E. (2017). The contribution of glyphosate to agriculture and potential impact of restrictions on use at the global level, *GM Crops and Food*, Vol. 8, No. 4, pp.216-228, https://doi.org/10.1080/21645698.2017.1390637.
- Brooks, D.H., Ferrarini, B. and Go, E.C. (2013). Bilateral trade and food security, *Journal of International Commerce, Economics and Policy*, Vol. 4, No. 3, pp.1-23, 1350015, doi: 10.1142/S 1793993313500154.
- Brooks, J. and Matthews, A. (2015). *Trade dimensions of food security*, OECD Food, Agriculture and Fisheries Paper No. 77, Paris, France: Organisation for Economic Co-operation and Development Publishing, https://doi.org/10.1787/5js65xn790nv-en [accessed 11th April 2019].
- Brooks, K. and Place, F. (2019). Global food systems: can foresight learn from hindsight? *Global Food Security*, Vol. 20, pp.66-71, https://doi.org/10.1016/j.gfs.2018.12.004 [accessed 11th April 2019].
- Brooks, S. (2007). *Agri-food system dynamics for sustainability*, From STEPS Working Paper 4: Agri-food System Dynamics: pathways to sustainability in an era of uncertainty, Brighton, UK: University of Sussex STEPS Centre, Institute of Development Studies.
- Broom, D.M., Galindo, F.A. and Murgueitio, E. (2013). Sustainable, efficient livestock production with high biodiversity and good welfare for animals, *Philosophical Transactions of the Royal Society B*, Vol. 280, 20132025, http://dx.doi.org/10.1098/rspb.2013.2025 [accessed 11th April 2019].
- Brouziyne, Y., Abouabdillah, A., Hirich, A., Bouabid, R., Zaaboul, R. and Benaabidate, L. (2018). Modeling sustainable adaptation strategies toward a climate-smart agriculture in a Mediterranean watershed under projected climate change scenarios, *Agricultural Systems*, Vol. 162, pp. 154-163, https://doi.org/10.1016/j.agsy.2018.01.024 [accessed 11th April 2019].
- Brown, C., Alexander, P., Arneth, A., Holman, I. and Rounsevell, M. (2019). Achievement of Paris climate goals unlikely due to time lags in the land system, *Nature Climate Change*, Vol. 9, pp.203-208, doi:10.1038/s41558-019-0400-5.
- Brown, H.M., Rollo, Megan E., de Vlieger, N.M., Collins, C.E. and Bucher, T. (2018). Influence of the nutrition and health information presented on food labels on portion size consumed: a systematic review, *Nutrition Reviews*, Vol. 76, Iss.9, pp.655-677, doi: 10.1093/nutrit/nuy019.
- Brown, L.R. (2013). *Full planet, empty plates: the new geopolitics of food scarcity*, New York, USA: W.W. Norton & Company.
- Brown, M.E. (2014). *Food security, food prices and climate variability*, London, UK: Routledge, https://doi.org/10.4324/9780203071687 [accessed 11th April 2019].
- Brown, M.E. and Funk, C.C. (2008). Food security under climate change, *Science*, Vol. 319, No. 5863, pp.580-581, doi: 10.1126/science.ll54102.

- Brown, M.E., Antle, J.M., Backlund, P., Carr, E.R., Easterling, W.E., Walsh, M.K., Ammann, C., Attavanich, W., Barrett, C.B., Bellemare, M.F., Dancheck, V., Funk, C., Grace, K., Ingram, J.S.I., Jiang, H., Maletta, H., Mata, T., Murray, A., Ngugi, M., Ojima, D., O'Neill, B. and Tebaldi, C. (2015). *Climate change, global food security, and the U.S. food system*, doi: 10.7930/J0862DC7, http://www.usda.gov/oce/climate_change/FoodSecurity.htm [accessed 11th April 2019].
- Brown, M.E., Carr, E.R., Grace, K.L., Wiebe, K., Funk, C.C., Attavanich, W., Backlund, P. and Bujah, L. (2017). Do markets and trade help or hurt the global food system adapt to climate change? *Food Policy*, Vol. 68, pp.154-159, https://doi.org/10.1016/j.foodpol.2017.02.004 [accessed 11th April 2019].
- Brown, P.T. and Caldeira, K. (2017). Greater future global warming inferred from Earth's recent energy budget, *Nature*, Vol. 552, No. 7683, p.45, doi: 10.1038/nature24672.
- Brown, S., Agnewa, D.J. and Martin, W. (2016). On the road to fisheries certification - the value of the Objections Procedure in achieving the MSC sustainability standard, *Fisheries Research*, Vol. 182, pp.136-148, http://dx.doi.org/10.1016/j.fishres.2015.10.015 [accessed 11th April 2019].
- Bruce, A. (2015). National Research Council of the National Academies Critical role of animal science research in food security and sustainability, *Food Security*, Vol. 8, pp.299-300, doi: 10.1007/s12571-015-0520-3.
- Bruckner, M., Häyhä, T., Giljum, S., Maus, V., Fischer, G., Tramberend, S. and Börner, J. (2019). Quantifying the global cropland footprint of the European Union's non-food bioeconomy, *Environmental Research Letters*, Vol. 14, No. 045011, https://doi.org/10.1088/1748-9326/ab07f5 [accessed 11th April 2019].
- Bruckner, T., Bashmakov, I.A., Mulugetta, Y., Chum, H., de la Vega Navarro, A., Edmonds, J., Faaij, A., Fungtammasan, B., Garg, A., Hertwich, E., Honnery, D., Infield, D., Kainuma, M., Khennas, S., Kim, S., Nimir, H.B., Riahi, K., Strachan, N., Wiser, R. and Zhang, X. (2014). Energy Systems. In: *Climate Change 2014: Mitigation of Climate Change*, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx eds.). Cambridge University Press, Cambridge, UK and New York, NY, USA.
- Bruinsma, J. (2009). The resource outlook to 2050: bby how much do land, water and crop yields need to increase by 2050? (pp. 33). Food and Agriculture Organization of the United Nations (FAO) Expert Meeting on How to Feed the World in 2050, 24th-26th June, https://www.cabdirect.org/cabdirect/abstract/20093293510 [accessed 11th April 2019].
- Brulle, R.J. (2018). The climate lobby: a sectoral analysis of lobbying spending on climate change in the USA, 2000 to 2016, *Climatic Change*, doi: 10.1007/s10584-018-2241-z.
- Brundtland, G.H. (1987). *Our Common Future: Report of the World Commission on Environment and Development*, Dokument A/42/42, Geneva, Switzerland: The United Nations.

- Brunner, E.J., Jones P., Friel S. and Bartley, M. (2009). Fish, human health and marine ecosystem health - policies in collision, *International Journal of Epidemiology*, Vol. 38, No. 1, pp.93-100, doi: 10.1093/ije/dyn157.
- Brunori, G. and Di Iacovo, F. (2014). Urban food security and landscape change: a demand-side approach, *Landscape Research*, Vol. 39, No. 2, pp.141-157, doi: 10.1080/01426397.2014.891725.
- Bryce, E. (2013). Small and wild - how to feed fish to the world, *The Guardian*, 10th June, https://www.theguardian.com/environment/world-on-a-plate/2013/jun/10/fish-fishing [accessed 11th April 2019].
- Bryce, E. (2014). Sylvia Earle on eating fish - 'Think of them as wildlife, first and foremost', *The Guardian*, 18th September, https://www.theguardian.com/environment/world-on-a-plate/2014/sep/18/sylvia-earle-overfishing-seafood-ocean-hope-spots [accessed 11th April 2019].
- Bryce, E. (2018). A new digital tool to help fishers dodge bycatch with precision, *Anthropocene*, 22nd June, http://www.anthropocenemagazine.org/2018/06/a-new-digital-tool-to-help-fishers-dodge-bycatch-with-precision/ [accessed 11th April 2019].
- Bryce, E. (2018). Agriculture is now the major driver of permanent forest loss, *Anthropocene*, 21st September, http://www.anthropocenemagazine.org/2018/09/agriculture-is-now-the-major-driver-of-permanent-forest-loss/ [accessed 11th April 2019].
- Bryce, E. (2018). Carbon emissions of lobster and shrimp outstrip chicken and pork—and sometimes even beef, *Anthropocene Magazine*, 6th April, http://www.anthropocenemagazine.org/2018/04/carbon-emissions-of-lobster-and-shrimp-outstrip-chicken-and-pork-and-sometimes-even-beef/ [accessed 11th April 2019].
- Bryce, E. (2018). Deconstructing the environmental footprint of a sandwich, *Anthropocene*, 2nd February, http://www.anthropocenemagazine.org/2018/02/deconstructing-the-environmental-footprint-of-a-sandwich/ [accessed 11th April 2019].
- Bryce, E. (2018). Individual foods can have wildly different footprints, depending on how they're produced, *Anthropocene*, 8th June, http://www.anthropocenemagazine.org/2018/06/individual-foods-can-have-wildly-different-footprints-depending-on-how-theyre-produced/ [accessed 11th April 2019].
- Bryce, E. (2018). Metropolitan areas are becoming significant sources of sustainable produce, *Anthropocene*, 12th October, http://www.anthropocenemagazine.org/2018/10/metropolitan-areas-are-becoming-significant-sources-of-sustainable-produce/ [accessed 11th April 2019]
- Bryce, E. (2018). What if we treated meat consumption like food waste? *Anthropocene*, 30th March, http://www.anthropocenemagazine.org/2018/03/what-if-we-treated-meat-consumption-like-food-waste/ [accessed 11th April 2019].
- Bryngelsson, D., Wirsenius, S., Hedenus, F. and Sonesson, U. (2016). How can the EU climate targets be met? A combined analysis of technological and demand-side changes in food and agriculture, *Food Policy*, Vol. 59, pp.152-164, https://doi.org/10.1016/j.foodpol.2015.12.012 [accessed 11th April 2019].

- Brysse, K., Oreskes, N., O'Reilly, J. and Oppenheimer, M. (2013). Climate change prediction: erring on the side of least drama? *Global Environmental Change*, Vol. 23, Iss. 1, pp.327-337, https://doi.org/10.1016/j.gloenvcha.2012.10.008 [accessed 11th April 2019].
- BSI (2008). *Guide to PAS 2050: how to assess the carbon footprint of goods and services*, London, UK: BSI British Standards and Carbon Trust.
- BSI (2018). *Sustainability guide product carbon footprinting for beginners: puidance for smaller businesses on tackling the carbon footprinting challenge*, London, UK: British Standards Institute.
- Bucher, T., Collins, C., Rollo, M.E., McCaffrey, T.A., De Vlieger, N., Van Der Bend, D., Truby, H. and Perez-Cueto, F.J.A. (2016). Nudging consumers towards healthier choices: a systematic review of positional influences on food choice, *British Journal of Nutrition*, Vol. 115, No. 12, pp.2252-2263, doi: 10.1017/S0007114516001653.
- Buckwell, A. and Nadeau, E. (2018). *What is the safe operating space for EU livestock*? Brussels, Belgium: RISE foundation, http://www.risefoundation.eu/images/files/2018/2018_RISE_LIVESTOCK_FULL.pdf [accessed 11th April 2019].
- Budge, G.E., Garthwaite, D., Crowe, A., Boatman, N.D., Delaplane, K.S., Brown, M.A., Thygesen, H.H. and Pietravalle, S. (2015). Evidence for pollinator cost and farming benefits of neonicotinoid seed coatings on oilseed rape, *Nature Scientific Reports*, Vol. 5, 12574, doi: 10.1038/srep12574.
- Bugallo, P.M.B., Andrade, L.C., Iglesias, A.M. and López, R.T. (2013). Integrated environmental permit through best available techniques - evaluation of the fish and seafood canning industry, *Journal of Cleaner Production*, Vol. 47, pp.253-264, http://dx.doi.org/10.1016/j.jclepro.2012.12.022 [accessed 11th April 2019].
- Bukvic, A. (2018).Towards the sustainable climate change population movement: the Relocation Suitability Index, *Climate and Development*, Vol. 10, No. 4, pp.307-320, https://doi.org/10.1080/17565529.2017.1291407 [accessed 11th April 2019].
- Bull, J.W., Diogo Verissimo, D. and Milner-Gulland, E.J. (2017). When a ripple becomes a flood – why we didn't sign Ripple *et al*.'s "world scientists' warning to humanity: a second notice", *Interdisciplinary Centre for Conservation Science*, 18th December, https://www.iccs.org.uk/blog/when-ripple-becomes-flood-why-we-didnt-sign-ripple-et-als-world-scientists-warning-humanity [accessed 11th April 2019].
- Bunyavanich, S., Landrigan, C.P., McMichael, A.J. and Epstein, P.R. (2003). The impact of climate change on child health, *Ambulatory Pediatrics*, Vol. 3, pp.44-52, doi:10.1367/1539-4409(2003).
- Bureau, J-C. and Swinnen, J. (2018). EU policy and global food security, *Global Food Security*, Vol. 16, pp.106-115, https://doi.org/10.1016/j.gfs.2017.12.001 [accessed 11th April 2019].

- Burke, E.J., Brown, S.J. and Christidis, N. (2006). Modelling the recent evolution of global drought and projections for the twenty-first century with the Hadley centre climate model, *Journal of Hydrometeorology*, Vol. 7, No. 5, pp.1113-1125, https://doi.org/10.1175/JHM544.1 [accessed 11th April 2019].
- Burke, K.D., Williams, J.W., Chandler, M.A., Haywood, A.M., Lunt, D.J. and Otto-Bliesner, B.L. (2018). Pliocene and Eocene provide best analogs for near-future climates, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 52, pp.13288-13293, https://doi.org/10.1073/pnas.1809600115 [accessed 11th April 2019].
- Burke, M., Craxton, M., Kolstad, C.D., Onda, C., Allcott, H., Baker, E., Barrage, L., Carson, R., Gillingham, K., Graff-Zivin, J., Greenstone, M., Hallegatte, S., Hanemann, W.M., Heal, G., Hsiang, S., Jones, B., Kelly, D.L., Kopp, R., Kotchen, M., Mendelsohn, R., Meng, K., Metcalf, G., Moreno-Cruz, J., Pindyck, R., Rose, S., Rudik, I., Stock, J. and Tol, R.S.J. (2016). Opportunities for advances in climate change economics, *Science*, Vol. 352, No. 6283, pp.292-293, doi: 10.1126/science.aad963.
- Burke, M., Davis, W.M. and Diffenbaugh, N.S. (2018). Large potential reduction in economic damages under UN mitigation targets, *Nature*, Vol. 557, No. 24, pp.549–553, https://www.nature.com/articles/s41586-018-0071-9 [accessed 11th April 2019].
- Burke, M., Hsiang, S.M. and Miguel, E. (2015). Global non-linear effect of temperature on economic production, *Nature*, Vol. 527, pp.235-239, doi:10.1038/nature15725.
- Burlingame, B. (2004). Holistic and reductionist nutrition, *Journal of Food Composition and Analysis*, Vol. 17, pp.585-586, doi:10.1016/j.jfca.2004.06.002.
- Burlingame, B. and Dernini, S. (2012). Sustainable diets and biodiversity - directions and solutions for policy, research and action, Proceedings of the International Scientific Symposium *Biodiversity and Sustainable Diets United Against Hunger*, 3–5th November, Rome, Italy: Food and Agriculture Organization of the United Nations.
- Burlingame, S. and Dernini, S. (2011). Sustainable diets: the Mediterranean diet as an example, *Public Health Nutrition*, Vol. 14, No. 12A, pp.2285-2287, doi: 10.1017/S1368980011002527.
- Burns, C., Gravey, V. and Jordan, A. (2018). *UK environmental policy post-Brexit: a risk analysis*, a report for Friends of the Earth, Brexit and Environment, March, https://cdn.friendsoftheearth.uk [accessed 11th April 2019].
- Burns, F., Eaton, M.A., Barlow, K.E., Beckmann, B.C., Brereton, T., Brooks, D.R., Brown, P.M.J., Al Fulaij, N., Gent, T., Henderson, I., Noble, D.G., Parsons, M., Powney, G.D., Roy, H.E., Stroh, P., Walker, K., Wilkinson, J.W., Wotton, S.R. and Gregory, R.D. (2016). Agricultural management and climatic change are the major drivers of biodiversity change in the UK, *PLoS One*, Vol. 11, pp.e0151595, https://doi.org/10.1371/journal.pone.0151595 [accessed 11th April 2019].

- Buse, G.C., Oestreicher, J.S., Ellis, N.R., Patrick, R., Brisbois, B., Jenkins, A.P., McKellar, K., Kingsley, J., Gislason, M., Galway, L., McFarlane, R.A., Walker, J., Frumkin, H. and Parkes, M. (2018). Public health guide to field developments linking ecosystems, environments and health in the Anthropocene, *British Medical Journal*, http://dx.doi.org/10.1136/jech-2017-210082 [accessed 11th April 2019].
- Bush, R. (2010). Food riots - poverty, power and protest, *Journal of Agrarian Change*, Vol. 10, No. 1, pp.119-129, https://doi.org/10.1111/j.1471-0366.2009.00253.x [accessed 11th April 2019].
- Bush, S.R. and Mol, A.P.J. (2015). Governing in a placeless environment: sustainability and fish aggregating devices, *Environmental Science and Policy*, Vol. 53, pp.27-37, http://dx.doi.org/10.1016/j.envsci.2014.07.016 [accessed 11th April 2019].
- Bush, S.R., Oosterveer, P., Bailey, M. and Mol, A.P.J. (2015). Sustainability governance of chains and networks, *Journal of Cleaner Production*, Vol. 107, pp.8-19, http://dx.doi.org/10.1016/j.jclepro.2014.10.019 [accessed 11th April 2019].
- Bustamante, M., Robledo-Abad, C., Harper, R., Mbow, C., Ravindranat, N.H., Sperling, F., Haberl, H., Pinto Ade, S. and Smith, P. (2014). Co-benefits, trade-offs, barriers and policies for greenhouse gas mitigation in the agriculture, forestry and other land use (AFOLU) sector, *Global Change Biology*, Vol. 20, pp.3270-3290, doi: https://doi.org/10.1111/gcb.12591.
- Butler, C. (ed)(2014). *Climate change and global health*, Canberra, Australia: University of Canberra, ISBN: 9781780642659.
- Butler, C.D. (2016a). Planetary overload, limits to growth and health, *Current Environmental Health Reports*, Vol. 3, pp.360-369, doi: 10.1007/s40572-016-0110-3.
- Butler, C.D. (2016b). Sounding the alarm: health in the Anthropocene, *International Journal of Environmental Research and Public Health*, Vol. 13, pp.665, doi:10.3390/ijerph13070665.
- Butler, C.D. and Dixon, J. (2012). Plentiful food? Nutritious food? In: C. Rosin, P. Stock, and H. Campbell (eds) *Food system failure: the global food crisis and the future of agriculture* (pp. 98–113). London, UK: Earthscan London, ISBN 9781136529429.
- Butler, E.E. and Huybers, P. (2012). Adaptation of US maize to temperature variations, *Nature Climate Change*, Vol. 3, pp.68-72, doi:10.1038/nclimate1585.
- Butler, E.E. and Huybers, P. (2015). Variations in the sensitivity of US maize yield to extreme temperatures by region and growth phase, *Environmental Research Letters*, Vol. 10, pp.034009, doi:10.1088/1748-9326/10/3/034009.
- Butler, E.E., Mueller, N.D. and Huybers, P. (2018). Peculiarly pleasant weather for US maize, *Proceedings of the National Academy of Sciences*, pp.201808035, doi: 10.1073/pnas.1808035115.
- Buttriss, J. (2010). What is a healthy diet for the UK? In: Johnson, N. (ed). *Feeding Britain - what consumers want*, chapter 3, London, UK: The Smith Institute.
- Buttriss, J. and Riley, H. (2013). Sustainable diets - harnessing the nutrition agenda, *Food Chemistry*, Vol. 140, Iss. 3, pp.402-407, https://doi.org/10.1016/j.foodchem.2013.01.083 [accessed 11th April 2019].

- Buzby, J.C., Wells, H.F. and Vocke, G. (2006). Possible implications for U.S. agriculture from adoption of selected dietary guidelines, *Economic Research Report*, No. 31, doi: 10.22004/ag.econ.7230, http://www.ers.usda.gov/publications/err-economic-research-report/err31.aspx [accessed 11th April 2019].
- Byelashov, O.A. and Griffin, M.E. (2014). Fish in, fish out - perception of sustainability and contribution to public health, *Fisheries*, Vol. 39, No. 11, pp.531-535, doi: 10.1080/03632415.2014.967765.
- Byrd, K.M. and Byrd, C. (2017). We eat to live, we live to eat: thoughts on the sociological study of food, culture, and inequality, *Marine Pollution Bulletin*, Vol. 114, No. 2, pp.689-698, https://doi.org/10.1177/0160597617733600 [accessed 11th April 2019].
- Byrne, A. (2017). Trouble in the air: recent developments under the 1979 Convention on Long-Range Transboundary Air Pollution, *Review of European, Comparative and International Environmental Law*, Vol. 26, pp.210-219, https://doi.org/10.1111/reel.12219 [accessed 11th April 2019].
- Byskov, M.F. (2019). Climate change: focusing on how individuals can help is very convenient for corporations, *The Conversation*, 10th January, https://theconversation.com/climate-change-focusing-on-how-individuals-can-help-is-very-convenient-for-corporations-108546 [accessed 11th April 2019].
- CABI (2019). *About Plantwise: Increasing food security and improving rural livelihoods by reducing crop losses CAB International*, www.plantwise.org/about/ [accessed 11th April 2019].
- Cabinet Office (2008). *Food matters: towards a strategy for the 21st*, London, UK: Cabinet Office, https://webarchive.nationalarchives.gov.uk/+/http:/www.cabinetoffice.gov.uk/media/cabinetoffice/strategy/assets/food/food_matters_es.pdf [accessed 11th April 2019].
- Cabinet Office (2008). *Food: an analysis of the issues*, London, UK: Cabinet Office, https://webarchive.nationalarchives.gov.uk/+/http:/www.cabinetoffice.gov.uk/media/cabinetoffice/strategy/assets/food/food_analysis.pdf [accessed 11th April 2019].
- Caesar, L., Rahmstorf, S., Robinson, A., Feulner, G. and Saba, V. (2018). Observed fingerprint of a weakening Atlantic Ocean overturning circulation, *Nature*, Vol. 556, pp.191-196, doi:10.1038/s41586-018-0006-5.
- Cafiero, C., Viviani, S. and Nord, M. (2018). Food security measurement in a global context: the food insecurity experience scale, *Measurement*, Vol. 116, pp.146-152, https://doi.org/10.1016/j.measurement.2017.10.065 [accessed 11th April 2019].
- Cahill, S.M., Desmarchelier, P., Fattori, V., Bruno, A. and Cannavan, A. (2017). Global perspectives on antimicrobial resistance in the food chain, *Food Protection Trends,* Vol. 37, No. 5, pp.353-361, http://www.foodprotection.org/files/food-protection-trends/sep-oct-17-cahill.pdf [accessed 11th April 2019].
- Cai, Y., Bandara, J.S. and Newth, D. (2016). A framework for integrated assessment of food production economics in South Asia under climate change, *Environmental Modelling & Software*, Vol. 75, pp.459-497, doi.org/10.1016/j.envsoft.2015.10.024.

- Cairns, G. (2019). A critical review of evidence on the sociocultural impacts of food marketing and policy implications, *Appetite*, Vol. 136, pp.193-207, doi:10.1016/j.appet.2019.02.002.
- Calancie, L., Leeman, J., Jilcott Pitts, S.B., Khan, L.K., Fleischhacker, S., Kelly R. Evenson, Schreiner, M., Byker, C., Owens, C., McGuirt, J., Barnidge, E., Dean, W., Johnson, D., Kolodinsky, J., Piltch, E., Pinard, C., Quinn, E., Whetstone, L. and Ammerman, A. (2015). Nutrition-related policy and environmental strategies to prevent obesity in rural communities: a systematic review of the literature, 2002-2013, *Preventing Chronic Disease*, Vol. 12, No. 4, 140540, doi: 10.5888/pcd12.140540.
- Caldecott, B., Hall, S. and Ives, E. (2017). *A greener more pleasant land*, London, UK: Bright Blue Campaign, https://brightblue.org.uk/wp-content/uploads/2017/11/Agreenermorepleasantland.pdf [accessed 11th April 2019].
- Callicott, J.B. and Mumford, K. (1997). Ecological sustainability as a conservation concept, *Conservation Biology*, Vol. 11, pp.32-40, doi:10.1046/j.1523-1739.1997.95468.x
- Calvet-Mir, L., Gómez-Baggethun, E. and Reyes-García, V. (2012). Beyond food production - Ecosystem services provided by home gardens: a case study in Northeastern Spain, *Ecological Economics*, Vol. 74, pp.153-160, doi:10.1016/j.ecolecon.2011.12.011.
- Calzadilla, A., Rehdanz, K., Betts, R., Falloon, P., Wiltshire, A. and Tol, R.S.J. (2013). Climate change impacts on global agriculture, *Climatic Change*, Vol. 120, pp.357-374, doi: 10.1007/s10584-013-0822-4.
- Camargo, M.C., Hogarth, N.J., Pacheco, P., Nhantumbo, I. and Kanninen, M. (2019). Greening the dark side of chocolate: a qualitative assessment to inform sustainable supply chains, *Environmental Conservation*, Vol. 46, No. 1, pp.9-18, doi: 10.1017/S0376892918000243.
- Camenisch, C., Keller, K.M., Salvisberg, M., Amann, B., Bauch, M., Blumer, S., Brázdil, R., Brönnimann, S., Büntgen, U., Campbell, B.M.S., Fernández-Donado, L., Fleitmann, D., Glaser, R., González-Rouco, F., Grosjean, M., Hoffmann, R.C., Huhtamaa, H., Joos, F., Kiss, A., Kotyza, O., Lehner, F., Luterbacher, J., Maughan, N., Neukom, R., Novy, T., Pribyl, K., Raible, C.C., Riemann, D., Schuh, M., Slavin, P., Werner, J.P. and Wetter, O. (2016). The 1430s: a cold period of extraordinary internal climate variability during the early Spörer Minimum with social and economic impacts in north-western and central Europe, *Climate of the Past*, Vol. 12, No. 11, pp.2107-2126, doi: 10.5194/cp-12-2107-2016.
- Campbell, B.M., Beare, D.J., Bennett, E.M., Hall-Spencer, J.H., Ingram, J.S.I., Jaramillo, F., Ortiz, R., Ramankutty, N., Sayer, J.A. and Shindell, D. (2017). Agriculture production as a major driver of the Earth system exceeding planetary boundaries, *Ecology and Society*, Vol. 22, No. 4, p.8, https://doi.org/10.5751/ES-09595-220408 [accessed 11th April 2019].
- Campbell, B.M., Hansen, J., Rioux, J., Stirling, C.M., Twomlow, S. and Wollenbe, E. (2018). Urgent action to combat climate change and its impacts (SDG 13): transforming agriculture and food systems, *Current Opinion in Environmental Sustainability*, Vol. 34, pp.13-20, https://doi.org/10.1016/j.cosust.2018.06.005 [accessed 11th April 2019].

- Campbell, B.M., Vermeulen, S.J., Aggarwal, P.K., Corner-Dolloff, C., Girvetz, E., Loboguerrero, A.M., Ramirez-Villegas, J., Rosenstock, T., Sebastian, L., Thornton, P.K. and Wollenberg, E. (2016). Reducing risks to food security from climate change, *Global Food Security*, Vol. 11, pp.34-43, https://doi.org/10.1016/j.gfs.2016.06.002 [accessed 11th April 2019].
- Campbell, M. (2012). Why the silence on population? In: Cafaro, P. and Crist, E. (eds). *Life on the brink*, Athens, USA: University of Georgia Press.
- Campbell, M., Buckeridge, D., Dwyer, J., Fong, S., Mann, V., Sanchez-Sweatman, O., Stevens, A. and Fung, L. (2000). A systematic review of the effectiveness of environmental awareness interventions, *Canadian Journal of Public Health / Revue Canadienne de Sante'e Publique,* Vol. 91, No. 2, pp.137-143, www.jstor.org/stable/41993128.
- Canada's Food Price Report (2020). Canada's Food Price Report, 10th Ed., Dalhousie University Faculties of Management and Agriculture and the University of Guelph Arrell Food Institute.
- Canadell, P. and Jackson, R. (2019). Turning methane into carbon dioxide could help us fight climate change, *The Conversation*, 20th May, https://theconversation.com/turning-methane-into-carbon-dioxide-could-help-us-fight-climate-change-117317 [accessed 11th April 2019].
- Canavan, B. (2019). Consumerism in crisis as millennials stay away from shops, *The Conversation*, 15th January, https://theconversation.com/consumerism-in-crisis-as-millennials-stay-away-from-shops-109827 [accessed 11th April 2019].
- Cancer Research UK (2018). *Food industry told to cut calories to tackle obesity*, Cancer Research UK, 6th March, http://www.cancerresearchuk.org/about-us/cancer-news/news-report/2018-03-06-food-industry-told-to-cut-calories-to-tackle-obesity [accessed 11th April 2019].
- Candel, J.J. and Biesbroek, R. (2018). Policy integration in the EU governance of global food security, *Food Security*, Vol. 10, No. 1, pp.195-20, https://doi.org/10.1007/s12571-017-0752-5 [accessed 11th April 2019].
- Candel, J.J.L. (2014). Food security governance: a systematic literature review, *Food Security*, Vol. 6, No. 4, pp.585-601, doi: 10.1007/s12571-014-0364-2.
- Candel, J.J.L. and Pereira, L. (2017). Towards integrated food policy: main challenges and steps ahead, *Environmental Science & Policy*, Vol. 73, pp.89-92, https://doi.org/10.1016/j.envsci.2017.04.010 [accessed 11th April 2019].
- Cang, F.A., Wilson, A.A. and Wiens, J.J. (2016). Climate change is projected to outpace rates of niche change in grasses, *Biology Letters*, Vol. 12, pp.20160368, http://dx.doi.org/10.1098/rsbl.2016.0368 [accessed 11th April 2019].
- Cannon, G. and Leitzmann, C. (2005). The new nutrition science project, *Public Health Nutrition*, Vol. 8, pp.673-694, doi: 10.1079/phn2005819.

- Cantarello, E., Newton, A.C. and Hill, R.A. (2011). Potential effects of future land-use change on regional carbon stocks in the UK, *Environmental Science & Policy*, Vol. 14, Iss. 1, pp.40-52, https://doi.org/10.1016/j.envsci.2010.10.001 [accessed 11th April 2019].
- Capacci, S., Mazzocchi, M., Shankar, B., Brambila Macias, J., Verbeke, W., Pérez-Cueto, F.J., KoziolŁ-Kozakowska, A., Piórecka, B., Niedzwiedzka, B., D'Addesa, D., Saba, A., Turrini, A., Aschemann-Witzel, J., Bech-Larsen, T., Strand, M., Smillie, L., Wills, J. and Traill, W.B. (2012). Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness, *Nutrition Reviews*, Vol. 70, pp.188-200, doi: 10.1111/j.1753-4887.2011.00442.x.
- Capon, A.G., Horton, R.C. and Talley, N.J. (2018). Planetary health: what is it and what should doctors do? *Medical Journal of Australia*, Vol. 208, pp.296-297, https://www.mja.com.au/journal/2018/208/7/planetary-health-what-it-and-what-should-doctors-do [accessed 11th April 2019].
- Capone, R., Bilali, H.E., Debs, P., Cardone, G. and Driouech, N. (2014). Food system sustainability and food security: connecting the dots, *Journal of Food Security*, Vol. 2, No. 1, pp.13-22, doi: 10.12691/jfs-2-1-2.
- Capulto, S. (2018). How urban farmers are learning to grow food without soil or natural light, *The Conversation*, 13th February, https://theconversation.com/how-urban-farmers-are-learning-to-grow-food-without-soil-or-natural-light-88720 [accessed 11th April 2019].
- Caradonna, J.L. (2014). *Sustainability: a history*, Oxford, UK: Oxford University Press, ISBN: 0-19-937240-3, 978-0-19-937240-9.
- Carattini, S., Kallbekken, S. and Orlov, A. (2019). How to win public support for a global carbon tax, *Nature*, Vol. 565, No. 7739, p.289, doi: 10.1038/d41586-019-00124-x.
- Carbon Brief (2015). How do scientists measure global temperature? *Carbon Brief*, 16th January, https://www.carbonbrief.org/explainer-how-do-scientists-measure-global-temperature [accessed 11th April 2019].
- Carbon Brief (2016). How BECCS became climate change's 'saviour' technology, *Carbon Brief*, 13th April, https://www.carbonbrief.org/beccs-the-story-of-climate-changes-saviour-technology [accessed 11th April 2019].
- Carbon Brief (2017a). Factcheck: Lord Lawson's inaccurate claims about climate change on BBC Radio 4, *Carbon Brief*, 10th August, https://www.carbonbrief.org/factcheck-lord-lawson-inaccurate-claims-about-climate-change-bbc-radio-four [accessed 11th April 2019].
- Carbon Brief (2017b). Major correction to satellite data shows 140% faster warming since 1998, *Carbon Brief*, 30th June, https://www.carbonbrief.org/major-correction-to-satellite-data-shows-140-faster-warming-since-1998 [accessed 11th April 2019].
- Carbon Brief (2018a). Climate modelling: how do climate models work, *Carbon Brief*, 15th January, https://www.carbonbrief.org/qa-how-do-climate-models-work [accessed 11th April 2019].

- Carbon Brief (2018b). How integrated assessment models are used to study climate change, Carbon Brief, 2nd October, https://www.carbonbrief.org/qa-how-integrated-assessment-models-are-used-to-study-climate-change [accessed 11th April 2019].
- Carbon Brief (2018c). How will your local area warm in the future? *Carbon Brief*, 26th September, Mapped: how every part of the world has warmed – and could continue to warm: https://www.carbonbrief.org/mapped-how-every-part-of-the-world-has-warmed-and-could-continue-to-warm?utm_content=buffer61645&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer [accessed 11th April 2019].
- Carbon Brief (2018d). Mapped: where 'afforestation' is taking place around the world, https://www.carbonbrief.org/mapped-where-afforestation-is-taking-place-around-the-world? [accessed 11th April 2019].
- Carbon Brief (2018e). The impacts of climate change at 1.5C, 2C and beyond, https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/. [accessed 11th April 2019].
- Carbon Brief (2019a). Global warming varies greatly depending where you live, https://twitter.com/i/status/1082328777697447936 [accessed 11th April 2019].
- Carbon Brief (2019b). How do climate models work? https://www.carbonbrief.org/qa-how-do-climate-models-work?utm_content=bufferf33cd&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer [accessed 11th April 2019].
- Carbon Brief (2019c). In-depth: the UK should reach 'net-zero' climate goal by 2050, says CCC, Carbon Brief, 2nd May, https://www.carbonbrief.org/in-depth-the-uk-should-reach-net-zero-climate-goal-by-2050-says-ccc [accessed 11th April 2019].
- Carbon Disclosure Project (2012). *Insights into climate change adaptation by UK Companies*, London, UK: Defra for the Carbon Disclosure Project.
- Carbon Disclosure Project (2014). *Global forests report*, London, UK: Carbon Disclosure Project, https://www.cdp.net [accessed 11th April 2019].
- Carbon Disclosure Project (2015). *The forgotten 10% - climate mitigation in agricultural supply chains*, London, UK: Carbon Disclosure Project, https://www.cdp.net [accessed 11th April 2019].
- Carbon Disclosure Project (2017). *The carbon majors database*, London, UK: Carbon Disclosure Project, https://www.cdp.net [accessed 11th April 2019].
- Carbon Trust (2008). *Product carbon footprinting - the new business opportunity: experience from leading companies*, London, UK: The Carbon Trust.
- Carbon Trust (2011a). *Creating an awareness campaign*, London, UK: The Carbon Trust.
- Carbon Trust (2011b). *Take control of your sustainability strategy*, London, UK: The Carbon Trust.

- Carbon Trust (2014). *Opportunities in a resource constrained world; how business is rising to the challenge*, London, UK: The Carbon Trust.
- Carbon Trust (2015). *The case for protein diversity - accelerating the adoption of more sustainable eating patterns in the UK*, London, UK: The Carbon Trust.
- Carbon Trust (2016). *The Eatwell Guide: a more sustainable diet - methodology and results summary,* London, UK: The Carbon Trust, https://www.carbontrust.com/media/672635/phe-sustainable-diets.pdf [accessed 11th April 2019].
- Cardinael, R., Umulisa, V., Toudert, A., Olivier, A., Bockel, L. and Bernoux, M. (2018). Revisiting IPCC Tier 1 coefficients for soil organic and biomass carbon storage in agroforestry systems, *Environmental Research Letters*, Vol. 13, No. 12, pp.124020, doi: 10.1088/1748-9326/aaeb5f.
- Carey, K. (2015). Water's time has surely come, *The Grocer*, 3rd October, p.20.
- Carey, R., Sheridan, J. and Larsen, K. (2018). Feeding cities in the 21st century: why urban-fringe farming is vital for food resilience, *The Conversation*, 28th November, https://theconversation.com/feeding-cities-in-the-21st-century-why-urban-fringe-farming-is-vital-for-food-resilience-106162 [accessed 11th April 2019].
- Cargill (2019). *Food for thought: eating better*, The Economist Intelligence Unit Limited, https://eiuperspectives.economist.com/sites/default/files/multimedia/eating_better_report.pdf [accessed 11th April 2019].
- Carlson, A., Lino, M., Juan, W-Y. and Basiotis, P.P. (2007). *Thrifty food plan, 2006*, United States Department of Agriculture Center for Nutrition Policy and Promotion, https://fns-prod.azureedge.net/sites/default/files/usda_food_plans_cost_of_food/TFP2006Report.pdf [accessed 11th April 2019].
- Carlson, K., Curran, L., Asner, G., Pittman, A., Trigg, S. and Adeney, J. (2012). Carbon emissions from forest conversion by Kalimantan oil palm plantations, *Nature Climate Change*, Vol. 3, pp.283-287, doi: 10.1038/NCLIMATE1702.
- Carlson, K.M., Gerber, J.S., Mueller, N.D., Herrero, M., MacDonald, G.K., Brauman, K.A., Havlik, P., O'Connell, C.S., Johnson, J.A., Saatchi, S. and West, P.C. (2016). Greenhouse gas emissions intensity of global croplands, *National Climate Change*, Vol. 7, pp.63-68, doi:10.1038/nclimate3158.
- Carlsson, L., Callaghan, E., Morley, A. and Broman, G. (2017). Food system sustainability across scales: a proposed local-to-global approach to community planning and assessment, *Sustainability*, Vol. 9, No. 1061; doi:10.3390/su9061061.
- Carlsson-Kanyama, A. and González, A.D. (2009). Potential contributions of food consumption patterns to climate change, *The American Journal of Clinical Nutrition*, Vol. 89, No. 5, pp.1704S-1709S, https://doi.org/10.3945/ajcn.2009.26736AA [accessed 11th April 2019].

- Carney, M., Villeroy de Galhau, F. and Elderson, F. (2019). *Open letter on climate-related financial risks, from the Governor of Bank of England from the Governor of Bank of England, Governor of Banque de France and Chair of the Network for Greening the Financial Services*, London, UK: Bank of England, https://www.bankofengland.co.uk/news/2019/april/open-letter-on-climate-related-financial-risks [accessed 17th April, 2019]
- Carolan, M. (2014). *Reclaiming food security*, London, UK: Routledge, ISBN 9781135067656.
- Carolan, M. (2016). Food, agriculture, and the environment. In: *The sociology of food and agriculture*, 2nd Edition, London, UK: Routledge, ISBN 9781317368618.
- Carolan, M. (2016). More-than-active food citizens: a longitudinal and comparative study of alternative and conventional eaters, *Rural Sociology*, Vol. 82, No.2, pp.197-225, doi: 10.1111/ruso.12120.
- Carolan, M. (2018). Big data and food retail: nudging out citizens by creating dependent consumers, *Geoforum*, Vol. 90, pp.142-150, https://doi.org/10.1016/j.geoforum.2018.02.006 [accessed 11th April 2019].
- Carpenter, S.R., Pingali, P.L., Bennett, E.M. and Zurek, M.B. (2005). *Ecosystems and human well-being: findings of the Scenarios Working Group of the Millennium Ecosystem Assessment*, Millennium Ecosystem Assessment Series, Vol. 2. Washington, USA: Island Press
- Carr, J.A., D'Odorico, P., Laio, F. and Ridolfi, L. (2012). On the temporal variability of the virtual water network, *Geophysical Research Letters*, Vol. 39, L06404, doi:10.1029/2012GL051247.
- Carr, J.A., D'Odorico, P., Laio, F. and Ridolfi, L. (2013). Recent history and geography of virtual water trade, *PLoS One*, Vol. 8, No. 2, e55825, doi:10.1371/journal.pone.0055825.
- Carrington, D. (2013). Tar sands exploitation would mean game over for climate, warns leading scientist, *The Guardian*, 19th May, https://www.theguardian.com/environment/2013/may/19/tar-sands-exploitation-climate-scientist [accessed 11th April 2019].
- Carrington, D. (2014). Britain's food self-sufficiency is in long-term decline, warn farmers, *The Guardian*, 7th August, https://www.theguardian.com/environment/2014/aug/07/britain-food-self-sufficiency-decline-imports-nfu [accessed 11th April 2019].
- Carrington, D. (2016). The Anthropocene epoch: scientists declare dawn of human-influenced age, *The Guardian*, 29th Aug, https://www.theguardian.com/environment/2016/aug/29/declare-anthropocene-epoch-experts-urge-geological-congress-human-impact-earth [accessed 11th April 2019].
- Carrington, D. (2017a). Assumed safety of pesticide use is false, says top government scientist, *The Guardian*, 22nd Sept, https://www.theguardian.com/environment/2017/sep/21/assumed-safety-of-widespread-pesticide-use-is-false-says-top-government-scientist [accessed 11th April 2019].
- Carrington, D. (2017b). English rivers polluted by powerful insecticides, first tests reveal, *The Guardian*, 13th December, https://www.theguardian.com/environment/2017/dec/13/english-rivers-polluted-by-powerful-insecticides-first-tests-reveal [accessed 11th April 2019].

- Carrington, D. (2017c). UK killer whale died with extreme levels of toxic pollutants, *The Guardian*, 2nd May, https://www.theguardian.com/environment/2017/may/02/uk-killer-whale-died-extreme-levels-toxic-pollutants [accessed 11th April 2019].
- Carrington, D. (2018a). Avoiding meat and dairy is 'single biggest way' to reduce your impact on Earth, *The Guardian*, 31st May, https://www.theguardian.com/environment/2018/may/31/avoiding-meat-and-dairy-is-single-biggest-way-to-reduce-your-impact-on-earth [accessed 11th April 2019].
- Carrington, D. (2018b). Insect declines: new alarm over mayfly is 'tip of iceberg', warn experts, *The Guardian*, 11th January, https://www.theguardian.com/environment/2018/jan/11/insect-declines-new-alarm-over-mayfly-is-tip-of-iceberg-warn-experts [accessed 11th April 2019].
- Carrington, D. (2018c). Marine life worse off inside 'protected' areas, analysis reveals: Findings expose 'big lie' behind European marine conservation, scientists say, *The Guardian*, 20th December, https://www.theguardian.com/environment/2018/dec/20/marine-life-worse-off-inside-protected-areas-analysis-reveals?CMP=twt_a-environment_b-gdneco [accessed 11th April 2019].
- Carrington, D. (2018d). The briefing: What is biodiversity and why does it matter to us? *The Guardian*, 12th March, https://www.theguardian.com/news/2018/mar/12/what-is-biodiversity-and-why-does-it-matter-to-us [accessed 11th April 2019].
- Carrington, D. (2018e). Beef-eating 'must fall drastically' as world population grows - current food habits will lead to destruction of all forests and catastrophic climate change by 2050, report finds, *The Guardian*, 5th December, https://www.theguardian.com/environment/2018/dec/05/beef-eating-must-fall-drastically-as-world-population-grows-report [accessed 11th April 2019].
- Carrington, D. (2019a). Climate crisis reducing land's ability to sustain humanity, *The Guardian*, 8th August, https://www.theguardian.com/environment/2019/aug/08/climate-crisis-reducing-lands-ability-to-sustain-humanity-says-ipcc [accessed 11th April 2019].
- Carrington, D. (2019b). How climate's impact on land threatens civilisation – and how to fix it, *The Guardian*, 8th August, https://www.theguardian.com/environment/2019/aug/08/how-climates-impact-on-land-threatens-civilisation-and-how-to-fix-it [accessed 11th April 2019].
- Carrington, D. (2019c). Tree planting 'has mind-blowing potential' to tackle climate crisis, *The Guardian*, 4th July, https://www.theguardian.com/environment/2019/jul/04/planting-billions-trees-best-tackle-climate-crisis-scientists-canopy-emissions [accessed 11th April 2019].
- Carrington, D. (2019d). True cost of cheap food is health and climate crises, says commission, *The Guardian*, 16th July, https://www.theguardian.com/environment/2019/jul/16/true-cost-of-cheap-food-is-health-and-climate-crises-says-commission [accessed 11th April 2019].
- Carrington, D. (2020a). Coronavirus: 'Nature is sending us a message', says UN environment chief, *The Guardian*, 25th March, https://www.theguardian.com/world/2020/mar/25/coronavirus-nature-is-sending-us-a-message-says-un-environment-chief [accessed 11th April 2020].

- Carrington, D. (2020b). Supertrawlers 'making a mockery' of UK's protected seas: vast vessels spent almost 3,000 hours fishing in officially protected areas in 2019, *The Guardian*, 11th June, https://www.theguardian.com/environment/2020/jun/11/supertrawlers-making-a-mockery-of-uks-protected-seas [accessed 11th June, 2020].
- Carson, R. (1962). *Silent spring*, London, UK: Houghton Mifflin, ISBN 9780618249060.
- Carter, C. (2015). Who governs Europe? Public versus private regulation of sustainability of fish feeds, *Journal of European Integration*, Vol. 37, No. 3, pp.335-352, https://doi.org/10.1080/07036337.2014.968566 [accessed 11th April 2020].
- Carter, C. (2015). Who governs Europe? Public versus private regulation of sustainability of fish feeds, *Journal of European Integration*, Vol. 37, No. 3, pp.335-352, doi: 10.1080/07036337.2014.968566 [accessed 11th April 2019].
- Carter, J. and Griffiths, D. (2015). Future climate – challenges and opportunities, *Journal of European Integration*, Vol. 37, No.3, pp.335-352, doi:10.1080/07036337.2014.968566 [accessed 11th April 2019].
- Carter, N.D. (2019). Animal agriculture's contributions to climate change MA Thesis,
- Case, K.E. and Fair, R.C. (1999). *Principles of economics*, Upper Saddle River, New Jersey, USA: Prentice Hall, ISBN-13: 978-0136055488.
- Case, P. (2019). Farmers blast Rees-Mogg for Brexit 'cheap food' claim, *Famers Weekly*, 25th March, https://www.fwi.co.uk/news/eu-referendum/farmers-blast-rees-mogg-for-brexit-cheap-food-claim [accessed 11th April 2019].
- Casini, L., Contini, C., Romano, C. and Scozzafava, G. (2014). Changes in dietary preference - new challenges for sustainability and innovation, *Chain and Network Science*, Vol. 14, doi:10.3920/JCNS2014.x013.
- Casini, L., Contini, C., Romano, C. and Scozzafava, G. (2015). Trends in food consumptions: what is happening to generation X? *British Food Journal*, Vol. 117, Iss. Vol. 2, pp.705-718, https://doi.org/10.1108/BFJ-10-2013-0283 [accessed 11th April 2019].
- Caspi, C.E., Sorensen, G., Subramanian, S.V. and Kawachi, I. (2012). The local food environment and diet: a systematic review, *Health Place*, Vol. 18, No. 5, pp.1172-1187, doi:10.1016/j.healthplace.2012.05.006.
- Casselman, J.M., Wang, Y. and Shen, Z. (2008). Response, adaptation, and sustainability of fish in two changing and diverse global environments — Asian Qinghai–Tibetan Plateau and North American great lakes, *Comparative Biochemistry and Physiology Part C Toxicology & Pharmacology*, Vol. 148, No. 4, pp.449-449, doi:10.1016/j.cbpc.2008.10.011.
- Cassidy, E.S., Wes, P.C., Gerber, J.S. and Foley, J.A. (2013). Redefining agricultural yields: from tonnes to people nourished per hectare, *Environmental Research Letters*, Vol. 8, doi: 10.1088/1748-9326/8/3/034015.

- Cassman, K.G. (1999). Ecological intensification of cereal production systems: yield potential, soil quality, and precision agriculture, *Proceedings of the National Academy of Science*, Vol. 96, No. 11, pp.5952-5959; https://doi.org/10.1073/pnas.96.11.5952 [accessed 11th April 2019].
- Castellini, C., Boggia, A., Cortina, C., Dal Bosco, A., Luisa Paolotti, L., Novelli, E. and Mugnai, C. (2012). A multicriteria approach for measuring the sustainability of different poultry production systems, *Journal of Cleaner Production*, Vol. 37, pp.192-201, http://dx.doi.org/10.1016/j.jclepro.2012.07.006 [accessed 11th April 2019].
- Castro, C.J. (2004). Sustainable development: mainstream and critical perspectives, *Organization & Environment*, Vol. 17, pp.195-225, https://doi.org/10.1177/1086026604264910 [accessed 11th April 2019].
- Cawthorn, D-M. and Mariani, S. (2017). Global trade statistics lack granularity to inform traceability and management of diverse and high-value fishes, *Nature Scientific Reports*, Vol. 7, 12852, doi:10.1038/s41598-017-12301-x.
- Cazzolla Gatti, R., Liang, J., Velichevskaya, A. and Zhou, M. (2019). Sustainable palm oil may not be so sustainable, *Science of the Total Environment*, Vol. 652, pp.48-51, https://doi.org/10.1016/j.scitotenv.2018.10.222 [accessed 11th April 2020].
- CDP (2018). *Tracking climate progress 2017 – CDP*, Second annual analysis, London, UK: CDP Worldwide, www.cdp.net/en/research/global-reports/tracking-climate-progress-2017 [accessed 11th April 2019].
- Ceballos, G., Ehrlich, P., Barnosky, A., García, A., Pringle, R. and Palmer, T. (2015). Accelerated modern human–induced species losses: entering the sixth mass extinction, *Science Advances*, Vol. 1, No. 5, p.e1400253, doi: 10.1126/sciadv.1400253.
- Ceballos, G., Ehrlich, P.R. and Dirzo, R. (2017). Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines, *Proceedings of the National Academy of Science*, 201704949, doi: https://doi.org/10.1073/pnas.1704949114.
- Cebula, R.J. and Payne, J.E. (2014). Introduction – environmental sustainability symposium, *The American Journal of Economics and Sociology*, Vol. 73, No. 2, pp.295-298, https://doi.org/10.1111/ajes.12074 [accessed 11th April 2019].
- Cecchini, M. and Warin, L. (2016). Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies, *Obesity Reviews*, Vol. 17, No. 3, pp.201-210, doi: 10.1111/obr.12364
- Cederberg, C., Hedenus, F., Wirsenius, S. and Sonesson, U. (2012). Trends in greenhouse gas emissions from consumption and production of animal food products – implications for long-term climate targets, *Animal*, Vol. 7, No. 02, pp.330-340, doi: 10.1017/S1751731112001498.

- Cederberg, C., Sonesson, U., Henriksson, M., Sund, V. and Davis, J. (2009). *Greenhouse gas emissions from Swedish production of meat, milk and eggs 1990 and 2005*, The Swedish Institute for Food and Biotechnology, SIK Report No 793, ISBN 978-91-7290-284-8.
- Celnik, D., Gillespie, L. and Lean, M. (2012). Time-scarcity, ready-meals, ill-health and the obesity epidemic, *Trends in Food Science and Technology*, Vol. 4, pp.4-11, https://doi.org/10.1016/j.tifs.2012.06.001 [accessed 11th April 2019].
- Cembalo, L., Migliore, G. and Schifani, G. (2012). Consumers in postmodern society and alternative food networks - the organic food fairs case in Sicily, *New Medit*, Vol. 11, No. 3, pp.41-49.
- Centeno, M.A., Nag, M., Patterson, T.S., Shaver, A. and Windawi, A.J. (2015). The emergence of global systemic risk, *Annual Review of Sociology*, Vol. 41, pp.65-85, https://doi.org/10.1146/annurev-soc-073014-112317 [accessed 11th April 2019].
- Centre for Environmental Risks and Futures (2015). *Extreme weather and resilience in the food chain*, Cranfield, UK: Cranfield University, Final Report for Defra project FO0456.
- Centre for Food Policy (2018a). *How can evidence of lived experience make food policy more effective and equitable in addressing major food system challenges*, London, UK: City University of London Centre for Food Policy.
- Centre for Food Policy (2018b). *Why engage with evidence of lived experience as a means of addressing major food systems challenges*, London, UK: City University of London Centre for Food Policy.
- Centre for Food Policy (2019a). *Tackling food systems challenges - the role of food policy*, Rethinking Food Policy - A Fresh Approach to Policy and Practice, Brief 1, London, UK: City University of London Centre for Food Policy.
- Centre for Food Policy (2019b). *Understanding the food system - Why it matters for food policy*, Rethinking Food Policy - A Fresh Approach to Policy and Practice, Brief 2, London, UK: University College London Centre for Food Policy.
- Cerri, J., Thogersen, J. and Testa, F. (2019). Social desirability and sustainable food research: a systematic literature review, *Food Quality and Preference*, Vol. 71, pp.136-140, https://doi.org/10.1016/j.foodqual.2018.06.013.
- CFS (2014). *Sustainable fisheries and aquaculture for food security and nutrition*, Recommendations following the 41st Session, Rome, Italy: Committee on World Food Security.
- CFS (2015a). *Making a difference in food security and nutrition - framework for action for food security and nutrition in protracted crises*, Forty-second session 12-15th October, Rome, Italy: Committee on World Food Security.
- CFS (2015b). *Water for food security and nutrition*, Forty-second session 12-15th October, Rome, Italy: Committee on World Food Security.
- CFS (2017). *Making a difference in food security and nutrition*, 9-13th October, Rome, Italy: Committee on World Food Security.

- CFS (2019a). *City Food Symposium - How to develop and deliver a national food policy*, Workshops and Roundtables, Rome, Italy: Committee on World Food Security.
- CFS (2019b). *Voluntary guidelines on food systems and nutrition*, Rome, Italy: Committee on World Food Security.
- Chabbi, A., Lehmann, J., Ciais, P., Loescher, H.W., Cotrufo, M.F., Don, A., SanClements, M., Schipper, L., Six, J., Smith, P. and Rumpel, C. (2017). Aligning agriculture and climate policy, *Nature Climate Change*, Vol 7, No. 5, pp.307-309, doi:10.1038/nclimate3286.
- Chackal, T. (2016). Autonomy and the politics of food choice: from individuals to communities, *Journal of Agriculture and Environmental Ethics*, Vol. 29, pp.123-141, doi: 10.1007/s10806-015-9585-4.
- Chadwick, V. (2017). Banks to incentivize sustainable supply chains under DFID-backed pilot, Devex, Paris, www.devex.com/news/banksto-incentivize-sustainable-supply-chains-under-dfid-backed-pilot-91730 [accessed 11th April 2019].
- Chai, B.C., van der Voort, J.R., Grofelnik, K., Eliasdottir, H.G., Klöss, I. and Perez-Cueto, F.J.A. (2019). Which diet has the least environmental impact on our planet? A systematic review of vegan, vegetarian and omnivorous diets, *Sustainability*, Vol. 11, No. 4110, doi: 10.3390/su11154110.
- Chakrabortty, A. (2018). The school that shows good food is not just for posh kids, *The Guardian*, 25th April, https://www.theguardian.com/commentisfree/2018/apr/25/school-good-food-not-just-posh-kids-poorest-town-oldham?CMP=share_btn_tw [accessed 11th April 2019].
- Chakraborty, R. and Dobson, P. (2018). Why the UK has such cheap food, *BBC News*, 1st Oct, https://www.bbc.co.uk/news/business-45559594 [accessed 11th April 2019].
- Chakraborty, S. and Newton, A.C. (2011). Climate change, plant diseases and food security: an overview, *Plant Pathology*, Vol. 60, No. 1, pp.2-14, doi: 10.1111/j.1365-3059.2010.02411.x.
- Chalak, A., Abou-Daher, C., Chaaban, J., and Abiad, M.G. (2016). The global economic and regulatory determinants of household food waste generation: a cross-country analysis. *Waste Management*, Vol. 48, pp.418-422, doi:10.1016/J.WASMAN.2015.11.040.
- Challinor, A., Adger, W.N., Di Mauro, M., Baylis, M., Benton, T., Conway, D., Depledge, D., Geddes, A., McCorriston, S., Stringer, L., and Wellesley, L. (2016). *UK Climate change risk assessment evidence report*: Chapter 7, International Dimensions. Report prepared for the Adaptation Sub-Committee of the Committee on Climate Change, London, UK, https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Chapter-7-International-dimensions.pdf [accessed 11th April 2019].
- Challinor, A.J., Müller, C., Asseng, S., Deva, C., Nicklin, K.J., Wallach, D., Vanuytrecht, E., Whitfield, S., Ramirez-Villegas, J. and Koehlera, A-K. (2018a). Transmission of climate risks across sectors and borders, *Agricultural Systems*, Vol. 159, pp.296-306, http://dx.doi.org/10.1016/j.agsy.2017.07.010 [accessed 11th April 2019].

- Challinor, A.J., Müller, C., Asseng, S., Deva, C., Nicklin, K.J., Wallach, D., Vanuytrecht, E., Whitfield, S., Ramirez-Villegas, J. and Koehler, A-K. (2018b). Improving the use of crop models for risk assessment and climate change adaptation, *Agricultural Systems*, Vol. 159, pp. 296-306, https://doi.org/10.1016/j.agsy.2017.07.010 [accessed 11th April 2019].
- Challinor, A.J., Watson, J., Lobell, D.B., Howden, S.M., Smith, D.R. and Chhetri, N. (2014). A meta-analysis of crop yield under climate change and adaptation, *Nature Climate Change*, Vol. 4, pp.287-291, doi:10.1038/nclimate2153.
- Chalmers, N., Stetkiewicz, S., Sudhakar, P., Osei-Kwasi, H. and Reynolds, C. (2019). Impacts of reducing UK beef consumption using a revised sustainable diets framework, *Sustainability*, Vol. 11, No. 23, 6863, https://doi.org/10.3390/su11236863.
- Chalmers, N.G., Brander, M. and Revoredo-Giha, C. (2015). The implications of empirical and 1 to 1 substitution ratios for consequential LCA - using a 1 % tax on whole milk as an illustrative example, *The International Journal of Life Cycle Assessment*, Vol. 20, pp.1268-1276, doi: 10.1007/s11367-015-0939-y.
- Chambers, D.P., Cazenave, A., Champollion, N., Dieng, H., Llovel, W., Forsberg, R., von Schuckmann, K. and Wada, K. (2016). Evaluation of the Global Mean Sea Level Budget between 1993 and 2014, *Surveys in Geophysics*, Vol. 38, No. 1, pp.1-19, doi:10.1007/s10712-016-9381-3.
- Chambers, R. (2019). Is this our Silent Spring moment? *Green Alliance*, 13th November, https://greenallianceblog.org.uk/2019/11/13/is-this-our-silent-spring-moment/ [accessed 11th April 2019].
- Chandon, P. (2010). Nudging consumers towards healthier food choices, *Advances in Consumer Research*, Vol. 37, pp.73-76, http://www.acrwebsite.org/volumes/1504340/volumes/v37/NA-37 [accessed 11th April 2019].
- Chandon, P. and Wansink, B. (2012). Does food marketing need to make us fat - a review and solutions, *Nutrition Reviews*, Vol. 70, No. 10, pp.571-593, doi:10.1111/j.1753-4887.2012.00518.x.
- Chang, C-C., Lee, H-L. and Hsu, S-H. (2015). The potential impact of climate change-induced sea-level rise on the global rice market and food security. In: Elbehri, A. (ed) (2015). *Climate change and food systems: global assessments and implications for food security and trade*, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), ISBN 978-92-5-108699-5.
- Changing Markets Foundation (2018a). *Busting the myth of science based formula - an investigation into Nestlé infant milk products and claims*, Utrecht, The Netherlands: Changing Markets Foundation.
- Changing Markets Foundation (2018b). *Growing the good - the case for low-carbon transition in the food sector*, Utrecht, The Netherlands: Changing Markets Foundation.
- Changing Markets Foundation (2018c). *Heading burnout - why the food industry and regulators need to wake up to the acrylamide crisis*, Utrecht, The Netherlands: Changing Markets Foundation.
- Changing Markets Foundation (2018d). *How milk formula companies are putting profits before science*, Utrecht, The Netherlands: Changing Markets Foundation.

- Chapagain, A.K. and Hoekstra, A.Y. (2011). The blue, green and grey water footprint of rice from production and consumption perspectives, *Ecological Economics*, Vol. 70, Iss. 4, pp.749-775, https://doi.org/10.1016/j.ecolecon.2010.11.012 [accessed 11th April 2019].
- Chapagain, A.K. and Orr, S. (2008). *UK water footprint: the impact of the UK's food and fibre consumption on global water resources*, Godalming, UK: WWF-UK, wwf.org.uk [accessed 11th April 2019].
- Chaplin-Kramer, R., Dombeck, E., Gerber, J., Knuth, K.A., Mueller, N.D., Mueller, M., Ziv, G. and Klein, A-M. (2014). Global malnutrition overlaps with pollinator-dependent micronutrient production, *Philosophical Transactions of the Royal Society B*, Vol. 281, pp.20141799, http://dx.doi.org/10.1098/rspb.2014.1799 [accessed 11th April 2019].
- Chaplin-Kramer, R., Sim, S., Hamel, P., Bryant, B., Noe, R., Mueller, C., Rigarlsford, G., Kulak, M., Kowal, V., Sharp, R., Clavreul, J., Price, E., Polasky, S., Ruckelshaus, M. and Daily, G. (2017). Life cycle assessment needs predictive spatial modelling for biodiversity and ecosystem services, *Nature Communications*, Vol. 8, 15065, doi: 10.1038/ncomms15065.
- Chapman, M., LaValle, A., Furey, G. and Chan, K.M.A. (2017). Sustainability beyond city limits - can "greener" beef lighten a city's Ecological Footprint, *Sustainability Science*, Vol. 12, pp.597-610, doi: 10.1007/s11625-017-0423-7.
- Chappell, A., Baldock, J. and Sanderman, J. (2015). The global significance of omitting soil erosion from soil organic carbon cycling schemes*, Nature Climate Change*, Vol. 6, pp.187-191, doi: 10.1038/NCLIMATE2829.
- Charles, C., Gerasimchuk, I., Bridle, R., Moerenhout, T., Asmelash, E. and Laan, T. (2013). *Biofuels—at what cost - review of costs and benefits of EU biofuel policies*, Research Report, Châtelaine, Switzerland: The International Institute for Sustainable Development.
- Chatzivasileiadis, T., Estrada, F., Hofkes, M.W. and Tol, R.S.J. (2018). Systematic sensitivity analysis of the full economic impacts of sea-level rise, *Computational Economics*, pp.1-35, doi: 10.1007/s10614-017-9789-y.
- Chatzivasileiadis, T., Hofkes, M.W., Kuik, O.J. and Tol, R.S.J. (2016). *Full economic impacts of sea-level rise: loss of productive resources and transport disruptions*, University of Sussex: Department of Economics, Working Paper Series No. 99, doi: 10.13140/RG.2.2.11004.74883.
- Chau, M.M., Burgermaster, M. and Mamykina, L. (2018). The use of social media in nutrition interventions for adolescents and young adults: a systematic review, *International Journal of Medical Informatics*, Vol. 120, pp.77-91, doi: 10.1016/j.ijmedinf.2018.10.001.
- Chaudhary, A. and Kastner, T. (2016). Land use biodiversity impacts embodied in international food trade, Global Environmental Change, Vol. 38, pp.195-204, https://doi.org/10.1016/j.gloenvcha.2016.03.013 [accessed 11th April 2019].

- Chavez, F.P., Messié, M. and Pennington, J.T. (2011). Marine primary production in relation to climate variability and change, *Annual Review of Marine Science*, Vol. 3, pp.227-260,
- Chekima, B., Chekima, S., Syed, K.W., Syed, A.W., Igau, O. and Sondoh, S. (2016). Sustainable consumption: the effects of knowledge, cultural values, environmental advertising, and demographics, *International Journal of Sustainable Development and World Ecology*, Vol. 23, No. 2, pp.210-220, doi: 10.1080/13504509.2015.1114043.
- Chen, C., Chaudhary, A. and Mathys, A. (2019). Dietary change scenarios and implications for environmental, nutrition, human health and economic dimensions of food sustainability, *Nutrients*, Vol. 11, No. 4, pii: E856, doi: 10.3390/nu11040856.
- Chen, C., van Groenigen, K.J., Yang, H., Hungate, B.A., Yang, B., Tian, Y., Chen, J., Dong, W., Huang, S., Deng, A., Jiang, Y. and Zhang, W. (2020). Global warming and shifts in cropping systems together reduce China's rice production, *Global Food Security*, Vol. 24, 100359, doi: 10.1016/j.gfs.2020.100359.
- Chen, F.Y. and Yano, C.A. (2010). Improving supply chain performance and managing risk under weather-related demand uncertainty, *Management Science*, Vol. 56, No. 8, August 2010, pp.1380-1397, doi: 10.1287/mnsc.1100.1194.
- Chen, G. C., Lv, D. B., Pang, Z. and Liu, Q. F. (2013). Red and processed meat consumption and risk of stroke: a meta-analysis of prospective cohort studies, *European Journal of Clinical Nutrition*, Vol. 67, No. 1, pp.91-95, https://doi.org/10.1038/ejcn.2012.180 [accessed 15th April 2020].
- Chen, H., Li, X., Hu, F. and Shi, W. (2013). Soil nitrous oxide emissions following crop residue addition: a meta-analysis, *Global Change Biology*, Vol. 19, pp.2956-2964, doi:10.1038/s41558-018-0313-8.
- Chen, J. and Mueller, V. (2018). Coastal climate change, soil salinity and human migration in Bangladesh, *Nature Climate Change*, Vol. 8, pp.981-985, doi:10.1038/s41558-018-0313-8
- Chen, J.J. and Mueller, V. (2018). Climate change is making soils saltier, forcing many farmers to find new livelihoods, *The Conversation*, 29th November, https://theconversation.com/climate-change-is-making-soils-saltier-forcing-many-farmers-to-find-new-livelihoods-106048 [accessed 11th April 2019].
- Cheng, L., Trenberth, K.E., Fasullo, J., Boyer, T., Abraham, J. and Zhu, J. (2017). Improved estimates of ocean heat content from 1960 to 2015, *Science Advances*, Vol. 10, March, E1601545, Vol. 3, No. 3, e1601545, doi: 10.1126/sciadv.1601545.
- Cheng, S.Y. and Moxham, C. (2013). Rethinking food supply chains: examining the case for alternative food networks. In: *73rd Annual Meeting of the Academy of Management*, 9th-13th August 2013, Florida, USA. (Unpublished)
- Chesson, J., Morgan, L. and Whitworth, B. (2006). *Assessing environmental performance of the food value chain: an extension of the Signposts for Australian Agriculture framework*, Final Report to the National Land and Water Resources Audit, Australian Bureau of Rural Sciences.

- Cheung, W.W., Jones, M.C., Reygondeau, G., Stock, C.A., Lam, V.W.Y. and Frolicher, T.L. (2016). Structural uncertainty in projecting global fisheries catches under climate change, *Ecology Modelling*, Vol. 325, pp.57-66, https://doi.org/10.1016/j.ecolmodel.2015.12.018 [accessed 11th April 2019].
- Cheung, W.W., Watson, R. and Pauly, D. (2013). Signature of ocean warming in global fisheries catch, *Nature*, Vol. 497, pp.365-368, doi:10.1038/nature12156.
- Cheung, W.W.L., Lam, V.W.Y. and Wabnitz, C.C.C. (2019). *Future scenarios and projections for fisheries on the high seas under a changing climate*, IIED Working Paper, London, UK: International Institute for Environment and Development, http://pubs.iied.org/16653IIED [accessed 11th April 2019].
- Chiang, F., Mazdiyasni, O. and AghaKouchak, A. (2018). Amplified warming of droughts in southern United States in observations and model simulations, *Science Advances*, Vol. 4, No. 8, pp.eaat2380, doi: 10.1126/sciadv.aat2380.
- Chiles, R.M. and Fitzgerald, A.J. (2018). Why is meat so important in Western history and culture? A genealogical critique of biophysical and political-economic explanations, *Agriculture and Human Values*, pp.1-17, doi:10.1007/s10460-017-9787-7.
- Chiras, D. and Reganold, J. (2013). *Natural Resource Conservation*, Pearson New International Edition, Management for a Sustainable Future, 10th Edition, Cambridge, UK: Pearson Publishing, ISBN: 9781292040981.
- Chirinda, N., Loaiza, S., Arenas, L., Ruiz, V., Faverín, C., Alvarez, C., Savian, J.V., Belfon, R., Zuniga, K., Morales-Rincon, L.A., Trujillo, C., Arango, M., Rao, I., Arango, J., Peters, M., Barahona, R., Costa, C., Rosenstock, T.S., Richards, M., Martinez-Baron, D. and Cardenas, L. (2019). Adequate vegetative cover decreases nitrous oxide emissions from cattle urine deposited in grazed pastures under rainy season conditions, *Scientific Reports*, Vol. 9, No. 1, doi: 10.1038/s41598-018-37453-2.
- Chiu, Y. (2019). Environmental implications of taiwanese oolong tea and the opportunities of impact reduction, *Sustainability*, Vol. 11, No. 21, pp. 6042, doi: 10.3390/su11216042.
- Chkanikova, O. and Lehner, M. (2015). Private eco-brands and green market development - towards new forms of sustainability governance in the food retailing, *Journal of Cleaner Production*, Vol. 107, pp.74-84, http://dx.doi.org/10.1016/j.jclepro.2014.05.055 [accessed 11th April 2019].
- Chmielewski, F.M. (2013). Phenology in agriculture and horticulture, In: Schwartz M. (eds) *Phenology: an integrative environmental science*, Dordrecht, Germany: Springer.
- Chopra, T. (2015). Persistent narratives, persistent failures: why GM crops do not—and will not—“feed the world”, *Canadian Food Studies*, Vol. 2, No. 2, pp.209-216, doi: 10.15353/cfs-rcea.v2i2.123.
- Choudhury, M.A. (2011). Some structural issues in demand and supply of global food production, *Journal of Economic Studies*, Vol. 38, Iss. 1, pp.91-113, http://dx.doi.org/10.1108/01443581111096169 [accessed 11th April 2019].

- Christensen, J.H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, R., Jones, R., Kolli, R.K., Kwon, W.K., Laprise, R., Magana Rueda, V., Mearns, L., Menendez, C.G., Räisänen, J., Rinke, A., Sarr, A., Whetton, P., Arritt, R., Benestad, R., Beniston, M., Bromwich, D., Caya, D., Comiso, J., de Elia, R. and Dethloff, K. (2007). Regional Climate Projections. In: *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge.
- Christian, C., Ainley, D., Bailey, M., Dayton, P., Hocevar, J., LeVine, M., Nikoloyuk, J., Nouvian, C., Velarde, E., Werner, R. and Jacquet, J. (2013). A review of formal objections to Marine Stewardship Council fisheries certifications, *Biological Conservation*, Vol. 161, pp.10-17, http://dx.doi.org/10.1016/j.biocon.2013.01.002.
- Christmann, S. (2019). Under which conditions would a wide support be likely for a Multilateral Environmental Agreement for pollinator protection? *Environmental Science & Policy*, Vol. 91, pp.1-5, https://doi.org/10.1016/j.envsci.2018.10.004 [accessed 11th April 2019].
- Christoph, M.J. and An, R. (2018). Effect of nutrition labels on dietary quality among college students: a systematic review and meta-analysis, *Nutrition Reviews*, Vol. 76, pp.187-203, doi: 10.1093/nutrit/nux069.
- Christoplos, I. and Pain, A. (2014). *New challenges to food security: from climate change to fragile states*, London, UK: Routledge, ISBN 1136777679.
- Church, J.A. and White, N.J. (2006). A 20th century acceleration in global sea-level rise, *Geophysical Research Letters*, Vol. 33, L01602, doi:10.1029/2005GL024826.
- CIAA (2008). *Managing environmental sustainability in the European food & drink industries*, European Technology Platform Food for Life, Brussels, Belgium: The Confederation of the Food and Drink Industry of the EU.
- CIAA (2010). *Promoting balanced diets and healthy lifestyles, Europe's food and drink industry in action*, Brussels, Belgium: The Confederation of the Food and Drink Industry of the EU.
- Ciais, P., Reichstein, M., Viovy, N., Granier, A., Ogee, J., Allard, V., Aubinet, M., Buchmann, N., Bernhofer, C., Carrara, A., Chevallier, F., De Noblet, N., Friend, A.D., Friedlingstein, P., Grünwald, T., Heinesch, B., Keronen, P., Knohl, A., Krinner, G., Loustau, D., Manca, G., Matteucci, G., Miglietta, F., Ourcival, J.M., Papale, D., Pilegaard, K., Rambal, S., Seufert, G., Soussana, J.F., Sanz, M.J., Schulze, E.D., Vesala, T. and Valentini, R. (2005). Europe-wide reduction in primary productivity caused by the heat and drought in 2003, *Nature*, Vol. 437, No. 7058, pp.529-533, doi:http://dx.doi.org.ezproxy.bangor.ac.uk/10.1038/nature03972.
- CIBE-CEFS (2010). *The EU beet and sugar sector - a model of environmental sustainability,* Brussels: International Confederation of European Beet Growers (CIBE) and Comité Européen des Fabricants de Sucre (CEFS).

- Cirera, X. and Masset, E. (2010). Income distribution trends and future food demand, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2821-2834, https://doi.org/10.1098/rstb.2010.0164 [accessed 11th April 2019].
- Ciscar, J.-C., Fisher-Vanden, K. and Lobell, D.B. (2018). Synthesis and review: an inter-method comparison of climate change impacts on agriculture, *Environmental Research Letters*, Vol. 13, No. 7, 070401, doi: 10.1088/1748-9326/aac7cb.
- Ciscar, J.C., Iglesias, A., Feyen, L., Szabó, L., Van Regemorter, D., Amelung, B. and Soria, A. (2011). Physical and economic consequences of climate change in Europe, *Proceedings of the National Academy of Sciences*, Vol. 108, No. 7, pp.2678-2683, https://doi.org/10.1073/pnas.1011612108 [accessed 11th April 2019].
- CiWF (2019). Turning the food system round: the role of government in evolving to a food system that is nourishing, sustainable, equitable and humane, Godalming, UK: Compassion in World Farming, https://www.ciwf.org.uk/news/2019/07/its-time-to-turn-our-food-system-round [accessed 11th April 2019].
- Clapp, J. (2009). The global food crisis and international agricultural policy - which way forward, *Global Governance*, Vol. 15, pp.299-312, https://www.jstor.org/stable/27800756 [accessed 11th April 2019].
- Clapp, J. (2015). *Food security and international trade - unpacking disputed narratives*, Background paper prepared for The State of Agricultural Commodity Markets 2015–16, Rome, Italy: Food Agriculture Organization of the United Nations (FAO).
- Clapp, J. (2016). Food self-sufficiency and international trade: a false dichotomy? The State of Agricultural Commodity Markets 2015–16, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), http://www.fao.org/3/a-i5222e.pdf [accessed 11th April 2019].
- Clapp, J. (2017a). Concentration and power in the food system: who controls what we eat? *Global Environmental Politics*, Vol.17, No. 3, pp.151-152, https://www.muse.jhu.edu/article/667512 [accessed 11th April 2019].
- Clapp, J. (2017b). Food self-sufficiency: making sense of it, and when it makes sense, *Food Policy*, Vol. 66, pp.88-96, https://doi.org/10.1016/j.foodpol.2016.12.001 [accessed 11th April 2019].
- Clapp, J. and Cohen, M.J. (eds)(2012). *The global food crisis - governance challenges and opportunities*, Waterloo, Canada: The Centre for International Governance Innovation (CIGI) and Wilfrid Laurier University Press.
- Clapp, J. and Helleiner, E. (2012). Troubled futures? The global food crisis and the politics of agricultural derivatives regulation, *Review of International Political Economy*, Vol. 19, No. 2, pp.181-207, http://dx.doi.org/10.1080/09692290.2010.514528 [accessed 11th April 2019].
- Clapp, J. and Scrinis, G. (2017). Big food, nutritionism, and corporate power, *Globalizations*, Vol. 14, pp.578-595, https://doi.org/10.1080/14747731.2016.1239806 [accessed 11th April 2019].

- Clapp, J., Desmarais, A.A. and Margulis, M.E. (2015). Food sovereignty, *Canadian Food Studies*, Special Issue: Mapping the Global Food Landscape, Vol. 2, No. 2, pp.152-153, doi: 10.15353/cfs-rcea.v2i2.125.
- Clapp, J., Desmarais, A.A. and Margulis, M.E. (2015). Global food governance in an era of crisis, *Canadian Food Studies*, Special Issue: Mapping the Global Food Landscape, Vol. 2, No. 2, pp.326-327, doi: 10.15353/cfs-rcea.v2i2.81.
- Clapp, J., Desmarais, A.A. and Margulis, M.E. (2015). Land grabs and agrarian reform, *Canadian Food Studies*, Special Issue: Mapping the Global Food Landscape, Vol. 2, No. 2, pp.223-224, doi: 10.15353/cfs-rcea.v2i2.126.
- Clapp, J., Desmarais, A.A. and Margulis, M.E. (2015). Progress on the right to food, *Canadian Food Studies*, Special Issue: Mapping the Global Food Landscape, Vol. 2, No. 2, pp.39-40, doi: 10.15353/cfs-rcea.v2i2.79.
- Clapp, J., Desmarais, A.A., and Margulis, M.E. (2015). Sustainable food systems and global environmental change, *Canadian Food Studies/RCÉA*, Special Issue, Vol. 2, No. 2, pp.294-295,
- Clapp, J., Newell, P. and Brent, Z.W. (2018). The global political economy of climate change, agriculture and food systems, *The Journal of Peasant Studies*, Vol. 45, No. 1, pp. 80-88,
- Clark, C., Crumpler, C. and Notley, H. (2020). Evidence for environmental noise effects on health for the United Kingdom policy context: a systematic review of the effects of environmental noise on mental health, wellbeing, quality of life, cancer, dementia, birth, reproductive outcomes, and cognition, *International Journal of Environmental Research and Public Health*, Vol. 17, No. 2, 393, doi: 10.3390/ijerph17020393.
- Clark, H., Coll-Seck, A.M., Banerjee, A., Peterson, S., Dalglish, S.L., Ameratunga, S., Ameratunga, S., Balabanova, D., Bhan, M.K., Bhutta, Z.A., Borrazzo, J., Claeson, M., Doherty, T., El-Jardali, F., George, A.S., Gichaga, A., Gram, L., Hipgrave, D.B., Kwamie, A., Meng, Q., Mercer, R., Narain, S., Nsungwa-Sabiiti, J., Olumide, A.O., Osrin, D., Powell-Jackson, T., Rasanathan, K., Rasul, I., Reid, P., Requejo, J., Rohde, S.S., Rollins, N., Romedenne, M., Sachdev, H.S., Saleh, R., Shawar, Y.R., Shiffman, J., Simon, J., Sly, P.D., Stenberg, K., Tomlinson, M., Ved, R.R. and Costello, A. (2010). A future for the world's children? A WHO–UNICEF–Lancet Commission, *The Lancet*, 18th February, doi:https://doi.org/10.1016/S0140-6736(19)32540-1.
- Clark, M. and Tilman, D. (2017). Comparative analysis of environmental impacts of agricultural production systems, input efficiency and food choice, *Environmental Research Letters*, Vol. 12, No. 6, pp.064016, doi.org/10.1088/1748-9326/aa6cd5.
- Clark, M., Hill, J. and Tilman, D. (2018a). The diet, health, and environment trilemma, *Annual Review of Environment and Resources*, Vol. 43, pp.109-134, https://doi.org/10.1146/annurev-environ-102017-025957 [accessed 11th April 2019].

- Clark, M.A., Springmann, M., Hill, J. and Tilman, D. (2019). Multiple health and environmental impacts of foods, *Proceedings of the National Academy of Sciences*, Oct, 201906908; doi: 10.1073/pnas.1906908116.
- Clark, P.U., Mix, A.C., Eby, M., Levermann, A., Rogelj, J., Nauels, A. and Wrathall, D.J. (2018b). Sea-level commitment as a gauge for climate policy, *Nature Climate Change*, Vol. 8, pp.653-655, https://doi.org/10.1038/s41558-018-0226-6 [accessed 11th April 2019].
- Clarke, B., Swinburn, B. and Sacks, G. (2016). The application of theories of the policy process to obesity prevention: a systematic review and meta-synthesis, *BMC Public Health*, Vol. 16, No. 1, 1084, doi: 10.1186/s12889-016-3639-z.
- Clarke, S., Serwicka, I. and Winters, L.A. (2017). *Changing lanes - the impact of different post-Brexit trading policies on the cost of living*, University of Sussex and the UK Trade Policy Observatory (UKTPO).
- Clarkson, M.O., Stirling, C.H., Jenkyns, H.C., Dickson, A.J., Porcelli, D., Moy, C.M., Pogge von Strandmann, P.A.E., Cooke, I.R. and Lenton, T.M. (2018). Uranium isotope evidence for two episodes of deoxygenation during Oceanic Anoxic Event, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 12, pp.2918-2923, doi: 10.1073/pnas.1715278115.
- Claro, D.P. and Claro, P.B.O. (2008). Managing trust in supply chains. In: *9th International Conference on Management of Chain and Networks*, Wageningen, The Netherlands.
- Claro, D.P., Claro, P.B.O. and Amâncio, R. (2008). Outgrower partnership agreements and sustainability at the Amazon forest: two Schemes at the Jari Valley, *9th International Conference on Management of Chain and Networks*, Wageningen, The Netherlands.
- Claro, D.P., Neto, S.A.L. and Claro, P.B.O. (2013). Sustainability drivers in food retail, *Journal of Retailing and Consumer Services*, Vol. 20, pp.365-371, http://dx.doi.org/10.1016/j.jretconser.2013.02.003 [accessed 11th April 2019].
- Clay, N., Garnett, T. and Lorimer, J. (2019). Dairy intensification: drivers, impacts and alternatives, *Ambio*, pp.1-14, https://doi.org/10.1007/s13280-019-01177-y [accessed 11th April 2019].
- Claydon, L. (2015). The future of trust, *The Grocer*, 22nd August, p.21.
- Clayton, P. and Rowbotham, J. (2009). How the mid-Victorians worked, ate and died, *International Journal of Environmental Research and Public Health*, Vol. 6, pp.1235-1253, doi:10.3390/ijerph6031235.
- Clayton, S., Manning, C.M., Krygsman, K. and Speiser, M. (2017). *Mental health and our changing climate: impacts, implications, and guidance*, Washington, USA: American Psychological Association, and ecoAmerica, https://www.apa.org/news/press/releases/2017/03/mental-health-climate.pdf [accessed 11th April 2019].
- Clements, K.W. and Si, J. (2019). Engel's Law, diet diversity, and the quality of food consumption, *American Journal of Agricultural Economics*, Vol. 100, No. 1, pp.1-22, https://doi.org/10.1093/ajae/aax053 [accessed 11th April 2019].

- Clifton-Brown, J., Hastings, A., Mos, M., Mccalmont, J.P., Ashman, C., Awty-Carroll, D., Cerazy, J., Chiang, Y-C., Cosentino, S., Cracroft-Eley, W., Scurlock, J., Donnison, I.S., Glover, C., Gołab, I., Greef, J.M., Gwyn, J., Harding, J., Hayes, C., Helios, W., Hsu, T-W., Huang, L.S., Jeźowski, S., Kim, D-S., Kiesel, A., Kotecki, A., Krzyzak, J., Lewandowski, I., Lim, S.H., Liu, J., Loosely, M., Meyer, H., Murphy-Bokern, D., Nelson, W., Pogrzeba, M., Robinson, G., Robson, P., Rogers, C.E., Scalici, G., Schuele, H., Shafiei, R., Shevchuk, O., Schwarz, K-U., Squance, M., Swaller, T., Thornton, J., Truckses, T., Botnari, V., Vizir, I., Wagner, M., Warren, R., Webster, R., Yamada, T., Youell, S., Xi, Q., Zong, J. and Flavell, R. (2017). Progress in upscaling Miscanthus biomass production for the European bio-economy with seed-based hybrids, *GCB Bioenergy*, Vol. 9, No. 6-17, doi: 10.1111/gcbb.12357.
- Climate Central (2019). *Flooded future: global vulnerability to sea-level rise worse than previously understood*, 29th October, Princeton, USA: Climate Central, https://www.climatecentral.org/pdfs/2019CoastalDEMReport.pdf [accessed 11th April 2020].
- Climate Central (2019). *Flooded future: global vulnerability to sea-level rise worse than previously understood*, 29th October, Princeton, USA: Climate Central, https://www.climatecentral.org/news/report-flooded-future-global-vulnerability-to-sea-level-rise-worse-than-previously-understood [accessed 11th April 2019].
- Climate Council of Australia (2019). Impacts of climate change on the food system, Potts Point: Climate Council of Australia, https://www.climatecouncil.org.au/ [accessed 11th April 2019].
- Climate Focus (2015). *The Paris Agreement – Summary*, Client Brief on the Paris Agreement III, 28th December, https://climatefocus.com/sites/default/files/20151228%20COP%2021%20briefing%20FIN.pdf [accessed 11th April 2019].
- Cline, W.R. (2007). *Global warming and agriculture: impact estimates by country*, Washington, USA: Peterson Institute, http://maps.grida.no/go/graphic/projected-agriculture-in-2080-due-*to-climate-change* [accessed 11th April 2019].
- Clinton, N., Stuhlmacher, M., Miles, A., Aragon, N.U., Wagner, M., Georgescu, M., Herwig, C. and Gong, P. (2018). A global geospatial ecosystem services estimate of urban agriculture, *Earth's Future*, Vol. 6, Iss. 1, pp.40-60, doi.org/10.1002/2017EF000536.
- Clonan, A. and Holdsworth, M. (2012). The challenges of eating a healthy and sustainable diet, *American Journal of Clinical Nutrition*, Vol. 96, pp.459-460, doi: 10.3945/ajcn.112.044487.
- Clonan, A., Holdsworth, M., Swift, J. and Wilson, P. (2009). *Awareness and attitudes of consumers to sustainable food*, Eursafe, Nottingham, UK: Wageningen Academic.
- Clonan, A., Holdsworth, M., Swift, J.A., Leibovici, D. and Wilson, P. (2011). The dilemma of healthy eating and environmental sustainability - the case of fish, *Public Health Nutrition*, Vol. 15, No. 2, pp.277-284, doi:10.1017/S1368980011000930.

- Clonan, A., Roberts, K.E. and Holdsworth, M. (2016). Socioeconomic and demographic drivers of red and processed meat consumption: implications for health and environmental sustainability, *The Proceedings of the Nutrition Society*, Vol. 75, No. 3, pp.367-373, doi: 10.1017/S0029665116000100.
- Clonan, A., Wilson, P., Swift, J.A., Leibovici, D.G. and Holdsworth, M. (2015). Red and processed meat consumption and purchasing behaviours and attitudes: impacts for human health, animal welfare and environmental sustainability, *Public Health Nutrition*, Vol. 18, pp.2446-2456, doi: 10.1017/S1368980015000567.
- Clover, C. (2004). *The end of the line*, London, UK: Ebury Press, ISBN: 978-1-59558-109-9.
- Clover, C. (2012). It is now make or break time for the world's fish stocks, *Sunday Times*, 10th June, p.19.
- Clune, S., Crossin, E. and Verghese, K. (2017). Systematic review of greenhouse gas emissions for different fresh food categories, *Journal of Cleaner Production,* Vol. 140, pp.766-783, https://doi.org/10.1016/j.jclepro.2016.04.082 [accessed 15th April 2020).
- Clune, S., Crossin, E. and Verghese, K. (2017). Systematic review of greenhouse gas emissions for different fresh food categories, *Journal of Cleaner Production*, Vol. 140, pp.766-783, https://doi.org/10.1016/j.jclepro.2016.04.082 [accessed 11th April 2019].
- Clutterbuck, C. (2017). *Bittersweet Brexit: the future of food, farming, land and labour*, London, UK: Pluto Press, ISBN-10: 0745337708.
- CNA (2014). *National security and the accelerating risks of climate change*, Alexandria, USA: CNA Military Advisory Board.
- Coates, J. (2013). Build it back better – deconstructing food security for improved measurement and action, *Global Food Security*, Vol. 2, pp.188-194, http://dx.doi.org/10.1016/j.gfs.2013.05.002 [accessed 11th April 2019].
- Cobb, L.K., Appel, L.J., Franco, M., Jones-Smith, J.C., Nur, A. and Anderson, C.A. (2015). The relationship of the local food environment with obesity: a systematic review of methods, study quality, and results, *Obesity*, Vol. 23, Iss. 7, pp.1331-1344, doi: 10.1002/oby.21118.
- Cobiac, L.J., Scarborough, P., Kaur, A. and Rayner, M. (2016) The Eatwell Guide: modelling the health implications of incorporating new sugar and fibre guidelines, *PLoS ONE*, Vol. 11, No. 12, pp.e0167859, https://doi.org/10.1371/journal.pone.0167859.
- Coca-Cola Enterprises (2013). *Sustainability insights learning from business leaders*, October, Economist Intelligence Unit.
- Cochrane Library (2017). *About Cochrane Reviews,* Cochrane Library, http://www.cochranelibrary.com/about/about-cochrane-systematic-reviews.html [accessed 15th April 2020].
- Cogato, A., Meggio, F., Migliorati, M.D.A. and Marinello, F. (2019). Extreme weather events in agriculture: a systematic *review, Sustainability*, Vol. 11, No. 9, 2547, doi: 10.3390/su11092547.

- Cohen, D. (2011). Will industry influence derail the UN Summit, *British Medical Journal*, Vol. 343, d5328, https://www.bmj.com/content/343/bmj.d5328 [accessed 11th April 2019].
- Cohen, D.A. and Babey, S.H. (2012). Candy at the cash register — a risk factor for obesity and chronic disease, *New England Medical Journal*, Vol. 367, pp.1381-1383, doi: 10.1056/NEJMp1209443.
- Cohen, J., Mole, N. and Tyrell, K. (2018). *Brexit and pesticides: UK food and agriculture at a crossroads*, Food Research Collaboration Food Brexit Briefing, London, UK: City University London, Centre for Food Policy.
- Cohen, J.E. (1995). *How many people can the earth support?* New York, USA: W.W. Norton & Company.
- Cohen, M. (2018). It's poverty, not individual choice that is driving extraordinary obesity levels, *The Conversation*, 19th February, https://theconversation.com/its-poverty-not-individual-choice-that-is-driving-extraordinary-obesity-levels-91447 [accessed 11th April 2019].
- Cohen, M. and Leroy, F. (2019). Why we shouldn't all be vegan, *The Conversation,* 16th January, https://theconversation.com/why-we-shouldnt-all-be-vegan-109308 [accessed 11th April 2019].
- Cohen, M.J. and Garrett, J.L. (2009). *The food price crisis and urban food (in)security*, London and New York: International Institute for Environment and Development (IIED) and the Population and Development Branch of the United Nations Population Fund (UNFPA).
- Cole-Hamilton, D. (2018). Periodic table: new version warns of elements that are endangered, *The Conversation*, 24th January, https://theconversation.com/periodic-table-new-version-warns-of-elements-that-are-endangered-110377 [accessed 11th April 2019].
- Coleman, A. (2013). Is the answer still blowin' in the wind, *The Grocer*, 28th September, p.52.
- Coley, D., Howard, M. and Winter, M. (2009). Local food, food miles and carbon emissions - a comparison of farm shop and mass distribution approaches, *Food Policy*, Vol. 34, pp.150-155, doi:10.1016/j.foodpol.2008.11.001.
- Coll, M., Libralato, S. Tudela, S., Palomera, I. and Pranovi, F. (2008). Ecosystem overfishing in the ocean, *PLoS One*, Vol. 3, No. 12, e3881, doi: 10.1371/journal.pone.0003881.
- Colley, P., Myer, B., Seabrook, J. and Gilliland, J. (2019). The impact of Canadian school food programs on children's nutrition and health: a systematic review, *Canadian Journal of Dietetic Practice and Research*, Vol. 80, No. 2, pp.79-86, doi: 10.3148/cjdpr-2018-037.
- Collins, M., Knutti, R., Arblaster, J., Dufresne, J.-L., Fichefet, T., Friedlingstein, P., Gao, X., Gutowski, W.J., Johns, T., Krinner, G., Shongwe, M., Tebaldi, C., Weaver, A.J. and Wehner, M. (2013). Long-term Climate Change: Projections, Commitments and Irreversibility. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

- Collison, M. (2014). *Greater Lincolnshire agri-food sector plan 2014-2020*, Greater Lincolnshire LEP, www.greaterlincolnshirelep.co.uk/assets/documents/Agri-food_sector_plan_final.pdf [accessed 27th February 2019].
- Collison, M. (2017). *Greater Lincolnshire agri-food sector plan 2014-2020 - refresh*, Greater Lincolnshire LEP, https://www.greaterlincolnshirelep.co.uk/assets/documents/Greater_Lincolnshire_AgriFood_Sector_Plan_refresh_2017_final.pdf [accessed 27th February 2019].
- Colloca, F., Cardinale, M., Maynou, F., Giannoulaki, M., Scarcella, G., Jenko, K., Bellido, J.M. and Fiorentino, F. (2013). Rebuilding Mediterranean fisheries: a new paradigm for ecological sustainability, *Fish and Fisheries*, Vol. 14, Iss. 1, pp.89-109, https://doi.org/10.1111/j.1467-2979.2011.00453.x [accessed 11th April 2019].
- Combris, P. (2006). Le poids des contraintes économiques dans les choix alimentaires, *Cahiers de Nutrition et de Diététique*, Vol. 41, doi:10.1016/S0007-9960(06)70640-X.
- Committee on Climate Change (2013). *Managing the land in a changing climate*, Adaptation Sub-Committee Progress Report, London, UK: Committee on Climate Change. https://www.theccc.org.uk/wp-content/uploads/2013/07/ASC-2013-Book-singles_2.pdf [accessed 11th April 2019].
- Committee on Climate Change (2014). *Managing climate risks to well-being and the economy*, Adaptation Sub-Committee Progress Report 2014, London, UK: Committee on Climate Change.
- Committee on Climate Change (2016a). *UK climate action following the Paris Agreement*, October, London, UK: Committee on Climate Change.
- Committee on Climate Change (2016b). *UK Climate Change Risk Assessment 2017 Synthesis report: priorities for the next five years*, London, UK: Committee on Climate Change, https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Synthesis-Report-Committee-on-Climate-Change.pdf [accessed 11th April 2019].
- Committee on Climate Change (2016c). *UK Climate Change Risk Assessment 2017 – priorities for the next five years*, London, UK: Committee on Climate Change.
- Committee on Climate Change (2016d). Meeting Carbon Budgets – Implications of Brexit for UK climate policy, London, UK: Committee on Climate Change.
- Committee on Climate Change (2017a). *What is the Evidence Report?* London, UK: Committee on Climate Change.
- Committee on Climate Change (2017b). *UK Climate Change Risk Assessment 2017 Evidence Report*, Chapter 3, Natural environment and natural assets, London, UK: Committee on Climate Change.
- Committee on Climate Change (2017c). *Key messages from the synthesis report*, London, UK: Committee on Climate Change.

- Committee on Climate Change (2017d). *UK Climate Change Risk Assessment 2017*, Key messages from the Synthesis Report, London, UK: Committee on Climate Change, www.theccc.org.uk/uk-climate-change-risk-assessment-2017 [accessed 11th April 2019].
- Committee on Climate Change (2018a). *An independent assessment of the UK's Clean Growth Strategy: from ambition to action*, 17th January, https://www.theccc.org.uk/wp-content/uploads/2018/01/CCC-Independent-Assessment-of-UKs-Clean-Growth-Strategy-2018.pdf [accessed 11th April 2019].
- Committee on Climate Change (2018b). *Biomass in a low-carbon economy*, London, UK: Committee on Climate Change.
- Committee on Climate Change (2018c). *Hydrogen in a low carbon economy*, London, UK: Committee on Climate Change.
- Committee on Climate Change (2018d). *Land use: Reducing emissions and preparing for climate change*, London, UK: Committee on Climate Change, https://www.theccc.org.uk/wp-content/uploads/2018/11/Land-use-Reducing-emissions-and-preparing-for-climate-change-CCC-2018.pdf [accessed 11th April 2019].
- Committee on Climate Change (2018e). *Managing the coast in a changing climate*, October, London, UK: Committee on Climate Change.
- Committee on Climate Change (2018f). *Managing the coast in a changing climate*, London, UK: Committee on Climate Change, https://www.theccc.org.uk/publication/managing-the-coast-in-a-changing-climate/ [accessed 11th April 2019].
- Committee on Climate Change (2018g). *UK regulations: the Climate Change Act,* London, UK: Committee on Climate Change, https://www.theccc.org.uk/tackling-climate-change/the-legal-landscape/the-climate-change-act/ [accessed 11th April 2019].
- Committee on Climate Change (2019a). How the UK is progressing, London, UK: Committee on Climate Change, https://www.theccc.org.uk/tackling-climate-change/reducing-carbon-emissions/how-the-uk-is-progressing/ [accessed 11th April 2019].
- Committee on Climate Change (2019b). *Final Assessment of the first Scottish Climate Change Adaption Programme*, London, UK: Committee on Climate Change.
- Committee on Climate Change (2019b). *Net Zero: the UK's contribution to stopping global warming*, May, London, UK: Committee on Climate Change.
- Committee on Climate Change (2019d). *Resilient food supply chains*, London, UK: Committee on Climate Change, https://www.theccc.org.uk/wp-content/uploads/2019/07/Outcomes-Supply-chain-case-study.pdf [accessed 11th April 2019].
- Committee on Climate Change (2019e). *The first Scottish Climate Change Adaptation Programme*, 19th March, Climate Change Adaptation Programme, London, UK: Committee on Climate Change, https://www.theccc.org.uk/publication/final-assessment-of-scotlands-first-climate-change-adaptation-programme/ [accessed 11th April 2019].

- Committee on Climate Change (2019f). *Reducing UK emissions – 2019 Progress Report to Parliament*, London, UK: Committee on Climate Change, https://www.theccc.org.uk [accessed 11th April 2020].
- Committee on Climate Change (2020). *Major shift in UK land use needed to deliver Net Zero emissions*, 23rd January, London, UK: Committee on Climate Change.
- Compassion in World Farming and Friends of the Earth (2009). *Eating the planet*, London and Godalming, UK: Compassion in World Farming and Friends of the Earth, ISBN 1-900156-47-4
- Conant, R.T. and Paustian, K. (2002). Spatial variability of soil organic carbon in grasslands: implications for detecting change at different scales, *Environmental Pollution*, Vol. 116, No. 1, pp.127-135, https://doi.org/10.1016/S0269-7491(01)00265-2 [accessed 11th April 2019].
- Conceição, P. and Mendoza, R.U.(2009). Anatomy of the global food crisis, *Third World Quarterly*, Vol. 30, No. 6, pp.1159-1182, doi: 10.1080/01436590903037473.
- Conduto, A.D.S., Sanseverino, I., Pozzoli, L. and Lettieri, T. (2017). *Toward climate change impact: vectors carrying viral infection*, Luxembourg: Publication Office of the European Union, doi.org/10.2760/067022.
- Confalonieri, U., Menne, B., Akhtar, R., Ebi, K.L., Hauengue, M., Kovats, R.S., Revich, B. and Woodward, A. (2007). Human health. In: *Climate change 2007: impacts, adaptation and vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (eds M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. v. d. Linden and C. E. Hanson), pp.273-313, Cambridge, UK: Cambridge University Press.
- Conforti, P. (ed) (2011). *Looking ahead in world food and agriculture: perspectives to 2050*, Rome, Italy: Food and Agriculture Organization of the United Nations.
- Conijn, J.G., Bindraban, P.S., Schroder, J.J. and Jongschaap, R.E.E. (2018). Can our global food system meet food demand within planetary boundaries? *Agriculture Ecosystems and Environment*, Vol. 251, pp.244-256, https://doi.org/10.1016/j.agee.2017.06.001 [accessed 11th April 2019].
- Connell, J. (2015). Sustainable futures: linking population, resources and the environment, *Population Studies*, Vol. 69, No. 2, pp.253-254, doi: 10.1080/00324728.2015.1052238.
- Connolly, C.N. (2017). Nerve agents in honey: analysis of local honey samples shows global landscape contamination by pesticides, *Science*, Vol. 358, No. 6359, pp.38-39, https://doi.org/10.1126/science.aao6000 [accessed 11th April 2019].
- Connor, D.J. (2008). Organic agriculture cannot feed the world, *Field Crops Research*, Vol. 106, pp.187-190, doi:10.1016/j.fcr.2007.11.010.
- Connor, D.J. (2018). Organic agriculture and food security: a decade of unreason finally implodes, *Field Crops Research*, Vol. 225, pp.128-129, https://doi.org/10.1016/j.fcr.2018.06.008 [accessed 11th April 2019].
- Conroy, E. (2006). *The food miles challenge: how consumers and retailers in the UK are responding*, London, UK: Report Buyer.

- Conservation Evidence (2019). *Conservation evidence synopses*, Cambridge, UK: University of Cambridge Department of Zoology, www.conservationevidence.com/synopsis/index [accessed 11th April 2019].
- Constantine, J. and Santarelli, M. (2017). Brazil's Food and Nutritional Governance Plan, Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2017/07/4-Briefing-Brazil_vF.pdf [accessed 11th April 2019].
- Consumer International (2015). *The role of consumer protection in meeting the UN Sustainable Development Goals*, September, London, UK: Consumer International.
- Conway, G. (2012). *One billion hungry - can we feed the world*, Ithaca, USA: Comstock/ Cornell University Press, ISBN 9780801466083.
- Cook, C. and Bakker, K. (2012). Water security: debating an emerging paradigm, *Global Environmental Change,* Vol. 22, No. 1, pp.94-102, https://doi.org/10.1016/j.gloenvcha.2011.10.011 [accessed 11th April 2019].
- Cook, C., Muirwood, M. and Holmes, C. (2018). Families and food: how the environment influences what families eat, London, UK: Guy's and St Thomas' Charity, https://www.gsttcharity.org.uk/sites/default/files/Families_and_food_v4_new.pdf [accessed 11th April 2019].
- Cook, I., Crang, P. and Thorpe, M. (1998). Biographies and geographies: consumer understandings of the origins of foods, *British Food Journal*, Vol. 100, No. 3, pp.162-167, https://doi.org/10.1108/00070709810207522 [accessed 11th April 2019].
- Cook, J., Nuccitelli, D., Green, S.A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P. and Skuce, A. (2013). Quantifying the consensus on anthropogenic global warming in the scientific literature, *Environmental Research Letters*, Vol. 8, No. 2, pp.024024, doi:10.1088/1748-9326/8/2/024024.
- Cook, J., Oreskes, N., Doran, P.T., Anderegg, W.R.L., Verheggen, B., Maibach, E.W., Carlton, J.S., Lewandowsky, S., Skuce, A.G., Green, S.A., Nuccitelli, D., Jacobs, P., Richardson, M., Winkler, B., Painting, R. and Rice, K. (2016). Consensus on consensus: a synthesis of consensus estimates on human-caused global warming, *Environmental Research Letters*, Vol. 11, No. 4, pp.048002, doi:10.1088/1748-9326/11/4/048002.
- Cook, S. (2018). *The spice of life: the fundamental role of diversity on the farm and on the plate*, London and The Hague: International Institute for Environment and Development and Hivos.
- Cookson, C. (2017). GM crops take the line of least resistance in their global spread: gene editing technology is expected to accelerate the introduction of new plants, *Financial Times*, 7th December, https://www.ft.com/content/a828419a-c545-11e7-b30e-a7c1c7c13aab [accessed 11th April 2019].
- Cookson, C. (2019). How to change your diet to save the planet, *Financial Times*, 8th January, https://www.ft.com/content/82a1947c-02c9-11e9-bf0f-53b8511afd73 [accessed 11th April 2019].

- Cooley, S.R., Lucey, N., Kite-Powell, H. and Doney, S.C. (2012). Nutrition and income from molluscs today imply vulnerability to ocean acidification tomorrow, *Fish and Fisheries*, Vol. 13, pp.182-215, https://doi.org/10.1111/j.1467-2979.2011.00424.x [accessed 11th April 2019].
- Co-op (2018a). *Sustainable development policy*, Manchester, UK: Co-op Food, https://www.co-operative.coop/ethics/sustainable-development-policy [accessed 11th April 2019].
- Co-op (2018b). *The future of food a recipe for sustainability*, Manchester, UK: Co-op Food, https://www.coop.co.uk/environment/sustainability [accessed 11th April 2019].
- Cooper, N. and Dumpleton, S. (2013). *Walking the breadline: the scandal of food poverty in 21st-century Britain*, Oxford, UK: Oxfam GB Church Action on Poverty, https://policy-practice.oxfam.org.uk/publications/walking-the-breadline-the-scandal-of-food-poverty-in-21st-century-britain-292978 [accessed 11th April 2019].
- Cooper, N., Purcell, S. and Jackson, R. (2014). *Below the breadline - the relentless rise of food poverty in Britain*, Church Action on Poverty, Oxford, UK: Oxfam GB and the Trussell Trust, https://www.trusselltrust.org/wp-content/uploads/sites/2/2016/01/Below-the-Breadline-The-Trussell-Trust.pdf [accessed 11th April 2019].
- Coppes, M. (2019). Canada has released its first ever National Food Policy and it has specific impacts for the Canadian North, *High North News*, 21st June, https://www.highnorthnews.com/en/canada-has-released-its-first-ever-national-food-policy-and-it-has-specific-impacts-canadian-north [accessed 11th April 2020].
- Coppola, A. and Pascucci, S. (2008). Governance “archetypes” and innovative behaviours in the Italian agrifood sector, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands.
- Cordell, A., Maslin, M., Montgomery, H., Johnson, A.M. and Ekins, P. (2008). Global food security and food, *Philosophical Transactions of the Royal Society A*, Vol. 369, pp.1866-1882, doi:10.1098/rsta.2011.0007.
- Cordell, D., Drangert, J-O. and White, S. (2009). The story of phosphorus: global food security and food for thought, *Global Environmental Change*, Vol. 19, No. 2, pp.292-305, doi:10.1016/j.gloenvcha.2008.10.009.
- Cordell, D., Rosemarin, A., Schröder, J.J. and Smit, A.L. (2011). Towards global phosphorus security: a systems framework for phosphorus recovery and reuse options, *Chemosphere*, Vol. 84, pp.747-758, https://doi.org/10.1016/j.chemosphere.2011.02.032 [accessed 11th April 2019].
- Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J.D., Jäger, J., Chabay, I., de Wit, B., Langlais, R., Mills, D., Moll, P., Otto, I.M., Petersen, A., Pohl, C. and van Kerkhoff, L. (2013). Opening up knowledge systems for better responses to global environmental change, *Environmental Science & Policy*, Vol. 28, pp.60-70, https://doi.org/10.1016/j.envsci.2012.11.008 [accessed 11th April 2019].

- Cornelsen, L., Green, R., Turner, R., Dangour, A.D., Shankar, B., Mazzocchi, M. and Smith, R.D. (2015). What happens to patterns of food consumption when food prices change? Evidence from a systematic review and meta-analysis of food price elasticities globally, *Health Economics*, Vol. 24, pp.1548-1559, doi: 10.1002/hec.3107.
- Cosstick, N. (2017). *Monitoring the global food system building trust and resilience for UK citizens and consumers*, Centre for Science and Policy Workshop, summary of the discussions held on 13th September, Cambridge University's Global Food Security Strategic Research Initiative and Public Policy Strategic Research Initiative.
- Costain, F. (2019). *Ruminant agriculture can help us deliver net zero emissions*, London, UK: British Veterinary Association, https://www.bva.co.uk/news-and-blog/blog-article/ruminant-agriculture-can-help-us-deliver-net-zero-emissions/ [accessed 11th April 2019].
- Costello, A., Abbas, M., Allen, A., Ball, S., Bell, S., Bellamy, R., Friel, S., Groce, N., Johnson, A., Kett, M., Lee, M., Levy, C., Maslin, M., McCoy, D., McGuire, B., Montgomery, H., Napier, D., Pagel, C., Patel, J., de Oliveira, J.A.P., Redclift, N., Rees, H., Rogger, D., Scott, J., Stephenson, J., Twigg, J., Wolff, J. and Patterson, C. (2009). Managing the health effects of climate change, Lancet and University College London Institute for Global Health Commission, *The Lancet*, Vol. 373, pp.1693-1733, doi:https://doi.org/10.1016/S0140-6736(09)60935-1 [accessed 11th April 2019].
- Costello, A., Maslin, M., Montgomery, H., Johnson, A.M. and Ekins, P. (2011). Global health and climate change: moving from denial and catastrophic fatalism to positive action, *Philosophical Transactions of the Royal Society A*, Vol. 369, Iss. 1942, doi: 10.1098/rsta.2011.0007.
- Costello, C., Cao, L. and Gelcich, S. (2019). *The future of food from the sea*, Washington, USA: World Resources Institute, www.oceanpanel.org/future-food-sea [accessed 11th April 2019].
- Costello, C., Ovando, D., Clavelle, T., Strauss, C.K., Hilborn, R., Melnychuk, M.C., Branch, T.A., Gaines, S.D., Szuwalski, C.S., Cabral, R.B., Rader, D.N. and Leland, A. (2016). Global fishery prospects under contrasting management regimes, *Proceedings of the National Academy of Science*, Vol. 113, No. 18, pp.5125-5129, https://doi.org/10.1073/pnas.1520420113 [accessed 11th April 2019].
- Cotter, J. and Hutchison, R.W. (1999). The impact of accounting reporting techniques on earnings enhancement in the UK retailing sector, *The International Review of Retail, Distribution and Consumer Research*, Vol. 9, No. 2, pp.147-162, doi: 10.1080/095939699342615.
- Cottrell, R.S., Nash, K.L., Halpern, B.S., Remenyi, T.A., Corney, S.P., Fleming, A., Fulton, E.A., Hornborg, S., Johne, A., Watson, R.A. and Blanchard, J.L. (2019). Food production shocks across land and sea, *Nature Sustainability*, Vol. 2, pp.130-137, https://doi.org/10.1038/s41893-018-0210-1 [accessed 11th April 2019].
- Cotula, L., Vermeulen, S., Leonard, R. and Keeley, J. (2009). *Land grab or development opportunity? Agricultural investment and international land deals in Africa*, London/Rome: IIED/FAO/IFAD, ISBN: 978-1-84369-741-1.

- Council of Canadian Academies (2019). *Canada's top climate change risks*, Ottawa, Canada: The Expert Panel on Climate Change Risks and Adaptation Potential, Council of Canadian Academies, https://cca-reports.ca/wp-content/uploads/2019/07/Report-Canada-top-climate-change-risks.pdf [accessed 11th April 2019].
- Countryfile (2018). Can the UK feed itself after Brexit? *BBC Countryfile*, 5th January, https://www.countryfile.com/news/can-the-uk-feed-itself-after-brexit/ [accessed 11th April 2019].
- Cowling, W.A., Li, L., Siddique, K.H.M., Banks, R.G. and Kinghorn, B.P. (2019). Modeling crop breeding for global food security during climate change, *Food and Energy Security*, Vol. 8, No. 2, e00157, https://doi.org/10.1002/fes3.157 [accessed 11th April 2019].
- Cowtan, K. and Lewandowsky, S. (2018). Global warming 'hiatus' is the climate change myth that refuses to die, *The Conversation*, 19th December, https://theconversation.com/global-warming-hiatus-is-the-climate-change-myth-that-refuses-to-die-108524 [accessed 11th April 2019].
- Cox, S. (2018). Sea levels could also rise by six metres or more even if the world does meet the 2 degree target of the Paris accord, *The Guardian*, 6th July, https://www.theguardian.com/environment/2018/jul/06/global-temperature-rises-could-be-double-those-predicted-by-climate-modelling [accessed 11th April 2019].
- CPRE (2016). *From field to fork - the value of England's local food webs*, London, UK: Campaign to Protect Rural England, https://www.cpre.org.uk/resources/from-field-to-fork-2/ [accessed 11th April 2019].
- CPRE (2017). *Uncertain harvest - does the loss of farms matter*, London: Campaign to Protect Rural England, https://www.cpre.org.uk/resources/farming-and-food/farming/item/4647-uncertain-harvest-does-the-loss-of-farms-matter [accessed 11th April 2019].
- Craine, J.M., Elmore, A.J., Wang, L., Aranibar, J., Bauters, M., Boeckx, P., Crowley, B.E., Dawes, M.A., Delzon, S., Fajardo, A., Fang, Y., Fujiyoshi, L., Gray, A., Guerrieri, R., Gundale, M.J., Hawke, D.J., Hietz, P., Jonard, M., Kearsley, E., Kenzo, T., Makarov, M., Marañón-Jiménez, S., McGlynn, T.P., McNeil, B.E., Mosher, S.G., Nelson, D.M., Peri, P.L., Roggy, J.C., Sanders-DeMott, R., Song, M., Szpak, P., Templer, P.H., Van der Colff, D., Werner, C., Xu, X., Yang, Y., Yu, G. and Zmudczyńska-Skarbek, K. (2018). Isotopic evidence for oligotrophication of terrestrial ecosystems, *Nature Ecology & Evolution*, Vol. 2, No. 11, pp.1735, doi: 10.1038/s41559-018-0694-0.
- Crall, J.D., Switzer, C.M., Oppenheimer, R.L., Versypt, A.N.F., Biswadip Dey, B., Brown, A., Eyster, M., Guérin, C., Pierce, N.A., Combes, S.A. and de Bivort, B.L. (2018). Neonicotinoid exposure disrupts bumblebee nest behavior, social networks, and thermoregulation, *Science*, Vol. 362, Iss. 6415, pp.683-686, doi: 10.1126/science.aat1598.

- Cramer, L., Huyer, S., Lavado, A., Loboguerrero, A.M., Martínez-Barón, D., Nyasimi, M., Thomas, T., Thornton, P., van Etten, J. and van Wijk, M. (2017). *Methods proposed to evaluate the potential impact of climate change on food and nutrition security in Central America and the Dominican Republic*, CCAFS Working Paper no. 196, Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), www.ccafs.cgiar.org [accessed 11th April 2019].
- Cranfield (2014). *Plausible future scenarios for the UK food and feed system - 2015 & 2035*, Cranfield, UK: Cranfield University, Institute for Environment, Health Risks and Futures.
- Cranfield, J.A.L., Hertel, T.W., Eales, J.S. and Preckel, P.V. (1998). Changes in the structure of global food demand, *American Journal of Agricultural Economics*, Vol. 80, No. 5, pp.1042-1050, doi: 10.2307/1244202.
- Crawford, E.O. and Montague, L. (2017). Conscientious consumerism: a curriculum pilot to support the sustainable development goals, *Childhood Education*, Vol. 93, No. 6, pp.480-492, doi: 10.1080/00094056.2017.1398556.
- Crawley, H. (2017). *Healthy eating as a public concern - nutrition policy throughout the UK*, London, UK: City University London Centre for Food Policy.
- Creasey, S. (2014). Farmed and dangerous, *The Grocer*, 26th April, p.50-52.
- Creasey, S. (2014). Proof at last that organic food is better for you, *The Grocer*, 19th July, p.16.
- Crippa, M., Guizzardi, D., Muntean, M., Schaaf, E., Dentener, F., van Aardenne, J.A., Monni, S., Doering, U., Olivier, J.G.J., Pagliari, V., and Janssens-Maenhout, G. (2018). Gridded emissions of air pollutants for the period 1970–2012 within EDGAR v4.3.2, *Earth System Science Data*, Vol. 10, pp.1987-2013, https://doi.org/10.5194/essd-10-1987-2018 [accessed 11th April 2019].
- Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F.N. and Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions, *Nature Food*, 2, pp.198-209, https://doi.org/10.1038/s43016-021-00225-9.
- Cristea, A., Hummels, D., Puzzello, L. and Avetisyan, M. (2013). Trade and the greenhouse gas emissions from international freight transport, *Journal of Environmental Economics and Management*, Vol. 65, pp.153-173, https://doi.org/10.1016/j.jeem.2012.06.002 [accessed 11th April 2019].
- Criveanu, R.C. and Sperdea, N.M. (2014). Organic agriculture, climate change, and food security, *Economics, Management and Financial Markets*, Vol. 9, No. 1, pp.118-123, ISBN 1842-3191.
- Crockett, R.A., King, S.E., Marteau, T.M., Prevost, A.T., Bignardi, G., Roberts, N.W., Stubbs, B., Hollands, G.J. and Jebb, S.A. (2010). Nutritional labelling to promote healthier food purchasing and consumption: preliminary results of a systematic literature review, *International Journal of Behavioral Medicine*, Vol. 17, Iss. Suppl. 1, p.56, doi: 10.1002/14651858.CD009315.pub2.

- Croker, H., Packer, J., Russell, S.J., Stansfield, C. and Viner, R.M. (2020). Front of pack nutritional labelling schemes: a systematic review and meta-analysis of recent evidence relating to objectively measured consumption and purchasing, *Journal of Human Nutrition and Dietetics*, https://doi.org/10.1111/jhn.12758.
- Cromsigt, J.P.G.M., te Beest, M., Kerley, G.I.H., Landman, M., le Roux, E. and Smith, F.A. (2018). Trophic rewilding as a climate change mitigation strategy? *Philosophical Transactions of the Royal Society B*, Vol. 373, Iss. 1761, 20170440, doi: 10.1098/rstb.2017.0440.
- Crossley, D. (2019). *10 reasons to take 'our future in the land' seriously*, London, UK: Food Ethics Council, https://www.foodethicscouncil.org/10-reasons-to-take-our-future-in-the-land-seriously/ [accessed 11th April 2019].
- Čuček, L., Klemeš, J.J. and Kravanja, Z. (2012). A review of footprint analysis tools for monitoring impacts on sustainability, *Journal of Cleaner Production*, Vol. 34, pp.9-20, doi:10.1016/j.jclepro.2012.02.036.
- Cui, Z., Wu, L., Ye, Y.L., Ma, W.Q., Chen, X.P. and Zhang, F.S. (2014). Trade-offs between high yields and greenhouse gas emissions in irrigation wheat cropland in China, *Biogeosciences*, Vol. 11, pp.2287-2294, https://doi.org/10.5194/bg-11-2287-2014 [accessed 11th April 2019].
- Cui, Z., Zhang, H., Chen, X., Zhang, C., Ma, W., Huang, C., Zhang, W., Mi, G., Miao, Y., Li, X., Gao, Q., Yang, J., Wang, Z., Ye, Y., Guo, S., Lu, J., Huang, J., Lv, S., Sun, Y., Liu, Y., Peng, X11, Ren, J., Li, S., Deng, X., Shi, X., Zhang, Q., Yang, Z., Tang, L., Wei, C., Jia, L., Zhang, J., He, M., Tong, Y., Tang, Q., Zhong, X., Liu, Z., Cao, N., Kou, C., Ying, H., Yin, Y., Jiao, X., Zhang, Q., Fan, M., Jiang, R., Zhang, F. and Dou, Z. (2018). Pursuing sustainable productivity with millions of smallholder farmers, *Nature*, Vol. 555, pp.363-366, doi:10.1038/nature25785.
- Cullerton, K., Adams, J., Forouhi, N., Oliver Francis, O. and White, M. (2019). What principles should guide interactions between population health researchers and the food industry? Systematic scoping review of peer-reviewed and grey literature, *Obesity Reviews*, Vol. 20, Iss. 8, pp.1073-1084, doi: 10.1111/obr.12851.
- Cullerton, K., Donnet, T., Lee, A. and Gallegos, D. (2016). Using political science to progress public health nutrition: a systematic review, *Public Health Nutrition*, Vol. 19, Iss. 11, pp.2070-2078, doi: https://doi.org/10.1017/S1368980015002712
- Cumberlege, T., Kazer, J. and Plotnek, J. (2015). *The case for protein diversity: accelerating the adoption of more sustainable eating patterns in the UK*, London: The Carbon Trust, https://www.carbontrust.com/resources/reports/advice/the-case-for-proteindiversity/ [accessed 11th April 2019].
- Cumming, G.S. and Peterson, G.D. (2017). Unifying research on social-ecological resilience and collapse, *Trends in Ecology & Evolution*, Vol. 32, No. 9, pp.695-713, doi: https://doi.org/10.1016/j.tree.2017.06.014 [accessed 11th April 2019].

- Cummins, E., Hospido, A. and Van Impe, J.F.M. (2019). Quantitative tools for sustainable food and energy in the food chain, *Food Research International*, Vol. 115, pp.126-127, https://doi.org/10.1016/j.foodres.2018.08.026 [accessed 11th April 2019].
- Curry, N. and Allen-Collinson, J. (2016). *A food strategy for the City of Lincoln*, Project Report, Lincoln, UK: University of Lincoln, http://eprints.lincoln.ac.uk/24922/ [accessed 11th April 2019].
- Curtin, J. (2019). Climate change is coming for global trade, *Foreign Policy*, 16th November, https://foreignpolicy.com/2019/11/16/climate-change-disrupt-global-container-shipping-trade-policymakers-take-note/ [accessed 11th April 2019].
- Cuthbert, M.O., Befus, K.M. and Gleeson, T. (2019). Water: underground source for billions could take more than a century to respond fully to climate change, *The Conversation*, 11th February, https://theconversation.com/water-underground-source-for-billions-could-take-more-than-a-century-to-respond-fully-to-climate-change-110551 [accessed 11th April 2019].
- D'Alessandro, A., Lampignano, L. and De Pergola, G. (2019). Mediterranean diet pyramid: a proposal for Italian people - a systematic review of prospective studies to derive serving sizes, *Nutrients*, Vol. 11, No. 6, 1296, doi: 10.3390/nu11061296.
- D'Autilia, R. and D'Ambrosi, I. (2015). Is there enough fertile soil to feed a planet of growing cities, *Physica A*, Vol. 419, pp.668-674, http://dx.doi.org/10.1016/j.physa.2014.10.048 [accessed 11th April 2019].
- D'Innocenzo, S., Biagi, C. and Lanari, M. (2019). Obesity and the Mediterranean diet: a review of evidence of the role and sustainability of the Mediterranean diet, *Nutrients*, Vol. 11, No. 16, pp.1306-1331, doi:10.3390/nu11061306.
- D'Odorico, P., Carr, J.A., Laio, F., Ridolfi, L. and Vandoni, S. (2014). Feeding humanity through global food trade, *Earth's Future*, Vol. 2, pp.458-469, doi:10.1002/2014EF000250.
- d'Orbcastel, E.R., Blancheton, J-P. and Aubin, J. (2009). Towards environmentally sustainable aquaculture: comparison between two trout farming systems using Life Cycle Assessment, *Aquacultural Engineering*, Vol. 40, No. 3, pp.113-119, https://doi.org/10.1016/j.aquaeng.2008.12.002 [accessed 11th April 2019].
- D'Silva, J. (2017). Golden fields, burning forests and hungry people: how corn and soy are impacting us all. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.52-66, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- da Silva, J.G. (2019). Transforming food systems for better health, *The Lancet*, Vol. 393, Iss. 10173, 27th January, pp.e30-e31, doi: https://doi.org/10.1016/S0140-6736(18)33249-5 [accessed 11th April 2019].
- Da, J., Zhang, Y.G., Li, G., Meng, X. and Ji, J. (2019). Low CO_2 levels of the entire Pleistocene epoch, *Nature Communications*, Vol. 10, No. 1, 4342, doi: 10.1038/s41467-019-12357-5.

- Dahabieh, M.S., Bröring, S. and Maine, E. (2018). Overcoming barriers to innovation in food and agricultural biotechnology, *Trends in Food Science & Technology*, Vol. 79, pp.204-213, https://doi.org/10.1016/j.tifs.2018.07.004 [accessed 11th April 2019].
- Dahlke, F.T., Butzin, M., Nahrgang, J., Puvanendran, V., Mortensen, A., Pörtner, H-O. and Storch, D. (2018). Northern cod species face spawning habitat losses if global warming exceeds 1.5 °C, *Science Advances*, doi: 10.1126/sciadv.aas8821.
- Dai, J., Xu, C., Liao, L. and An, H. (2016). Climate change and health, *The Lancet*, Vol. 387, Iss. 10017, pp.431-432, doi:https://doi.org/10.1016/S0140-6736(16)00173-2.
- Dairy 2020 (2014). *Scenarios for a sustainable UK dairy industry*, London, UK: Forum for the Future, http://www.forumforthefuture.org/sites/default/files/project/downloads/dairy-2020-scenarios.pdf [accessed 11th April 2019].
- Dalin, C., Wada, Y., Kastner, T. and Puma, M. J. (2017). Groundwater depletion embedded in international food trade, *Nature*, Vol. 543, pp.700-704, doi:10.1038/nature21403.
- Daly, J., Kellehear, A. and Gliksman, M. (1997). *The public health researcher: a methodological approach*, Melbourne, Australia: Oxford University Press, pp.611-618, ISBN 978-0195540758.
- DaMatta, F.M., Grandis, A., Arenque, B.C. and Buckeridge, M.S. (2010). Impacts of climate changes on crop physiology and food quality, *Food Research International*, Vol. 43, No. 7, pp. 1814-1823, https://doi.org/10.1016/j.foodres.2009.11.001 [accessed 11th April 2019].
- Dangour, A. (2019). Expert reaction to the EAT–Lancet Commission report on healthy diets from sustainable food systems, *Science Media Center*, 16th January, https://www.sciencemediacentre.org/expert-reaction-to-the-eat-lancet-commission-report-on-healthy-diets-from-sustainable-food-systems/ [accessed 11th April 2019].
- Dangour, A.D., Hawkesworth, S., Shankar, B., Watson, L., Srinivasan, C.S., Morgan, E.H., Haddad, L. and Waage, J. (2013). Can nutrition be promoted through agriculture-led food price policies? A systematic review, *BMJ Open*, Vol. 3, No. 6, e002937, doi: 10.1136/bmjopen-2013-002937.
- Dangour, A.D., Mace, G. and Shankar, B. (2017). Food systems, nutrition, health and the environment, *The Lancet*, 1st April, pp.e8-e9.
- Dania, W.A.P., Xing, K. and Amer, Y. (2018). Collaboration behavioural factors for sustainable agri-food supply chains: a systematic review, *Journal of Cleaner Production*, Vol. 186, pp.851-864, https://doi.org/10.1016/j.jclepro.2018.03.148.
- Danielson, J.J. and Gesch, D.B. (2008). An enhanced global elevation model generalized from multiple higher resolution source datasets, *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, Vol. XXXVII, pp.1857-1864, http://eros.usgs.gov/products/elevation/gtopo30/ gtopo30.html [accessed 11th April 2019].

- Danton, H. and Titus, S. (2018). Taking action: five ways to improve nutrition through agriculture now, *Global Food Security*, Vol. 18, pp.44-47, https://doi.org/10.1016/j.gfs.2018.07.005 [accessed 11th April 2019].
- Dao, H., Peduzzi, P. and Friot, D. (2018). National environmental limits and footprints based on the Planetary Boundaries framework: the case of Switzerland, *Global Environmental Change*, Vol. 52, pp.49-57, https://doi.org/10.1016/j.gloenvcha.2018.06.005 [accessed 11th April 2019].
- Darby, G. (2014). Premier Foods lesson in business ethics, *The Grocer*, 13th December, p.20.
- Darkow, I-L., Foerster, B. and von der Gracht, H.A. (2015). Sustainability in food service supply chains: future expectations from European industry experts toward the environmental perspective, *Supply Chain Management: An International Journal*, Vol. 20, Iss. 2, pp.163-178, http://dx.doi.org/10.1108/SCM-03-2014-0087 [accessed 11th April 2019].
- Darmon, N. and Drewnowski, A. (2015). Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis, *Nutrition Reviews*, Vol. 73, Iss. 10, pp.643-660, doi: 10.1093/nutrit/nuv027.
- Darwin, C. (1859). *On the origin of species by means of natural selection or preservation of favoured races in the struggle for life,* London, UK: John Murray.
- Dasgupta, N., Ranjan, S., Mundekkad, D., Ramalingam, C., Shanker, R. and Kumar, A. (2015). Nanotechnology in agro-food: from field to plate, *Food Research International*, Vol. 69, pp.381-400, https://doi.org/10.1016/j.foodres.2015.01.005 [accessed 11th April 2019].
- Dasgupta, S. and Meisner, C. (2009). *Climate change and sea-level rise: a review of the scientific evidence*, Environment department papers no. 118, Climate change series, Washington, USA: World Bank, https://openknowledge.worldbank.org/handle/10986/18382.
- Dass, P., Houlton, B.Z., Wang, Y. and Warlind, D. (2018). Grasslands may be more reliable carbon sinks than forests in California, *Environmental Research Letters*, Vol. 13, No. 7, pp.074027, doi: 10.1088/1748-9326/aacb39.
- Dauvergne, P. (2018). The global politics of the business of "sustainable" palm oil, *Global Environmental Politics*, Vol. 18, No. 2, pp.34-52, doi: 10.1162/glep_a_00455.
- Dauvergne, P. and Lister, J. (2012). Big brand sustainability - governance prospects and environmental limits, *Global Environmental Change*, Vol. 22, pp.36-45, doi:10.1016/j.gloenvcha.2011.10.007.
- David and Lucile Packard Foundation (2013). *Global agriculture and environmental issues landscape*, California, USA: California Environmental Associates, https://www.ceaconsulting.com/wp-content/uploads/global-agriculture-and-enironmental-issues-landscape.pdf [accessed 11th April 2019].
- Davidson, E.A. (2012). Representative concentration pathways and mitigation scenarios for nitrous oxide, *Environmental Research Letters*, Vol. 7, No. 2, 024005, doi: https://doi.org/10.1088/1748-9326/7/2/024005.

- Davidson, P.M. (2016). Rockefeller Foundation-Lancet Commission report: a call to action for human health, *International Journal of Nursing Studies*, Vol. 53, pp.1-2, doi: 10.1016/j.ijnurstu.2015.10.013.
- Davies, A.R. (2013). Food futures - co-designing sustainable eating practices for 2050, *EuroChoices: The Agricultural Economics Society and the European Association of Agricultural Economists*, Vol. 12, No. 2, pp.4-11, doi: 10.1111/1746-692X.12029.
- Davies, J. (2017). Carbon catch-22 - the pollution in our soil, *The Conversation*, 20th June, https://theconversation.com/carbon-catch-22-the-pollution-in-our-soil-78718 [accessed 11th April 2019].
- Davies, S.C. (2019). *Annual report of the Chief Medical Officer, 2019: health, our global asset – partnering for progress*, London, UK: Department of Health and Social Care, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832948/annual-report-of-the-chief-medical-officer-2019.pdf [accessed 11th April 2020].
- Davin, E.L., Seneviratne, S.I., Ciais, P., Olioso, A. and Want, T. (2014). Preferential cooling of hot extremes from cropland albedo management, *Proceedings of the National Academy of Science*, Vol. 111, pp.9757-9761, https://doi.org/10.1073/pnas.1317323111 [accessed 11th April 2019].
- Davis, A., Hirsch, D. and Padley, M. (2014). *A minimum income standard for the UK in 2014 – summary*, Ref. 2030, York, UK: Joseph Rowntree Foundation.
- Davis, A.P., Chadburn, H., Moat, J., O'Sullivan, R., Hargreaves, S. and Nic Lughadha, E. (2019). High extinction risk for wild coffee species and implications for coffee sector sustainability, *Science Advances*, Vol. 5, No. 1, pp.eaav3473, doi: 10.1126/sciadv.aav3473.
- Davis, F.R. (2012). Silent Spring after 50 years, *Endeavour*, Vol. 36, No. 4, pp.129-130, http://dx.doi.org/10.1016/j.endeavour.2012.09.003 [accessed 11th April 2019].
- Davis, J. (2013). Climate change and agri-food, *EuroChoices: The Agricultural Economics Society and the European Association of Agricultural Economists*, Vol. 12, No. 3, p.3, https://doi.org/10.1111/1746-692X.12032 [accessed 11th April 2019].
- Davis, J. (2015). Sustainability and the economics of climate change, *EuroChoices: The Agricultural Economics Society and the European Association of Agricultural Economists*, Vol. 14, No. 3, p.3, doi: 10.1111/1746-692X.12101.
- Davis, J., Legg, W. and Blandford, D. (2015). Climate change and agriculture: the role of socio-economic research, *EuroChoices*, Vol. 14, No. 2, p.3, doi:10.1111/1746-692X.12083.
- Davis, K.F. and D'Odorico, P. (2015). Livestock intensification and the influence of dietary change: a calorie-based assessment of competition for crop production, *Science of the Total Environment*, Vol. 538, pp.817-823, doi: 10.1016/j.scitotenv.2015.08.126.
- Davis, K.F., Chiarelli, D.D., Rulli, M.C., Chhatre, A., Richter, B., Singh, D. and DeFries, R. (2018). Alternative cereals can improve water use and nutrient supply in India, *Science Advances*, Vol. 4, No. 7, pp.eaao1108, doi: 10.1126/sciadv.aao1108.

- Davis, K.F., Gephart, J.A., Emery, K.A., Leach, A.M., Galloway, J.N. and D'Odoricoad, P. (2016). Meeting future food demand with current agricultural resources, *Global Environmental Change*, Vol. 39, pp.125-132, https://doi.org/10.1016/j.gloenvcha.2016.05.004 [accessed 11th April 2019].
- Dawkins, M.S. and Layton, R. (2012). Breeding for better welfare - genetic goals for broiler chickens and their parents, *Animal Welfare*, Vol. 21, pp.147-155, ISSN 0962-7286.
- Dawson, T.P., Perryman, A.H., and Osborne, T.M. (2016). Modelling impacts of climate change on global food security, *Climatic Change*, Vol. 134, pp.429-440, doi:10.1007/s10584-014-1277-y.
- Day, J.W., Moerschbaecher, M., Pimentel, D., Hall, C. and Yáñez-Arancibiad, A. (2013). Sustainability and place: how emerging mega-trends of the 21st century will affect humans and nature at the landscape level, *Ecological Engineering*, Vol. 65, pp.33-48, http://dx.doi.org/10.1016/j.ecoleng.2013.08.003 [accessed 11th April 2019].
- Day, W. and Lee, A. (2011). *Closing statement for the Sustainable Development Commission*, 25th March, London, UK: Sustainable Development Commission, http://www.sd-commission.org.uk/presslist.php/119/what-next-for-sustainable-development.html [accessed 11th April 2019].
- Daziano, M.F., Neyra, F., Senesi, S.I. and Vilella, F. (2008). Leadership and entrepreneurship in the development of the biodiesel industry in Argentina - three productive models, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands.
- de Almeida, R., Steiner, M.T.A., dos Coelho, L.S., Francisco, C.A.C. and Steiner Neto, P.J. (2019). A case study on environmental sustainability: a study of the trophic changes in fish species as a result of the damming of rivers through clustering analysis, *Computers and Industrial Engineering*, Vol. 135, pp.1239-1252, https://doi.org/10.1016/j.cie.2018.09.032 [accessed 11th April 2020].
- de Amorim, W.S., Valduga, I.B., Ribeiro, J.M.P., Williamson, V.G., Krauser, G.E., Magtoto, M.K. and De Andrade Guerra, J.B.S.O. (2018). The nexus between water, energy, and food in the context of the global risks: an analysis of the interactions between food, water, and energy security, *Environmental Impact Assessment Review*, Vol. 72, pp.1-11, https://doi.org/10.1016/j.eiar.2018.05.002 [accessed 11th April 2019].
- de Azevedo, D.B., Pedrozo, E.A., de Silva, T.N. and Malafaia, G.C. (2008). The inclusion of stakeholders in the coordination of problems derived from climatic changes in agribusiness, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks,* 28th-30th May, *Ede, the Netherlands.*
- de Bellaigue, C. (2020). The end of farming? *The Guardian*, 25th February, https://www.theguardian.com/environment/2020/feb/25/the-end-of-farming-rewilding-intensive-agriculture-food-safety [accessed 25th February 2020].

- de Boer, B.F., Rodrigues, J.F.D. and Tukker, A. (2019). Modeling reductions in the environmental footprints embodied in European Union's imports through source shifting, *Ecological Economics*, Vol. 164, 106300, doi: 10.1016/J.ECOLECON.2019.04.012.
- de Boer, I.J.M., Cederberg, C., Eady, S., Gollnow, S., Kristensen, T., Macleod, M., Meul, M., Nemecek, T., Phong, L.T., Thoma, G., van der Werf, H.M.G., Williams, A.G. and Zonderland-Thomassen, M.A. (2011). Greenhouse gas mitigation in animal production: towards an integrated life cycle sustainability assessment, *Current Opinion in Environmental Sustainability*, Vol. 3, pp.423-431, https://doi.org/10.1016/j.cosust.2011.08.007 [accessed 11th April 2019].
- de Boer, J. and Aiking, H. (2017). Pursuing a low meat diet to improve both health and sustainability: how can we use the frames that shape our meals? *Ecological Economics*, Vol. 142, pp.238-248, https://doi.org/10.1016/j.ecolecon.2017.06.037 [accessed 11th April 2020].
- de Boer, J., de Witt, A. and Aiking, H. (2018). Help the climate, change your diet: a cross-sectional study on how to involve consumers in a transition to a low-carbon society, *Appetite*, Vol. 98 pp.19-27, https://doi.org/10.1016/j.appet.2015.12.001 [accessed 11th April 2019].
- de Boer, J., Schösler, H. and Aiking, H. (2014). "Meatless days" or "less but better"? Exploring strategies to adapt Western meat consumption to health and sustainability challenges, *Appetite*, Vol. 76, pp.120-128, https://doi.org/10.1016/j.appet.2014.02.002 [accessed 11th April 2019].
- de Boer, J., Schösler, H., and Boersema, J.J. (2013). Climate change and meat eating: an inconvenient couple? *Journal of Environmental Psychology*, Vol. 33, pp.1-8, https://doi.org/10.1016/j.jenvp.2012.09.001 [accessed 11th April 2019].
- de Carvalho, A.M., César, C.L., Fisberg, R.M. and Marchioni, D.M. (2013). Excessive meat consumption in Brazil: diet quality and environmental impacts, *Public Health Nutrition*, Vol. 16, No. 10, pp.1893-1899, doi: 10.1017/S1368980012003916.
- de Coninck, H., Revi, A., Babiker, M., Bertoldi, P., Buckeridge, M., Cartwright, A., Dong, W., Ford, J., Fuss, S., Hourcade, J.C., Ley, D., Mechler, R., Newman, P., Revokatova, A., Schultz, S., Steg, L. and Sugiyama, T. (2018). Strengthening and implementing the global response. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. MassonDelmotte, P. Zhai, H.O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.
- de Grave, R., Rust, N., Reynolds, C., Watson, A., Smeddinck, J. and de Souza Monteiro, D. (2020). A catalogue of UK household datasets to monitor transitions to sustainable diets, *Global Food Security*, Vol. 24, 100344, https://doi.org/10.1016/j.gfs.2019.100344.

- de Haas, H. (2011). Mediterranean migration futures: patterns, drivers and scenarios, *Global Environmental Change*, Vol. 21, pp.S59-S69, https://doi.org/10.1016/j.gloenvcha.2011.09.003 [accessed 11th April 2019].
- de Oliveira Silva, R., Barioni, L.G. and Moran, D. (2015). Greenhouse gas mitigation through sustainable intensification of livestock production in the Brazilian Cerrado, *EuroChoices: Agricultural Economics Society and European Association of Agricultural Economists*, Vol. 14, No. 1, pp.28-34, https://doi.org/10.1111/1746-692X.12079 [accessed 11th April 2019].
- de Pee, A., Pinner, D., Roelofsen, O., Somers, K., Speelman, E. and Witteveen, M. (2018). *How industry can move toward a low-carbon future*, New York, USA: McKinsey and Company, https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/how-industry-can-move-toward-a-low-carbon-future [accessed 11th April 2019].
- de Ponti, T., Rijk, B. and van Ittersum, M.K. (2012). The crop yield gap between organic and conventional agriculture, *Agricultural Systems*, Vol. 108, pp.1-9, doi:10.1016/j.agsy.2011.12.004.
- De Ridder, D., Kroese, F., Evers, C., Adriaanse, M. and Gillebaart, M. (2017). Healthy diet: health impact, prevalence, correlates, and interventions, *Psychology & Health*, Vol. 32, pp.907-941, doi: 10.1080/08870446.2017.1316849.
- de Ruijter, F.J., Huijsmans, J.F.M. and Rutgers, B. (2010). Ammonia volatilization from crop residues and frozen green manure crops, *Atmospheric Environment*, Vol. 44, pp.3362-3368, https://doi.org/10.1016/j.atmosenv.2010.06.019 [accessed 11th April 2019].
- de Ruiter, H., Kastner, T. and Nonhebel, S. (2014). European dietary patterns and their associated land use: variation between and within countries, *Food Policy*, Vol. 44, pp.158-166, https://doi.org/10.1016/j.foodpol.2013.12.002 [accessed 11th April 2019].
- de Ruiter, H., Macdiarmid, J.I., Matthews, R.B. and Smith, P. (2018). Moving beyond calories and protein: micronutrient assessment of UK diets and land use, *Global Environmental Change*, Vol. 52, September, pp.108-116, https://doi.org/10.1016/j.gloenvcha.2018.06.007 [accessed 11th April 2019].
- de Ruiter, H., Macdiarmid, J.I., Matthews, R.B., Kastner, T. and Smith, P. (2016). Global cropland and greenhouse gas impacts of UK food supply are increasingly located overseas, *Journal of the Royal Society Interface*, Vol. 13, Iss. 114, pp.20151001, doi: 10.1098/rsif.2015.1001.
- de Ruiter, H., Macdiarmid, J.I., Matthews, R.B., Kastner, T., Lynd, L.R. and Smith, P. (2017). Total global agricultural land footprint associated with UK food supply 1986–2011, *Global Environmental Change*, Vol 43, pp.72-81, https://doi.org/10.1016/j.gloenvcha.2017.01.007 [accessed 11th April 2019].
- De Schutter, O. (2009). The right to food: fighting for adequate food in a global crisis, *Harvard International Review*, Summer, pp.38-42, https://www.jstor.org/stable/42763295 [accessed 11th April 2019].

- De Schutter, O. (2013). *What are the impacts of agrofuels on the right to food*, Geneva, Switzerland: Office of the High Commissioner for Human Rights, https://www.ohchr.org/Documents/Issues/Food/AgrofuelsQA.pdf [accessed 11th April 2019].
- De Schutter, O. (2014). The political economy of food systems reform, *European Review of Agricultural Economics*, pp.1-27, doi:10.1093/erae/jbx009.
- De Schutter, O. (2019). *Towards a common food policy for the European Union: the policy reform and realignment that is required to build sustainable food systems in Europe*, February, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems (IPES-Food), http://www.ipes-food.org/pages/CommonFoodPolicy [accessed 11th April 2019].
- De Schutter, O., Jacobs, N. and Clément, C. (2020). A 'Common Food Policy' for Europe: how governance reforms can spark a shift to healthy diets and sustainable food systems, *Food Policy*, pp.101849, https://doi.org/10.1016/j.foodpol.2020.101849 [accessed 11th April 2020].
- de Sherbinin, A., Bukvic, A., Rohat, G., Gall, M., McCusker, B., Preston, B., Apotsos, A., Fish, C., Kienberger, S., Muhonda, P., Wilhelmi, O., Macharia, D., Shubert, W., Sliuzas, R., Tomaszewski, B. and Zhang, S. (2019). Climate vulnerability mapping: a systematic review and future prospects, *Climate Change*, Vol. 10, No. 5, art. no. e600, doi: 10.1002/wcc.600.
- de Silva, S. and Soto, D. (2009). Climate change and aquaculture: potential impacts, adaptation, and mitigation. In: *Climate Change and Aquaculture: Overview of Current Scientific Knowledge*, (eds.) K. Cochrane, C. De Young, D. Soto, and T. Bahri, Rome, Italy: Food and Agriculture Organization of the United Nations, http://re.indiaenvironmentportal.org.in/files/desilva_and_sato.pdf [accessed 11th April 2019].
- de Souza Barbosa de Melo, R.M., Bezerra, I.M.P., dos Santos, J.A. and de Abreu, L.C. (2018). Legal proceedings against a unified health system, SUS, by its patients: systematic review, *Journal of Public Health*, Vol. 26, No. 1, pp.99-108, doi: 10.1007/s10389-017-0827-y.
- De Stefano, L., Duncan, J., Dinar, S., Stahl, K., Strzepek, K.M. and Wolf, A.T. (2012). Climate change and the institutional resilience of international river basins, *Journal of Peace Research*, Vol. 49, No. 1, pp.193-209, https://doi.org/10.1177/0022343311427416 [accessed 11th April 2019].
- de Tavernier, J. (2012). Food citizenship: is there a duty for responsible consumption? *Journal of Agricultural and Environmental Ethics*, Vol. 25, No. 6, pp. 895-907, https://doi.org/10.1007/s10806-011-9366-7 [accessed 11th April 2019].
- de Vos, J., Joppa, L., Gittleman, J., Stephens, P. and Pimm, S. (2014). Estimating the normal background rate of species extinction, *Conservation Biology*, Vol. 29, No. 2, pp.452-462, doi: 10.1111/cobi.12380.
- de Vries, G., de Hoog, J., Stellinga, B. and Dijstelbloem, H. (2014). *Towards a food policy*, The Hague, The Netherlands: Scientific Council for Government Policy, https://english.wrr.nl/ [accessed 11th April 2019].

- de Vries, M. and de Boer, I.J.M. (2010). Comparing environmental impacts for livestock products: a review of life cycle assessments, *Livestock Science*, Vol. 128, pp.1-11, https://doi.org/10.1016/j.livsci.2009.11.007 [accessed 11th April 2019].
- de Vries, W., Kros, J., Kroeze, C. and Seitzinger, S.P. (2013). Assessing planetary and regional nitrogen boundaries related to food security and adverse environmental impacts, *Current Opinion in Environmental Sustainability*, Vol. 5, pp.392-402, doi:10.1016/j.cosust.2013.07.004.
- Deckard, S. (2019). Introduction: reading Ireland's food, energy, and climate, *Irish University Review*, Vol. 49, No. 1, pp.1-12, doi: 10.3366/iur.2019.0375.
- deClerck, F.A.J., Jones, S.K., Attwood, S., Bossio, D., Girvetz, E., Chaplin-Kramer, B., Enfors, E., Fremier, E.K., Gordon, L.J., Kizito, F., Noriega, I.L., Matthews, N., McCartney, M., Meacham, M., Noble, N., Quintero, M., Remans, R., Soppe, R. and Zhang, W. (2017). Agricultural ecosystems and their services: the vanguard of sustainability? *Current Opinion in Environmental Sustainability*, Vol. 23, pp.92-99, https://doi.org/10.1016/j.cosust.2016.11.016 [accessed 11th April 2019].
- DEFRA (2005). *The validity of food miles as a measure of sustainability*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2006a). *Environmental KPIs*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2006b). *Food industry sustainability strategies*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2006c). *Sustainable farming*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2006d). *Food security and the UK: an evidence and analysis paper*, Food Chain Analysis Group, December, London, UK: Department for Environment, Food and Rural Affairs.
- DEFRA (2006e). *SCP evidence base - sustainable commodities case studies case study – Soya*, December, London, UK: Department for Environment, Food and Rural Affairs.
- DEFRA (2008a). *Adapting to climate change in England - a framework for action*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2008b). *Ensuring the UK's food security in a changing world*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2009a). *Safeguarding our soils - a strategy for England*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].

- DEFRA (2009b). *UK food security analysis: detailed analysis*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2009c). *UK food security assessment: our approach*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2010a). *Food 2030*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2010b). *Food security assessment*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2010c). *Indicators for a sustainable food system*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2011a). *Attitudes and behaviours around sustainable food purchasing*, report SERP 1011/11, April, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2011b). *Natural environment white paper: the natural choice: securing the value of nature*, London, Norwich, Belfast, and Edinburgh: The Stationery Office, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2011c). *Evidence to define the sustainability of a healthy diet*, DEFRA Report No. FO0430, London, UK: Department for Environment, Food and Rural Affairs, http://randd.defra.gov.uk/Document.aspx?Document=AnnexC(Economicsustainability).docx [accessed 11th April 2019].
- DEFRA (2012a). *Adapting to climate change in the food industry*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2012b). *Climate change adaptation - risks and opportunities for businesses in the South East of England May 2012*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2012c). *Green food project*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/publications/green-food-project-conclusions [accessed 11th April 2019].
- DEFRA (2013a). *Sustainable land and soils and sustainable and competitive farming strategy: joint evidence plan*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- Defra (2013b). *Mapping current innovation and emerging R&D needs in the food and drink industry required for sustainable economic growth - FO0119*, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].

- DEFRA (2013c). *UK's carbon footprint 1993–2010*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/publications/uks-carbon-footprint [accessed 11th April 2019].
- DEFRA (2014a). *Overseas food and trade. UK's food production to supply ratio from 1956*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistical-data-sets/overseas-trade-in-food-feed-and-drink [accessed 11th April 2019].
- DEFRA (2014b). *Impact of climate change on the capability of the land for agriculture as defined by the agricultural land classification*, Defra research project report SP1104, London, UK: Department for Environment, Food and Rural Affairs, https://webarchive.nationalarchives.gov.uk [accessed 11th April 2019].
- DEFRA (2017a). *Agriculture in the United Kingdom 2017*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2017 [accessed 11th April 2019].
- DEFRA (2017b). *East Midlands: Defra statistics: agricultural facts - commercial holdings at June 2017*, London, UK: Department for Environment, Food and Rural Affairs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850569/regionalstatistics_overview_06dec19.pdf [accessed 11th April 2019].
- DEFRA (2017c). *Letter to Mary Creagh, environmental policy evidence session*, London: Department for Environment, Food and Rural Affairs, https://www.parliament.uk/documents/commons-committees/environmental-audit/correspondence/171130-SoS-to-Mary-Creagh-Environmental-policy-evidence-session.pdf [accessed 11th April 2019].
- DEFRA (2017d). *UK's Carbon Footprint 1997 – 2016*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/uks-carbon-footprint [accessed 11th April 2019].
- DEFRA (2018a). *A green future: our 25 year plan to improve the environment*, London, UK: Department for Environment, Food and Rural Affairs, www.assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf [accessed 11th April 2019].
- DEFRA (2018b). *Family Food Statistics 2016-7*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/publications/family-food-201617/about-family-food [accessed 11th April 2019].
- DEFRA (2018c). *Farming statistics - provisional crop areas, yields and livestock populations at June 2018 - United Kingdom*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/farming-statistics-provisional-crop-areas-yields-and-livestock-populations-at-1-june-2018-united-kingdom [accessed 11th April 2019].

- DEFRA (2018d). *Future farming environment evidence compendium*, London, UK: Department for Environment, Food and Rural Affairs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/683972/future-farming-environment-evidence.pdf [accessed 11th April 2019].
- DEFRA (2018e). *Health and harmony - the future for food, farming and the environment in a green brexit - summary of responses*, London, UK: Department for Environment, Food and Rural Affairs, https://consult.defra.gov.uk/farming/future-of-farming/ [accessed 11th April 2019].
- DEFRA (2018f). *Sustainable fisheries for future generations*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/consultations/fisheries-white-paper-sustainable-fisheries-for-future-generations [accessed 11th April 2019].
- DEFRA (2018g). *The future for food, farming and the environment – summary of responses*, 14th September, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/consultations/the-future-for-food-farming-and-the-environment [accessed 11th April 2019].
- DEFRA (2018h). *The national adaptation programme and the third strategy for climate adaptation reporting: making the country resilient to a changing climate*, July, London, UK: Department for Environment, Food and Rural Affairs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727252/national-adaptation-programme-2018.pdf [accessed 11th April 2019].
- DEFRA (2018i). *Draft Environment (Principles and Governance) Bill,* London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/publications/draft-environment-principles-and-governance-bill-2018 [accessed 11th April 2019].
- DEFRA (2019a). *Agriculture in the United Kingdom 2018*, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2018 [accessed 11th April 2019].
- DEFRA (2019b). *Defra Statistics: agricultural facts - England regional profiles*, May, London, UK: Department for Environment, Food and Rural Affairs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/850569/regionalstatistics_overview_06dec19.pdf [accessed 11th April 2019].
- DEFRA (2019c). *Farm type breakdown for commercial holdings*, London, UK: Department for Environment, Food and Rural Affairs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/848650/structure-england-farm_type_series_14nov19a.xls [accessed 11th April 2019].

- DEFRA (2019d). *Farming statistics: provisional crop areas, yields and livestock populations*, June, United Kingdom, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/farming-statistics-provisional-crop-areas-yields-and-livestock-populations-at-1-june-2019-united-kingdom [accessed 11th April 2019].
- DEFRA (2019e). *National Food Strategy: terms of reference*, 27th June, London, UK: Department for Environment, Food and Rural Affairs, https://www.nationalfoodstrategy.org/terms-of-reference/ [accessed 11th April 2019].
- DEFRA (2019f). Science research programme launched to inform Defra policy making, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/news/science-research-programme-launched-to-inform-defra-policy-making [accessed 11th April 2019].
- DEFRA (2019g). *Statistics - Agricultural Facts: England Regional Profiles*, December, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/agricultural-facts-england-regional-profiles [accessed 11th April 2019].
- DEFRA (2019h). *Statistics: Agricultural Facts, England Regional Profiles*, May, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/agricultural-facts-england-regional-profiles [accessed 11th April 2019].
- DEFRA (2019i). *Structure of the agricultural industry in England and the UK*, Agricultural Census, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june [accessed 11th April 2019].
- DEFRA (2019j). *UK climate projections: headline findings*, September, London, UK: Department for Environment, Food and Rural Affairs, https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf [accessed 11th April 2019].
- DEFRA (2019k). *UKCP18 Science Overview*, Executive Summary, January, London, UK: Department for Environment, Food and Rural Affairs / Met Office, https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf [accessed 11th April 2019].
- DEFRA (2019l). *UK's Carbon Footprint 1997–2016*, Consumption emissions, April, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/uks-carbon-footprint [accessed 11th April 2019].
- DEFRA (2019m). *Wild bird populations in the UK: annual trends in wild bird populations in the UK*, 7th November, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/statistics/wild-bird-populations-in-the-uk [accessed 7th November, 2019].

- DEFRA (2019n). *Horticulture Statistics 2018*, London, UK: Department for Environment, Food and Rural Affairs, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/876670/hort-report-30mar20.pdf [accessed 7th November, 2019].
- DEFRA (2020). *Food statistics in your pocket: global and UK supply*, 30 March, London, UK: Department for Environment, Food and Rural Affairs, https://www.gov.uk/government/publications/food-statistics-pocketbook/food-statistics-in-your-pocket-global-and-uk-supply [accessed 11th April 2020].
- DEFRA/DfIT (2016). *UK Food and Drink - International Action Plan 2016-2020*, London, UK: Department for Environment, Food and Rural Affairs/ Department for International Trade, www.gov.uk/government/publications [accessed 11th April 2019].
- DeFries, R. and Nagendra, H. (2017). Ecosystem management as a wicked problem, *Science*, Vol. 356, pp.265-270, doi: 10.1126/science.aal1950 [accessed 11th April 2019].
- DeFries, R., Fanzo, J., Remans, R., Palm, C., Wood, S. and Anderman, T.L. (2015). Metrics for land scarce agriculture, *Science*, Vol. 349, pp.238-240, doi: 10.1126/science.aaa5766.
- Dehghan, M., Mente, A., Rangarajan, S. and Yusuf, S. (2018). Association of dairy intake with cardiovascular disease and mortality in 21 countries from five continents (PURE): a prospective cohort study, *The Lancet*, Vol. 392, Iss. 10161, pp.2288-2297, doi:https://doi.org/10.1016/S0140-6736(18)31812- [accessed 11th April 2019].
- Deimel, M., Frentru, M. and Theuvsen, L. (2008). Transparency in food supply chains: empirical results from German pig and dairy production, *Journal on Chain and Network Science*, Vol. 8, No.1, pp.21-32, https://doi.org/10.3920/JCNS2008.x086 [accessed 11th April 2019].
- Del Prado, A., Crosson, P., Olesen, J.E. and Rotz, C.A. (2013). Whole-farm models to quantify greenhouse gas emissions and their potential use for linking climate change mitigation and adaptation in temperate grassland ruminant-based farming systems, *Animal*, Vol. 7, pp.373-385, doi: 10.1017/S1751731113000748.
- Delgado, C.L. (2003). Rising consumption of meat and milk in developing countries has created a new food revolution, *The Journal of Nutrition*, Vol. 133, Suppl. 2, pp.3907-3910, doi: 10.1093/jn/133.11.3907S.
- Delgado, C.L., Delgado, Wada, N., Rosegrant, M.W., Meijer, S. and Ahmed, M. (2003). *The future of fish - issues and trends to 2020*, Washington, USA: International Food Policy Research Institute and Malaysia: WorldFish Center [accessed 11th April 2019].
- Dell'Angelo, J., D'Odoricoc, P. and Rullie, M.C. (2017a). Threats to sustainable development posed by land and water grabbing, *Current Opinion in Environmental Sustainability*, Vol. 26-27, pp.120-128, http://dx.doi.org/10.1016/j.cosust.2017.07.007 [accessed 11th April 2019].

- Dell'Angelo, J., D'Odoricoc, P., Rullie, M.C. and Marchand, P. (2017b). The tragedy of the grabbed commons coercion and dispossession in the global land rush, *World Development*, Vol. 92, pp.1-12, http://dx.doi.org/10.1016/j.worlddev.2016.11.005 [accessed 11th April 2019].
- Deloitte (2016). *Capitalizing on the shifting consumer food value equation*, London: Deloitte Touche Tohmatsu Limited, https://www2.deloitte.com/us/en/pages/consumer-business/articles/us-food-industry-consumer-trends-report.html [accessed 11th April 2019].
- Deloitte (2017). *Global health care outlook: making progress against persistent challenges*, London: Deloitte Touche Tohmatsu Limited [accessed 11th April 2019].
- Dembek, Z.F., Kortepeter, M.G. and Pavlin, J.A. (2007). Discernment between deliberate and natural infectious disease outbreaks, *Epidemiology and Infection,* Vol. 135, pp.353-371, doi: 10.1017/S0950268806007011.
- Denef, K., Paustian, K., Archibeque, S., Biggar, S. and Pape, D. (2012). *Report of greenhouse gas accounting tools for agriculture and forestry sectors*, Interim report to USDA under Contract No. GS23F8182H, Fort Collins, https://www.usda.gov/oce/climate_change/techguide/Denef_et_al_2012_GHG_Accounting_Tools_v1.pdf [accessed 11th April 2019].
- Denham, F., Howieson, F.R., Solah, V.A. and Biswas, W.K. (2015). Environmental supply chain management in the seafood industry - past, present and future approaches, *Journal of Cleaner Production*, Vol. 90, pp.82-90, http://dx.doi.org/10.1016/j.jclepro.2014.11.079 [accessed 11th April 2019].
- Denis, N., Fiocco, D. and Oppenheim, J. (2015). *From liability to opportunity - How to build food security and nourish growth*, London, UK: McKinsey.
- Denkenberger, D.C. and Pearce, J.M. (2015). Feeding everyone solving the food crisis in event of global catastrophes that kill crops or obscure the sun, *Futures*, Vol. 72, pp.57-68, doi:http://dx.doi.org/10.1016/j.futures.2014.11.008.
- Denning, S. (2018). New findings on ocean warming - 5 questions answered, *The Conversation*, 2nd November, https://theconversation.com/new-findings-on-ocean-warming-5-questions-answered-106215 [accessed 11th April 2019].
- Denton, F., Wilbanks, T.J., Abeysinghe, A.C., Burton, I., Gao, Q., Lemos, M.C., Masui, T., O'Brien, K.L. and Warner, K. (2014). Climate-resilient pathways: adaptation, mitigation, and sustainable development. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1101-1131.

- Department for Business, Industry, Energy and Skills (2017). *Industrial strategy: building a Britain fit for the future*, London, UK: Department for Business, Industry, Energy and Skills, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/730048/industrial-strategy-white-paper-web-ready-a4-version.pdf [accessed 11th April 2019].
- Department for Health and Social Care (2016). *Childhood obesity: a plan for action*, London, UK: Department for Health and Social Care, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/546588/Childhood_obesity_2016__2__acc.pdf [accessed 11th April 2019].
- Department of Agriculture and Rural Development (2014). *NI Executive response to "going for growth"*, Belfast, UK: Department of Agriculture and Rural Development.
- Dernini, S. (2012). Towards the development of guidelines for improving the sustainability of diets and food consumption patterns in the Mediterranean area, *The Sustainability of Food Systems in the Mediterranean Area*, CIHEAM International Seminar, Rome, Italy: Food and Agricultural Organisation.
- Dernini, S. (2016). Sustainable diets and the decalogue for sustainable food and nutrition in the community, *Journal of Environmental Health Science & Engineering*, Vol. 2, No. 5, pp.1-3, doi: 10.15436/2378-6841.16.1085.
- Dernini, S. and Berry, E.M. (2015). Mediterranean diet: from a healthy diet to a sustainable dietary pattern, *Frontiers in Nutrition*, Vol. 2, No. 15, doi: 10.3389/fnut.2015.00015.
- Dernini, S., Berry, E.M., Serra-Majem, L., La Vecchia, C., Capone, R., Medina, F.X., Aranceta-Bartrina, J., Belahsen, R., Burlingame, B., Calabrese, G., Corella, D., Donini, L.M., Lairon, D., Meybeck, A., Pekcan, A.G., Piscopo, S., Yngve, A. and Trichopoulou, A. (2017). Med Diet 4.0: the Mediterranean diet with four sustainable benefits, *Public Health Nutrition*, Vol. 20, Iss. 7, pp.1322-1330, doi: 10.1017/S1368980016003177.
- Deryng, D., Sacks, W.J., Barford, C.C. and Ramankutty, N. (2011). Simulating the effects of climate and agricultural management practices on global crop yield, *Global Biogeochemical Cycles*, Vol. 25, pp.GB2006, https://doi.org/10.1029/2009GB003765 [accessed 11th April 2019].
- Descateaux, P., Astudillo, M.F. and Amor, M.B. (2016). Assessing the life cycle environmental benefits of renewable distributed generation in a context of carbon taxes, *Renewable and Sustainable Energy Reviews*, Vol. 53, pp.1178-1189, http://dx.doi.org/10.1016/j.rser.2015.09.022 [accessed 11th April 2019].
- Deschenes, O. and Greenstone, M. (2006). *The economic impacts of climate change: evidence from agricultural profits and random fluctuations in weather*, 06-001 WP Joint Centre paper, Department of Economics, Laboratory for Energy and the Environment and Sloan School of Management, https://dspace.mit.edu/bitstream/handle/1721.1/45048/2006-001.pdf?sequence=1 [accessed 11th April 2019].

- Desmit, X., Thieu, V., Billen, G., Campuzano, F., Dulière, V., Garnier, J., Lassaletta, L., Ménesguen, A., Neves, R., Pinto, L., Silvestre, M., Sobrinho, J.L. and Lacroix, G. (2018). Reducing marine eutrophication may require a paradigmatic change, *Science of the Total Environment*, Vol. 635, pp.1444-1466, https://doi.org/10.1016/j.scitotenv.2018.04.181 [accessed 11th April 2019].
- Desquilbet, M., Dorin, B. and Couvet, D. (2017). Land sharing vs land sparing to conserve biodiversity - how agricultural markets make the difference, *Environmental Modelling and Assessment*, Vol. 22, pp.185-200, https://doi.org/10.1007/s10666-016-9531-5 [accessed 11th April 2019].
- Deumling, D., Wackernagel, M. and Monfreda, C. (2003). Eating up the earth: how sustainable food systems shrink our ecological footprint, Oakland, USA: Redefining Progress, pp.1-12, www.RedefiningProgress.org, [accessed 11th April 2019].
- Deutsch, C.A., Tewksbury, J.J., Tigchelaar, M., Battisti, D.S., Merrill, S.C., Huey, R.B. and Naylor, R.L. (2018). Increase in crop losses to insect pests in a warming climate, *Science*, 31st Aug, Vol. 361, No. 6405, pp.916-919, doi: 10.1126/science.aat3466.
- Development Initiatives (2017). *Global nutrition report 2017: nourishing the SDGs*, Bristol, UK: Development Initiatives.
- Development Initiatives (2018). *Global nutrition report 2018 - shining a light to spur action on nutrition*, Bristol, UK: Development Initiatives.
- Devine, S., Ince, M., Marshall, J. and Mitchell, N. (2015). *Food 4.0: growing university-business collaboration for the UK's food economy*, March, London: National Centre for Universities and Business, www.ncub.co.uk [accessed 11th April 2019].
- Devlin, S., Dosch, T., Esteban, A. and Carpenter, G. (2014). *Urgent recall - Our food system under review*, London, UK: New Economics Foundation, https://neweconomics.org/publications/entry/urgent-recall [accessed 11th April 2019].
- DeWeerdt, S. (2017). Climate effects of giving up meat depend on how you slice it, *Anthropocene*, 28th November, http://www.anthropocenemagazine.org/2017/11/climate-effects-of-giving-up-meat-depend-on-how-you-slice-it/ [accessed 11th April 2019].
- DeWeerdt, S. (2017). Where will U.S. climate migrants go? *Anthropocene*, 18th April, http://www.anthropocenemagazine.org/2017/04/where-will-u-s-climate-migrants-go/ [accessed 11th April 2019].
- DeWeerdt, S. (2018). In a century or two, the vegetation of this planet may look completely different than it does today, *Anthropocene*, 4th September, http://www.anthropocenemagazine.org/2018/09/climate-change-could-completely-transform-ecosystems-and-its-already-starting/ [accessed 11th April 2019].
- DfBEIS (2018). Digest of United Kingdom energy statistics (DUKES), London, UK: Department for Business, Energy and Industrial Strategy.

- DGAC (2015). *What is the relationship between population-level dietary patterns and food sustainability and related food security*? Scientific Report of the 2015, USA Dietary Guidelines Advisory Committee, Evidence Portfolio, Part D. Chapter 5, Food Sustainability and Safety, Appendix-E-2.37, https://health.gov/dietaryguidelines/2015-scientific-report/14-appendix-E2/e2-37.asp [accessed 11th April 2019].
- Dhahri, S. and Omri, A. (2018). Entrepreneurship contribution to the three pillars of sustainable development: what does the evidence really say? *World Development*, Vol. 106, pp.64-77, https://doi.org/10.1016/j.worlddev.2018.01.008 [accessed 11th April 2019].
- Dharmasena, S., Bessler, D.A. and Capps, O. (2016). Food environment in the United States as a complex economic system, *Food Policy*, Vol. 61, pp.163-175, https://doi.org/10.1016/j.foodpol.2016.03.003 [accessed 11th April 2019].
- Dholakia, R.R. (1999). Going shopping - key determinants of shopping behaviors and motivations, *International Journal of Retail and Distribution Management*, Vol. 27, No. 4, pp.154-165, https://doi.org/10.1108/09590559910268499 [accessed 11th April 2019].
- Diamond, J. (2005). *Collapse: how societies choose to fail or survive*, London, UK: Viking Press/Penguin, ISBN 0-14-303655-6.
- Dias, L., Gerlach, M., Scharloth, J. and Altmann, E.G. (2018). Using text analysis to quantify the similarity and evolution of scientific disciplines, *Royal Society Open Science*, Vol. 5, No. 171545, http://dx.doi.org/10.1098/rsos.171545 [accessed 11th April 2019].
- Díaz, S. (2019). Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 6th May, Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
- Dibb, S. and de Llaguno, E.S. (2018). Principles for eating meat and dairy more sustainably - the ‘less and better’ approach, *Eating Better*, https://www.eating-better.org/uploads/Documents/2018/better_meat_report_FINAL.pdf [accessed 11th April 2019].
- Dibb, S. and Fitzpatrick, I. (2014). Let’s talk about meat: changing dietary practices for the 21st century, *Eating Better*, December, https://www.eating-better.org/uploads/Documents/LetsTalkAboutMeat.pdf/ [accessed 11th April 2019].

- Dicks, L., Bardgett, R., Bell, J., Benton, T., Booth, A., Bouwman, J., Brown, C., Bruce, A., Burgess, P.J., Butler, S.J., Crute, I., Dixon, F., Drummond, C., Freckleton, R.P., Gill, M., Graham, A., Hails, R.S., Hallett, J., Hart, B., Hillier, J.G., Holland, J.M., Huxley, J.N., Ingram, J.S.I., King, V., MacMillan, T., McGonigle, D.F., McQuaid, C., Nevard, T., Norman, S., Norris, K., Pazderka, C., Poonaji, I., Quinn, C.H., Ramsden, S.J., Sinclair, D., Siriwardena, G.M., Vickery, J.A., Whitmore, A.P., Wolmer, W. and Sutherland, W.J. (2013). What do we need to know to enhance the environmental sustainability of agricultural production? A prioritisation of knowledge needs for the UK food system, *Sustainability*, Vol. 5, No. 7, pp.3095-3115, https://doi.org/10.3390/su5073095 [accessed 11th April 2019].
- Dicks, L.V., Rose, D.C., Ang, F., Aston, S., Birch, A.N.E., Boatman, N., Bowles, E.L., Chadwick, D., Dinsdale, A., Durham, S., Elliott, J., Firbank, L., Humphreys, S., Jarvis, P., Jones, D., Kindred, D., Knight, S.M., Lee, M.R.F., Leifert, C., Lobley, M., Matthews, K., Midmer, A., Moore, M., Morris, C., Mortimer, S., Murray, T.C., Norman, K., Ramsden, S., Roberts, D., Smith, L.G., Soffe, R., Stoate, C., Taylor, B., Tinker, D., Topliff, M., Wallace, J., Williams, P., Wilson, P., Winter, M. and Sutherland, W.J. (2018). What agricultural practices are most likely to deliver “sustainable intensification” in the UK? *Food and Energy Security*, Vol. 8, e00148, https://doi.org/10.1002/fes3.148 [accessed 11th April 2019].
- Diekmann, L.O., Gray, L.C. and Baker, G.A. (2020). Growing ‘good food’: urban gardens, culturally acceptable produce and food security, *Renewable Agriculture and Food Systems*, Vol. 35, No. 2, pp.169-181, doi: 10.1017/S1742170518000388.
- Dieng, H.B., Cazenave, A., Meyssignac, B. and Ablain, M. (2017). New estimate of the current rate of sea-level rise from a sea level budget approach, *Geophysical Research Letters*, Vol. 44, Iss. 8, pp.3744-375, https://doi-org.ezproxy.mmu.ac.uk/10.1002/2017GL073308 [accessed 11th April 2019].
- Dietary Guidelines Advisory Committee (2015). *Scientific report of the 2015 Dietary Guidelines Advisory Committee: advisory report to the Secretary of Health and Human Services and the Secretary of Agriculture*, Washington, USA: U.S. Department of Agriculture, Agricultural Research Service, https://health.gov/sites/default/files/2019-09/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf [accessed 11th April 2019].
- Dietz, S., Bowen, A., Doda, B., Gambhir, A. and Warren, R. (2018). The economics of 1.5°C climate change, *Annual Review of Environment and Resources*, Vol. 43, No. 1, doi: 10.1146/annurev-environ-102017-025817.
- Dietz, T., Ostrom, E. and Stern, P.C. (2003). The struggle to govern the commons, *Science*, 12th December, Vol. 302, pp.1907-1912, doi: 10.1126/science.1091015,
- Diffenbaugh, N.S., Singh, D. and Mankin, J.S. (2017). Quantifying the influence of global warming on unprecedented extreme climate events, *Science Advances*, Vol. 4, pp.eaao3354, https://doi.org/10.1073/pnas.1618082114 [accessed 11th April 2019].

- Diffenbaugh, N.S., Singh, D. and Mankin, J.S. (2018). Unprecedented climate events: historical changes, aspirational targets, and national commitments, *Science Advances*, Vol. 4, No. 2, eaao3354, doi: 10.1126/sciadv.aao3354.
- Dimitri, C. and Dettmann, R.L. (2010). Organic food consumers - what do we really know about them, *British Food Journal*, Vol. 114, No. 8, pp.1157-1183, doi: 10.1108/00070701211252101.
- Dimitri, C. and Rogus, S. (2014). Food choices, food security, and food policy, *Journal of International Affairs*, Spring/Summer, Vol. 67, No. 2, pp.19-31, https://www.jstor.org/stable/24461733 [accessed 11th April 2019].
- Dimova, R., Gang, I.N., Gbakou, M.B.P. and Hoffman, D. (2014). The impact of food and economic crises on diet and nutrition, *Journal of Development Studies*, Vol. 50, No. 12, pp.1687-1699, http://www.sciepub.com/JFS/abstract/1418 [accessed 11th April 2019].
- Dinu, M., Abbate, R., Gensini, G., Casini, A. and Sofi, F. (2016). Vegetarian, vegan diets and multiple health outcomes: a systematic review with meta-analysis of observational studies, *Critical Reviews in Food Science and Nutrition*, Vol. 57, No. 17, pp.3640-3649, doi: 10.1080/10408398.2016.1138447.
- Dittrich, M., Giljum, S., Lutter, S. and Polzin, C. (2012). Green economies around the world? Implications of resource use for development and the environment, *International Journal of Sustainability in Higher Education*, Vol. 14, No. 1, https://doi-org.ezproxy.mmu.ac.uk/10.1108/ijshe.2013.24914aaa.004 [accessed 11th April 2019].
- Dixon, J. (2015). *IUHPE position paper: Advancing health promoting food systems*, Saint Denis Cedex-France: International Union for Health Promotion and Education (IUHPE).
- Djekic, I. (2015). Environmental impact of meat industry – current status and future perspectives, *Procedia Food Science*, Vol. 5, pp.61-64, https://doi.org/10.1016/j.profoo.2015.09.025 [accessed 11th April 2019].
- Djekic, I. and Tomasevic, I. (2016). Environmental impacts of the meat chain – current status and future perspectives, *Trends in Food Science & Technology*, Vol. 54, pp.94-102, https://doi.org/10.1016/j.tifs.2016.06.001 [accessed 11th April 2019].
- Djekic, I., Sanjuan, N., Clemente, G., Jambrak, A.R., and Djukic-Vukovic, A.B. (2018). Review on environmental models in the food chain: current status and future perspectives, *Journal of Cleaner Production*, Vol. 176, pp.1012-1025, https://doi.org/10.1016/j.jclepro.2017.11.241 [accessed 11th April 2019].
- Dobbs, R., Oppenheim, J., Manyika, J., Nyquist, S.S. and Roxburgh, C. (2011). *Resource revolution: meeting the world's energy, materials, food and water needs*, New York, USA: McKinsey Global Institute.
- Dobbs, R., Sawers, C., Thompson, F., Manyika, J., Woetzel, Child, P., McKenna, S. and Spatharou, A. (2014). *Overcoming obesity: an initial economic analysis*, New York, USA: McKinsey Global Institute.

- Doberman, A. (2012). Getting back to the field, *Nature*, Vol. 485, pp.176-177, https://doi.org/10.1038/nj7349-115a [accessed 11th April 2019].
- Doberman, A. and Nelson, R. (2013). *Opportunities and solutions for sustainable food production: background paper for the high-level panel of eminent persons on the post-2015 development agenda*, Sustainable Development Solutions Network Thematic Group on Sustainable Agriculture and Food Production, http://unsdsn.org/wp-content/uploads/2014/02/130112-HLP-TG7-Solutions-for-sustainable-food-production.pdf [accessed 11th April 2019].
- Dobson, J. (2019). Shocking new maps show how sea-level rise will destroy coastal cities by 2050, *Forbes*, 30th October, https://www.forbes.com/sites/jimdobson/2019/10/30/shocking-new-maps-show-how-sea-level-rise-will-destroy-coastal-cities-by-2050/ [accessed 15th April, 2020].
- D'Odorico, P. and Rulli, M.C. (2013). The fourth food revolution, *Nature Geoscience*, Vol. 6, No. 6), pp.417-418, doi:10.1038/ngeo1842.
- D'Odorico, P., Laio, F. and Ridolfi, L. (2010). Does globalization of water reduce societal resilience to drought? *Geophysical Research Letters,* Vol. 37, L13403, doi:10.1029/2010GL043167.
- Doelman, J.C., Stehfest, E., Tabeau, A. and van Meijl, H. (2019). Making the Paris agreement climate targets consistent with food security objectives, *Global Food Security*, Vol. 23, pp.93-103, https://doi.org/10.1016/j.gfs.2019.04.003 [accessed 11th April 2020].
- Doherty, R. (2018). Europeans deserve a food policy that focuses on the environment and people's health, *The Conversation*, 1st June, https://theconversation.com/europeans-deserve-a-food-policy-that-focuses-on-the-environment-and-peoples-health-97622 [accessed 11th April 2019].
- Döll, P. and Schmied, H.M. (2012). How is the impact of climate change on river flow regimes related to the impact on mean annual runoff: a global-scale analysis, *Environmental Reserach Letters*, Vol. 7, pp.014037, doi:10.1088/1748-9326/7/1/014037.
- Donati, M., Menozzi, D., Zighetti, C., Rosi, A., Zinetti, A. and Scazzina, F. (2016). Towards a sustainable diet combining economic, environmental and nutritional objectives, *Appetite*, Vol. 106, pp.48-57, https://doi-org.ezproxy.mmu.ac.uk/10.1016/j.appet.2016.02.151 [accessed 11th April 2019].
- Dong, J., Gruda, N., Li, X., Tang, Y., Zhang, P. and Duan, Z. (2020). Sustainable vegetable production under changing climate: the impact of elevated CO_2 on yield of vegetables and the interactions with environments: a review, *Journal of Cleaner Production*, Vol. 253, 119920, doi: 10.1016/j.jclepro.2019.119920.
- Dong, S.K., Gao, H.W., Xu, G.C. and Hou, X.Y. (2007). Farmer and professional attitudes to the large-scale ban on livestock grazing of grasslands in China, *Environmental Conservation*, Vol. 34, pp.246-254, doi: 10.1017/S0376892907004213.
- Dooley, K. and Kartha, S. (2018). Land-based negative emissions: risks for climate mitigation and impacts on sustainable development, *International Environmental Agreements*, Vol. 18, No. 1, pp.79-98, doi:10.1007/s10784-017-9382-9.

- Dora, M. and Iacovidou, E. (2019). Why the answer to saving the environment isn't getting rid of all plastic food packaging, *The Independent*, 5th July, https://www.independent.co.uk/life-style/food-and-drink/plastic-packaging-food-waste-global-warming-carbon-footprint-a8968541.html [accessed 11th April 2019].
- Doré, L. (2015). Society will collapse by 2040 due to catastrophic food shortages, says study, *The Independent*, 22nd June, https://www.independent.co.uk/environment/climate-change/society-will-collapse-by-2040-due-to-catastrophic-food-shortages-says-study-10336406.html [accessed 11th April 2020].
- Dorward, L.J. (2012). Where are the best opportunities for reducing greenhouse gas emissions in the food system - a comment, *Food Policy*, Vol. 37, pp.463-466, http://dx.doi.org/10.1016/j.foodpol.2012.04.006 [accessed 11th April 2019].
- Dötsch-Klerk, M., Mela, D.J. and Kearney, M. (2015). Sustainable diets, *Journal of the Institute of Food Science and Technology*, 2nd March, https://www.fstjournal.org/features/29-1/sustainable-diets [accessed 11th April 2019].
- Douglas, F., Machray, K. and Entwistle, V. (2020). Health professionals' experiences and perspectives on food insecurity and long-term conditions: a qualitative, *Health & Social Care in the Community*, Vol. 28, Iss. 2, pp.404-413, doi: 10.1111/hsc.12872.
- Dowd, K. and Burke, K. J. (2013). The influence of ethical values and food choice motivations on intentions to purchase sustainably sourced foods, *Appetite*, Vol. 69, pp.137-144, https://doi.org/10.1016/j.appet.2013.05.024 [accessed 11th April 2019].
- Dower, E.A. and O'Connor, D.O. (2012). Rights-based approaches to addressing food poverty and food insecurity in Ireland and UK, *Social Science and Medicine*, Vol. 74, No. 1, pp.44-51, https://doi.org/10.1016/j.socscimed.2011.08.036 [accessed 11th April 2019].
- Dowler, E., Kneafsey, M., Lambie, H., Inman, A. and Collier, R. (2011). Thinking about 'food security': engaging with UK consumers, *Critical Public Health*, Vol. 21, No. 4, pp.403-416, https://doi.org/10.1080/09581596.2011.620945 [accessed 11th April 2019].
- Downing, T. (2012). Views of the frontiers in climate change adaptation economics, Wiley Interdisciplinary Reviews, *Climate Change*, Vol. 3, No. 2, pp.161-170, https://doi.org/10.1002/wcc.157 [accessed 11th April 2019].
- Downs, S.M., Payne, A. and Fanzo, J. (2017). The development and application of a sustainable diets framework for policy analysis: a case study of Nepal, *Food Policy*, Vol. 70, pp.40-49, https://doi.org/10.1016/j.foodpol.2017.05.005.
- Drewnowski, A. (2009). Obesity, diets, and social inequalities, *Nutrition Reviews*, Vol. 67, Suppl. 1, pp.S36-S39, doi: 10.1111/j.1753-4887.2009.00157.x.

- Drewnowski, A., Rehm, C.D., Martin, A., Verger, E.O., Voinnesson, M. and Imbert, P. (2014). Energy and nutrient density of foods in relation to their carbon footprint, *American Journal of Clinical Nutrition*, Vol. 101, Iss. 1, pp.184–191, https://doi.org/10.3945/ajcn.114.092486 [accessed 11th April 2019].
- Drewnowski, A. (2019). *Sustainable diets: linking nutrition and food systems*, Wallingford, UK: CABI, doi: 10.1079/9781786392848.0172.
- Drexhage, J. and Murphy, D. (2010). *Sustainable Development - from Brundtland to Rio 2012*, Background Paper prepared for consideration by the High Level Panel on Global Sustainability, 19th September, New York, USA: United Nations, http://www.surdurulebilirkalkinma.gov.tr/wp-content/uploads/2016/06/Background_on_Sustainable_Development.pdf [accessed 11th April 2019].
- Drummond, M. (2020). Ban fishing supertrawlers, *The Ecologist*, 18th June, https://theecologist.org/2020/jun/18/ban-fishing-supertrawlers [accessed 18th June, 2020].
- Duarte, C.M., Holmer, M., Olsen, Y., Soto, D., Marbà, N., Guiu, J., Black, K. and Karakassis, I. (2009). Will the oceans help feed humanity? *BioScience*, Vol. 59, pp.967-976, https://doi.org/10.1525/bio.2009.59.11.8 [accessed 15th April 2019].
- Dube, S., Scholes, R.J., Nelson, G.C., Mason-D'Croz, D. and Palazzo, A. (2013). South African food security and climate change: agriculture futures, *Economics*, Vol. 7, No. 2013-35, pp. 1, https://ccafs.cgiar.org/publications/south-african-food-security-and-climate-change-agriculture-futures#.XhWz-Uf7TIU [accessed 11th April 2019].
- Dubey, P.K., Singh, G.S. and Abhilash, P.C. (2016). Agriculture in a changing climate, *Journal of Cleaner Production*, Vol. 113, doi: 10.1016/j.jclepro.2015.11.067.
- Dubey, R., Gunasekaran, A., Childe, S.J., Papadopoulos, T., Wamba, S.F. and Song, M. (2016). Towards a theory of sustainable consumption and production: constructs and measurement, *Resources Conservation and Recycling*, Vol. 106, doi:10.1016/j.resconrec.2015.11.008.
- Dubuisson-Quellier, S. and Gojard, S. (2016). Why are food practices not (more) environmentally friendly in France? The role of collective standards and symbolic boundaries in food practices, *Environmental Policy and Governance*, Vol. 26, No. 2, pp.89-100, doi: 10.1002/eet.1703.
- Dubuisson-Quellier, S., Lamine, C. and Le Velly, R. (2011). Citizenship and consumption: mobilisation in alternative food systems in France, *Sociologia Ruralis*, Vol. 51, No. 3, pp.304-323, https://hal-sciencespo.archives-ouvertes.fr/halshs-00630238v2/document [accessed 11th April 2019].
- Duchin, F. (2005). Sustainable consumption of food: a framework for analyzing scenarios about changes in diets, *Journal of Industrial Ecology*, Vol. 9, No. 12, pp.99-114, doi:10.1162/1088198054084707.
- Dueri, S., Guillotreau, P., Jiménez-Toribioc, R., Oliveros-Ramosa, R., Boppe, L. and Maury, O. (2016). Food security or economic profitability: projecting the effects of climate and socioeconomic changes on global skipjack tuna fisheries under three management strategies, *Global Environmental Change*, Vol. 41, pp.1-12, http://dx.doi.org/10.1016/j.gloenvcha.2016.08.003 [accessed 11th April 2019].

- Duncan, J. (2015). Greening global food governance, *Canadian Food Studies*, Vol. 2, No. 2, pp.335-344, doi: https://doi.org/10.15353/cfs-rcea.v2i2.104 [accessed 11th April 2019].
- Duncan, J. and Bailey, M. (eds) (2017). *Sustainable Food Futures: Multidisciplinary Solutions*, London, UK: Routledge, ISBN 9781315463117.
- Dunlap, R.E. and Jacques, P.J. (2013). Climate change denial books and conservative think tanks: exploring the connection, *American Behavioral Scientist*, Vol. 57, pp.699-731, doi: 10.1177/0002764213477096.
- Dunwell, J.M. (2014).Genetically modified crops - European and transatlantic divisions, *Molecular Plant Pathology*, Vol. 15, No. 2, pp.119-121, doi: 10.1111/Mpp.12087.
- Durham, S, and Avant, S. (2011). Working to provide international food security, *Agricultural Research*, October, pp.4-13.
- Durrant, R. (2015). *Civil society roles in transition: towards sustainable food?* London, UK: Food Research Collaboration Briefing Paper, http://foodresearch.org.uk/wp-content/uploads/2014/12/FRC-Briefing-R-Durrant-2014-FINAL-16-12-14.pdf [accessed 11th April 2019].
- Dutkiewicz, S., Morris, J.J., Follows, M.J., Scott, J., Levitan, O., Dyhrman, S.T. and Berman-Frank, I. (2015). Impact of ocean acidification on the structure of future phytoplankton communities, *Nature Climate Change*, Vol. 5, pp.1002-1006, doi:10.1038/nclimate2722.
- Duveiller, G., Hooker, J., and Cescatti, A. (2018). The mark of vegetation change on Earth's surface energy balance, *Nature Communications*, Vol. 9, No. 1, doi: 10.1038/s41467-017-02810-8.
- Dwivedi, S.L., Lammerts van Bueren, E.T., Ceccarelli, S., Grando, S. and Upadhyay, H.D. (2017). Diversifying food systems in the pursuit of sustainable food production and healthy diets, *Trends in Plant Science*, Vol. 22, No. 10, pp.842-856, doi: 10.1016/j.tplants.2017.06.011.
- Dyke, J. (2019). Climate change: 'We've created a civilisation hell bent on destroying itself – I'm terrified', writes Earth scientist, *The Conversation*, 24th May, https://theconversation.com/climate-change-weve-created-a-civilisation-hell-bent-on-destroying-itself-im-terrified-writes-earth-scientist-113055 [accessed 11th June 2019].
- Dyson, T. (1996). *Population and food: global trends and future prospects*, London, UK: Routledge, ISBN 9780415119757.
- Dyson, T. (1999). World food trends and prospects to 2025, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 96, Iss. 11, pp.5929-5936, https://www.jstor.org/stable/47803 [accessed 11th April 2019].
- EA (2018). *Climate change impacts and adaptation*, Bristol, UK: Environment Agency, https://www.gov.uk/government/publications/climate-change-impacts-and-adaptation [accessed 11th April 2019].

- EAC (2019). *Our planet, our health*, Twenty-First Report of Session 2017-2019, HC 1803, 3rd September, London, UK: House of Commons Environmental Audit Committee, https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1803/1803.pdf [accessed 11th April 2019].
- EAC (2020). *Hunger, food insecurity and malnutrition in the UK*, London, UK: House of Commons Environmental Audit Committee, https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1491/149105.htm [accessed 11th April 2020].
- Eagle, J., Naylor, R. and Smith, W. (2004). Why farm salmon outcompete fishery salmon, *Marine Policy*, Vol. 28, pp.259-270, doi:10.1016/j.marpol.2003.08.001.
- Eakin, H., Connors, J.P., Wharton, C., Bertmann, F., Xiong, A. and Stoltzfus, J. (2017). Identifying attributes of food system sustainability - emerging themes and consensus, *Agriculture and Human Values*, Vol. 34, pp.757-773, doi: 10.1007/s10460-016-9754-8.
- Earle, S. (2013). Ocean 2050: how to sustain our biggest ecosystem, *BBC News*, 6th December, http://www.bbc.com/future/story/20131206-sos-save-our-seas [accessed 11th April 2019].
- Easterling, W. and Aggarwal, P. (2018). *Food, fibre and forest products*, Geneva, Switzerland: Intergovernmental Panel on Climate Change (IPCC), https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-chapter5-1.pdf [accessed 11th April 2019].
- Easterling, W.E. and Apps, M. (2005). Assessing the consequences of climate change for food and forest resources: a view from the IPCC, *Climatic Change*, Vol. 70, pp.165-189, https://doi.org/10.1007/s10584-005-5941-0 [accessed 11th April 2019].
- Easterling, W.E., Aggarwal, P.K., Batima, P., Brander, K.M., Erda, L., Howden, S.M., Kirilenko, A., Morton, J., Soussana, J.-F., Schmidhuber, J. and Tubiello, F.N. (2007). Food, fibre and forest products. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, (eds) Cambridge, UK: Cambridge University Press.
- Eastham, J., Aguiar, L.K. and Thelwell, S. (2017). *Contemporary issues in food supply chain management*, Oxford, UK: Goodfellow Publishers Limited, ISBN 9781911396109.
- EAT Foundation (2019). *Healthy diets from sustainable food systems: food planet health*, Summary Report of the EAT Lancet Commission, Oslo, Norway: EAT Foundation.
- EAT Foundation (2019). *Let's rethink food*, Oslo, Norway: EAT Foundation, https://itunes.apple.com/gb/podcast/lets-rethink-food/id1451540925?mt=2&i=1000430114363 [accessed 11th April 2019].
- Eating Better (2013). *For a fair green healthy future*, Brighton, UK: Eating Better, http://www.eating-better.org/ [accessed 15th April 2019].

- Eating Better (2017). *2016-2017 impact repoty*, Brighton, UK: Eating Better, http://www.eating-better.org/ [accessed 15th April 2019].
- Eating Better (2019). *Towards a common food policy in the EU and UK*, London, UK: Eating Better, https://www.eating-better.org/blog/towards-a-common-food-policy-in-the-eu-and-the-uk [accessed 11th April 2019].
- Ebadi, N. and Ahmadi, D. (2019). Association between food insecurity and low fruit and vegetable intake in the UK in 2016: a cross-sectional study, *The Lancet*, Vol. 394, p.36.
- EC (2013a). *Climate change, environmental degradation, and migration*, Commission staff working document, Brussels, Belgium: European Commission, http://ec.europa.eu/clima/policies/adaptation/what/docs/swd_2013_138_en.pdf [accessed 11th April 2019].
- EC (2013b). *EU strategy on adaptation to climate change*, Brussels, Belgium: European Commission, https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf [accessed 11th April 2019].
- EC (2013c). *Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy*, (2013)8631, Brussels, Belgium: European Commission, https://www.cencenelec.eu/research/tools/Horizon2020/SocietalChallenges/bioeconomy/Pages/default.aspx [accessed 11th April 2019].
- EC (2013d). *Recommendation 2013/179/EU on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations*, Brussels, Belgium: European Commission, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013H0179&from=EN [accessed 11th April 2019].
- EC (2013e). *State of the innovation union report: taking stock 2010 - 2014*, COM(2014) 339, Brussels, Belgium: European Commission.
- EC (2013f). *Sustainable food - a recipe for food security and environmental protection*, Report produced for the European Commission DG Environment, Science Communication Unit, University of the West of England, Bristol (2013). Science for Environment Policy In-depth Report, http://ec.europa.eu/science-environment-policy [accessed 11th April 2019].
- EC (2014). *Why talk about Sustainable Food?* Brussels, Belgium: The European Commission. http://ec.europa.eu/environment/eussd/food.htm [accessed 28th June 2018]
- EC (2015). *European agenda on migration*, Brussels, Belgium: European Commission, https://ec.europa.eu/home-affairs/what-we-do/policies/european-agenda-migration_en [accessed 11th April 2019].
- EC (2016). *The competitive position of the European food and drink industry*, Brussels, Belgium: European Commission, https://ec.europa.eu/growth/content/study-competitive-position-european-food-and-drink-industry-0_en [accessed 11th April 2019].

- EC (2017). *The economic impact of climate change on European agriculture*, Science for Environment Policy, 18th May, Iss. 488, Brussels, Belgium: European Commission DG Environment, https://ec.europa.eu/environment/integration/research/newsalert/pdf/economic_impact_of_climate_change_on_european_agriculture_488na2_en.pdf [accessed 11th April 2019].
- EC (2018a). *Dietary exposure to neonicotinoid-contaminated plant material poses risk to leaf-shredding invertebrates*, 7th March, Iss. 504, Brussels, Belgium: European Commission DG Environment, https://ec.europa.eu/environment/integration/research/newsalert/pdf/dietary_exposure_neonicotinoid_contaminated_plant_material_poses_risk_leaf_shredding_invertebrates_504na2_en.pdf [accessed 11th April 2019].
- EC (2018b). *EU agricultural outlook for markets and income, 2018-2030*, Brussels, Belgium: European Commission, DG Agriculture and Rural Development, https://ec.europa.eu/knowledge4policy/publication/eu-agricultural-outlook-2018-2030-changing-consumer-choices-shaping-agricultural-markets_en?page=19 [accessed 11th April 2019].
- EC (2018c). *Evaluation study of the impact of the CAP on climate change and greenhouse gas emissions*, Final report, Brussels, Belgium: European Commission, https://ec.europa.eu/agriculture/sites/agriculture/files/evaluation/market-and-income-reports/2019/cap-and-climate-evaluation-report_en.pdf [accessed 11th April 2019].
- EC (2018d). *Fishing TACs and quotas*, Brussels, Belgium: European Commission, https://ec.europa.eu/fisheries/cfp/fishing_rules/tacs_en [accessed 11th April 2019].
- EC (2018e). Mapping the vulnerability of European cities to climate change, Brussels, Belgium: European Commission, http://ec.europa.eu/environment/integration/research/newsalert/pdf/mapping_vulnerability_european_cities_to_climate_change_505na1_en.pdf [accessed 11th April 2019].
- EC (2018f). Climate change consequences, Brussels, Belgium: European Commission, https://ec.europa.eu/clima/change/consequences_en [accessed 20th July 2018].
- EC (2019a). First assessment of global cropland footprint of EU's non-food sector, Brussels, Belgium: European Commission, https://ec.europa.eu/environment/integration/research/newsalert/pdf/global_cropland_footprint_eu_non_food_sector_533na1_en.pdf [accessed 11th April 2019].
- EC (2019b). *The Environmental Implementation Review: United Kingdom*, Luxembourg, Belgium: Publications Office of the European Union, http://ec.europa.eu/environment/eir/index_en.htm [accessed 11th April 2019].
- EC (2019c). *Balancing research, policy and practice could help agriculture meet SDGs*, Brussels, Belgium: European Commission, https://ec.europa.eu/environment/integration/research/newsalert/pdf/research_policy_practice_agriculture_sustainable_development_goals_529na3_en.pdf [accessed 11th April 2019].

- Eccleston, C.H. (2009). Peak Food? Do recent shortages portend a leaner future? *Environmental Quality Management*, Spring, pp.9-17, doi: 10.1002/tqem.20212 [accessed 11th April 2019].
- Ecker, O. and Breisinger, C. (2012). *The food security system: a new conceptual framework*, IFPRI discussion papers 1166, Washington, USA: International Food Policy Research Institute (IFPRI).
- Economist Intelligence Unit – Barilla (2017a). *Fixing Food - The Mediterranean Region*, London, UK: Economist Intelligence Unit, https://www.barillacfn.com/m/publications/bcfn-fixingfoodthemediterraneanregion2017.pdf [accessed 11th April 2019].
- Economist Intelligence Unit – Barilla (2017b). *Fixing food: towards a more sustainable food system*, London, UK: Economist Intelligence Unit, https://www.barillacfn.com/en/publications/fixing-food-towards-a-more-sustainable-food-system/ [accessed 11th April 2019].
- Economist Intelligence Unit – Barilla (2017c). *Food Sustainability Index 2017*, London, UK: Economist Intelligence Unit, https://foodsustainability.eiu.com/wp-content/uploads/sites/34/2016/09/FoodSustainabilityIndex2017GlobalExecutiveSummary.pdf [accessed 11th April 2019].
- Economist Intelligence Unit – Barilla (2017d). *Understanding the GFSI - What is the Global Food Security Index*, London, UK: Economist Intelligence Unit, https://foodsecurityindex.eiu.com/ [accessed 11th April 2019].
- Economist Intelligence Unit – Barilla (2018a). *Fixing food 2018: best practices towards the sustainable development goals*, London, UK: Economist Intelligence Unit, https://www.cgiar.org/news-events/news/fixing-food-2018-best-practices-towards-sustainable-development-goals/ [accessed 11th April 2019].
- Economist Intelligence Unit – Barilla (2018b). *Food Sustainability Index 2018*, London, UK: Economist Intelligence Unit, https://www.barillacfn.com/en/food_sustainability_index/ [accessed 11th April 2019].
- Economist Intelligence Unit (2010). *Managing for sustainability*, London, UK: Economist Intelligence Unit, http://graphics.eiu.com/upload/eb/Enel_Managing_for_sustainability_WEB.pdf [accessed 11th April 2019].
- Economist Intelligence Unit (2016). *User guide for the Global Food Security Index: understanding the index and leveraging it for your work*, London, UK: Economist Intelligence Unit Limited, https://foodsecurityindex.eiu.com/Home/DownloadResource?fileName=EIU%20GFSI_User%20guide.pdf [accessed 11th April 2019].
- Economist Intelligence Unit (2017a). *Food Sustainability Index Methodology*, London, UK: Economist Intelligence Unit Limited, https://foodsustainability.eiu.com/wp-content/uploads/sites/34/2017/12/BCFN_EIU_FSI_methodology_final.pdf [accessed 11th April 2019].
- Economist Intelligence Unit (2017b). *No more excuses - responsible supply chains in a globalised world*, London, UK: Economist Intelligence Unit Limited, http://growthcrossings.economist.com/wp-content/uploads/sites/47/2017/07/EIU-SCB-RSC-WP.pdf [accessed 11th April 2019].

- Economist Intelligence Unit (2018a). *Food Sustainability Index*, Economist Intelligence Unit and Barilla Center, http://foodsustainability.eiu.com/country-profile/gb [accessed 11th April 2019].
- Economist Intelligence Unit (2018b). *Food for the future*, London, UK: Economist Intelligence Unit, https://innovationmatters.economist.com/food-for-the-future-sustaining-eiu [accessed 11th April 2019].
- Economist Intelligence Unit (2019) Food Sustainability Index, http://foodsustainability.eiu.com/what-does-brexit-mean-for-uk-food-sustainability/ [accessed 11th April 2019].
- *Economist, The* (2009). Whatever happened to the food crisis, 2nd July, *The Economist*, https://www.economist.com/international/2009/07/02/whatever-happened-to-the-food-crisis [accessed 11th April 2019].
- *Economist, The* (2013). *A healthy future for all - improving food quality for Asia*, London, UK: Economist Intelligence Unit.
- *Economist, The* (2014a). Governing the oceans: the tragedy of the high seas, *The Economist*, 22nd February, pp.10-11, http://www.economist.com/news/leaders/21596942-new-management-needed-planets-most-important-common-resource-tragedy-high [accessed 11th April 2019].
- *Economist, The* (2014b). Is polar warming to blame for America's and Britain's bad winter weather, *The Economist*, 22nd February, https://www.economist.com/science-and-technology/2014/02/22/jet-set [accessed 11th April 2019].
- *Economist, The* (2014c). *Humans are damaging the high seas - now the oceans are doing harm back*, London, UK: Economist Intelligence Unit, https://www.businessinsider.com/humans-are-damaging-the-high-seas--now-the-oceans-are-doing-harm-back-2015-1?r=US&IR=T [accessed 11th April 2019].
- *Economist, The* (2014d). *In deep water*, *The Economist*, 22nd February, pp.51-53, https://www.economist.com/international/2014/02/24/in-deep-water [accessed 11th April 2019].
- *Economist, The* (2014e). *How to keep stomachs full*, *The Economist*, 22nd February, p.35, https://www.economist.com/middle-east-and-africa/2014/02/22/how-to-keep-stomachs-full [accessed 11th April 2019].
- *Economist, The* (2015a). *Feeding the World Summit to address food and nutrition security*, London, UK: Economist Intelligence Unit, http://www.fao.org/fileadmin/templates/wsfs/Summit/WSFS_Issues_papers/WSFS_Background_paper_Feeding_the_world.pdf [accessed 11th April 2019].
- *Economist, The* (2017b). *Green finance: making the transition to a climate-resilient future - how the bond market is leading the way*, London, UK: Economist Intelligence Unit, https://perspectives.eiu.com/sites/default/files/S%26PGREENFINANCEINFOGRAPHICFINAL13Nov17.pdf [accessed 11th April 2019].

- *Economist, The* (2019). After a no-deal Brexit, should Britain abolish all tariffs? It would mean cheaper food—but bankrupt farmers, *The Economist*, 28th February, https://www.economist.com/britain/2019/02/28/after-a-no-deal-brexit-should-britain-abolish-all-tariffs [accessed 11th April 2019].
- Edame, G.E., Anam, B.E., Fonta, W.M. and Duru, E.J.C. (2011). Climate change, food security and agricultural productivity in Africa: issues and policy directions, *International Journal of Humanities and Social Science*, Vol. 1, No. 21, December, pp.205-223, https://www.ijhssnet.com/journals/Vol_1_No_21_Special_Issue_December_2011/21.pdf [accessed 11th April 2019].
- Edie (2019). Climate change threatening security of UK's food and medicine supply, MPs warn, *Edie News*, 17th September, https://iuenergy.co.uk/climate-change-threatening-security-of-uks-food-and-medicine-supply-mps-warn/ [accessed 11th April 2019].
- Edwards, P. (2015). Aquaculture environment interactions: past, present and likely future trends, *Aquaculture*, Vol. 447, pp.2-14, http://dx.doi.org/10.1016/j.aquaculture.2015.02.001.
- Edwards, R. (2017). Pollution leaves 45 lochs in Scotland a risk to human health, *Sunday Herald*, 7th March, https://www.heraldscotland.com/opinion/15134378.letters-loch-pollution-fears-and-questions/ [accessed 11th April 2019].
- Edwards, T. (2017). *Current and future impacts of sea-level rise on the UK*, Foresight – Future of the Sea Evidence Review, August, London, UK: Government Office for Science, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/663885/Future_of_the_sea_-_sea_level_rise.pdf [accessed 11th April 2019].
- EEA (2017). Food in a green light - a systems approach to sustainable food, Luxembourg: European Environment Agency, https://www.pbl.nl/en/publications/food-in-a-green-light [accessed 11th April 2019].
- EEA (2018). *EMEP/EEA air pollutant emission inventory guidebook*, Luxembourg: European Environment Agency, https://www.eea.europa.eu/themes/air/air-pollution-sources-1/emep-eea-air-pollutant-emission-inventory-guidebook/emep [accessed 11th April 2019].
- EFRA (2014). *Committee report on food security*, London, UK: HM Government Environment, Food and Rural Affairs Select Committee, http://www.publications.parliament.uk/pa/cm201415/cmselect/cmenvfru/243/24302.htm [accessed 11th April 2019].
- EFRA (2015). *Food security - demand, consumption and waste*, Environment, Food and Rural Affairs Committee Report HC 703, London, UK: House of Commons Stationery Office Limited, https://publications.parliament.uk/pa/cm201415/cmselect/cmenvfru/703/70302.htm [accessed 11th April 2019].

- EFSA (2019). The 2017 European Union report on pesticide residues in food, *EFSA Journal*, Vol. 17, No. 6, pp.n/a-n/a, https://www.efsa.europa.eu/en/efsajournal/pub/5743 [accessed 11th April 2019].
- Egger, M., Smith, G.D. and Phillips, A.N. (1997). Meta-analysis: principles and procedures, *BMJ*, Vol. 315, 6th December, pp.1533-1537, doi: https://doi.org/10.1136/bmj.315.7121.1533.
- Egli, L., Meyer, C., Scherber, C., Kreft, H. and Tscharntke, T. (2018). Winners and losers of national and global efforts to reconcile agricultural intensification and biodiversity conservation, *Global Change Biology*, Vol. 24, pp.2212-2228, https://doi.org/10.1111/gcb.14076 [accessed 11th April 2019].
- Ehleringer, J.R., Cerling, T.E. and Dearing, M.D. (2002). Atmospheric CO_2 as a global change driver influencing plant-animal interactions, *Integrative and Comparative Biology*, Vol. 42, pp.424-430, doi: 10.1093/icb/42.3.424.
- EHN (2017). Transforming European food and drink policies for cardiovascular health, Brussels, Belgium: European Heart Network (EHN), http://www.ehnheart.org/publications-and-papers/publications/1093:transforming-european-food-and-drinks-policies-for-cardiovascular-health.html [accessed 11th April 2019].
- Ehrlich, P.R. (1995). The scale of the human enterprise and biodiversity loss. In: *Extinction rates*, (eds) Lawton, J.H. and May, R.M., New York, USA: Oxford University Press, ISBN: 0-19-854829. X.
- Eilers, E.J., Kremen, C., Greenleaf, S.S., Garber, A.K. and Klein, A-M. (2011). Contribution of pollinator-mediated crops to nutrients in the human food supply, *PLoS One*, Vol. 6, pp.e21363, https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0021363 [accessed 11th April 2019].
- Einarsson, R., McCrory, G. and Persson, U.M. (2019). Healthy diets and sustainable food systems, *The Lancet*, Vol. 394, No. 10194, pp.215-215, doi: 10.1016/S0140-6736(19)31116-X.
- EIPRO (2006). *Analysis of the life cycle environmental impacts related to the final consumption of the EU-25*, Brussels, Belgium: European Commission Joint Research Centre, Institute for Prospective Technological Studies, Technical Report EUR 22284, https://ec.europa.eu/environment/ipp/pdf/eipro_report.pdf [accessed 11th April 2019].
- Eisde, J. and White, N. (2018). Coffee farmers struggle to adapt to Colombia's changing climate, *The Conversation*, 22nd August, https://theconversation.com/coffee-farmers-struggle-to-adapt-to-colombias-changing-climate-97916 [accessed 11th April 2019].
- Eisler, M.C., Lee, M.R.F., Tarlton, J.F., Martin, G.B., Beddington, J., Dungait, J.A.J., Greathead, H., Liu, J., Mathew, S., Miller, H., Misselbrook, T., Murray, P., Vinod, V.K., Van Saun, R. and Winter, M. (2014). Agriculture: steps to sustainable livestock, *Nature,* Vol. 507, Iss. 7490, https://www.nature.com/news/agriculture-steps-to-sustainable-livestock-1.14796 [accessed 11th April 2019].
- Ejeta, L.T., Ardalan, A. and Paton, D. (2015). Application of behavioral theories to disaster and emergency health preparedness: a systematic review, *PLoS Currents Disasters*, doi: 10.1371/currents.dis.31a8995ced321301466db400f1357829.

- Eker, S., Reese, G. and Obersteiner, M. (2019). Modelling the drivers of a widespread shift to sustainable diets, *Nature Sustainability*, Vol. 2, pp.725-735, https://doi.org/10.1038/s41893-019-0331-1.
- Ekwurzel, B., Boneham, J., Dalton, M.W., Heede, R., Mera, R.J., Allen, M.R. and Frumhoff, P.C. (2017). The rise in global atmospheric CO_2, surface temperature, and sea level from emissions traced to major carbon producers, *Climatic Change*, Vol. 144, No. 579, https://doi.org/10.1007/s10584-017-1978-0 [accessed 11th April 2019].
- El Bilali, H. (2019). Research on agro-food sustainability transitions: where are food security and nutrition? *Food Security*, Vol. 11, No. 3, pp.559-577, https://doi.org/10.1007/s12571-019-00922-1 [accessed 11th April 2020].
- El Bilali, H. (2019). Research on agro-food sustainability transitions: a systematic review of research themes and an analysis of research gaps, *Journal of Cleaner Production*, Vol. 221, pp.353-364, https://doi.org/10.1016/j.jclepro.2019.02.232 [accessed 11th April 2019].
- El Bilali, H. (2020). Transition heuristic frameworks in research on agro-food sustainability transitions, *Environment, Development and Sustainability*, Vol. 22, No. 3, pp.1693-1728, doi: 10.1007/s10668-018-0290-0.
- El Bilali, H., Callenius, C., Strassner, C. and Probst, L. (2019). Food and nutrition security and sustainability transitions in food systems, *Food and Energy Security*, Vol. 8, No. 2, e00154, https://doi.org/10.1002/fes3.154 [accessed 11th April 2019].
- Elbehri, A. (ed) (2015). *Climate change and food systems: global assessments and implications for food security and trade*, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), ISBN 978-92-5-108699-5.
- ELDC (2017). *East Lindsey strategic flood risk assessment: supporting economic growth for the future*, March, Louth, UK: East Lindsey District Council, https://www.e-lindsey.gov.uk/media/5974/CD54-SFRA-2017-Part-1/pdf/CD54_SFRA_2017_Part_1.pdf?m=636413249442670000 [accessed 11th April 2019].
- Eldridge, H.M. (2019). What does President Trump mean for UK farming, *Sustainable Food Trust*, 31st May, https://sustainablefoodtrust.org/articles/what-does-president-trump-mean-for-uk-farming/ [accessed 11th June 2019].
- Elefterie, K-A. (2016). North Sea cod fisheries: MEPs end time-at-sea limits, *European Parliament Press Release*, 22nd November, http://www.europarl.europa.eu/news/en/press-room/20161117IPR51566/north-sea-cod-fisheries-meps-end-time-at-sea-limits [accessed 11th April 2019].
- Elferink, M. and Schierhorn, F. (2016). Global demand for food is rising. Can we meet it? *Harvard Business Review*, 7th April, https://hbr.org/2016/04/global-demand-for-food-is-rising-can-we-meet-it [accessed 11th April 2019].

- Elfitasari, T. and Albert, A. (2017). Challenges encountered by small scale fish farmers in assuring fish product sustainability, *Omni-Akuatika*, Vol. 13, No. 2, doi: 10.20884/1.oa.2017.13.2.256.
- Elizabeth, K. and Lund, E.K. (2013). Health benefits of seafood - is it just the fatty acids, *Food Chemistry*, Vol. 14, pp.413-420, https://doi.org/10.1016/j.foodchem.2013.01.034 [accessed 11th April 2019].
- *Ellen MacArthur Foundation* (2015). *Growth within - a circular economy vision for a competitive Europe*, Cowes, Isle of Wight: Ellen MacArthur Foundation, https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_Growth-Within_July15.pdf [accessed 11th April 2019].
- *Ellen MacArthur Foundation* (2016). *Towards the circular economy: business rationale for an accelerated transition*, Cowes, Isle of Wight: Ellen MacArthur Foundation, https://www.ellenmacarthurfoundation.org/assets/downloads/TCE_Ellen-MacArthur-Foundation_9-Dec-2015.pdf [accessed 11th April 2019].
- *Ellen MacArthur Foundation* (2018). *Cities and the circular economy for food*, Cowes, Isle of Wight: Ellen MacArthur Foundation, https://www.ellenmacarthurfoundation.org/our-work/activities/cities-and-the-circular-economy-for-food [accessed 11th April 2019].
- Ellerton, P. (2018). How to use critical thinking to spot false climate claims, *The Conversation*, 7th February, https://theconversation.com/how-to-use-critical-thinking-to-spot-false-climate-claims-91314 [accessed 11th April 2019].
- Elliot, J. and Tippers, W.A. (2018). *Protecting standards in the UK food and farming through Brexit*, London, UK: Green Alliance, https://www.green-alliance.org.uk/resources/protecting_standards_in_UK_food_and_farming_through_Brexit.pdf [accessed 11th April 2019].
- Elliott, C. (2014). *Elliott review into the integrity and assurance of food supply networks: a national food crime prevention framework*, PB 14192, London, UK: HM Government, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/350726/elliot-review-final-report-july2014.pdf [accessed 11th April 2019].
- Elliott, C., Situ, C. and McEvoy, C. (2018). Vegan diets are adding to malnutrition in wealthy countries, *The Conversation*, 13th December, https://theconversation.com/vegan-diets-are-adding-to-malnutrition-in-wealthy-countries-107555 [accessed 11th April 2019].
- Elliott, J., Deryng, D., Müller, C., Frieler, K., Konzmann, M., Gerten, D., Glotter, M., Flörke, M., Wada, Y., Best, N., Eisner, S., Fekete, B.M., Folberth, C., Foster, I., Gosling, S.N., Haddeland, I., Khabarov, N., Ludwig, F., Masaki, Y., Olin, S., Rosenzweig, C., Ruane, A.C., Satoh, Y., Schmid, E., Stacke, T., Tang, Q. and Wisser, D. (2014). Constraints and potentials of future irrigation water availability on agricultural production under climate change, *Proceedings of the National Academy of Sciences*, Vol. 111, pp.3239-3244, https://doi.org/10.1073/pnas.1222474110 [accessed 11th April 2019].

- Elliott, L. (2018). Climate change will make the next global crash the worst. The storm clouds are gathering, but the world's economies now have far fewer shelters from disaster than they did in 1929, *The Guardian*, 11th October, https://www.theguardian.com/commentisfree/2018/oct/11/climate-change-next-global-crash-world-economies-1929 [accessed 11th April 2019].
- Ellis, E.C., Goldewijk, K.K., Siebert, S., Lightman, D. and Ramankutty, N. (2010). Anthropogenic transformation of the biomes, 1700 to 2000, *Global Ecological Biogeography*, Vol. 19, pp.589-606, https://doi.org/10.1111/j.1466-8238.2010.00540.x [accessed 11th April 2019].
- Ellis, E.C., Kaplan, J.O., Fuller, D.Q., Vavrus, S., Goldewijk, K.K. and Verburg, P.H. (2013). Used planet: a global history, *Proceedings of the National Academy of Science*, Vol. 110, pp.7978-7985, https://doi.org/10.1073/pnas.1217241110 [accessed 11th April 2019].
- Elwood, P.C., Pickering, J.C., Givens, I.D. and Gallacher, J.E. (2010). The consumption of milk and dairy foods and the incidence of vascular disease and diabetes - an overview of the evidence, *Lipids*, Vol. 45, pp.925-939, doi: 10.1007/s11745-010-3412-5.
- Embury-Dennis, T. (2017). Sea creatures in deepest parts of ocean found to have plastic fibres in their stomachs for first time, Shocking results show there is nowhere untouched by scale of human waste, *The Independent*, 16th November, http://www.independent.co.uk/news/science/sea-creatures-manmade-fibres-sea-pollution-deep-ocean-scientists-mariana-trench-newcastle-university-a8058106.html [accessed 11th April 2019].
- Eme, P.E., Douwes, J., Kim, N., Foliaki, S. and Burlingame, B. (2019). Review of methodologies for assessing sustainable diets and potential for development of harmonised indicators, *International Journal of Environmental Research and Public Health*, Vol. 16, No. 7, pp.1184, doi: 10.3390/ijerph16071184.
- EMSDRT (2000). *The potential impacts of climate change in the East Midlands: summary report*, July, Leamington Spa, UK: Entec UK Limited / East Midlands Sustainable Development Roundtable.
- Endo, A., Tsurita, I., Burnett, K. and Orencio, P.M. (2017). A review of the current state of research on the water, energy, and food nexus, *Journal of Hydrology: Regional Studies*, Vol. 11, pp. 20-30, https://doi.org/10.1016/j.ejrh.2015.11.010 [accessed 11th April 2019].
- Eng, M.L., Stutchbury, B.J.M. and Morrissey, C.A. (2019). A neonicotinoid insecticide reduces fueling and delays migration in songbirds, *Science*, 13th September, pp.1177-1180, doi: 10.1126/science.aaw9419.
- Engebretsen, E., Heggen, K. and Ottersen, O.P. (2017). The Sustainable Development Goals - ambiguities of accountability, *The Lancet*, Vol. 389, No. 10067, p.365, https://doi.org/10.1016/j.ejrh.2015.11.010 [accessed 11th April 2019].
- Engel, P., Enkvist, P-A. and Henderson, K. (2015). How companies can adapt to climate change, *McKinsey*, July, https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/how-companies-can-adapt-to-climate-change [accessed 11th April 2019].

- Engida, T.G., Rao, X., Berentsen, P.B.M. and Oude Lansink, A.G.J.M. (2018). Measuring corporate sustainability performance - the case of European food and beverage companies, *Journal of Cleaner Production*, Vol. 195, pp.734-743, https://doi.org/10.1016/j.jclepro.2018.05.095 [accessed 11th April 2019].
- Englert, D., Zubrod, J. P., Link, M., Mertins, S., Schulz, R. and Bundschuh, M. (2017). Does waterborne exposure explain effects caused by neonicotinoidcontaminated plant material in aquatic systems? *Environmental Science & Technology*, Vol. 51, No. 10, pp.5793-5802, doi: 10.1021/acs.est.7b00827.
- Environment Agency (2013). *Food and drink manufacturing water demand projections to 2050*, Report EBPLW12033, Bristol, UK: Environment Agency, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/297233/LIT_8767_4d1fe5.pdf [accessed 11th April 2019].
- EP (2017). EU – UK agricultural trade - state of play and possible impacts of Brexit, *Workshop on 'Implications of 'Brexit' for the EU agri-food sector and the CAP: budgetary, trade and institutional issues'*, Policy Department for Structural and Cohesion Policies, Brussels, Belgium: European Parliament Directorate-General for Internal Policies.
- EPA (2016). *Inventory of U.S. greenhouse gas emissions and sinks: 1990-2014*, Washington, USA: U.S. Environmental Protection Agency, https://www.epa.gov/sites/production/files/2016-04/documents/us-ghg-inventory-2016-main-text.pdf [accessed 11th April 2019].
- EPHA (2018). *CAP: 11 ways to deliver for better health*, Brussels, Belgium: European Public Health Alliance, https://epha.org/cap4health-11-ways-to-deliver/ [accessed 11th April 2019].
- EQUATOR (2016). *EQUATOR reporting guidelines decision tree*, Oxford, UK: University of Oxford, https://www.equator-network.org/toolkits/selecting-the-appropriate-reporting-guideline/ [accessed 15th April, 2020].
- Erb, K., Lauk, C., Kastner, T., Mayer, A., Theurl, M.C. and Haberl, H. (2016). Exploring the biophysical option space for feeding the world without deforestation, *Nature Communications*, Vol. 7, No. 11382, https://doi.org/10.1038/ncomms11382.
- Ercin, A.E., Aldaya, M.M. and Hoekstra, A.Y. (2012). The water footprint of soy milk and soy burger and equivalent animal products, *Ecological Indicators*, Vol. 18, pp.392-402, doi:10.1016/j.ecolind.2011.12.009.
- Ericksen, P.J., Ingram, J.S.I. and Liverma, D.M. (2009). Food security and global environmental change: emerging challenges, *Environmental Science & Policy*, Vol. 12, No. 4, pp.373-377, https://doi.org/10.1016/j.envsci.2009.04.007 [accessed 11th April 2019].
- Erisman, J.W., Sutton, M.A., Galloway, J., Klimont, Z. and Winiwarter, W. (2008). How a century of ammonia synthesis changed the world, *Nature Geoscience*, Vol. 1, pp.636-639, https://doi.org/10.1038/ngeo325 [accessed 15th April 2019].

- Ernst & Young (2011). *Biofuels and indirect land-use change - the case for mitigation*, London: Ernst & Young LLP, https://www.iucn.org/sites/dev/files/content/documents/biofuels_and_indirect_land_use_change.pdf [accessed 11th April 2019].
- Ersek, V. (2019). How climate change caused the world's first ever empire to collapse, *The Conversation*, 3rd January, https://theconversation.com/how-climate-change-caused-the-worlds-first-ever-empire-to-collapse-109060 [accessed 11th April 2019].
- Escajedo San-Epifanio, L. (2015). Challenging food governance models: analyzing the food citizen and the emerging food constitutionalism from an EU Perspective, *Journal of Agricultural and Environmental Ethics,* Vol. 28, No. 3, pp.435-454, doi:10.1007/s10806-015-9543-1.
- Escarcha, J.F., Lassa, J.A. and Zander, K.K. (2018). Livestock under climate change: a systematic review of impacts and adaptation, *Climate*, Vol. 6, No. 3, 54, doi: 10.3390/cli6030054.
- Escaron, A.L., Meinen, A.M., Nitzke, S.A. and Martinez-Donate, A.P. (2013). Supermarket and grocery store-based interventions to promote healthful food choices and eating practices: a systematic review, *Preventing Chronic Disease*, Vol. 10, No. 120156, doi: 10.5888/pcd10.120156.
- Escobar, N., Tizado, E.J., zu Ermgassen, E.K., Löfgren, P., Börner, J. and Godar, J. (2020). Spatially-explicit footprints of agricultural commodities: mapping carbon emissions embodied in Brazil's soy exports, *Global Environmental Change*, Vol. 62, p.102067, https://doi.org/10.1016/j.gloenvcha.2020.102067 [accessed 15th April 2020].
- Eshel, G., Shepon, A., Shaket, T., Cotler, B.D., Gilutz, S., Giddings, D., Raymo, M.E. and Milo, R. (2018). A model for 'sustainable' US beef production, *Nature Ecology and Evolution*, Vol. 2, No. 1, p.81, doi:10.1038/s41559-017-0390-5.
- Esnouf, C., Russel, M. and Bricas, N. (2013). *Food System Sustainability*, Cambridge, UK: Cambridge University Press, ISBN 9781107036468.
- Espinoza-Orias, N. and Azapagic, A. (2018). Understanding the impact on climate change of convenience food: carbon footprint of sandwiches, *Sustainable Production and Consumption*, Vol. 15, pp.1-15, https://doi.org/10.1016/j.spc.2017.12.002 [accessed 11th April 2019].
- Espitia, A., Rocha, N. and Ruta, M. (2020a). *COVID-19 and food protectionism: the impact of the pandemic and export restrictions on world food markets*, World Bank working paper, Washington USA: World Bank.
- Espitia, A., Rocha, N. and Ruta, M. (2020b). *Database on COVID-19 trade flows and policies*, Washington USA: World Bank.
- Esteban, A. (2011). We need to eat less fish – not more sustainable fish, *The Guardian*, 28th January, https://www.theguardian.com/environment/2011/jan/28/sustainable-fish [accessed 11th April 2019].

- Esteve-Llorens, X., Darriba, C., Moreira, M.T., Feijoo, G. and Gonzalez-Garcia, S. (2019). Towards an environmentally sustainable and healthy Atlantic dietary pattern - life cycle carbon footprint and nutritional quality, *Science of the Total Environment*, Vol. 646, pp.704-715, https://doi.org/10.1016/j.scitotenv.2018.07.264 [accessed 11th April 2019].
- Estrada, F., Tol, R.S.J. and Botzen, W.J.W. (2017). Global economic impacts of climate variability and change during the 20th century, *PLoS One*, Vol. 12, No. 2, pp.e0172201, doi: 10.1371/journal.pone.0172201.
- Estrella, N., Sparks, T.H. and Menzel, A. (2007). Trends and temperature responses in the phenology of crops in Germany, *Global Change Biology*, Vol. 13, pp.1737-1747, doi: 10.1111/j.1365-2486.2007.01374.x.
- ETC (2017). *Who will feed us - the industrial food chain vs. the peasant food web*, 3rd Edition, Val David, Ottawa, Canada: ETC Group, https://www.etcgroup.org/content/who-will-feed-us-industrial-food-chain-vs-peasant-food-web [accessed 11th April 2019].
- Etheridge, D., Pearman, G. and Fraser, P. (1992). Changes in tropospheric methane between 1841 and 1978 from a high accumulation-rate Antarctic ice core, *Tellus B: Chemical and Physical Meteorology*, Vol. 44, No. 4, pp.282-294, https://doi.org/10.1034/j.1600-0889.1992.t01-3-00006.x [accessed 11th April 2019].
- EU (2018b). *How has the EU progressed towards the SDGs, Eurostat monitoring report 147/2018*, 18th September, Brussels, Belgium: European Commission, https://ec.europa.eu/eurostat/documents/2995521/9234939/8-18092018-AP-EN.pdf [accessed 11th April 2019].
- EUC (2010). *Adapting to climate change: EU agriculture and forestry*, 8th Report of Session 2009–10, London, UK: House of Lords European Union Committee, https://publications.parliament.uk/pa/ld200910/ldselect/ldeucom/91/91i.pdf [accessed 11th April 2019].
- EUPHA (2017). *Healthy and sustainable diets for European countries*, Utrecht, The Netherlands: European Public Health Association (EUPHA), www.eupha.org/ [accessed 11th April 2019].
- European Parliament (2017). *Implications of 'Brexit' for the EU agri-food sector and the CAP budgetary, trade and institutional issues*, Directorate-General For Internal Policies, Brussels, Belgium: Policy Department for Structural and Cohesion Policies.
- European Public Health Alliance (2018). *A CAP for better health: 11 ways to deliver for better health*, Brussels: European Public Health Alliance, https://www.citizensforeurope.eu/learn/cap-11-ways-to-deliver-for-better-health [accessed 11th April 2019].
- EU-SCAR (2015). *Why talk about sustainable food?* Standing Committee on Agricultural Research (SCAR), https://ec.europa.eu/environment/archives/eussd/food.htm [accessed 11th April 2019].

- Evans, A. (2009). *The feeding of the nine billion: global food security for the 21st Century*, London, UK: Chatham House Royal Institute of International Affairs, http://www.appg-agscience.org.uk/linkedfiles/ChathamHouseFood%20SecurityJan09.pdf [accessed 11th April 2019].
- Evans, K. (2012). *Adapting to climate change in the food industry: actionable insights into attitudes and behaviours of food production, distribution and retail businesses in relation to managing climate risks*, report for DEFRA, May, Lincoln: Social Change UK.
- Evans, N., Baierl, A., Semenov, M.A., Gladders, P. and Fitt B.D.L. (2008). Range and severity of a plant disease increased by global warming, *Journal of the Royal Society Interface*, Vol. 5, pp.525-531, https://doi.org/10.1098/rsif.2007.1136 [accessed 11th April 2019].
- Ewers, R.M., Scharlemann, J.P.W., Balmford, A. and Green, R.E. (2009). Do increases in agricultural yield spare land for nature? *Global Change Biology*, Vol. 15, pp.1716-1726, doi:10.1111/j.1365-2486.2009.01849.x.
- Ewert, F., Rötter, R.P., Bindi, M., Webber, H., Trnka, M., Kersebaum, K.C., Olesen, J.E., van Ittersum, M.K., Janssen, S., Rivington, M., Semenov, M.A., Wallach, D., Porter, J.R., Stewart, D., Verhagen, J., Gaiser, T., Palosuo, T., Tao, F., Nendel, C., Roggero, P.P., Bartošová, L. and Asseng, S. (2015). Crop modelling for integrated assessment of risk to food production from climate change, *Environmental Modelling and Software*, Vol. 72, pp.287-303, https://doi.org/10.1016/j.envsoft.2014.12.003 [accessed 11th April 2019].
- Eyles, H., Ni Mhurchu, C., Nghiem, N. and Blakely, T. (2012). Food pricing strategies, population diets, and non-communicable disease: a systematic review of simulation studies, *PLoS Medicine*, Vol. 9, No. 12, e1001353, doi: 10.1371/journal.pmed.1001353.
- Eyring, V., Cox, P.M., Flato, G.M., Gleckler, P.J., Abramowitz, G., Caldwell, P., Collins, W.D., Gier, B.K., Hall, A.D., Hoffman, F.M., Hurtt, G.C., Jahn, A., Jones, C.D., Klein, S.A., Krasting, J.P., Kwiatkowski, L., Lorenz, R., Maloney, E., Meehl, G.A., Pendergrass, A.G., Pincus, R., Ruane, A.C., Russell, J.L., Sanderson, B.M., Santer, B.D., Sherwood, S.C., Simpson, I.R., Stouffer, R.J. and Williamson, M.S. (2019). Taking climate model evaluation to the next level, *Nature Climate Change*, Vol. 9, pp.102-110, doi: 10.1038/s41558-018-0355-y.
- Ezzine-de-Blas, D., Wunder, S., Ruiz-Pérez, M. and del Moreno-Sanchez, R.P. (2016). Global patterns in the implementation of payments for environmental services, *PLoS One*, Vol. 11, e0149847, doi:10.1371/journal.pone.0149847.
- Fabinyi, M., Dressler, W.H. and Pido, M.D. (2017). Fish, Trade and food security - moving beyond 'availability' discourse in marine conservation, *Human Ecology*, Vol. 45, pp.177-188, doi: 10.1007/s10745-016-9874-1.

- FACCE (2010). *Agriculture, food security and climate change*, Agriculture, Food Security and Climate Change Joint Programming Initiative (FACCE JPI), December, https://ccafs.cgiar.org/sites/default/files/pdf/Hague_Conference_Agriculture_Food_Security_and_Climate_Change_background_paper.pdf [accessed 11th April 2019].
- FACCE (2015). *Grand debate on nutrition security – a whole system approach*, A joint Agriculture, Food Security and Climate Change (FACCE-JPI – JPI HDHL) event on the impact of climate change on providing a sustainable food supply that has the nutritional requirements to ensure a healthy population, EXPO Milan, 13th May, https://europa.eu/expo2015/node/351 [accessed 11th April 2019].
- Facchini, A. and Laville, S. (2018). Chilean villagers claim British appetite for avocados is draining region dry. UK demand for fruit increased by 27% last year alone, prompting accusations that growers are illegally diverting rivers and leaving locals without water, *The Guardian*, 17th May, https://www.theguardian.com/environment/2018/may/17/chilean-villagers-claim-british-appetite-for-avocados-is-draining-region-dry [accessed 11th April 2019].
- Fader, M., Gerten, D., Krause, M., Lucht, W. and Cramer, W. (2013). Spatial decoupling of agricultural production and consumption: quantifying dependences of countries on food imports due to domestic land and water constraints, *Environmental Research Letters*, Vol. 8, No. 1, 014046, doi:10.1088/1748-9326/8/1/014046.
- Fagodiya, R.K., Pathak, H., Kumar, A., Bhatia, A. and Jain, N. (2017). Global temperature change potential of nitrogen use in agriculture: a 50-year assessment, *Scientific Reports*, Vol. 7, No. 44928, doi: 10.1038/srep44928.
- Fairfood International (2014). *The fruits of their labour - the low wages behind Moroccan tomatoes sold in European supermarkets*, Amsterdam, The Netherlands: Fairfood International, www.fairfood.org [accessed 15th April, 2019].
- Fairlie, S. (2007). Can Britain feed itself, *The Land*, Vol. 4, Winter 2007-8, pp.18-26, http://www.thelandmagazine.org.uk/sites/default/files/can_britain_feed_itself.pdf [accessed 11th April 2019].
- FAIRR (2018). *Factory farming in Asia: assessing investment risks*, Asia Research and Engagement, London, UK: The Farm Animal Investment Risk and Return (FAIRR).
- FAIRR (2019a). *Managing environmental risks in meat and dairy supply chains - engaging with companies to improve supply chain sustainability*, London, UK: The Farm Animal Investment Risk and Return (FAIRR).
- FAIRR (2019b). *Protein producer index 2019*, London, UK: Coller FAIRR Initiative, https://www.fairr.org/ [accessed 9th April 2020].
- Fairtrade International (2014). *The fruits of their labour - the low wages behind Moroccan tomatoes sold in European supermarkets*, Amsterdam, The Netherlands: Fairfoods International.

- Falagas, M.E., Pitsouni, E.I., Malietzis, G.A. and Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses, *FASEB Journal: Official Publication of the Federation of American Societies for Experimental Biology*, Vol. *22*, No. 2, pp.338-342, https://doi.org/10.1096/fj.07-9492LSF [accessed 15th April 2020].
- Falardeau, M. and Bennett, E.M. (2020). Towards integrated knowledge of climate change in arctic marine systems: a systematic literature review of multidisciplinary research, *Arctic Science*, Vol. 6, No. 1, pp.1-23, doi: 10.1139/as-2019-0006.
- Falloon, P.D. and Betts, R. (2010). Climate impacts on European agriculture and water management in the context of adaptation and mitigation – the importance of an integrated approach, *Science of the Total Environment*, Vol. 408, No. 23, pp.5667-5687, https://doi.org/10.1016/j.scitotenv.2009.05.002 [accessed 11th April 2019].
- Fan, S. and Brzeska, J. (2016). Sustainable food security and nutrition: demystifying conventional beliefs, *Global Food Security*, Vol. 11, pp. 11-16, https://doi.org/10.1016/j.gfs.2016.03.005 [accessed 11th April 2019].
- Fanzo, J. and Herrero, M. (2019). What we eat matters - to change climate crisis, we need to reshape the food system, *The Guardian*, 8th October, https://www.theguardian.com/commentisfree/2019/oct/08/climate-change-food-global-heating-livestock [accessed 11th April 2019].
- Fanzo, J., Davis, C., McLaren, R. and Choufani, J. (2018). The effect of climate change across food systems: implications for nutrition outcomes, *Global Food Security*, Vol. 18, pp.12-19, https://doi.org/10.1016/j.gfs.2018.06.001 [accessed 11th April 2019].
- FAO (1989). *Yield and nutritional value of the commercially more important fish species*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/docrep/003/T0219E/T0219E00.HTM [accessed 11th April 2019].
- FAO (2000a). *Code of conduct for responsible fisheries*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/iuu-fishing/international-framework/code-of-conduct-for-responsible-fisheries/en/ [accessed 11th April 2019].
- FAO (2000b). *Fisheries and aquaculture - code of conduct for responsible fisheries*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/v9878e/v9878e00.htm [accessed 11th April 2019].
- FAO (2006). *Livestock's long shadow: environmental issues and options*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a0701e/a0701e00.htm [accessed 11th April 2019].
- FAO (2007). *Poultry in the 21st century avian influenza and beyond*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i0323e.pdf [accessed 11th April 2019].

- FAO (2008). *Climate change and food security: a framework document*, FAO inter-departmental working group on climate change, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/forestry/15538-079b31d45081fe9c3dbc6ff34de4807e4.pdf [accessed 11th April 2019].
- FAO (2010a). *Final document international scientific symposium biodiversity and sustainable diets united against hunger*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/ag/humannutrition/23781-0e8d8dc364ee46865d5841c48976e9980.pdf [accessed 11th April 2019].
- FAO (2010b). Greenhouse gas emissions from the dairy sector: a life cycle assessment, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/k7930e/k7930e00.pdf [accessed 11th April 2019].
- FAO (2010c). *Joint FAO-WHO expert consultation on the risks and benefits of fish consumption*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/ba0136e/ba0136e00.pdf [accessed 11th April 2019].
- FAO (2010d). The second report on the state of the world's plant genetic resources for food and agriculture, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/i1500e/i1500e00.htm [accessed 11th April 2019].
- FAO (2011). *FAO in the 21st century - ensuring food security in a changing world*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/docrep/015/i2307e/i2307e.pdf [accessed 11th April 2019].
- FAO (2012). *World agriculture towards 2030/2015: the 2012 revision*, Rome, Italy, Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-ap106e.pdf [accessed 11th April 2019].
- FAO (2012a). *Livestock and landscapes*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/ar591e/ar591e.pdf [accessed 11th April 2019].
- FAO (2012b). *Responsible governance of tenure of land, fisheries and forests in the context of national food security*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/tenure/voluntary-guidelines/en/ [accessed 11th April 2019].
- FAO (2012c). *Towards the development of guidelines for improving the sustainability of diets and food consumption patterns in the Mediterranean area*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/docrep/016/ap101e/ap101e.pdf [accessed 11th April 2019].
- FAO (2012d). *Towards the future we want - end hunger and make the transition to sustainable agricultural and food systems*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/fsnforum/resources/fsn-resources/towards-future-we-want [accessed 11th April 2019].

- FAO (2012e). *Voluntary guidelines on the responsible governance of tenure of land, fisheries and forests in the context of National Food Security*. Rome, Italy: Food and Agriculture Organization of the United Nations, www.fao.org/docrep/016/i2801e/i2801e.pdf [accessed 11th April 2019].
- FAO (2013a). *Fish to 2030 - prospects for fisheries and aquaculture*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/i3640e/i3640e.pdf [accessed 11th April 2019].
- FAO (2013b). *Healthy people depend on healthy food systems*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/un-expo/en/multimedia/healthy-people-depend-healthy-food-systems.html [accessed 11th April 2019].
- FAO (2013c). *Sustainable food systems for food security and nutrition*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/fileadmin/templates/ags/docs/SFCP/towards_sustainable_food_systems_website.pdf [accessed 11th April 2019].
- FAO (2013d). *Tackling climate change through livestock - a global assessment of emissions and mitigation opportunities*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i3437e.pdf [accessed 11th April 2019].
- FAO (2013e). *The food insecurity experience scale*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-bl354e.pdf [accessed 11th April 2019].
- FAO (2014a). *Agriculture, forestry and other land use emissions by sources and removals by sinks - 1990-2011 analysis*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/docrep/019/i3671e/i3671e.pdf [accessed 11th April 2019].
- FAO (2014b). *Safa sustainability assessment of food and agriculture systems guidelines indicators*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/nr/sustainability/sustainability-assessments-safa/en/ [accessed 11th April 2019].
- FAO (2015a). *Assessing sustainable diets within the sustainability of food systems*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i4806e.pdf [accessed 11th April 2019].
- FAO (2015b). *Fish overview - major trends and issues*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/fishery/docs/DOCUMENT/COFI/COFI_23/trendse.pdf [accessed 11th April 2019].
- FAO (2015c). *Fishers' knowledge and the ecosystem approach to fisheries*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i4664e.pdf [accessed 11th April 2019].
- FAO (2015d). *Natural capital impacts in agriculture – supporting better business decision-making*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/nr/sustainability/natural-capital [accessed 11th April 2019].

- FAO (2015e). *Social protection and food security indicators*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i4796e.pdf [accessed 11th April 2019].
- FAO (2016a). *FishStatJ - software for fishery statistical time series (2016),* Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/fishery/statistics/software/fishstatj/en [accessed 11th April 2019].
- FAO (2016b). *Food and agriculture - key to achieving the 2030 agenda for sustainable development*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i5499e.pdf [accessed 11th April 2019].
- FAO (2016c). *Food and agriculture - key to achieving the 2030 agenda for sustainable development*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/policy-support/resources/resources-details/en/c/422261/ [accessed 11th April 2019].
- FAO (2016d). *Food balance sheets*, Rome, Italy: Food and Agriculture Organization of the United Nations, Statistics Division, http://www.fao.org/faostat/en/#data/FBS [accessed 11th April 2019].
- FAO (2016e). *Food supply* (kcal/capita/day), Rome, Italy: Food and Agriculture Organization of the United Nations, http://faostat3.fao.org/download/FB/CC/E [accessed 11th April 2019].
- FAO (2016f). *Household surveys*, Rome, Italy: Food and Agriculture Organization of the United Nations, Statistics Division, http://www.fao.org/economic/ess/ess-fs/fs-methods/fsreports/en/ [accessed 13th September 2018].
- FAO (2016g). *Methods for estimating comparable rates of food insecurity experienced by adults throughout the world*, Rome, Italy: Food and Agriculture Organization of the United Nations, https://iopscience.iop.org/article/10.1088/1742-6596/772/1/012060 [accessed 11th April 2019].
- FAO (2016h). *Save and grow in practice - a guide to sustainable cereal production*, Rome, Italy: Food and Agriculture Organization of the United Nations, https://www.echocommunity.org/en/resources/06a2f67d-3727-45bb-bdc6-87e71a3be5a4 [accessed 11th April 2019].
- FAO (2016i). *The climate is changing. Food and agriculture must too, 2016*, Rome, Italy: Food and Agriculture Organization of the United Nations.
- FAO (2016j). *The contribution of insects to food security, livelihoods and the environment*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/i3264e/i3264e00.pdf [accessed 11th April 2019].
- FAO (2016k). *The state of agricultural commodity markets: trade and food security achieving a better balance between national priorities and the collective good*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/policy-support/resources/resources-details/es/c/422811/ [accessed 11th April 2019].

- FAO (2016l). *The state of world fisheries and aquaculture 2018*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/i9540en/i9540en.pdf [accessed 11th April 2019].
- FAO (2016m). *Climate change and food security: risks and responses*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i5188e.pdf [accessed 11th April 2019].
- FAO (2017). *Strengthening sector policies for better food security and nutrition results*, Policy Guidance Series, http://www.fao.org/policy-support/resources/resources-details/en/c/885762/ [accessed 11th April 2019].
- FAO (2017a). *FAO in the 21st century - ensuring food security in a changing world*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/i2307e/i2307e.pdf [accessed 11th April 2019].
- FAO (2017b). *Food outlook biannual report on global food markets*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/ca4526en/ca4526en.pdf [accessed 11th April 2019].
- FAO (2017c). *How close are we to #ZeroHunger? The state of food security and nutrition in the world 2017,* Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/state-of-food-security-nutrition/en/ [accessed 11th April 2019].
- FAO (2017d). *The future of food and agriculture – trends and challenges*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i6583e.pdf [accessed 11th April 2019].
- FAO (2017e). *The state of food and agriculture*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i7658e.pdf [accessed 11th April 2019].
- FAO (2018a). *Crop prospects and food situation 1-4*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/giews/reports/crop-prospects/en/ [accessed 11th April 2019].
- FAO (2018b). *Maize, rice and wheat*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i4009e.pdf [accessed 11th April 2019].
- FAO (2018c). *Sustainable food systems: concept and framework*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/ca2079en/CA2079EN.pdf [accessed 11th April 2019].
- FAO (2018d). *The future of food and agriculture – alternative pathways to 2050*, Rome, Italy: Food and Agriculture Organization of the United Nations, Licence: CC BY-NC-SA 3.0 IGO, http://www.fao.org/3/CA1553EN/ca1553en.pdf [accessed 11th April 2019].
- FAO (2018e). *The role of cities in the transformation of food systems: sharing lessons from Milan pact cities*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.milanurbanfoodpolicypact.org/wp-content/uploads/2018/10/CA0912EN.pdf [accessed 11th April 2019].

- FAO (2018f). *The state of agricultural commodity markets 2018: agricultural trade*, climate change and food security, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/I9542EN/i9542en.pdf [accessed 11th April 2019].
- FAO (2018f). *The state of world fisheries and aquaculture*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/i9540en/I9540EN.pdf [accessed 11th April 2019].
- FAO (2018g). *Transition towards sustainable food and agriculture: an analysis of FAO's 2018-2019 work plan*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/in-action/agronoticias/detail/en/c/1118765/ [accessed 11th April 2019].
- FAO (2018j). *Transition towards sustainable food and agriculture*, 2018-2019 work plan, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/publications/card/en/c/I9007EN [accessed 11th April 2019].
- FAO (2019a). *AQUASTAT (Database) - Conservation Agriculture Adoption Worldwide (2019),* Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en [accessed 11th April 2019].
- FAO (2019b). *AQUASTAT*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/nr/water/aquastat [accessed 11th April 2019].
- FAO (2019d). *Fish stats*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/fishery/statistics/en [accessed 11th April 2019].
- FAO (2019e). *Food outlook*, November, CA6911EN, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/giews/reports/food-outlook/en/ [accessed 11th April 2019].
- FAO (2019f). *Global livestock environmental assessment model*, Reference Documentation v2.0, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/gleam/en/ [accessed 11th April 2019].
- FAO (2019g). *The state of food security and nutrition in the world - safeguarding against economic slowdowns and downturns*, Rome, Italy: Food and Agriculture Organization of the United Nations, https://www.wfp.org/publications/2019-state-food-security-and-nutrition-world-sofi-safeguarding-against-economic [accessed 11th April 2019].
- FAO (2019h). *Tracking progress on food and agriculture-related SDG indicators - a report on the indicators under FAO custodianship*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/policy-support/resources/resources-details/en/c/1204556/ [accessed 11th April 2019].
- FAO (2019i). *Save food: global initiative on food loss and waste reduction*, Rome, Italy: Food and Agriculture Organization of the United Nations, www.fao.org/save-food/en/ [accessed 11th April 2019].

- FAO (2019j). *FAO + United Kingdom: joint efforts for sustainable livelihoods and global food security*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/ca3592en/ca3592en.pdf [accessed 11th April 2019].
- FAO (2019k). *Evaluation of the strategy and vision for FAO's work in nutrition*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/evaluation [accessed 11th April 2019].
- FAO (2020). *State of World Fisheries and Aquaculture (SOFIA) 2020: sustainability in action*, Rome, Italy: Food and Agriculture Organization of the United Nations, https://doi.org/10.4060/ca9229en [accessed 15th June 2020].
- FAO (2020). *The State of World Fisheries and Aquaculture 2020*, Rome, Italy: Food and Agriculture Organization of the United Nations.
- FAO and GDP (2018). *Climate change and the global dairy cattle sector: the role of the dairy sector in a low-carbon future*, Rome, Italy: Food and Agriculture Organization of the United Nations and Global Dairy Platform Inc., http://www.fao.org/3/CA2929EN/ca2929en.pdf [accessed 11th April 2019].
- FAO and ITPS (2015). *Status of the world's soil resources*, Food and Agriculture Organization of the United Nations and Intergovernmental Technical Panel on Soils, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/documents/card/en/c/c6814873-efc3-41db-b7d3-2081a10ede50/ [accessed 11th April 2019].
- FAO and WHO (2019). *Sustainable healthy diets – guiding principles*, Rome, Italy: Food and Agriculture Organization of the United Nations,
- FAO/WHO (2016). *United Nations decade of action on nutrition 2016–2025*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/a-i6130e.pdf [accessed 11th April 2019].
- FAO/WHO (2019). *Sustainable healthy diets – guiding principles*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/3/ca6640en/CA6640EN.pdf [accessed 11th April 2019].
- FAOSTAT (2020). *Food and agriculture data*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/faostat/en/#home ca9229en [accessed 15th May 2020].
- Farchi, S., De Sario, M., Lapucci, E., Davoli, M. and Michelozzi, P. (2017). Meat consumption reduction in Italian regions: health co-benefits and decreases in GHG emissions, *PLoS One*, Vol. 12, No. 8, e0182960, doi: 10.1371/journal.pone.0182960.
- Farchi, S., De Sario, M., Lapucci, E., Davoli, M. and Michelozzi, P. (2017). Meat consumption reduction in Italian regions - health co-benefits and decreases in GHG emissions, *PLoS One*, Vol. 12, No. 8, e0182960, https://doi.org/10.1371/journal.pone.0182960 [accessed 11th April 2019].

- Fardet, A. and Rock, E. (2015). From a reductionist to a holistic approach in preventive nutrition to define new and more ethical paradigms, *Healthcare*, Vol. 3, No. 4, pp.1054-1063, doi: 10.3390/healthcare3041054.
- Fargione, J., Hill, J., Tilman, D., Polasky, S. and Hawthorne, P. (2009). Land clearing and the biofuel carbon debt, *Science*, Vol. 319, pp.1235-1237, doi: 10.1126/science.1152747.
- Fargione, J.E., Bassett, S., Boucher, T., Bridgham, S.D., Conant, R.T., Cook-Patton, S.C., Ellis, P.W., Falcucci, A., Fourqurean, J.W., Gopalakrishna, T. and Gu, H. (2018). Natural climate solutions for the United States, *Science Advances*, Vol. 4, No. 11, p.eaat1869, https://advances.sciencemag.org/content/4/11/eaat1869 [accessed 11th April 2019].
- Farina, W.M., Balbuena, M.S., Herbert, L.T., Mengoni Goñalons, C. and Vázquez, D.E. (2019). Effects of the herbicide glyphosate on honey bee sensory and cognitive abilities: individual impairments with implications for the hive, *Insects*, Vol. 10, No. 354, doi:10.3390/insects10100354.
- Farmery, A., Gardner, C., Green, B.S., Jennings, S. and Watson, R. (2015). Life cycle assessment of wild capture prawns: expanding sustainability considerations in the Australian Northern Prawn Fishery, *Journal of Cleaner Production*, Vol. 87, pp.96-104, https://doi.org/10.1016/j.jclepro.2014.10.063 [accessed 11th April 2019].
- Farmery, A.K., Gardner, C., Jennings, S., Green, B.S. and Watson, R.A. (2017). Assessing the inclusion of seafood in the sustainable diet literature, *Fish and Fisheries*, pp.1-12, doi: 10.1111/faf.12205.
- Farnworth, G. and Melchett, P. (2014). *Runaway maize: subsidised soil destruction*, Bristol, UK: The Soil Association.
- Fasullo, J.T. and Nerem, R.S. (2018). Altimeter-era emergence of the patterns of forced sea-level rise in climate models and implications for the future, *Proceedings of the National Academy of Sciences*, 201813233, doi: 10.1073/pnas.1813233115.
- Fattorini, N., Brunetti, C., Baruzzi, C., Macchi, E., Pagliarella, M.C., Pallari, N., Lovari, S., F (2018). Being “hangry”: food depletion and its cascading effects on social behaviour, *Biological Journal*, Vol. 125; No. 3, pp.640-656, https://doi.org/10.1093/biolinnean/bly119 [accessed 11th April 2019].
- Fawcett, S.E. and Magnan, G.M. (2002). The rhetoric and reality of supply chain integration, *International Journal of Physical Distribution & Logistics Management*, Vol. 32, Iss. 5, pp.339-361, http://dx.doi.org/10.1108/09600030210436222 [accessed 11th April 2019].
- FCRN (2014a). *Eating habits must change to protect people and planet*, Oxford, UK: Food Climate Research Network, https://www.fcrn.org.uk/sites/default/files/fcrn_wellcome_gfs_changing_consumption_report_final.pdf [accessed 11th April 2019].
- FCRN (2014b). *Grazing livestock in a world of climate change*, Oxford, UK: Food Climate Research Network, https://www.fcrn.org.uk/fcrn-blogs/grazing-livestock-world-climate-change-do-they-have-role [accessed 11th April 2019].

- FCRN (2018a). *An overview of food system challenges,* Chapter 1, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018b). *Environmental impacts of food: an introduction to LCA*, Chapter 2, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018c). *Focus: the difficult livestock issue*, Chapter 8, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018d). *Food systems and contributions to other environmental problems*, Chapter 5, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018e). *Food systems and greenhouse gas emissions*, Chapter 3, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018f). *How are food systems, diets, and health connected?* Chapter 7, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018g). *How can we reduce food-related greenhouse gas emissions?* Chapter 4, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018h). *Impacts of climatic and environmental change on food systems*, Chapter 6, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018i). *What can be done to shift eating patterns in healthier, more sustainable directions?* Chapter 10, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018j). *What is a healthy sustainable eating pattern?* Chapter 9, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018k). *What is the connection between infectious diseases in humans and livestock?* Chapter 11, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/ [accessed 11th April 2019].
- FCRN (2018l). *Grazed and confused? How much can grazing livestock help to mitigate climate change?* Oxford, UK: Food Climate Research Network, https://www.fcrn.org.uk/sites/default/files/project-files/fcrn_gnc_report.pdf [accessed 11th April 2019].
- FCRN (2019a). *Agricultural methane and its role as a greenhouse gas*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/agricultural-methane-and-its-role-greenhouse-gas [accessed 11th April 2019].
- FCRN (2019b). *Plating up progress - part 1*, Oxford, UK: Food Climate Research Network, https://fcrn.org.uk/sites/default/files/plating_up_progress_part_1_final.pdf [accessed 11th April 2019].
- FCRN (2019c). *What is environmental efficiency - and is it sustainable*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-environmental-efficiency-and-it-sustainable [accessed 11th April 2019].

- FCRN (2019d). *What is food security*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-food-security [accessed 11th April 2019].
- FCRN (2019e). *What is land use and land-use change*, Oxford, UK: Food Climate Research Network, https://www.fcrn.org.uk/research-library/keywords/land-use-and-land-use-change [accessed 11th April 2019].
- FCRN (2019f). *What is malnutrition*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-malnutrition [accessed 11th April 2019].
- FCRN (2019g). *What is sustainable intensification*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-sustainable-intensification [accessed 11th April 2019].
- FCRN (2019h). *What is the land sparing-sharing continuum*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-land-sparing-sharing-continuum [accessed 11th April 2019].
- FCRN (2019i). *What is the nutrition transition*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-nutrition-transition [accessed 11th April 2019].
- FCRN (2019j). *What is ultra-processed food*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-ultra-processed-food-and-why-do-people-disagree-about-its-utility-concept [accessed 11th April 2019].
- FCRN (2019k). *Plating up progress - part 1*, Oxford, UK: Food Climate Research Network, https://foodfoundation.org.uk/plating-up-progress-part-1/ [accessed 11th April 2019].
- FCRN (2019l). *Plating up progress part 2 - 'must-have' metrics*, Oxford, UK: Food Climate Research Network, https://foodfoundation.org.uk/plating-up-progress-part-2-is-here/ [accessed 11th April 2019].
- FCRN (2019m). *How far could changes in production practices reduce GHG emissions*, Oxford, UK: Food Climate Research Network, https://www.foodsource.org.uk/44-how-far-could-changes-production-practices-reduce-ghg-emissions [accessed 11th April 2019].
- FDA (2017). *What is a climate change agreement?* Note 01: What is a CCA? London, UK: Food and Drink Federation CCA Guidance Note, https://www.fdf.org.uk/publicgeneral/FDF_Note-01-What-is-a-CCA_18032016.pdf [accessed 11th April 2019].
- FDF (2013). *Five-fold environmental ambition: progress report 2013*, London, UK: Food and Drink Federation, http://www.fdf.org.uk/corporate_pubs/FEA-report-2013.pdf [accessed 11th April 2019].
- FDF (2014). *Delivering sustainable growth through innovation*, London, UK: Food and Drink Federation, https://www.fdf.org.uk/growth-through-innovation.aspx [accessed 11th April 2019].
- FDF (2014). *Saving water along the food supply chain*, London, UK: Food and Drink Federation, https://www.fdf.org.uk/corporate_pubs/Water%20Efficiency%20Booklet_WEB.pdf [accessed 11th April 2019].

- FDF (2017). *Ambition 2025 – shaping sustainable value chains*, London, UK: Food and Drink Federation, https://www.fdf.org.uk/sustainability-ambition2025.aspx [accessed 11th April 2019].
- FDF (2017). *Our five-fold environmental ambition*, London, UK: Food and Drink Federation, https://www.fdf.org.uk/environment_progress_report.aspx [accessed 11th April 2019].
- FDF (2017). *Sustainable sourcing: five steps towards managing supply chain risk*, London, UK: Food and Drink Federation, http://www.fdf.org.uk/sustainable-sourcing.aspx [accessed 11th April 2019].
- Fears, R., ter Meulen, V. and von Braun, J. (2019). Global food and nutrition security needs more and new science, *Science Advances*, Vol. 5, No. 12, eaba2946, doi: 10.1126/sciadv.aba2946.
- Feedback (2019). *Fishy business: the Scottish salmon industry's hidden appetite for wild fish and land*, London, UK: Feedback, www.feedbackglobal.org [accessed 11th April 2019].
- Fellmann, T., Witzke, P., Weiss, F., Van Doorslaer, B., Drabik, D., Huck, I., Salputra, G., Jansson, T. and Leip, A. (2018). Major challenges of integrating agriculture into climate change mitigation policy frameworks, *Mitigation and Adaptation Strategies for Global Change*, Vol. 23, No. 3, pp.451-468, https://doi-org.ezproxy.mmu.ac.uk/10.1007/s11027-017-9743-2 [accessed 11th April 2019].
- Fenger (2016). *Post-Paris policy workshop: addressing food consumption to deliver on the Paris Agreement*, 15th December, Oxford, UK: Food Climate Research Network [accessed 11th April 2019].
- Fenn, B. (2018). *Impacts of CASH on nutrition outcomes*, Available Scientific Evidence to Informed Actions, Research 4 Action, www.cashlearning.org/downloads/user-submitted-resources/2018/06/1529400438.WFP0000071735.pdf [accessed 11th April 2019].
- FERA (2017). *Hot source: global food integrity issues and emerging risks*, Iss. 3, July-September, York, UK: Fera Science Limited (Food and Environment Research Agency) [accessed 11th April 2019].
- FERA (2017). *Hot source: global food integrity issues and emerging risks*, Iss. 4, October- December, York, UK: Fera Science Limited (Food and Environment Research Agency) [accessed 11th April 2019].
- FERA (2019). Call on Government to narrow the global 'protein gap' with support for insect protein production, York, UK: Fera Science Limited (Food and Environment Research Agency), https://www.fera.co.uk/news/insect-protein-production/ [accessed 30th July 2019].
- Ferguson, D.L. (2009). *Measuring business value and sustainability performance*, Cranfield University, UK: Doughty Centre for Corporate Responsibility, https://dspace.lib.cranfield.ac.uk/handle/1826/3795 [accessed 11th April 2019].
- Fernandes, P.G. and Cook, R.M. (2013). Reversal of fish stock decline in the Northeast Atlantic, *Current Biology*, Vol. 23, pp.1432–1437, http://dx.doi.org/10.1016/j.cub.2013.06.016 [accessed 11th April 2019].
- Fernando, N., Panozzo, J., Tausz, M., Norton, R., Fitzgerald, G. and Seneweera, S. (2012). Rising atmospheric CO_2 concentration affects mineral nutrient and protein concentration of wheat grain, *Food Chemistry*, Vol. 133, pp.1307-1311, https://doi.org/10.1016/j.foodchem.2012.01.105 [accessed 11th April 2019].

- Ferns, G. (2018). Seven climate change myths that big oil continues to perpetuate, *The Conversation*, 21st February, https://theconversation.com/seven-climate-change-myths-that-big-oil-continues-to-perpetuate-92088 [accessed 11th April 2019].
- Ferrari, L., Cavaliere, A., De Marchi, E. and Banterle, A. (2019). Can nudging improve the environmental impact of food supply chain? A systematic review, *Trends in Food Science and Technology*, Vol. 91, pp.184-192, doi: 10.1016/j.tifs.2019.07.004.
- Ferrari, M., Benvenuti, L., Rossi, L., De Santis, A., Sette, S., Martone, D., Piccinelli, R., Le Donne, C., Leclercq, C. and Turrini, A. (2020). Could dietary goals and climate change mitigation be achieved through optimized diet? The experience of modeling the national food consumption data in Italy, *Frontiers in Nutrition*, Vol. 7, https://doi.org/10.3389/fnut.2020.00048 [accessed 15th April 2020].
- Ferreira Gregorio, V., Pié, L. and Terceño, A. (2018). A systematic literature review of bio, green and circular economy trends in publications in the field of economics and business management, *Sustainability,* Vol. 10, No. 11, pp. 4232, https://doi.org/10.3390/su10114232.
- Fezzi, C., Bateman, I., Askew, T., Munday, P., Pascual, U., Sen, A. and Harwood, A. (2014). Valuing provisioning ecosystem services in agriculture: the impact of climate change on food production in the United Kingdom, *Environmental and Resource Economics*, Vol. 57, No. 2, pp.197-214, doi: https://doi-org.mmu.idm.oclc.org/10.1007/s10640-013-9663-x [accessed 11th April 2019].
- Fiala, N. (2008). Measuring sustainability - why the ecological footprint is bad economics and bad environmental science, *Ecological Economics*, Vol. 67, Iss. 4, pp.519-525, doi:10.1016/j.ecolecon.2008.07.023.
- Fiala, N. (2008). Meeting the demand - an estimation of potential future greenhouse gas emissions from meat production, *Ecological Economics*, Vol. 67, Iss. 4, pp.412-419, doi:10.1016/j.ecolecon.2007.12.021.
- Fielding, A.J. (2011). The impacts of environmental change on UK internal migration, *Global Environmental Change*, Vol. 21, S121-S130, https://doi.org/10.1016/j.gloenvcha.2011.08.003 [accessed 11th April 2019].
- Findlay, A.M. (2011). Migrant destinations in an era of environmental change, *Global Environmental Change,* Vol. 21, S50-S58, https://doi.org/10.1016/j.gloenvcha.2011.09.004 [accessed 11th April 2019].
- Finkbeiner, M. (2009). Carbon footprinting - opportunities and threats, *International Journal of Life Cycle Assessment*, Vol. 14, pp.91-94, doi: 10.1007/s11367-009-0064-x.
- Firbank, L.G. (2018). What is sustainable agriculture, *The Biochemist*, August, Vol. 40, No. 4, pp.4-8, https://orcid.org/0000-0003-1242-8293 [accessed 11th April 2019].
- Firbank, L.G., Elliott, E., Drake, B., Cao, Y. and Gooday, R. (2013). Evidence of sustainable intensification among British farms, *Agriculture, Ecosystems and Environment*, Vol. 173, pp.58-65, http://dx.doi.org/10.1016/j.agee.2013.04.010 [accessed 11th April 2019].

- Firbank, L.G., Elliott, J., Field, R.H., Lynch, M.J., Peach, W.J., Ramsden, S. and Turner, C. (2018). Assessing the performance of commercial farms in England and Wales - lessons for supporting the sustainable intensification of agriculture, *Food and Energy Security*, Vol. 7, e00150, https://doi.org/10.1002/fes3.150 [accessed 11th April 2019].
- Fischer, B. and Lamey, A. (2018). Field deaths in plant agriculture, *Journal of Agricultural and Environmental Ethics*, Vol. 31, pp.409-428, https://doi.org/10.1007/s10806-018-9733-8 [accessed 11th April 2019].
- Fischer, C.G. and Garnett, G. (2016). *Plates, pyramids and planet – developments in national healthy and sustainable dietary guidelines, a state of play assessment*, Oxford, UK: Food and Agriculture Organization of the United Nations and The Food Climate Research Network at The University of Oxford, http://www.fao.org/sustainable-food-value-chains/library/details/en/c/415611/ [accessed 11th April 2019].
- Fischer, G., Frohberg, K., Parry, M.L. and C. Rosenzweig, C. (1994). Climate change and world food supply, demand and trade: who benefits, who loses? *Global Environmental Change*, Vol. 4, pp.7-23, https://doi.org/10.1016/0959-3780(94)90018-3 [accessed 11th April 2019].
- Fischer, H., Meissner, K.J., Mix, A.C., Abram, N.J., Austermann, J., Brovkin, V., Capron, E., Colombaroli, D., Daniau, A.L., Dyez, K.A., Felis, T., Finkelstein, S.A., Jaccard, S.L., McClymont, E.L., Rovere, A., Sutter, J., Wolff, E.W., Affolter, S., Bakker, P., Ballesteros-Cánovas, J.A., Barbante, C., Caley, T., Carlson, A.E., Churakova (Sidorova), O., Cortese, G., Cumming, B.F., Davis, B.A.S., de Vernal, A. Emile-Geay, J. Fritz, S.C., Gierz, P., Gottschalk, J., Holloway, M.D., Joos, F., Kucera, M., Loutre, M.F., Lunt, D.J., Marcisz, K., Marlon, J.R., Martinez, P., Masson-Delmotte, V., Nehrbass-Ahles, C. Otto-Bliesner, B.L., Raible, C.C., Risebrobakken, B., Sánchez Goñi, M.F., Arrigo, J.S., Sarnthein, M., Sjolte, J., Stocker, T.F., Velasquez Alvárez, P.A., Tinner, W., Valdes, P.J., Vogel, H., Wanner, H., Yan, Q., Yu, Z., Ziegler, M. and Zhou, L. (2018). Palaeoclimate constraints on the impact of 2°C anthropogenic warming and beyond, *Nature Geoscience*, Vol. 11, pp. 474-485, doi: 10.1038/s41561-018-0146-0.
- Fischer, T., Byerlee, D. and Edmeades, G. (2014). *Crop yields and global food security: will yield increase continue to feed the world*, Canberra, Australia: Australian Centre for International Agricultural Research, ACIAR Monograph No. 158, ISBN 9781925133059 and ISBN 9781925133066.
- Fiscus, E.L., Booker, F.L. and Burkey, K.O. (2005). Crop responses to ozone: uptake, modes of action, carbon assimilation and partitioning, *Plant Cell Environment*, Vol. 28, pp.997–1011, https://doi.org/10.1111/j.1365-3040.2005.01349.x [accessed 11th April 2019].
- Fisher, A. (2017). *Big Hunger – the unholy alliance between corporate America and anti-hunger groups*, Food, Health, and the Environment Series, Cambridge, Massachusetts: The MIT Press, ISBN 9780262339520.

- Fisher, M.C., Henk, D.A., Briggs, C.J., Brownstein, J.S., Madoff, L.C., McCraw, S.L. and Gurr, S.J. (2012). Emerging fungal threats to animal, plant and ecosystem health, *Nature*, Vol. 484, pp.186-194, doi:10.1038/nature10947.
- Fitzpatrick, I., Young, R., Perry, M. and Rose, E. (2017). *The hidden cost of food*, Bristol, UK: The Sustainable Food Trust, http://sustainablefoodtrust.org/wp-content/uploads/2013/04/HCOF-Report-online-version.pdf [accessed 11th April 2019].
- Fitzpatrick, S., Bramley, G., Sosenko, F. and Blenkinsopp, J. (2018). *Destitution in the UK 2018*, Edinburgh: I-SPHERE / Heriot-Watt University report for the Joseph Rowntree Foundation, https://www.jrf.org.uk/report/destitution-uk-2018 [accessed 11th April 2019].
- Flachowsky, G. and Kamphues, J. (2012). Carbon footprints for food of animal origin: what are the most preferable criteria to measure animal *yields? Animals*, Vol. 2, No. 2, pp.108-126, doi:10.3390/ani2020108.
- Flagg, L., Sen, B., Kilgore, M. and Locher, J. (2013). The influence of gender, age, education and household size on meal preparation and food shopping responsibilities, *Public Health Nutrition*, Vol. 17, No. 09, pp.2061-2070, doi: 10.1017/S1368980013002267.
- Flavell, R. (2010). Knowledge and technologies for sustainable intensification of food production, *New Biotechnology*, Vol. 27, No. 5, pp.505-516, doi: 10.1016/j.nbt.2010.05.019.
- Fleischhacker, S.E., Evenson, K.R., Rodriguez, D.A. and Ammerman, A.S. (2011). A systematic review of fast food access studies, *Obesity Reviews*, Vol. 12, Iss.501, pp.e460-e471, doi: 10.1111/j.1467-789X.2010.00715.x.
- *Fleischwirtschaft International* (2017). Quality Assurance - cracking the food safety code in a global supply chain is a must, *Fleischwirtschaft International*, Vol. 32, No. 4, pp.48, https://english.fleischwirtschaft.de/epaper/78/epaper/index.html [accessed 11th April 2019].
- Fleming, A. (1945). *Penicillin*, Nobel Lecture, 11th December, https://www.nobelprize.org/uploads/2018/06/fleming-lecture.pdf [accessed 11th April 2019].
- Fleming, N. (2018). Eating our way to hell: the story of how the US food industry hijacks science is a chiller, *New Scientist*, Vol. 3203, p.44.
- Fleming, N. (2018). Unsavory truth: review – exposing the food industry's abuse of science, *New Scientist*, Vol. 3203, p.44, https://www.newscientist.com/article/mg24032030-300-unsavory-truth-review-exposing-the-food-industrys-abuse-of-science/ [accessed 11th April 2019].
- Flies, E.J., Brook, B.W., Blomqvist, L. and Buettel, J.C. (2018). Forecasting future global food demand: a systematic review and meta-analysis of model complexity, *Environment International*, Vol. 120, pp.93-103, doi: 10.1016/j.envint.2018.07.019.
- Flint, S.W. and McKenna, J. (2018). Public transport and the promotion of unhealthy food and drink, *The Lancet*, July, doi: https://doi.org/10.1016/S2468-2667(18)30113-0 [accessed 11th April 2019].

- Flood, J. (2010). The importance of plant health to food security, *Food Security*, Vol. 2, pp.215-231, doi: 10.1007/s12571-010-0072-5.
- Florea, A. (2012). Dynamics of food security in recent decades, Annals of the University of Oradea, *Economic Science Series*, Vol. 21, No. 2, pp.192-196, http://anale.steconomiceuoradea.ro/volume/2012/n2/027.pdf [accessed 11th April 2019].
- Flores, S.S. (2018). What is sustainability in the wine world? A cross-country analysis of wine sustainability frameworks, *Journal of Cleaner Production*, Vol. 172, pp.2301-2312, https://doi.org/10.1016/j.jclepro.2017.11.181 [accessed 11th April 2019].
- Florin, T.H. and Allen, D.W. (2019). Health and climate change, *The Lancet*, Vol. 393, Iss. 10187, pp.2196-2197, https://doi.org/10.1016/S0140-6736(19)30303-4 [accessed 11th April 2019].
- FoE (2008). *What's feeding our food: the environmental and social impacts of the livestock sector,* London, UK: Friends of the Earth, https://www.ciwf.org.uk/factory-farming/people-and-poverty/ [accessed 11th April 2019].
- FoE (2015). *Failures in Wilmar's promise to clean up the palm oil business*, London, UK: Friends of the Earth, https://www.foeeurope.org/up-in-smoke-failures-Wilmar%E2%80%99s-promise-clean-up-palm-oil-business [accessed 11th April 2019].
- Folberth, C., Skalsky, R., Moltchanova, E., Balkovic, J., Azevedo, L.B., Obersteiner, M. and van der Velde, M. (2016). Uncertainty in soil data can outweigh climate impact signals in global crop yield simulations, *Nature Communications*, Vol. 7, pp.11872, doi: 10.1038/ncomms11872.
- Foley, J. (2019a). *Beef rules*, Jonathan Foley website, https://globalecoguy.org/beef-rules-d5bbf65a24e3 [accessed 11th April 2019].
- Foley, J.A., DeFries, R., Asner, G.P., Barford, C., Bonan, G., Carpenter, S.R., Helkowski, J.H., Holloway, T., Howard, E.A., Kucharik, C.J., Monfreda, C., Patz, J.A., Prentice, I.C., Ramankutty, N. and Snyder, P.K. (2005). Global consequences of land use, S*cience*, Vol. 309, No. 5734, pp.570-574, doi: 10.1126/science.1111772.
- Foley, J.A., Ramakutty, N., Brauman, K.A., Cassidy, E.S., Gerber, J.S., Johnston, M., Mueller, N.D., O'Connell, C., Ray, D.K., West, P.C., Balzer, C., Bennett, E.M., Carpenter, S.R., Hill, J., Monfreda, C., Polasky, S., Rockström, J., Sheehan, J., Siebert, S., Tilman, D. and Zaks, D.P.M. (2011). Solutions for a cultivated planet, *Nature*, Vol. 478, No. 7369, pp.337-342, doi: 10.1038/nature10452.
- FOLU (2019). *Growing better ten critical transitions to transform food and land use - Executive Summary*, London, UK: Food and Land Use Coalition (FOLU), https://www.foodandlandusecoalition.org/wp-content/uploads/2019/09/FOLU-GrowingBetter-GlobalReport.pdf [accessed 11th April 2019].

- Food Citizenship (2017). *How thinking of ourselves differently can change the future of our food system,* Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/uploads/publications/FoodCitizenship2017_web.pdf [accessed 11th April 2019].
- Food Ethics Council (2013). *Beyond business as usual: towards a sustainable food system*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/beyond-business-as-usual-towards-a-sustainable-food-system/ [accessed 11th April 2019].
- Food Ethics Council (2017a). *Industry-sponsored science is clouding the picture of how food systems impact health*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/resource/industry-sponsored-science-is-clouding-the-picture-of-how-food-systems-impact-health-ipes-food/ [accessed 11th April 2019].
- Food Ethics Council (2017b). *The beginning of the end of cheap food? How should we prepare for food inflation and true cost food?* Brighton, UK: Food Ethics Council. https://www.foodethicscouncil.org/uploads/publications/170131%20The%20beginning%20of%20the%20end%20of%20cheap%20food_FINAL.pdf [accessed 11th April 2019].
- Food Ethics Council (2018a). *A toolkit for food businesses*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/resources/ethicaltools/ethics-a-toolkit-for-food-businesses.html [accessed 11th April 2019].
- Food Ethics Council (2018b). *For whom - questioning the food and farming research agenda*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/research-agenda.html [accessed 11th April 2019].
- Food Ethics Council (2018c). *FSI 2018 UK ranked 16/28th in EU and 24/67 globally – performing badly on over nourishment, GHGs, desertification of agriculture*, Brighton, UK: Food Ethics Council.
- Food Ethics Council (2018d). Lessons from France… World leader on sustainable food and farming? Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/resource/lessons-from-france-world-leader-on-sustainable-food-farming/?types=business-forum-report [accessed 11th April 2019].
- Food Ethics Council (2018e). *Meat tax - does tax have to be taxing*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/uploads/publications/180522 [accessed 11th April 2019].
- Food Ethics Council (2018f). Snapshot: UK sustainable food systems in the spotlight, https://www.foodethicscouncil.org/app/uploads/2019/02/Snapshot-FSI_analysis_2018.pdf [accessed 11th April 2019].
- Food Ethics Council (2018g). *Snapshot: UK sustainable food systems in the spotlight*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/ [accessed 29th November 2018].
- Food Ethics Council (2019a). *Harnessing the power of food citizenship_Oct-2019*, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/resource/harnessing-the-power-of-food-citizenship/ [accessed 11th April 2019].

- Food Ethics Council (2019b). *Submission to the National Food Strategy*, October, Brighton, UK: Food Ethics Council, https://www.foodethicscouncil.org/app/uploads/2019/10/Food-Ethics-Council-submission-to-the-national-food-strategy_FINAL.pdf [accessed 11th April 2019].
- Food for Life (2018). *State of the nation: children's food*, Bristol, UK: Soil Association, https://www.foodforlife.org.uk/~/media/files/policyreports/state-of-the-nation-soil-association-report.pdf [accessed 11th April 2019].
- Food Foundation (2016a). *Food environment policy brief - priorities for tackling the obesity crisis in England*, October, London, UK: The Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2016/11/Food-Environment-policy-brief.pdf [accessed 11th April 2019].
- Food Foundation (2016b). *Force fed - does the food system constrict healthy choices for typical British families*, London, UK: Food Foundation, http://foodfoundation.org.uk/food-foundation-launches-its-first-report-force-fed/ [accessed 11th April 2019].
- Food Foundation (2016c). *Household food insecurity - the missing data*, London, UK: Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2016/11/FF-Food-insecurity-4pp-V3.pdf [accessed 11th April 2019].
- Food Foundation (2016d). *Measuring household food insecurity in the UK and why we must do it - 4 facts you should know*, London, UK: Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2016/07/MeasuringHouseholdFoodInsecurity.pdf [accessed 11th April 2019].
- Food Foundation (2017). *Farming for 5 a day - Brexit bounty or dietary disaster*, London, UK: Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2017/11/Farming-for-five-a-day-final.pdf [accessed 11th April 2019].
- Food Foundation (2018a). *Peas please progress report*, London, UK: Food Foundation, https://foodfoundation.org.uk/publication/2018-peas-please-progress-report/ [accessed 11th April 2019].
- Food Foundation (2018b). *Affordability of the UK's Eatwell Guide*, London, UK: Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2018/09/Affordability-of-the-Eatwell-Guide_Final_Web-Version.pdf [accessed 11th April 2019].
- Food Foundation (2019a). *Children's future food inquiry*, London, UK: Food Foundation, https://foodfoundation.org.uk/wp-content/uploads/2019/04/Childrens-Future-Food-Inquiry-report.pdf [accessed 11th April 2019].
- Food Foundation (2019b). *The broken plate*, London, UK: Food Foundation, https://foodfoundation.org.uk/publication/the-broken-plate-report/ [accessed 11th April 2019].
- Food Matters Live (2019). Climate change: heat waves and food insecurity weaken immune systems, Food Matters Live, 7th February, https://www.foodmatterslive.com/news-and-comment/news/climate-change-heat-waves-and-food-insecurity-weaken-immune-systems [accessed 11th April 2019].

- Food Policy for Canada (2019). *Food policy will bring diverse actors and stakeholders from across the food system together through the Canadian Food Policy Advisory Council*, Ottawa, Canada: Parliament of Canada, https://www.canada.ca/content/dam/aafc-aac/documents/20190614-en.pdf [accessed 11th April 2019].
- Food Policy for Canada (2019). *Why does Canada need a food policy? Food systems, including the way food is produced, processed, distributed, consumed and disposed of, have direct impacts on the lives of Canadians*, Ottawa, Canada: Parliament of Canada, https://www.canada.ca/en/campaign/food-policy/thefoodpolicy.html [accessed 11th April 2019].
- Food Service Footprint (2018a). Common Food Policy will address CAP failings, 31st May, http://www.foodservicefootprint.com/news/common-food-policy-will-address-cap-failings [accessed 11th April 2019].
- *Food Service Footprint* (2018b). Could 2018 be the year we start paying the true cost of our food, *Food Service Footprint*, http://www.foodservicefootprint.com/news/news-analysis/2018-year-start-paying-true-cost-food [accessed 11th April 2019].
- *Food Service Footprint* (2018e). Food ranks alongside oil for natural capital risk, The food and drink industry is in a "danger zone", *Food Service Footprint*, 28th June, https://www.foodservicefootprint.com/food-ranks-alongside-oil-for-natural-capital-risk/ [accessed 11th April 2019].
- *Food Service Footprint* (2018g). Protein companies failing to manage sustainability risks, *Food Service Footprint*, 31st May, http://www.foodservicefootprint.com/news/protein-companies-failing-to-manage-sustainability-risks [accessed 11th April 2019].
- Food Standards Agency (2016). *Our food future*, London, UK: Food Standards Agency, https://www.food.gov.uk/sites/default/files/media/document/our-food-future-full-report.pdf [accessed 11th April 2019].
- Foord, W., Barry, J. and Shortall, S. (2018). *The Climate-Energy-Food Security Nexus - Report on multi-stakeholder scenario planning workshops in Northern Ireland*, Economic and Social Research Council (UK Research and Innovation), https://www.thenexusnetwork.org/wp-content/uploads/2018/08/QUB-Nexus-project-report-final.pdf [accessed 11th April 2019].
- *Foot Print* (2018). Microplastics found in 75% of deep sea fish, *Food Service Foot Print*, 22nd February, http://www.foodservicefootprint.com/grocery-news/microplastics-found-75-deep-sea-fish [accessed 11th April 2019].
- *Foot Print* (2019). Companies failing to set dietary targets, *Food Service Foot Print*, 5th September, https://www.foodservicefootprint.com/companies-failing-to-set-dietary-targets/ [accessed 11th April 2019].

- Foresight (2010). *Land use futures project - executive summary*, London, UK: The Government Office for Science, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/288845/10-634-land-use-futures-summary.pdf [accessed 11th April 2019].
- Foresight (2011a). *Foresight international dimensions of climate change: final project report*, Final Project Report, London, UK: The Government Office for Science, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287853/11-1042-international-dimensions-of-climate-change.pdf [accessed 11th April 2019].
- Foresight (2011b). *Migration and global environmental change (2011): final project report*, Final Project Report, London, UK: The Government Office for Science, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287717/11-1116-migration-and-global-environmental-change.pdf [accessed 11th April 2019].
- Foresight (2011c). *The future of food and farming - challenges and choices for global sustainability*, Final Project Report, Final Project Report, London, UK: The Government Office for Science, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/288329/11-546-future-of-food-and-farming-report.pdf [accessed 11th April 2019].
- Foresight4food (2019). *Supporting enhanced foresight and scenario analysis for global food systems*, International Collaborative Initiative through the Global Challenges Research Fund, https://www.foresight4food.net/wp-content/uploads/2018/02/F4F-brochure-def-1.pdf [accessed 11th April 2019].
- Forouhi, N.G. and Unwin, N. (2019). Global diet and health: old questions, fresh evidence, and new horizons, *The Lancet*, Vol. 393, Iss. 10184, 11-17th May, pp.1916-1918, http://dx.doi.org/10.1016/S0140-6736(19)30500-8 [accessed 11th April 2019].
- Forse, A., Drakeford, B. and Potts, J. (2019). Fish fights - Britain has a long history of trading away access to coastal waters, *The Conversation*, 25th March, https://theconversation.com/fish-fights-britain-has-a-long-history-of-trading-away-access-to-coastal-waters-112988 [accessed 11th April 2019].
- Forster, P., Jackson, L., Lorenz, S., Simelton, E., Fraser, E. and Bahadur, K. (2012). *Food security: near future projections of the impact of drought in Asia*, Report No. 011, Centre for Low Carbon Futures, York, UK: White Rose University Consortium, http://www.lowcarbonfutures.org/ [accessed 11th April 2019].
- Fortune (2017). The looming threat of extinction from climate change makes the lack of diversity in the world's food supplies, *Fortune*, 23rd August, http://fortune.com/2017/08/23/uk-food-industry-brexit/ [accessed 11th April 2019].
- *Forum for the Future* (2012). *Dairy 2020: using 'futures' to create systemic change*, London, UK: Forum for the Future, https://dairy.ahdb.org.uk/news/news-archive/2012/april-2012/dairy-2020-strategy-launch/#.Xhgdf0f7TIU [accessed 11th April 2019].

- *Forum for the Future* (2017a). *Check-out carbon: supporting slides,* London, UK: Forum for the Future.
- *Forum for the Future* (2017a). *Disrupting food logistics - an innovative project to reduce supply chain food wastage*, London, UK: Forum for the Future.
- *Forum for the Future* (2017b). *Shaping the future of protein - the protein challenge 2040 - accelerating innovation and action*, London, UK: Forum for the Future, https://www.forumforthefuture.org/protein-challenge [accessed 11th April 2019].
- *Forum for the Future* (2017c). *What feeds our food? Why retailers and foodservice have the power to act on #animalfeed, and why they need to care*, London, UK: Forum for the Future, https://www.forumforthefuture.org/protein-challenge-2040-feed-compass [accessed 11th April 2019].
- *Forum for the Future* (2019). *The feed behind our food: time to act on feed*, London, UK: Global Protein Challenge 2040 Coalition / Forum for the Future, http://www.igfa.ie/resources/FeedBehindOurFood.pdf [accessed 11th April 2019].
- Foster, C., Green, K., Bleda, M., Dewick, P., Evans, B., Flynn, A. and Mylan, J. (2006). *Environmental impacts of food production consumption: a report to the Department for Environment, Food and Rural Affairs*, London, UK: Manchester Business School/DEFRA, http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=14071 [accessed 11th April 2019].
- Foti, N., Pauls, S. and Rockmore, D. (2013). Stability of the world trade web over time: an extinction analysis, *Journal of Economic Dynamics and Control*, Vol. 37, pp.1889-1910, https://doi.org/10.1016/j.jedc.2013.04.009 [accessed 11th April 2019].
- Fraanje, W. and Garnett, T. (2019). *What is ultra-processed food? And why do people disagree about its utility as a concept*? Foodsource: building block, Oxford, UK: University of Oxford Food Climate Research Network, https://www.foodsource.org.uk/building-blocks/what-ultra-processed-food-and-why-do-people-disagree-about-its-utility-concept [accessed 11th April 2019].
- Fraanje, W. and Garnett, T. (2020). *Soy: food, feed, and land-use change*, Foodsource: Building Blocks, Food Climate Research Network, University of Oxford.
- Frame, B., Lawrence, J., Ausseil, A-G., Reisinger, A. and Daigneault, A. (2018). Adapting global shared socio-economic pathways for national and local scenarios, *Climate Risk Management*, Vol. 21, pp.39-51, https://doi.org/10.1016/j.crm.2018.05.001 [accessed 11th April 2019].
- Francis, A. (2018). *Setting the standard - shifting to sustainable food production in the UK*, Green Alliance policy insight, March, London, UK: Green Alliance, www.green-alliance.org.uk [accessed 11th April 2019].
- Francis, A. and Elliott, J. (2019). *New routes to decarbonise land use with Natural Infrastructure Schemes*, 27th February, Swindon, UK: National Trust, https://www.green-alliance.org.uk/resources/New_routes_to_decarbonise_land_use.pdf [accessed 11th April 2019].

- Francis, C.A. and Porter, P. (2011). Ecology in sustainable agriculture practices and systems, *Critical Reviews in Plant Sciences*, Vol. 30, No. 1, doi: 10.1080/07352689.2011.553147.
- Franco, S.C., Keane, J.B., O'Connor, R.S., Scott-Brown, A.S. and Wade, R. (2020). Multifunctional landscapes in the UK: tools for policy and practice, Report produced for the Global Food Security Programme, March, www.foodsecurity.ac.uk/publications/multifunctional-landscapes-in-the-uk.pdf [accessed 11th April 2020].
- Frank, D.M. (2018). Sustainability for a warming planet, *Ethics, Policy & Environment*, Vol. 21, No. 3, pp.400-404, https://doi.org/10.1080/21550085.2018.1562535 [accessed 11th April 2019].
- Frankelius, P. (2019). Back to the root causes of war: food shortages, *The Lancet*, Vol. 393, No. 10170, pp.981-982, doi:https://doi.org/10.1016/S0140-6736(19)30018-2.
- Frankowska, A., Jeswani, H.K. and Azapagic, A. (2019). Environmental sustainability issues in the food-energy-water nexus in the UK vegetables sector: energy and water consumption, *Energy Procedia*, Vol. 161, pp.150-156, https://doi.org/10.1016/j.egypro.2019.02.074 [accessed 11th April 2020].
- Franks, J.R. (2014). Sustainable intensification: a UK perspective, *Food Policy*, Volume 47, pp. 71-78, https://doi.org/10.1016/j.foodpol.2014.04.007 [accessed 11th April 2019].
- Franzen, J. (2019). What if we stopped pretending? The climate apocalypse is coming. To prepare for it, we need to admit that we can't prevent it, *The New Yorker*, 8th September, https://www.newyorker.com/culture/cultural-comment/what-if-we-stopped-pretending [accessed 11th April 2019].
- Fraser, E., Legwegoh, A., KC Krishna, K., CoDyre, M., Dias, G., Hazen, S., Legwegoh, A., Hazen, S., Johnson, R., Martin, R., Ohberg, L., Sethuratnam, S., Sneyd, L., Smithers, J., Van Acker, R., Vansteenkiste, J., Wittman, H. and Yada, R. (2016). Biotechnology or organic? Extensive or intensive? Global or local? A critical review of potential pathways to resolve the global food crisis, *Trends in Food Science & Technology*, Vol. 48, pp.78-87, http://dx.doi.org/10.1016/j.tifs.2015.11.006 [accessed 15th April, 2019].
- Free, C.M., Thorson, J.T., Pinsky, M.L., Oken, K.L., Wiedenmann, J. and Jensen, O.P. (2019). Impacts of historical warming on marine fisheries production, *Science*, Vol. 363, Iss. 6430, pp.979-983, doi: 10.1126/science.aau1758.
- Freebairn, J. (2018). Effects of supermarket monopsony pricing on agriculture, *Australian Journal of Agricultural and Resource Economics*, Vol. 62, No. 4, pp.548-562, https://doi.org/10.1111/1467-8489.12251 [accessed 11th April 2019].
- Freibauer, A., Mathijs, E., Brunori, G., Damianova, Z., Faroult, E., i Gomis, J.G., O´Brien, L. and Treyer, S. (2011). *Sustainable food consumption and production in a resource-constrained world*, February, The 3rd SCAR Foresight Exercise, Brussels, Belgium: European Commission – Standing Committee on Agricultural Research (SCAR).

- Freidberg, S. (2018). Assembled but unrehearsed - corporate food power and the 'dance' of supply chain sustainability, *The Journal of Peasant Studies*, pp.1-18, doi: 10.1080/03066150.2018.1534835.
- Freitas, F.L., Sparovek, G., Berndes, G., Persson, U.M., Englund, O., Barretto, A. and Mörtberg, U. (2018). Potential increase of legal deforestation in Brazilian Amazon after Forest Act revision, *Nature Sustainability*, Vol. 1, No. 11, pp.665-670, doi:10.1038/s41893-018-0171-4.
- Fremeth, A.R. and Richter, B.K. (2011). Profiting from environmental regulatory uncertainty: integrated strategies for competitive advantage, *California Management Review*, Vol. 54, No. 1, pp.145-165, https://doi.org/10.1525/cmr.2011.54.1.145 [accessed 11th April 2019].
- Fresco, L.O. (2009). Challenges for food system adaptation today and tomorrow, *Environmental Science & Policy*, Vol. 12, No. 4, pp.378-385, https://doi.org/10.1016/j.envsci.2008.11.001 [accessed 11th April 2019].
- Fresco, L.O. and Poppe, K.J. (2016). *Toward a common agricultural and food policy*, Wageningen, The Netherlands: Wageningen University and Research.
- Frewer, L.J., Risvik, E. and Schifferstein, H. (eds)(2013). *Food, people and society: a European perspective of consumers' food choices*, Berlin, Germany: Springer Science & Business Media, ISBN 9783540415213.
- Frewer, L.J., van der Lans, I.A., Fischer, A.R., Reinders, M.J., Menozzi, D., Zhang, X., van Den Berg, I. and Zimmermann, K.L. (2013). Public perceptions of agri-food applications of genetic modification–a systematic review and meta-analysis, *Trends in Food Science & Technology*, Vol. 30, No. 2, pp.142-152, https://doi.org/10.1016/j.tifs.2013.01.003 [accessed 11th April 2019].
- Friedlingstein, P., Andrew, R.M., Rogelj, J., Peters, G.P., Canadell, J.G., Knutti, R., Luderer, G., Raupach, M.R., Schaeffer, M., van Vuuren, D.P. and Le Quéré, C. (2014). Persistent growth of CO_2 emissions and implications for reaching climate targets, *Nature Geoscience*, Vol. 7, pp.709-715, doi:10.1038/ngeo2248.
- Friel, S. and Ford, L. (2015). Systems, food security and human health, *Food Security*, Vol. 7, No. 2, pp.437-451, https://doiorg.ezproxy.mmu.ac.uk/10.1007/s12571-015-0433-1 [accessed 11th April 2019].
- Friel, S., Barosh, L.J. and Lawrence, M. (2013). Towards healthy and sustainable food consumption: an Australian case study, *Public Health Nutrition*, Vol. 17, No.5, pp.1156-1166, doi:10.1017/S1368980013001523.
- Friel, S., Dangour, A.D., Garnett, T., Lock, K., Chalabi, Z., Roberts, I., Butler, A., Butler, C.D., Waage, J., McMichael, A.J. and Haines, A. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: food and agriculture, *The Lancet*, Vol. 374, No. 9706, pp.2016-2025, doi:10.1016/S0140-6736(09)61753-0.
- Friend, T. (2019). Can a burger help solve climate change, *The New Yorker*, 30th September, https://www.newyorker.com/magazine/2019/09/30/can-a-burger-help-solve-climate-change [accessed 11th April 2019].

- Frison, E.A., Cherfas, J. and Hodgkin, T. (2011). Agricultural biodiversity is essential for a sustainable improvement in food and nutrition security, *Sustainability*, Vol. 3, pp.238-253, https://doi.org/10.3390/su3010238 [accessed 11th April 2019].
- Fritz, M. and Matopoulos, A. (2008). Sustainability in the agri-food industry - a literature review and overview of current trends, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands.
- Fritz, M. and Schiefer, G. (2008). Food chain management for sustainable food system develoment, *Agribusiness*, Vol. 24, No. 4, pp.440-452, doi: 10.1002/agr.20172.
- Froehlich, H.E., Runge, C.A., Gentry, R.R., Gaines, S.C. and Halpern, B.S. (2018). Comparative terrestrial feed and land use of an aquaculture-dominant world, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 20, pp.5295-5300, https://doi.org/10.1073/pnas.1801692115 [accessed 11th April 2019].
- Froehlich, H.E., Runge, C.A., Gentry, R.R., Gaines, S.C. and Halpern, B.S. (2018). Avoiding the ecological limits of forage fish for fed aquaculture, *Proceedings of the National Academy of Sciences,* Vol. 115, Iss. 20, pp.5295-5300, doi:10.1038/s41893-018-0077-1.
- Froese, R., Zeller, D., Kleisner, K. and Pauly, D. (2012). What catch data can tell us about the status of global fisheries, *Marine Biology*, Vol. 159, pp.1283-1292, doi: 10.1007/s00227-012-1909-6.
- FSA (2001). *The balance of good health*, Hayes, UK: Food Standards Agency, www.food.gov.uk/eatwellplate [accessed 11th April 2019].
- FSA (2016a). *Our food future*, FSA full-report, York, UK: Food Standards Agency, https://www.food.gov.uk/sites/default/files/media/document/our-food-future-full-report.pdf [accessed 11th April 2019].
- FSA (2016b). *Our food future: literature review*, York, UK: Food Standards Agency, https://www.food.gov.uk/sites/default/files/media/document/our-food-future-lit-review.pdf [accessed 11th April 2019].
- FT (2014). Definition of business sustainability, *Financial Times Lexicon*, http://lexicon.ft.com/term?term=business-sustainability [accessed 11th April 2019].
- FT (2017). *Future of the food industry*, Special Report, Financial Times, https://www.ft.com/reports/future-food-industry [accessed 11th April 2019].
- FT (2018). *Special report on the future of the food industry*, Financial Times, https://www.ft.com/reports/future-food-industry [accessed 11th April 2019].
- Fuhrer, J. (2009). Ozone risk for crops and pastures in present and future climates, *Naturwissenschaften*, Vol. 96, pp.173-194, doi: 10.1007/s00114-008-0468-7.

- Fujimori, S., Hasegawa, T., Krey, V., Riahi, K., Bertram, C., Bodirsky, B.L., Bosetti, V., Callen, J., Després, J., Doelman, J., Drouet, L., Emmerling, J., Frank, S., Fricko, O., Havlik, P., Humpenöder, F., Koopman, J.F.L., van Meijl, H., Ochi, Y., Popp, A., Schmitz, A., Takahashi, K. and van Vuuren, D. (2019). A multi-model assessment of food security implications of climate change mitigation, *Nature Sustainability*, Vol. 2, pp.386-396, https://doi.org/10.1038/s41893-019-0286-2 [accessed 11th April 2019].
- Fukase, E. and Martin, W. (2016). *Who will feed China in the 21st century?* Policy Research Working Paper, No. 6926, Washington, USA: World Bank. https://openknowledge.worldbank.org/handle/10986/18808 [accessed 11th April 2019].
- Fullbrook, D. (2010). Food as security, *Food Security*, Vol. 2, pp.5-20, doi: 10.1007/s12571-009-0050-y.
- Fuller, R.J., Norton, L.R., Feber, R.E., Johnson, P.J., Chamberlain, D.E., Joys, A.C., Mathews, F., Stuart, R.C., Townsend, M.C., Manley, W.J., Wolfe, M.S., Macdonald, D.W. and Firbank, L.G. (2005). Benefits of organic farming to biodiversity vary among taxa, *Biology Letters*, Vol. 1, pp.431-434, doi:10.1098/rsbl.2005.0357.
- Funk, C. and Kennedy, B. (2018). *The politics of climate*, Pew Research Centre: Internet, Science & Tech, http://www.pewinternet.org/2016/10/04/the-politics-of-climate/ [accessed 9th August 2018].
- Furceri, D., Loungani, P., Simon, J. and Wachter, S. (2016). *Global food prices and domestic inflation - some cross-country evidence*, IMF Working Paper WP/15/133, International Monetary Fund, https://www.imf.org/en/Publications/WP/Issues/2016/12/31/Global-Food-Prices-and-Domestic-Inflation-Some-Cross-Country-Evidence-43024 [accessed 11th April 2019].
- Furman, C., Roncoli, C., Nelson, D.R. and Hoogenboom, G. (2014). Growing food, growing a movement: climate adaptation and civic agriculture in the south-eastern United States, *Agriculture and Human Values*, Vol. 31, No. 1, pp.69-82, doi: 10.1007/s10460-013-9458-2.
- Fusar-Poli, P. and Radua, J. (2018). Ten simple rules for conducting umbrella reviews, *Evidence-Based Mental Health*, Vol. 21, pp.95-100, http://dx.doi.org/10.1136/ebmental-2018-300014 [accessed 15th April 2020].
- Future Food (2016). The future of food: ten trends in food sustainability, *Future Food*, 4th July, https://futurefood.network/the-future-of-food-ten-trends-in-foo-sustainability/ [accessed 11th April 2019].
- Future of Food (2017). *Unravelling the food–health nexus addressing practices, political economy, and power relations to build healthier food systems*, Global Alliance for the Future of Food, https://futureoffood.org/impact-areas/advancing-well-being/unravelling-the-food-health-nexus/ [accessed 11th April 2019].
- G20 (2015). *Action plan on food security and sustainable food systems*, Implementation Plan of the G20 Food Security and Nutrition Framework, G20 Development Working Group Food Security and Nutrition, Paris, France: Organisation for Economic Co-operation and Development, https://www.mofa.go.jp/files/000111212.pdf [accessed 11th April 2019].

- G20 (2018a). *Food security and nutrition framework*, G20 Food Security and Nutrition Framework, Paris, France: Organisation for Economic Co-operation and Development, http://www.g20.utoronto.ca/2014/g20_food_security_nutrition_framework.pdf [accessed 11th April 2019].
- G20 (2018b). *The Wheat Initiative, set up by the G20 agriculture ministers to coordinate global wheat research, moves its headquarters to Berlin,* 20th March, https://www.wheatinitiative.org/press-releases/wheat-initative-headquarters-moves-to-berlin [accessed 15th June, 2020].
- Gabriel, D., Sait, S.M., Kunin, W.E., Benton, T.G. and Steffan-Dewenter, I. (2013). Food production vs. biodiversity: comparing organic and conventional agriculture, *Journal of Applied Ecology*, Vol. 50, No. 2, pp.355-364, https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/1365-2664.12035 [accessed 11th April 2019].
- Gabriel, M., Stanley, S. and Saunders, T. (2017). *Open innovation in health – a guide to transforming healthcare through collaboration*, London, UK: Nesta.
- Gabrysch, S. (2018). Global nutrient availability - a call for accountability and action, *The Lancet*, Vol 2, September, pp.e372-373.
- Gaffney, J., Bing, J., Byrne, P.F., Cassman, K.G., Ciampitti, I., Delmer, D., Habben, J., Lafitte, H.R., Lidstrom, U.E., Porter, D.O., Sawyer, J.E., Schussler, J., Setter, T., Sharp, R.E., Vyn, T.J. and Warner, D. (2019). Science-based intensive agriculture: sustainability, food security, and the role of technology, *Global Food Security*, Vol. 23, pp.236-244, https://doi.org/10.1016/j.gfs.2019.08.003 [accessed 11th April 2020].
- Gaines, S.D., Costello, C., Owashi, B., Mangin, T., Bone, J., Molinos, J.G., Burden, M., Dennis, H., Halpern, B.S., Kappel, C.V., Kleisner, K.M. and Ovando, D. (2018). Improved fisheries management could offset many negative effects of climate change, *Science Advances*, Vol. 4, No. 8, pp.eaao1378, doi: 10.1126/sciadv.aao1378.
- Gaitán-Cremaschi, D., Klerkx, L. and Duncan, J. (2019). Characterizing diversity of food systems in view of sustainability transitions - a review, *Agronomy for Sustainable Development*, Vol. 39, No. 1, https://doi.org/10.1007/s13593-018-0550-2 [accessed 15th April 2020].
- Galea, S. (2017). An argument for a common-sense global public health agenda, *The Lancet*, Vol. 2, Iss. 10, pp.E445-E446, doi: http://dx.doi.org/10.1016/S2468-2667(17)30164-0.
- Galea, S. (2019). The public health and industry partnership conundrum, *The Lancet*, July, Vol. 394, Iss. 10195, pp.291-292, doi: 10.1016/S0140-6736(19)31615-0.
- Galiay, P. (2010). Science in society perspective, *Local Food Systems: practices and strategies*, a Facilitating Alternative Agro-food Networks (FANN) conference, 22nd February, Brussels.
- Gallagher, J. (2018). Ultra-processed foods 'linked to cancer'. A link between highly processed foods and cancer has been suggested by French researchers, *BBC News*, 12th February, http://www.bbc.co.uk/news/health-43064290 [accessed 11th April 2019].

- Galli, A., Iha, K., Halle, M., El Bilali, H., Grunewald, N., Eaton, D., Capone, R., Debs, P. and Bottalico, F. (2017). Mediterranean countries' food consumption and sourcing patterns: an Ecological Footprint viewpoint, *Science of the Total Environment*, Vol. 578, pp.383-391, https://doi.org/10.1016/j.scitotenv.2016.10.191 [accessed 11th April 2019].
- Galli, F. and Brunori, G. (2013). *Short food supply chains as drivers of sustainable development*, Evidence Document, Frick: Research Institute of Organic Agriculture, http://www.fao.org/family-farming/detail/en/c/415240/ [accessed 11th April 2019].
- Galli, F., Favilli, E., D'Amico, S. and Brunori, G. (2018). *A transition towards sustainable food systems in Europe: food policy blue print scoping study*, Pisa, Italy: Laboratorio di Studi Rurali Sismondi, https://www.ifoam-eu.org/sites/default/files/food_policy_report_clean19-5-18.pdf [accessed 11th April 2019].
- Galli, F., Prosperi, P., Favilli, E., D'Amico, S., Bartolini, F. and Brunori, G. (2020). How can policy processes remove barriers to sustainable food systems in Europe? Contributing to a policy framework for agri-food transitions, *Food Policy*, pp.101871, https://doi.org/10.1016/j.foodpol.2020.101871 [accessed 11th April 2020].
- Galloway, J.N., Burke, M., Bradford, G.E., Naylor, R., Falcon, W., Chapagain, A.K., Gaskell, J.C., McCullough, E., Mooney, H.A., Oleson, K.L.L., Steinfeld, H., Wassenaar, T., Smil, V. (2007). International trade in meat: the tip of the pork chop, *Ambio*, Vol. 36, No. 8, pp.622-629, doi: 10.1579/0044-7447(2007)36[622:itimtt]2.0.co;2.
- Game & Wildlife Conservation Trust (2018). *Farming through Brexit: a vision for the future, England*, Fordingbridge, UK: Game & Wildlife Conservation Trust, https://www.gwct.org.uk/media/878712/farming-through-brexit-lr.pdf [accessed 11th April 2019].
- Gamso, J. (2018). Is China worsening the developing world's environmental crisis? *The Conversation*, 22nd August, https://theconversation.com/is-china-worsening-the-developing-worlds-environmental-crisis-100284 [accessed 11th April 2019].
- Ganten, D., Haines, A. and Souhami, R. (2010). Health co-benefits of policies to tackle climate change, *The Lancet*, 27th November, Vol. 376, pp.1802-1804.
- Gao, C.X. (2018). The future of CRISPR technologies in agriculture, *Nature Reviews Molecular Cell Biology*, Vol. 19, pp.275-276, doi:10.1038/nrm.2018.2.
- Gao, G. (2012). World food demand, *American Journal of Agricultural Economics*, Vol. 94, No. 1, pp.25-51, doi: 10.1093/ajae/aar133.
- Gao, J., Kovats, S., Vardoulakis, S., Wilkinson, P., Woodward, A., Li, J., Gu, S., Liu, X., Wu, H., Wang, J., Song, X., Zhai, Y., Zhao, J. and Liu, Q. (2018). Public health co-benefits of greenhouse gas emissions reduction: a systematic review, *Science of the Total Environment*, Vol. 627, pp.388-402, doi: 10.1016/j.scitotenv.2018.01.193.

- Garb, Y., Pulver, S. and VanDeveer, S.D. (2008). Scenarios in society, society in scenarios: toward a social scientific analysis of storyline-driven environmental modelling, *Environmental Research Letters*, Vol. 3, No. 4, 045015, doi:10.1088/1748-9326/3/4/045015.
- Garcia, A.L., Morillo-Santander, G., Parrett, A. and Mutoro, A.N. (2019). Confused health and nutrition claims in food marketing to children could adversely affect food choice and increase risk of obesity, *Archives of Disease in Childhood*, Vol. 104, No. 6, pp.541-546, http://dx.doi.org/10.1136/archdischild-2018-315870 [accessed 11th April 2019].
- Garcia, D., Galaz, V. and Daume, S. (2019). EAT Lancet vs yes2meat: the digital backlash to the planetary health diet, *The Lancet*, Vol. 394, Iss. 10215, pp.2153-2154, 14th December, 2019, doi:https://doi.org/10.1016/S0140-6736(19)32526-7.
- Garcia, S.M. and Rosenberg, A.A. (2010). Food security and marine capture fisheries: characteristics, trends, drivers and future perspectives, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2869-2880, https://doi.org/10.1098/rstb.2010.0171 [accessed 11th April 2019].
- Garcia-Muros, X., Markandya, A., Romero-Jordán, D. and González-Eguino, M. (2017). The distributional effects of carbon-based food taxes, *Journal of Cleaner Production*, Vol. 140, pp.996-1006, https://doi.org/10.1016/j.jclepro.2016.05.171 [accessed 11th April 2019].
- Gardi, C., Panagos, P., Van Liedekerke, M., Bosco, C. and De Brogniez, D. (2015). Land take and food security - assessment of land take on the agricultural production in Europe, *Journal of Environmental Planning and Management*, Vol. 58, No.5, pp.898-912, doi: 10.1080/09640568.2014.899490.
- Gardiner (2012). *UK food production to supply ratio commonly referred to as the self-sufficiency ratio*, London, UK: Department for Environment, Food and Rural Affairs.
- Garibaldi, L. (2012). The FAO global capture production database: a six-decade effort to catch the trend, *Marine Policy*, Vol. 36, pp.760-768, https://doi.org/10.1016/j.marpol.2011.10.024 [accessed 11th April 2019].
- Garnett, K., Delgado, J., Lickorish, F., Medina-Vaya, A., Magan, N., Shaw, H., Rathé, A., Chatterton, J., Prpich, G., Pollard, S. and Terry, L. (2014). *Plausible future scenarios for the UK food and feed system – 2015 & 2035*, Cranfield, UK: Institute for Environment, Health Risks and Futures School of Applied Sciences, https://www.food.gov.uk/sites/default/files/media/document/FINAL_FFS_Report-June-2014.pdf [accessed 11th April 2019].
- Garnett, T. (2008). *Cooking up a storm: food, greenhouse gas emissions and our changing climate*, Guildford, UK: Food Climate Research Network, https://www.fcrn.org.uk/fcrn/publications/cooking-up-a-storm [accessed 11th April 2019].
- Garnett, T. (2009). Livestock-related greenhouse gas emissions: impacts and options for policy makers, *Environmental Science & Policy*, Vol. 12, pp.491-530, https://doi.org/10.1016/j.envsci.2009.01.006 [accessed 11th April 2019].

- Garnett, T. (2010a). *Intensive versus extensive livestock systems and greenhouse gas emissions*, FCRN briefing paper, January, Oxford, UK: Food Climate Research Network.
- Garnett, T. (2010b). *Livestock and GHG emissions - what role for technology*, Oxford, UK: Food Climate Research Network.
- Garnett, T. (2011a). *Consuming livestock - human health & nutrition, climate change, livelihoods and animal welfare*, 7th- 8th June, Oxford, UK: Food Climate Research Network.
- Garnett, T. (2011b). Where are the best opportunities for reducing greenhouse gas emissions in the food system (including the food chain)? *Food Policy*, Vol. 36, pp.S23–S32, https://doi.org/10.1016/j.foodpol.2010.10.010 [accessed 11th April 2019].
- Garnett, T. (2013a). Food sustainability: problems, perspectives and solutions, *Proceedings of The Nutrition Society*, Vol. 72, Iss. 1, pp.29-39, doi: 10.1017/S0029665112002947.
- Garnett, T. (2013b). Three perspectives on sustainable food security: efficiency, demand restraint, food system transformation. What role for LCA? *Journal of Cleaner Production*, Vol. 73, No. 10, pp.1-9, http://dx.doi.org/10.1016/j.jclepro.2013.07.045 [accessed 11th April 2019].
- Garnett, T. (2014b). *Changing consumption: how can we change the way we eat?* Oxford, UK: Food Climate Research Network, https://www.fcrn.org.uk/sites/default/files/fcrn_sustainable_diets_and_changing_consumption_final.pdf [accessed 11th April 2019].
- Garnett, T. (2014c). *Changing what we eat: a call for research & action on widespread adoption of sustainable healthy eating*, Oxford, UK: Food Climate Research Network.
- Garnett, T. (2014d). *What is a sustainable healthy diet? A discussion paper*, Oxford, UK: Food Climate Research Network, pp.1-31, http://www.fcrn.org.uk/sites/default/files/fcrn_what_is_a_sustainable_healthy_diet_final.pdf [accessed 11th April 2019].
- Garnett, T. (2015a). *Food, climate change & the city*, 28th October, http://www.iufn.org/wp-content/uploads/2015/11/Climate-Change-Urban-Food-Presentation-Tara-GARNETT.pdf [accessed 11th April 2019].
- Garnett, T. (2015b). *Gut feelings and possible tomorrows - where does animal farming fit*, Oxford, UK: Food Climate Research Network, https://www.fcrn.org.uk/sites/default/files/fcrn_gut_feelings.pdf [accessed 11th April 2019].
- Garnett, T. (2016a). Plating up solutions - can eating patterns be both healthier and more sustainable? *Science*, Vol. 353, No. 6305, 16th September, pp.1202-1204, https://www.oxfordmartin.ox.ac.uk/downloads/academic/Sciencemag%20Garnett%20FINAL%200916.pdf [accessed 11th April 2019].

- Garnett, T. (2016b). *What is a sustainable healthy diet*, Oxford, UK: Food Climate Research Network.
- Garnett, T. (2017). Livestock and climate change. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.31-51, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Garnett, T. (no date). *The food sustainability challenge*, Oxford, UK: Food Climate Research Network.
- Garnett, T. and Godfray, H.C.J. (2012). *Sustainable intensification in agriculture: navigating a course through*, A report on a workshop, Food Climate Research Network and the Oxford Martin Programme on the Future of Food, University of Oxford, UK.
- Garnett, T. and Wilkes, A. (2014). *Appetite for change - social, economic and environmental transformations in China's food system*, Oxford, UK: Food Climate Research Network.
- Garnett, T., Appleby, M.C., Balmford, A., Bateman, I.J., Benton, T.G., Bloomer, P., Burlingame, B., Dawkins, M., Dolan, L., Fraser, D., Herrero, M., Hoffmann, I., Smith, P., Thornton, P.K., Toulmin, C., Vermeulen, S.J. and Godfray, H.C.J. (2013). Sustainable intensification in agriculture - premises and policies, *Science*, Vol. 341, 5th July, pp.33-34, doi: 10.1126/science.1234485.
- Garnett, T., Godde, C., Muller, A., Röös, E., Smith, P., de Boer, I.J.M., Ermgassen, E., Herrero, M., van Middelaar, C., Schader, C. and van Zanten, H. (2017). *Grazed and confused? Ruminating on cattle, grazing systems, methane, nitrous oxide, the soil carbon sequestration question,* Oxford, UK: Food Climate Research Network, www.fcrn.org.uk [accessed 11th April 2019].
- Garnett, T., Mathewson, S., Angelides, P. and Borthwick, F. (2015). *Policies and actions to shift eating patterns: what works? A review of the evidence of the effectiveness of interventions aimed at shifting diets in more sustainable and healthy directions*, Oxford and London: Food Climate Research Network, University of Oxford and Chatham House, https://www.fcrn.org.uk/sites/default/files/fcrn_chatham_house_0.pdf [accessed 11th April 2019].
- Garnett, T., Röös, E. and Little, D. (2015). *Lean, green, mean, obscene…? What is efficiency? And is it sustainable? Animal production and consumption reconsidered*, Oxford, UK: Food Climate Research Network, www.fcrn. org.uk/fcrn-publications/discussion-papers/ lean-green-mean-obscene [accessed 11th April 2019]
- Garnier, J., Le Noe, J., Marescaux, A., Sanz-Cobena, A., Lassaletta, L., Silvestre, M., Thieu, V. and Billen, G. (2019). Long-term changes in greenhouse gas emissions from French agriculture and livestock (1852–2014): from traditional agriculture to conventional intensive systems, *Science of the Total Environment*, Vol. 660, pp.1486-1501, https://doi.org/10.1016/j.scitotenv.2019.01.048 [accessed 11th April 2019].
- Garofalo, P., D'Andrea, L., Tomaiuolo, M., Venezia, A. and Castrignanò, A. (2017). Environmental sustainability of agri-food supply chains in Italy: the case of the whole-peeled tomato production under life cycle assessment methodology, *Journal of Food Engineering*, Vol. 200, pp.1-12, https://doi.org/10.1016/j.jfoodeng.2016.12.007 [accessed 11th April 2019].

- Garrett, J.J. (2017). Future visions - a sustainable and healthy local food production system, *Rangelands*, Vol. 38, Iss. 1, pp.42-46, https://doi.org/10.1016/j.rala.2015.12.001 [accessed 11th April 2019].
- Garrett, R.D. and Rausch, L.L. (2016). Green for gold: social and ecological tradeoffs influencing the sustainability of the Brazilian soy industry, *The Journal of Peasant Studies*, Vol. 43, No. 2, pp.461-493, doi:10.1080/03066150.2015.1010077.
- Garrett, R.D., Koh, I., Lambin, E.F., le Polain de Waroux, Y, Kastens, J.H. and Brown, J.C. (2018). Intensification in agriculture-forest frontiers: land use responses to development and conservation policies in Brazil, *Global Environmental Change*, Vol. 53, pp.233-243, https://doi.org/10.1016/j.gloenvcha.2018.09.011 [accessed 11th April 2020].
- Garst, G., Blok, V., Jansen, L. and Omta, O.S.W.F. (2017). Responsibility versus profit - the motives of food firms for healthy product innovation, *Sustainability*, Vol. 9, No. 2286, doi:10.3390/su9122286.
- Gasparrini, A., Guo, Y., Sera, F., Gasparrini, A., Guo, Y., Sera, F., Vicedo-Cabrera, A.M., Huber, V., Tong, S., de Sousa Zanotti Stagliorio Coelho, M., Hilario, P., Saldiva, N., Lavigne, E., Correa, P.M., Ortega, N.V., Kan, H., Osorio, S., Kyselý, J., Urban, A., KJaakkola, J.J., IRyti, N.R., Pascal, M., Goodman, P.G., Zeka, A., Michelozzi, P., Scortichini, M., Hashizume, M., Honda, Y., Hurtado-Diaz, M., Cruz, J.C., Seposo, X., Kim, H., Tobias, A., Iñiguez, C., Forsberg, B., Åström, D.O., Ragettli, M.S., Guo, Y.L., Wu, C-f., Zanobetti, A., Schwartz, J., Bell, M.L., Dang, T.N., Van, D.D., Heaviside, C., Vardoulakis, S., Hajat, S., Haines, A. and Armstrong, B. (2017). Projections of temperature-related excess mortality under climate change scenarios, *The Lancet Planet Health*, Vol. 1, pp.e360-e367, https://doi.org/10.1016/S2542-5196(17)30156-0 [accessed 11th April 2019].
- Gattuso, J.P., Magnan, A., Bille, R., Cheung, W.W., Howes, E.L., Joos, F., Allemand, D., Bopp, L., Cooley, S.R., Eakin, C.M., Hoegh-Guldberg, O., Kelly, R.P., Pörtner, H-O., Rogers, A.D., Baxter, J.M., Laffoley, D., Osborn, D., Rankovic, A., Rochette, J., Sumaila, U.R., Treyer, S. and Turley, C. (2015). Contrasting futures for ocean and society from different anthropogenic CO_2 emissions scenarios, *Science*, Vol. 349, pp.aac4722, doi: 10.1126/science.aac4722.
- Gaus, A. (2012). *Food security - a mapping of European approaches*, GPPi Research Paper No. 15, Berlin, Germany: Global Public Policy Institute (GPPi).
- Gawith, D. and Hodge, I. (2017). Policy brief on an alternative approach to rural land policy after Brexit, Envisioning a British ecosystem services policy, Cambridge, UK: University of Cambridge Centre for Food Science and Policy, http://www.csap.cam.ac.uk/media/uploads/files/1/besp-policy-brief---15-5-17.pdf [accessed 11th April 2019].
- GBD (2017). Diet collaborators - health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017, *The Lancet*, 3rd April, doi: 10.1016/S0140-6736(19)30041-8.

- Geddes, B.A., Paramasivan, P., Joffrin, A., Thompson, A.L., Christensen, K., Jorrin, B., Brett, P., Conway, S.J., Oldroyd, G.E.D. and Poole, P.S. (2019). Engineering transkingdom signalling in plants to control gene expression in rhizosphere bacteria, *Nature Communications*, Vol. 10, 3430, https://doi.org/10.1038/s41467-019-10882-x [accessed 15th April 2019].
- Geels, F.W., Sovacool, B.K., Schwanen, T. and Sorrell, S. (2017). Sociotechnical transitions for deep decarbonisation, *Science*, Vol. 357, Iss. 6357, pp.1242-1244, doi: 10.1126/science.aao3760.
- Geeraert, F. (2013). Sustainability and dietary change: the implications of Swedish food consumption patterns 1960–2006, *International Journal of Consumer Studies*, Vol. 37, pp.121-129, https://doi.org/10.1111/j.1470-6431.2012.01100.x [accessed 11th April 2019].
- Geissdoerfer, M., Savaget, P., Bocken, N.M.P. and Hultink, E.J. (2017). The circular economy – a new sustainability paradigm? *Journal of Cleaner Production*, Vol. 143, pp.757-768, https://doi.org/10.1016/j.jclepro.2016.12.048 [accessed 11th April 2019].
- Genovese, F. (2019). COP24: what to expect, *The Conversation*, 7th December, https://theconversation.com/cop24-what-to-expect-107862 [accessed 11th April 2019].
- Gentle, L. (2019). Top five threats to UK's wildlife (and what to do about them) – new report, *The Conversation*, 3rd October, https://theconversation.com/top-five-threats-to-uks-wildlife-and-what-to-do-about-them-new-report-124670 [accessed 11th April 2019].
- GEO (2020). *Work programme 2020-2022*, Geneva, Switzerland: Group on Earth Observations, https://www.earthobservations.org/geoss_wp.php [accessed 11th April 2019].
- Georgakopoulos, G. and Thomson, I. (2005). Organic salmon farming: risk perceptions, decision heuristics and the absence of environmental accounting, *Accounting Forum*, Vol. 29, Iss. 1, pp.49-75, https://doi.org/10.1016/j.accfor.2004.12.002 [accessed 11th April 2019].
- Georges, F. and Ray, H. (2017). Genome editing of crops: a renewed opportunity for food security, *GM Crops & Food*, Vol. 8, No. 1, pp.1-12, https://doi.org/10.1016/j.accfor.2004.12.002 [accessed 11th April 2019].
- Georgopoulou, E., Mirasgedis, S., Sarafidis, Y., Vitaliotou, M., Lalas, D.P., Theloudis, I., Giannoulaki, D., Dimopoulos, D. and Zavras, V. (2017). Climate change impacts and adaptation options for the Greek agriculture in 2021–2050 - a monetary assessment, *Climate Risk Management*, Vol. 16, pp.164-182, https://doi.org/10.1016/j.crm.2017.02.002 [accessed 11th April 2019].
- Gephart, J.A., Davis, K.F., Emery, K.A., Leach, A.M., Galloway, J.N. and Pace, M.L. (2016). The environmental cost of subsistence: optimizing diets to minimize footprints, *Science of The Total Environment*, Vol. 553, pp.120-127, doi: 10.1016/j.scitotenv.2016.02.050.
- Gerbens-Leenes, P.W. and Nonhebel, S. (2003). Consumption patterns and their effects on land required for food, *Ecological Economics*, Vol. 42, No. 1-2, pp.185-199, https://doi.org/10.1016/S0921-8009(02)00049-6 [accessed 11th April 2019].

- Gerbens-Leenes, P.W., Nonhebel, S. and Iven, W.P.M.F. (2002). A method to determine land requirements relating to food consumption patterns, *Agriculture, Ecosystems and Environment*, Vol. 90, No. 1, pp.47-58, https://doi.org/10.1016/S0167-8809(01)00169-4 [accessed 11th April 2019].
- Gerbens-Leens, P.W., Moll, H.C. and Uiterkamp, A.J.M.S. (2003). Design and development of a measuring method for environmental sustainability in food production systems, *Ecological Economics*, Vol. 46, No. 2, pp.231, https://doi.org/10.1016/S0921-8009(03)00140-X [accessed 11th April 2019].
- Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Faluccci, A. and Tempio, G. (2013). *Tackling climate through livestock: a global assessment of emissions and mitigation opportunities*, Rome, Italy: Food and Agriculture Organization of the United Nations, http://www.fao.org/docrep/018/i3437e/i3437e00.htm [accessed 11th April 2019].
- Gerland, P., Raftery, A.E., Ševčíková, H., Li, N., Gu, D., Spoorenberg, T., Alkema, L., Fosdick, B.K., Chunn, J., Lalic, N., Bay, G., Buettner, T., Heilig, G.K. and Wilmoth, J. (2014). World population stabilization unlikely this century, *Science*, Vol. 346, Iss. 6206, pp.234-237, doi: 10.1126/science.1257469.
- German, R.N., Thompson, C.E. and Benton, T.G. (2017). Relationships among multiple aspects of agriculture’s environmental impact and productivity: a meta-analysis to guide sustainable agriculture, *Biological Reviews*, Vol. 92, No. 2, pp.716-738, doi: 10.1111/brv.12251.
- Germani, A., Vitiello, V., Giusti, A.M., Pinto, A., Donini, L.M. and del Balzo, V. (2014). Environmental and economic sustainability of the Mediterranean diet, *International Journal of Food Sciences and Nutrition*, Vol. 65, No.8, pp.1008-1012, doi: 10.3109/09637486.2014.945152.
- GFS (2010). *Strategic plan 2011-2016*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2012). *Priority research questions for the UK food system*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2012a). *Global food systems and UK food imports - resilience, safety and security*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2012b). *Global food systems and UK food imports: resilience, safety and security*, Discussions from the ESRC Public Policy Seminar 30th March, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2013a). *From field to fork*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2013b). *Global food systems and UK food imports - resilience, safety and security*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].

- GFS (2015a). *Extreme weather and resilience of the global food system*, Final Project Report from the UK-US Taskforce on Extreme Weather and Global Food System Resilience, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2015b). *Resilience of the UK food system in a global context*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2015c). *Water use in our food imports*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), http://www.foodsecurity.ac.uk/assets/pdfs/water-used-in-imports-report.pdf [accessed 11th April 2019].
- GFS (2016). *Meeting the challenge*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2017a). *Game changing developments in the context of food security and future research priorities*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2017b). *Global food security strategic plan*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2017c). *Paris-compliant healthy food systems*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2017d). *UN Sustainable Development Goals and the UK food retail and manufacturing business*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2017e). *Public attitudes to climatic shocks and their interaction with the food system*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2018). *A food systems approach to policy for health and sustainability*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2019a). *Exploring the resilience of the UK food system in a global context*, Oxford, UK: Global Food Security Food Systems Group of the Environmental Change Institute at the University of Oxford, file:///D:/Downloads/exploring-the-resilience-of-the-uk-food-system-in-a-global-context.pdf [accessed 11th April 2019].

- GFS (2019b). *Facing the future together*, Global Food Security Programme, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- GFS (2019d). *Transformative innovation across supply chains to improve decision-making*, Global Food Security Programme, UK: Biotechnology and Biological Sciences Research Council (BBSRC), https://www.foodsecurity.ac.uk/publications/ [accessed 11th April 2019].
- Ghadge, A., Wurtmann, H. and Seuring, S. (2020). Managing climate change risks in global supply chains: a review and research agenda, *International Journal of Production Research*, Vol. 58, No. 1, pp. 44-64, doi: 10.1080/00207543.2019.1629670.
- Ghai, S., Sharma, A. and Dasgupta, P. (2017). Is eating organic a healthy or safer option? Health claims for organic food consumption, food quality and safety - a systematic review, *Indian Journal of Community Health*, Vol. 29, No. 4, pp.340-349.
- Ghosh, P. (2017). Hawking urges Moon landing to 'elevate humanity', *BBC News*, 20th June, https://www.bbc.co.uk/news/science-environment-40345048 [accessed 11th April 2019].
- Giannetti, B.F., Sevegnani, F., Almeida, C.M.V.B., Agostinho, F. and Moreno Garcia, R. (2019). Five sector sustainability model: a proposal for assessing sustainability of production systems, *Ecological Modelling*, Vol. 406, pp.98-108, https://doi.org/10.1016/j.ecolmodel.2019.06.004 [accessed 11th April 2019].
- Gibbens, S. (2018). Can the ocean feed a growing world? *National Geographic*, 15th August, https://www.nationalgeographic.com.au/nature/can-the-ocean-feed-a-growing-world.aspx [accessed 11th April 2019].
- Gibbs, H.K., Munger, J., L'Roe, J., Barreto, P., Pereira, R., Christie, M., Amaral, T. and Walker, N.F. (2015). Did ranchers and slaughterhouses respond to zero-deforestation agreements in the Brazilian Amazon, *Conservation Letters*, Vol. 9, pp.1-10, doi: 10.1111/conl.12175.
- Gibson, M. (2013). Food security - a commentary - what is it and why is it so complicated, *Foods*, Vol. 1, No. 1-x manuscripts; doi:10.3390/foods10x000x.
- Gibson, R.B. (2006). Beyond the pillars: sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making, *Journal of Environmental Assessment Policy and Management*, Vol. 8, No. 3, pp.259-280, https://doi.org/10.1142/S1464333206002517 [accessed 11th April 2019].
- Gilbert, C.L. and Morgan, C.W. (2010). Food price volatility, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.3023-3034, https://doi.org/10.1098/rstb.2010.0139 [accessed 11th April 2019].
- Gill, M. and Johnston, K. (2010). Session 2 Informing food policy: balancing the evidence, *Proceedings of the Nutrition Society*, Vol. 69, No. 4, pp 621-627, http://pascal-francis.inist.fr/vibad/index.php?action=getRecordDetail&idt=23366334 [accessed 11th April 2019].

- Gill, M. and Stott, R. (2009). Health professionals must act to tackle climate change, *The Lancet*, 12th December, Vol. 12, No. 374(9706), pp.1953-1955, doi: 10.1016/S0140-6736(09)61830-4.
- Gill, M., Smith, P. and Wilkinson, J.M. (2010). Mitigating climate change - the role of domestic livestock, *Animal*, Vol. 4, No.3, pp.323-333, doi:10.1017/S1751731109004662.
- Gill, T. (2012). *Building climate resilience in agriculture*, report for the UK Environment Agency, Stapeley, UK: Promar International.
- Gillam, C. (2020). Science shouldn't be for sale – we need reform to industry-funded studies to keep people safe, *The Guardian*, 18th February, https://www.theguardian.com/commentisfree/2020/feb/18/science-shouldnt-be-for-sale-we-need-reform-industry-funded-studies-monsanto [accessed 11th April 2019].
- Gilland, B. (2002). World population and food supply: can food production keep pace with population growth in the next half-century, *Food Policy*, Vol. 27, pp.47-63, https://doi.org/10.1016/S0306-9192(02)00002-7 [accessed 11th April 2019].
- Gillespie, A.H. and Smith, L.E. (2008). Food decision-making framework: connecting sustainable food systems to health and well-being, *Journal of Hunger & Environmental Nutrition*, Vol. 3, No. 2-3, pp.328-346, doi: 10.1080/19320240802244363.
- Gillespie, S. and van den Bold, M. (2017). Agriculture, food systems, and nutrition - meeting the challenge, *Global Challenges*, Vol.1, No. 3, 1600002, pp.1-12, doi: 10.1002/gch2.201600002.
- Gillespie, S., van den Bold, M. and Hodge, J. (2019). Nutrition and the governance of agri-food systems in South Asia: a systematic review, *Food Policy*, Vol. 82, pp.13-27, https://doi.org/10.1016/j.foodpol.2018.10.013 [accessed 11th April 2019].
- Gillund, F.T., Gillund, F.T., Myhr, A.I., Myhr, A.I., Utskarpen, A., Utskarpen, A. and Hilbeck, A. (2016). Stakeholder views on issues to consider when assessing the sustainability of genetically modified potato, *International Journal of Agricultural Sustainability*, Vol. 14, No. 3, pp.357-376, https://doi.org/10.1080/14735903.2016.1140013 [accessed 11th April 2020].
- Giner, C. and Brooks, J. (2019). *Policies for encouraging healthier food choices*, OECD Food, Agriculture and Fisheries Papers No. 137, Paris: OECD Publishing, http://dx.doi.org/10.1787/11a42b51-en [accessed 11th April 2019].
- Gingerich, P.D. (2019). Temporal scaling of carbon emission and accumulation rates: modern anthropogenic emissions compared to estimates of PETM-Onset accumulation, *Paleoceanography and Paleoclimatology*, Vol. 34, pp.329-335, doi: 10.1029/2018PA003379.
- Giovannucci, D., Scherr, S., Nierenberg, D., Hebebrand, C., Shapiro, J., Milder, J. and Wheeler, J. (2012). *Food and agriculture: the future of sustainability - a strategic input to the Sustainable Development in the 21st Century (SD21) project*. New York, USA: United Nations Department of Economic and Social Affairs, Division for Sustainable Development.

- Girod, B., van Vuuren, D.P. and Hertwich, E.G. (2014). Climate policy through changing consumption choices: options and obstacles for reducing greenhouse gas emissions, *Global Environmental Change*, Vol. 25, No. 1, pp.5-15, doi: 10.1016/j.gloenvcha.2014.01.004.
- Giskes, K., van Lenthe, F., Avendano-Pabon, M. and Brug, J. (2011). A systematic review of environmental factors and obesogenic dietary intakes among adults: are we getting closer to understanding obesogenic environments? *Obesity Reviews*, Vol. 12, e95–e106, doi: 10.1111/j.1467-789X.2010.00769.x.
- Gittelsohn, J., Trude, A.C.B. and Kim, H. (2017). Pricing strategies to encourage availability, purchase, and consumption of healthy foods and beverages: a systematic review, *Preventing Chronic Disease*, Vol. 14, No. 11, E107, doi: 10.5888/pcd14.170213.
- Givens, D.I. (2012). Food chain and health - milk in the diet - good or bad for vascular disease, *Proceedings of the Nutrition Society*, Vol. 71, pp.98-104, doi:10.1017/S0029665111003223.
- Gladek, E., Fraser, M., Roemers, G., Sabag Muñoz, O., Kennedy, E. and Hirsch, P. (2016). *The global food system: an analysis*, Amsterdam, The Netherlands: Metabolic.
- Gleditsch, N. (2012). Whither the weather? Climate change and conflict, *Journal of Peace Research*, Vol. 49, pp.3-9, https://doi.org/10.1177/0022343311431288 [accessed 11th April 2019].
- Gleick, P. (2013). *Protecting the world's water resources*, podcast, Washington, USA: International Monetary Fund, https://www.imf.org/en/News/Podcasts/All-Podcasts/2017/11/11/protecting-the-worlds-water-resources [accessed 11th April 2019].
- Gleick, P.H. (2014). Water, drought, climate change, and conflict in Syria, *Weather, Climate, and Society*, Vol. 6, pp.331-340, https://doi.org/10.1175/WCAS-D-13-00059.1 [accessed 11th April 2019].
- Glenk, K., Eory, V., Colombo, S. and Barnes, A. (2014). Adoption of greenhouse gas mitigation in agriculture: an analysis of dairy farmers' perceptions and adoption behaviour, *Ecological Economics*, Vol. 108, pp.49-58, https://doi.org/10.1016/j.ecolecon.2014.09.027 [accessed 11th April 2019].
- Gliessman, S. (2018). Transforming our food systems, *Agroecology and Sustainable Food Systems*, Vol. 42, No. 5, pp.475-476, https://doi.org/10.1080/21683565.2018.1412568 [accessed 11th April 2019].
- Gliessman, S. (2019). Feeding Prometheus: agroecology and unchaining our desire for food system transformation, *Agroecology and Sustainable Food Systems*, Vol. 43, No. 1, pp.1-2, doi: 10.1080/21683565.2018.1515541.
- Gliessman, S. (2019). Making the transition away from industrial agriculture: using agroecology to promote food systems transformation, *Agroecology and Sustainable Food Systems*, Vol. 43, No. 2, pp.121-122, doi: 10.1080/21683565.2018.1529358.
- Global Forest Alliance (2016). *Whats at steak: the real cost of meat - impacts of the industrial livestock and feedstock industries on forests, climate change, farmers and communities*, Amsterdam, The Netherlands: Global Forest Coalition.

- Global Material Flows Database (2019). *The global reference database for natural resource extraction for all countries and all primary raw materials world-wide*, https://resourcewatch.org/data/explore/082e2262-c58e-46a0-b6b7-56083cfcbd34?utm_source=twitter&utm_medium=resource_watch&utm_campaign=socialmedia [accessed 11th April 2019].
- Global Panel (2015). *Climate smart food systems for enhanced nutrition*, Policy Brief, London, UK: Global Panel on Agriculture and Food Systems for Nutrition, https://glopan.org/climate-change [accessed 11th April 2019].
- Global Research Priorities Unit (2014). *The long and the short of it: sustainable food supply chains*, final report of the Sustainable Food Supply Chains Commission, organised by the Industry and Parliament Trust, Food Ethics Council and the University of Warwick's Global Research Priorities Unit.
- Global Witness (2018). *At what cost: irresponsible business and the murder of land and environmental defenders in 2017*, London, UK: Global Witness, https://www.globalwitness.org/en-gb/campaigns/environmental-activists/at-what-cost/ [accessed 11th April 2019].
- GMI (2018). *Globalmethane.org.* https://www.globalmethane.org/ [accessed 11th April 2019].
- Godfray, H.C.J. (2013). The challenge of feeding 9-10 billion people equitably and sustainably, *The Journal of Agricultural Science*, Vol. 152, Iss. S1 (Special Issue from the 17th International Nitrogen Workshop) December, pp.2-8, https://doi.org/10.1017/S0021859613000774 [accessed 11th April 2019].
- Godfray, H.C.J. (2014). Challenges in the food system, https://www.sbs.ox.ac.uk/sites/default/files/Skoll_Centre/Docs/essay-godfray.pdf [accessed 11th April 2019].
- Godfray, H.C.J. (2015). *Neonicotinoids and insect pollinators 2015*, Oxford Martin Restatement3_Neonicotinoids2015, Oxford, UK: University of Oxford Oxford Martin School, http://www.oxfordmartin.ox.ac.uk/ [accessed 11th April 2019].
- Godfray, H.C.J. and Garnett, T. (2014). Food security and sustainable intensification, *Philosophical Transactions of the Royal Society B*, Vol. 369, Iss. 1639, doi: 10.1098/rstb.2012.0273.
- Godfray, H.C.J., Aveyard, P., Garnett, T., Hall, J.W., Key, T.J., Lorimer, J., Pierrehumbert, R.T., Scarborough, P., Springmann, M. and Jebb, S.A. (2018). Meat consumption, health and the environment, *Science*, July, Vol. 361, Iss. 6399, Eaam5324, doi: 10.1126/science.aam5324.
- Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M. and Toulmin, C. (2010b). Food security: the challenge of feeding 9 billion people, *Science*, Vol. 327, No. 5967, pp.812-818, doi: 10.1126/science.1185383.
- Godfray, H.C.J., Blacquière, T., Field, L.M., Hails, R.S., Potts, S.G., Raine, N.E., Vanbergen, A.J. and McLean, A.R. (2015). A restatement of recent advances in the natural science evidence base concerning neonicotinoid insecticides and insect pollinators, *Proceedings of the Royal Society B*, Vol. 282, No. 20151821, http://dx.doi.org/10.1098/rspb.2015.182 [accessed 11th April 2019].

- Godfray, H.C.J., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Nisbett, N., Pretty, J., Robinson, S., Toulmin, C. and Whiteley, R. (2010c). The future of the global food system, *Philosophical Transactions of the Royal Society B*, Vol. 365, pp.2769–2777, doi:10.1098/rstb.2010.0180.
- Godfray, H.C.J., Pretty, J., Thomas, S.M., Warham, E.J. and Beddington, J.R. (2011). Linking policy on climate and food, *Science*, Vol. 331, No. 6020, pp.1013-1014, https://www-jstor-org.mmu.idm.oclc.org/stable/41075740 [accessed 11th April 2019].
- Godfray, H.C.J., Pretty, J., Thomas, S.M., Warham, E.J. and Beddington, J.R. (2011). Linking policy on climate and food, *Science*, Vol. 331, No. 6020, pp.1013-1014, doi: 10.1126/science.1202899.
- Goedkoop, M., Heijungs, R., Huijbregts, M., De Schryver, A., Struijs, J. and van Zelm, R. (2008). *ReCiPE 2008 - A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level*, Nijmegen Netherlands: Radboud University, http://www.lcia-recipe.net [accessed 11th April 2019].
- Goglio, P., Grant, B.B., Smith, W.N., Desjardins, R.L., Worth, D.E., Zentner, R. and Malhi, S.S. (2014). Impact of management strategies on the global warming potential at the cropping system level, *Science of The Total Environment*, Vol. 490, pp.921-933, https://doi.org/10.1016/j.scitotenv.2014.05.070 [accessed 11th April 2019].
- Goglio, P., Smith, W.N., Grant, B.B., Desjardins, R.L., Gao, X., Hanis, K., Tenuta, M., Campbell, C.A., McConkey, B.G., Nemecek, T., Burgess, P.J. and Williams, A.G. (2018). A comparison of methods to quantify greenhouse gas emissions of cropping systems in LCA, *Journal of Cleaner Production*, Vol. 172, pp.4010-4017, https://doi.org/10.1016/j.jclepro.2017.03.133 [accessed 11th April 2019].
- Goglio, P., Smith, W.N., Grant, B.B., Desjardins, R.L., McConkey, B.G., Campbell, C.A. and Nemecek, T. (2015). Accounting for soil carbon changes in agricultural life cycle assessment (LCA): a review, *Journal of Cleaner Production*, Vol. 104, pp.23-39, https://doi.org/10.1016/j.jclepro.2015.05.040 [accessed 11th April 2019].
- Goglio, P., Smith, W.N., Worth, D.E., Grant, B.B., Desjardins, R.L., Chen, W., Tenuta, M., McConkey, B.G., Williams, A.G. and Burgess, P. (2018). Development of Crop.LCA, an adaptable screening life cycle assessment tool for agricultural systems: a Canadian scenario assessment, *Journal of Cleaner Production*, Vol. 172, pp.3770-3780, https://doi.org/10.1016/j.jclepro.2017.06.175 [accessed 11th April 2019].
- Gohar, A.A. and Cashman, A. (2016). A methodology to assess the impact of climate variability and change on water resources, food security and economic welfare, *Agricultural Systems*, Vol. 147, pp.51-64, https://doi.org/10.1016/j.agsy.2016.05.008 [accessed 11th April 2019].
- Gohar, G., Bernie, D., Good, P. and Lowe, J.A. (2018). *UKCP18 Derived Projections of Future Climate over the UK*, Exeter, UK: Met Office.
- Goklany, I.M. (2009a). Climate change is not the biggest global health threat, *The Lancet*, Vol. 374, Iss. 9694, pp.973-974, doi: 10.1016/S0140-6736(09)61655-X.

- Goklany, I.M. (2009b). Is climate change the 'defining challenge of our age'? *Energy & Environment*, Vol. 20, No. 3, pp.279-302, https://doi.org/10.1260/095830509788066439.
- Gold, S. and Heikkurinen, P. (2013). Corporate responsibility, supply chain management and strategy - in search of new perspectives for sustainable food production, *Journal of Global Responsibility*, Vol. 4, Iss. 2, pp.276-291, https://doi.org/10.1108/JGR-10-2012-0025 [accessed 11th April 2019].
- Gold, S., Hahn, R. and Seuring, S. (2000). Sustainable supply chain management in ''Base of the Pyramid'' food projects: a path to triple bottom line approaches for multinationals, *International Business Review*, Vol. 22, pp.784-799, http://dx.doi.org/10.1016/j.ibusrev.2012.12.006 [accessed 11th April 2019].
- Goldberg, J. (2004). *Medieval England: a social history 1250-1550*, London, UK: Edward Arnold, ISBN: 10: 0340577452.
- Golden, C.D., Allison, E.H., Cheung, W.W.L., Dey, M.M., Halpern, B.S., McCauley, D.J., Smith, M., Vaitla, B., Zeller, D. and Myers, S.S. (2016). Fall in fish catch threatens human health, *Nature*, Vol. 534, pp.317-320, doi:10.1038/534317a.
- Goldie, J. and Betts, K. (eds)(2015). *Sustainable futures: linking population, resources and the environment*, Clayton, Victoria, Australia: CSIRO Publishing, ISBN: 9781486301898.
- Goldring, A. (2019). *National Food Strategy evidence submission 2019*, Permaculture Association, https://blog.permaculture.org.uk/articles/national-food-strategy-evidence-submission-2019 [accessed 11th April 2019].
- Goldstein, A., Turner, W.R., Gladstone, J. and Hole, D.G. (2018). The private sector's climate change risk and adaptation blind spots, *Nature Climate Change*, Vol. 9, pp.18-25, https://doi.org/10.1038/s41558-018-0340-5 [accessed 11th April 2019].
- Goldstein, B., Hauschild, M., Fernández, J. and Birkved, M. (2016). Testing the environmental performance of urban agriculture as a food supply in northern climates, *Journal of Cleaner Production*, Vol. 135, pp.984e994, http://dx.doi.org/10.1016/j.jclepro.2016.07.004 [accessed 11th April 2019].
- Golledge, N.R., Keller, E.D., Gomez, N., Naughten, K.A., Bernales, J., Trusel, L.D. and Edwards, T.L. (2019). Global environmental consequences of twenty-first-century ice-sheet melt, *Nature*, Vol. 566, pp.65-72, https://doi.org/10.1038/s41586-019-0889-9 [accessed 11th April 2019].
- Gollnow, S., Lundie, S., Moore, A.D., McLaren, J., Buuren, N., Stahle, P., Christie, K., Thylmann, D. and Rehl, T. (2014). Carbon footprint of milk production from dairy cows in Australia, *International Dairy Journal*, Vol. 37, Iss. 1, pp.31-38, http://dx.doi.org/10.1016/j.idairyj.2014.02.005 [accessed 11th April 2019].
- Gomez-Echeverri, L. (2018). Climate and development - enhancing impact through stronger linkages in the implementation of the Paris Agreement and the Sustainable Development Goals (SDGs), *Philosophical Transactions of the Royal Society A: Mathematical, Physical, and Engineering Sciences*, Vol. 376, No. 2119, pii: 20160444, doi: 10.1098/rsta.2016.0444.

- Gönman, K., Ypyä, J., Virtanen, Y., Kurppa, S., Soukka, R., Seuri, P., Finér, A., and Linnanen, L. (2016). Nutrient footprint as a tool to evaluate the nutrient balance of a food chain, *Journal of Cleaner Production*, Vol. 112, pp.2429-2440, https://doi.org/10.1016/j.jclepro.2015.09.129 [accessed 11th April 2019].
- Gonzalez-Silvera, D., Guardiola, F.A., Cordero, H., Cuesta, A., Esteban, M.A. and Martinez-Lopez, F.J. (2017). The short-term effects of farmed fish food consumed by wild fish congregating outside the farms, *Marine Pollution Bulletin*, Vol. 114, Iss. 2, pp.689-698, https://doi.org/10.1016/j.marpolbul.2016.10.055 [accessed 11th April 2019].
- Goodland, R. (1997). Environmental sustainability in agriculture - diet matters, *Ecological Economics*, Vol. 23, pp.189-200, http://dx.doi.org/10.1016/S0921-8009(97)00579-X [accessed 11th April 2019].
- Goodman, D. (2002). Rethinking food production–consumption, *Sociologia Ruralis*, Vol 42, No. 4, October, pp.271-277, https://doi.org/10.1111/1467-9523.00216 [accessed 11th April 2019].
- Goodman, D. (2009). *Place and space in alternative food networks - connecting production and consumption*, Department of Geography Working Paper Series 21, London, UK: King's College - Environment, Politics and Development.
- Goodman, W. and Minner, J. (2019). Will the urban agricultural revolution be vertical and soilless, *Land Use Policy*, Vol. 83, pp.160-173, https://doi.org/10.1016/j.landusepol.2018.12.038 [accessed 11th April 2019].
- Gordon, K., Dynan, L. and Siegel, R. (2018). Healthier choices in school cafeterias: a systematic review of cafeteria intervention, *Journal of Pediatrics*, Vol. 203, pp.273-279, doi: 10.1016/j.jpeds.2018.07.031.
- Gordon, L.J., Bignet, V., Crona, B., Henriksson, P.J.G., Van Holt, T., Jonell, M., Lindahl, T., Troell, M., Barthel, S., Deutsch, L., Folke, C., Haider, L.J., Rockström, J. and Queiroz, C. (2017). Rewiring food systems to enhance human health and biosphere stewardship, *Environmental Research Letters*, Vol. 12, No. 10, pp.100201, doi: 10.1088/1748-9326/aa81dc.
- Gordon, T.A.C., Harding, H.R., Clever, F.K., Davidson, I.K., Davison, W., Montgomery, D.W., Weatherhead, R.C., Windsor, F.M., Armstrong, J.D., Bardonnet, A., Bergman, E., Britton, J.R., Côté, I.M., D'agostino, D., Greenberg, L.A., Harborne, A.R., Kahilainen, K.K., Metcalfe, N.B., Mills, S.C., Milner, N.J., Mittermayer, F.H., Montorio, L., Nedelec, S.L., Prokkola, J.M., Rutterford, L.A., Salvanes, A.G.V., Simpson, S.D., Vainikka, A., Pinnegar, J.K. and Santos, E.M. (2018). Fishes in a changing world: learning from the past to promote sustainability of fish populations, *Journal of Fish Biology*, Vol. 92, No. 3, pp.804-827, doi:10.1111/jfb.13546.
- Görg, C., Plank, C., Wiedenhofer, D., Mayer, A., Pichler, M., Schaffartzik, A. and Krausmann, F. (2020). Scrutinizing the great acceleration: the Anthropocene and its analytic challenges for social-ecological transformations. *The Anthropocene Review*, Vol. *7*, No. 1, pp.42-61, https://doi.org/10.1177/2053019619895034 [accessed 11th April 2019].

- Gornall, J., Betts, R., Burke, E., Clark, R., Camp, J., Willett, K. and Wilture, A. (2010). Implications of climate change for agricultural productivity in the early twenty-first century, *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 365, No. 1554, pp.2973-2989, https://doi.org/10.1098/rstb.2010.0158 [accessed 11th April 2019].
- Gorski, M.T. and Roberto, C.A. (2015). Public health policies to encourage healthy eating habits: recent perspectives, *Journal of Healthcare Leadership*, Vol. 7, pp.81-90, doi:10.2147/JHL.S69188.
- Gortmaker, S.L., Swinburn, B.A., Levy, D., Carter, R., Mabry, P.L., Finegood, D.T., Huang, T., Marsh, T. and Moodie, M.L. (2011). Changing the future of obesity: science, policy, and action, *The Lancet*, Vol. 378, pp.838-847, doi:https://doi.org/10.1016/S0140-6736(11)60815-5,
- Goubau, A. (2011). *The AquAdvantage salmon controversy – a tale of aquaculture, genetically engineered fish and regulatory uncertainty*, Cambridge, USA: Harvard University, http://nrs.harvard.edu/urn-3:HUL.InstRepos:8789564 [accessed 11th April 2019].
- Goucher, L., Bruce, R., Cameron, D., Koh, S.C.L. and Horton, P. (2017). Environmental impact of fertiliser embodied in a wheat-to-bread supply chain, *Nature Plants*, Vol. 3, No. 3, 17012, doi: 10.1038/nplants.2017.12.
- Gouel, C. and Guimbard, H. (2019). Nutrition transition and the structure of global food demand, *American Journal of Agricultural Economics*, Vol. 101, No. 2, pp.383-403, https://doi.org/10.1093/ajae/aay030 [accessed 11th April 2019].
- Goulson, D. (2019). *Insect declines and why they matter*, Taunton, Somerset, UK: South West Wildlife Trusts, https://www.somersetwildlife.org/sites/default/files/2019-11/FULL%20AFI%20REPORT%20WEB1_1.pdf [accessed 11th April 2019].
- Government of Canada (2018). What we heard report – a food policy for Canada, Ottawa, Canada: Government of Canada, https://www.canada.ca/en/campaign/food-policy/what-we-heard/fullreport.html [accessed 11th April 2019].
- *Government of Canada* (2019). The Food Policy, *Government of Canada*, 21st June, https://www.canada.ca/en/campaign/food-policy/thefoodpolicy.html [accessed 11th April 2020].
- Government of Canada (2020). *Food policy for Canada: everyone at the table*, https://www.canada.ca/en/campaign/food-policy/learn-more/food-policy-for-canada-everyone-at-the-table.html [accessed 11th April 2020].
- Govindan, K. (2018). Sustainable consumption and production in the food supply chain: a conceptual framework, *International Journal of Production Economics*, Vol. 195, pp.419-431, https://doi.org/10.1016/j.ijpe.2017.03.003 [accessed 11th April 2019].
- Govindasamy, R., Italia, J. and Adelaja, A. (2002). Farmers' markets - consumer trends, preferences, and characteristics, *Journal of Extension*, Vol. 40, No 1, doi: 10.22004/ag.econ.36722.

- Grab, H., Branstetter, M.G., Amon, N., Urban-Mead, K.R., Park, M.G., Gibbs, J., Blitzer, E.J., Poveda, K., Loeb, G. and Danforth, D.N. (2019). Agriculturally dominated landscapes reduce bee phylogenetic diversity and pollination services, *Science*, 18th January,Vol. 363, Issue 6424, pp. 282-284, doi: 10.1126/science.aat6016.
- Grab, H., Danforth, B., Poveda, K. and Loeb, G. (2018). Landscape simplification reduces classical biological control and crop yield, *Ecological Applications*, Vol. 28, Iss. 2, pp.1-8, doi: 10.1126/science.aat6016.
- Graça, J., Calheiros, M. and Oliveira, A. (2014). Moral disengagement in harmful but cherished food practices? An exploration into the case of meat, *Journal of Agricultural and Environmental Ethics*, Vol. 27, No. 5, pp.749-765, https://doi.org/10.1007/s10806-014-9488-9 [accessed 11th April 2019].
- Graefe, L. (2009). Peak oil debate, *Federal Reserve Bank of Atlanta Economic Review*, Vol. 94, No. 2, http://hdl.handle.net/10419/57664 [accessed 11th April 2019].
- Graffeo, M. (2017). Agriculture: mitigation through food, *Nature Climate Change*, Vol. 7, No. 4, pp.236-236, doi: 10.1038/nclimate3269.
- Grafton, R., Daugbjerg, C. and Qureshi, M. (2015). Towards food security by 2050, *Food Security*, Vol. 7, No. 2, pp.179-183, https://doi.org/10.1007/s12571-015-0445-x [accessed 11th April 2019].
- Grafton, R.Q., Williams, J. and Jiang, Q. (2015). Food and water gaps to 2050: preliminary results from the global food and water system (GFWS) platform, *Food Security*, Vol. 7, pp.209-220, doi:10.1007/s12571-015-0439-8.
- Graham, S. and Potter, A. (2015). Environmental operations management and its links with proactivity and performance, *International Journal of Production Economics*, Vol. 170, pp.146-159, https://doi.org/10.1016/j.ijpe.2015.09.021 [accessed 11th April 2019].
- Graham-Rowe, D. (2011). Agriculture beyond food versus fuel, *Nature*, Vol. 474, S6–S8, https://doi.org/10.1038/474S06a [accessed 11th April 2019].
- GRAIN (2017). *Grabbing the bull by the horns: it's time to cut industrial meat and dairy to save the climate*, Barcelona, Spain: GRAIN, https://www.grain.org/article/entries/5639-grabbing-the-bull-by-the-horns-it-s-time-to-cut-industrial-meat-and-dairy-to-save-the-climate [accessed 11th April 2019].
- GRAIN (2019). Emissions impossible: how big meat and dairy are heating up the planet, Barcelona, Spain: GRAIN, https://www.grain.org/article/entries/5976-emissions-impossible-how-big-meat-and-dairy-are-heating-up-the-planet [accessed 11th April 2019].
- Grainger, C. and Beauchemin, K.A. (2011). Can enteric methane emissions from ruminants be lowered without lowering their production, *Animal Feed Science and Technology*, Vol. 166-167, pp.308– 320, doi:10.1016/j.anifeedsci.2011.04.021.
- Grant Thompson (2011). *Sustainable growth in the food and drink manufacturing industry*, London, UK: Grant Thompson.

- Grant, G. (2014). *Shocks and disruptions - the relationship between food security and national security*, London, UK: The Henry Jackson Society.
- Grant, M. (2015). A food systems approach for food and nutrition security, *Sight and Life*, Vol. 29, No.1, pp.87-90, https://sightandlife.org/wp-content/uploads/2015/11/SAL_Mag_Frontiers_In_Nutrition_2015_Food_systems_approach_for_food.pdf [accessed 11th April 2019].
- Grant, M. and Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies, *Health Information and Libraries Journal*, Vol. 26, No. 2, pp.91-108, doi: 10.1111/j.1471-1842.2009.00848.
- Grassini, P., Eskridge, K.M. and Cassman, K.G. (2013). Distinguishing between yield advances and yield plateaus in historical crop production trends, *Nature Communications*, Vol. 4, 2918, https://doi.org/10.1038/ncomms3918 [accessed 11th April 2019].
- Graves, A.R., Morris, J., Deeks, L.K., Rickson, R.J., Kibblewhite, M.G., Harris, J.A., Farewell, T.S. and Truckle, I. (2015). The total cost of soil degradation in England and Wales, *Ecological Economies*, Vol. 116, pp.399-413, https://doi.org/10.1016/j.ecolecon.2015.07.026 [accessed 11th April 2019].
- Gray, S.B. and Brady, S.M. (2016). Plant developmental responses to climate change, *Developmental Biology*, Vol. 419, pp.64-77, http://dx.doi.org/10.1016/j.ydbio.2016.07.023 [accessed 11th April 2019].
- Grayson, D. (2011). Embedding corporate responsibility and sustainability, *Journal of Management Development*, Vol. 30, Iss. 10, pp.1017-1026, doi: 10.1108/02621711111182510.
- Greater London Authority (2018). *Draft London Food Strategy*, London, UK: Greater London Authority
- Green Facts (2009). Fisheries latest data, http://www.greenfacts.org/ [accessed 11th April 2019].
- Green, D.P. (2010). Sustainable food supply chains, *Journal of Aquatic Food Product Technology*, Vol. 19, No. 2, pp.55-56, https://doi.org/10.1080/10498850.2010.493992 [accessed 11th April 2019].
- Green, J.M.H., Cranston, G.R., Sutherland, W.J., Tranter, H.R., Bell, S.J., Benton, T.G., Blixt, E., Bowe, C., Broadley, S., Brown, A., Brown, C., Burns, N., Butler, D., Collins, H., Crowley, H., DeKoszmovszky, J., Firbank, L.G., Fulford, B., Gardner, T.A., Hails, R.S., Halvorson, S., Jack, M., Kerrison, B., Koh, L.S.C., Lang, S.C., McKenzie, E.J., Monsivais, P., O Riordan, T., Osborn, J., Oswald, S., Price Thomas, E., Raffaelli, D., Reyers, B., Srai, J.S., Strassburg, B.B.N., Webster, D., Welters, R., Whiteman, G., Wilsdon, J. and Vira, B. (2017). Research priorities for managing the impacts and dependencies of business upon food, energy, water and the environment, *Sustainability Science*, Vol. 12, pp.319, https://doi.org/10.1007/s11625-016-0402-4 [accessed 11th April 2019].
- Green, J.M.H., Croft, S.A., Durán, A.P., Balmford, A.P., Burgess, N.D., Fick, S., Gardner, T.A., Godar, J., Suavet, C., Virah-Sawmy, M., Young, L.E. and West, C.D. (2019). Linking global drivers of agricultural trade to on-the-ground impacts on biodiversity, *Proceedings of the National Academy of Sciences of the United States of America*, 12th November, Vol. 116, No. 46, pp.23202-23208, https://doi.org/10.1073/pnas.1905618116 [accessed 11th April 2019].

- Green, R., Cornelsen, L. and Dangour, A.D. (2013). The effect of rising food prices on food consumption: systematic review with meta-regression, *British Medical Journal*, Vol. 346, f3703, doi: https://doi.org/10.1136/bmj.f3703 [accessed 11th April 2019].
- Green, R., Milner, J., Dangour, A.D., Wilkinson, P., Haines, A., Chalabi, Z., Markandya, A., Spadaro, J. and Wilkinson, P. (2015). The potential to reduce greenhouse gas emissions in the UK through healthy and realistic dietary change, *Climate Change*, Vol. 129, No. 253, doi: 10.1007/s10584-015-1329-y.
- Green, R., Milner, J., Joy, E.J.M., Agrawal, S. and Dangour, A.D. (2016). Dietary patterns in India: a systematic review, *British Journal of Nutrition*, No. 116, No. 1, pp.142-148, doi: 10.1017/S0007114516001598.
- Green, R.F., Joy, E.J.M., Harris, F., Agrawal, S., Aleksandrowicz, L., Hillier, J., Macdiarmid, J.I., Milner, J., Vetter, S.H., Smith, P., Haines, A. and Dangour, A.D. (2018). Greenhouse gas emissions and water footprints of typical dietary patterns in India, *Science of The Total Environment*, Vol. 643, pp.1411-1418, https://doi.org/10.1016/j.scitotenv.2018.06.258 [accessed 11th April 2019].
- Greenberg, P. (2010). *Four fish: a journey from the ocean to your plate*, London, UK: Allen Lane, ISBN-10: 1846140021.
- Greendex (2014). *Increased fears about environment, but little change in consumer behaviour, according to new national geographic/globescan study*, National Geographic Partners Press Room, http://press.nationalgeographic.com/2014/09/26/greendex/ [accessed 11th April 2019].
- Greenhalgh, S. (2019). Soda industry influence on obesity science and policy in China, *Journal of Public Health Policy*, Vol. 40, pp.5-16, https://doi.org/10.1057/s41271-018-00158-x [accessed 11th April 2019].
- Greenpeace (2008). *Challenging the aquaculture industry on sustainability*, London, UK: Greenpeace, https://www.greenpeace.de/sites/www.greenpeace.de/files/Challenging_the_Aquaculture_Industry_on_Sustainability_0.pdf [accessed 11th April 2019].
- Greenpeace (2012a). *Changing-tuna*, London, UK: Greenpeace, https://storage.googleapis.com/planet4-new-zealand-stateless/2012/03/27a9cd0c-409-changing-tuna.pdf [accessed 11th April 2019].
- Greenpeace (2012b). *How KFC is junking the jungle by driving rainforest destruction in Indonesia,* London, UK: Greenpeace, https://www.greenpeace.org/usa/research/junking-the-jungle/ [accessed 11th April 2019].
- Greenpeace (2012c). *Oceans in the balance - the crisis facing our waters*, London, UK: Greenpeace.
- Greenpeace (2013). *Recipe for change - supermarkets respond to the challenge of sourcing sustainable seafood*, London, UK: Greenpeace.
- Greenpeace (2016). *Burning Issue - why IOI's destruction in Ketapang is a burning issue for the RSPO and the palm oil plantation sector*, London, UK: Greenpeace.

- Greenpeace (2017). *Are you inadvertently supporting this destruction through the brands in your home?* 1st October, London, UK: Greenpeace, https://www.facebook.com/greenpeace.international/videos/10155346226773300/ [accessed 11th April 2019].
- Greenpeace (2018a). *EU moves closer to ban of three bee-killing neonicotinoid insecticides*, 26th April, London, UK: Greenpeace, http://www.greenpeace.org/eu-unit/en/News/2018/EU-vote-ban-three-bees-neonicotinoids-insecticides/ [accessed 11th April 2019].
- Greenpeace (2018b). *Less is more: the Greenpeace vision of the meat and dairy system towards 2050 - reducing meat and dairy for a healthier life and planet*, London, UK: Greenpeace.
- Greenpeace (2018c). *Moment of truth - time for brands to come clean about their links to forest destruction for palm oil*, London, UK: Greenpeace.
- Greenpeace (2018d). *Protect paradise*, London, UK: Greenpeace, https://twitter.com/twitter/statuses/989844227055144961 [accessed 11th April 2019].
- Greenpeace (2018f). *We are in a war for the very existence of life on this planet as we know it. That's no exaggeration. We need to invest in the future, not the past*, London, UK: Greenpeace, VIDEO, https://twitter.com/twitter/statuses/989513769184350208 [accessed 11th April 2019].
- Greenpeace (2019a). *Countdown to extinction*, London, UK: Greenpeace, https://www.greenpeace.org/international/publication/22247/countdown-extinction-report-deforestation-commodities-soya-palm-oil/ [accessed 11th April 2019].
- Greenpeace (2019b). *Feeding the problem: the dangerous intensification of animal farming in Europe*, London, UK: Greenpeace, https://storage.googleapis.com/planet4-eu-unit-stateless/2019/02/83254ee1-190212-feeding-the-problem-dangerous-intensification-of-animal-farming-in-europe.pdf [accessed 11th April 2019].
- Greenville, J., Kawasaki, K. and Beaujeu, R. (2017a). *How policies shape global food and agriculture value chains*, OECD Food, Agriculture and Fisheries Paper No. 100, Paris, France: OECD Publishing, https://doi.org/10.1787/aaf0763a-en [accessed 11th April 2019].
- Greenville, J., Kawasaki, K. and Beaujeu, R. (2017b). *A method for estimating global trade in value added within agriculture and food value chains*, OECD Food, Agriculture and Fisheries Paper No. 99, Paris, France: OECD Publishing, https://doi.org/10.1787/f3a84910-en [accessed 11th April 2019].
- Greenwood, M. (2019). *Fish, fishing and Brexit*, London, UK: City University/FRC Food Brexit Briefing, https://foodresearch.org.uk/publications/fish/ [accessed 11th April 2019].
- Greger, M. (2017). Industrial animal agriculture's role in the emergence and spread of disease. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.217-227, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].

- Gregory P.J., Johnson S.N., Newton A.C., and Ingram J.S.I. (2009). Integrating pests and pathogens into the climate change/food security debate, *Journal of Experimental Botany*, Vol. 60, pp.2827-2838, doi: 10.1093/jxb/erp080.
- Gregory, A.S., Ritz, K., McGrath, S.P., Quinton, J.N., Goulding, K.W., Jones, R.J.A., Harris, J.A., Bol, R., Wallace, P., Pilgrim, E.S. and Whitmore, A.P. (2015). A review of the impacts of degradation threats on soil properties in the UK, *Soil Use and Management*, Vol., 31, pp.1-15, https://doi.org/10.1111/sum.12212 [accessed 11th April 2019].
- Gregory, C.A. and Coleman-Jensen, A. (2013). Do high food prices increase food insecurity in the United States, *Applied Economic Perspectives and Policy*, Vol. 35, No. 4, pp.679-707, doi:10.1093/aepp/ppt024.
- Gregory, P. (2017). *The magic of soil*, University of British Colombia, https://www.phas.ubc.ca/~gregory/papers/GregoryBowenIslandPresentation24Jan2017sht.pdf [accessed 11th April 2019].
- Gregory, P.J. and George, T.S. (2011). Feeding nine billion - the challenge to sustainable crop production, *Journal of Experimental Botany*, Vol. 62, No. 15, pp.5233–5239, doi:10.1093/jxb/err232.
- Gregory, P.J. and Ingram, J.S.I. (2008). Climate change and the current food crisis, *CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, Vol. 3, No. 099, doi: 10.1079/PAVSNNR20083099.
- Gregory, P.J., Ingram, J.S.I. and Brklacich, M. (2005). Climate change and food security, *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 360, No. 1463, pp. 2139-2148, doi:10.1098/rstb.2005.1745.
- Gren, I-M., Moberg, E., Sall, S. and Roos, E. (2019). Design of a climate tax on food consumption: examples of tomatoes and beef in Sweden, *Journal of Cleaner Production*, Vol. 211, pp.1576-1585, https://doi.org/10.1016/j.jclepro.2018.11.238 [accessed 11th April 2019].
- GRID-Arendal (2012). *Why value the oceans*, Paris, France: United Nations Environment Programme, https://www.grida.no/publications/135 [accessed 11th April 2019].
- GRID-Arendal (2013). *Large scale land aquisition in Africa*, Paris, France: United Nations Environment Programme, https://www.grida.no/publications/187 [accessed 11th April 2019].
- Grieger, J.A., Johnson, B.J., Wycherley, T.P. and Golley, R.K. (2017). Evaluation of simulation models that estimate the effect of dietary strategies on nutritional intake: a systematic review, *Journal of Nutrition*, Vol. 147, No. 5, pp.908-931, doi:10.3945/jn.116.245027.
- Griffiths, J., Blair-Stevens, C. and Thorpe, A. (2008). *Social marketing for health and specialised health promotion -stronger together – weaker apart*, The National Social Marketing Centre, https://www.thensmc.com/resource/social-marketing-health-and-specialised-health-promotion-stronger-together-weaker-apart [accessed 11th April 2019].

- Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Ohman, M.C., Shyamsundar, P., Steffen, W., Glaser, G., Kanie, N. and Noble, I. (2013). Sustainable development goals for people and planet, *Nature*, Vol. 495, pp.305-307, https://doi.org/10.1038/495305a [accessed 11th April 2019].
- Grigorakis, K. (2010). Ethical Issues in aquaculture production, *Journal of Agriculture and Environmental Ethics*, Vol. 23, pp.345-370, doi: 10.1007/s10806-009-9210-5.
- Grimm, J.H., Hofstetter, J.S. and Sarkis, J. (2014). Critical factors for sub-supplier management: a sustainable food supply chains perspective, *International Journal of Production Economics*, Vol. 152, pp.159-173, http://dx.doi.org/10.1016/j.ijpe.2013.12.011 [accessed 11th April 2019].
- Grinnell-Wright, V. (2014). *Review of evidence on consumer food-related behaviours that impact on sustainability*, Executive Summary EVO541.
- Griscom, B.W., Adams, J., Ellis, P.W., Houghton, R.A., Lomax, G., Miteva, D.A. and Woodbury, P. (2017). Natural climate solutions, *Proceedings of the National Academy of Sciences*, Vol. 114, No. 44, pp.11645-11650, doi:10.1073/pnas.1710465114.
- *Grocer, The* (2017). Millions of people like farmed salmon, *The Grocer*, 24th February, https://www.thegrocer.co.uk/letters/millions-of-people-like-farmed-salmon/549085.article [accessed 11th April 2019].
- Grönman, K., Ypyä, J., Virtanen, Y., Kurppa, S., Soukka, R., Seuri, P., Finér, A., and Linnanen, L. (2016). Nutrient footprint as a tool to evaluate the nutrient balance of a food chain, *Journal of Cleaner Production*, Vol. 112, pp.2429-2440, https://doi.org/10.1016/j.jclepro.2015.09.129 [accessed 11th April 2019].
- Grove, J.M. (2004). *Little ice ages: ancient and modern*, London, UK: Routledge, ISBN-10: 041509948X.
- Grunert, K. (2011). Sustainability in the food sector: a consumer behaviour perspective, *International Journal on Food System Dynamics*, Vol. 2, No. 3, pp.207-218, https://doi.org/10.18461/ijfsd.v2i3.232 [accessed 11th April 2019].
- Grunert, K.G. (2018). Drivers of food choice: a cognitive structure approach to the determinants of food choice and implications for affecting behavior change, *Nutrition*, Vol. 55, pp.S4-S5, doi: 10.1016/j.nut.2018.07.004.
- Grunert, K.G., Hieke, S. and Wills, J. (2014). Sustainability labels on food products: consumer motivation, understanding and use, *Food Policy*, Vol. 44, pp.177-189, https://doi.org/10.1016/j.foodpol.2013.12.001 [accessed 11th April 2019].
- GSF (2014). *Global strategic framework for food security & nutrition*, Rome, Italy: Committee on World Food Security, http://www.fao.org/fileadmin/templates/cfs/Docs1213/gsf/GSF_Version_2_EN.pdf [accessed 11th April 2019].
- *Guardian, The* (2009). Fish capture by country, *The Guardian*, 2nd September, https://www.theguardian.com/environment/datablog/2009/sep/02/fish-capture-country [accessed 11th April 2019].

- Guest, G., Bunce, A. and Johnson, L. (2006). How many interviews are enough? *Field Methods*, Vol. 18, No. 1, pp.59-82, https://doi.org/10.1177/1525822X05279903 [accessed 11th April 2019].
- Guidotti, T.L. (2017). Different facets, one hard problem - health, environment, energy, sustainability, *Archives of Environmental & Occupational Health*, Vol. 72, No. 3, pp.123-125, doi: 10.1080/19338244.2017.1293410.
- Guillaume, T., Kotowska, M.M., Hertel, D., Knohl, A., Krashevska, A., Murtilaksono, K., Scheu, S. and Kuzyakov, Y. (2018). Carbon costs and benefits of Indonesian rainforest conversion to plantations, *Nature Communications*, Vol. 9, 2388, doi: 10.1038/s41467-018-04755-y.
- Guiry, E., Beglane, F., Szpak, P., Schulting, R., Mccormick, F. and Richards, M.P. (2018). Anthropogenic changes to the Holocene nitrogen cycle in Ireland, *Science Advances*, 13th June, Vol. 4, No. 6, eaas9383, doi: 10.1126/sciadv.aas9383.
- Guis, H., Caminade, C., Calvete, C., Morse, A., Tran, A. and Baylis, M. (2012). Modelling the effects of past and future climate on the risk of bluetongue emergence in Europe, *Journal of the Royal Society Interface*, Vol. 9, No. 67, pp.339-350, doi: 10.1098/rsif.2011.0255.
- Gulbrandsen, L.H. (2009). The emergence and effectiveness of the Marine Stewardship Council, *Marine Policy*, Vol. 33, pp.654-660, doi:10.1016/j.marpol.2009.01.002.
- Gunasekera, D., Newth, D. and Finnigan, J. (2011). Reconciling the competing demands in the human-earth system - ensuring food security, *Economic Papers*, Vol. 30, No. 3, pp.296-306, doi: 10.1111/j.1759-3441.2011.00121.x.
- Gundling, R. (2014). Fish friendly farming - water, wine, and fish—sustainable agriculture for a thirsty world, *California Management Review*, Vol. 57, No. 1, Fall 2014, pp.117-132, doi: 10.1525/cmr.2014.57.1.117.
- Gunn, M. and Mont, O. (2014). Choice editing as a retailers' tool for sustainable consumption, *International Journal of Retail & Distribution Management*, Vol. 42, No. 6, pp.464-481, https://doi.org/10.1108/IJRDM-12-2012-0110 [accessed 11th April 2019].
- Guo, F., Lenoir, J., and Bonebrake, T.C. (2018). Land-use change interacts with climate to determine elevational species redistribution, *Nature Communications*, Vol. 9, No. 1, doi: 10.1038/s41467-018-03786-9.
- Gupta, J. (2004). Global sustainable food governance and hunger: traps and tragedies, *British Food Journal*, Vol. 106, No. 5, pp.406-416, doi: 10.1108/00070700410531624.
- Gussow, J.D. and Clancy, K.L. (1986). Dietary guidelines for sustainability, *Journal of Nutrition Education*, Vol. 18, No. 1, pp.1-5, https://doi.org/10.1016/S0022-3182(86)80255-2 [accessed 11th April 2019].
- Gutteridge, S. (2018). The impact of a changing atmosphere on chloroplast function, photosynthesis, yield, and food security, *Essays in biochemistry*, Vol. 62, No. 1, pp.1-11, doi: 10.1042/EBC20180023.

- Guy's and St Thomas' Charity (2018). *Bite size: breaking down the challenge of inner-city childhood obesity*, London, UK: Guy's and St Thomas' Charity, https://www.gsttcharity.org.uk/bitesize [accessed 11th April 2019].
- Guyomard, H., Darcy-Vrillon, B., Esnouf, C., Marin, M., Russel, M. and Guillou, M. (2012). Eating patterns and food systems: critical knowledge requirements for policy design and implementation, *Agriculture & Food Security*, Vol. 1, No. 13, pp.1-21, https://doi.org/10.1186/2048-7010-1-13 [accessed 11th April 2019].
- Guzman, P. and Reynolds, C. (2019). *Food hubs in the UK – where are we and what next*, Food Research Collaboration, London, UK: City, University of London, Centre for Food Policy, https://foodresearch.org.uk/publications/food-hubs/ [accessed 11th April 2019].
- Ha, M-A. (2018). Processed food linked to cancer? Uncritical media coverage ignores problems with study, *The Conversation*, 16th February, https://theconversation.com/processed-food-linked-to-cancer-uncritical-media-coverage-ignores-problems-with-study-91935 [accessed 11th April 2019].
- Haby, M.M., Chapman, E., Clark, R. and Galvão, L.A.C. (2016). Agriculture, food, and nutrition interventions that facilitate sustainable food production and impact health: an overview of systematic reviews, *Pan American Journal of Public Health*, Vol. 40, No. 1, pp.48-56, https://www.scielosp.org/article/rpsp/2016.v40n1/48-56/en/ [accessed 15th April 2020].
- Haddad, E.H. and Tanzman, J.S. (2003). What do vegetarians in the United States eat, *American Journal of Clinical Nutrition*, Vol. 78, pp.26S–632S, https://doi.org/10.1093/ajcn/78.3.626S [accessed 11th April 2019].
- Haddad, L. (2018). Reward food companies for improving nutrition, *Nature*, Vol. 556, No. 7699, pp.19-22, https://www.nature.com/articles/d41586-018-03918-7 [accessed 11th April 2019].
- Haddad, L. and Hawkes, C. (2016). A new global research agenda for food, *Nature*, Vol. 540, pp.30-32, doi:10.1038/540030a.
- Haddad, L. and Nabarro, D. (2018). Sustainable development depends on better nutrition for all nations, *Inter Press Service News*, 16th October, http://www.ipsnews.net/2018/10/sustainable-development-depends-better-nutrition-nations/ [accessed 11th April 2019].
- Haddad, L., Hawkes, C., Waage, J., Webb, P., Godfray, C. and Toulmin, C. (2016). *Food systems and diets: facing the challenges of the 21st century*, London, UK: Global Panel on Agriculture and Food Systems for Nutrition, https://www.ifpri.org/publication/food-systems-and-diets-facing-challenges-21st-century [accessed 11th April 2019].
- Hadjikakou, M. and Wiedmann, T. (2017). Shortcomings of a growth-driven food system. In: *Handbook on Growth and Sustainability*, (eds) Victor, P.A. and Dolter, B., Edward Elgar Publishing.
- Hadjikakou, M., Ritchie, E., Watermeyer, K. and Bryan, B.A. (2019). Improving the assessment of food system sustainability, *The Lancet Planet Health*, Vol 3, pp.e62–e63, doi:https://doi.org/10.1016/S2542-5196(18)30244-4.

- Hadjimichael, M. and Hegland, T.J. (2016). Really sustainable - Inherent risks of eco-labeling in fisheries, *Fisheries Research*, Vol. 174, pp.129-135, http://dx.doi.org/10.1016/j.fishres.2015.09.012 [accessed 11th April 2019].
- Hadjimichael, M., Bruggeman, A. and Lange, M.A. (2014). Tragedy of the few - a political ecology perspective of the right to the sea, *Marine Policy*, Vol. 49, pp.12-19, http://dx.doi.org/10.1016/j.marpol.2014.04.003 [accessed 11th April 2019].
- Hagmann, D., Ho, E. H. and Loewenstein, G. (2019). Nudging out support for a carbon tax, *Nature Climate Change*, Vol. 9, pp.484-489, doi:10.1038/s41558-019-0474-0.
- Haidich, A.B. (2010). Meta-analysis in medical research, *Hippokratia*, Vol. 14, 29.
- Haines, A. (2016). Addressing challenges to human health in the Anthropocene epoch—an overview of the findings of the Rockefeller/Lancet Commission on Planetary Health, *Public Health Reviews*, Vol. 37, No. 14, https://doi.org/10.1186/s40985-016-0029-0 [accessed 11th April 2019].
- Haines, A. (2017). Health co-benefits of climate action, *The Lancet*, Vol. 1, April, pp.e5-e5.
- Haines, A., Epstein, P.R. and McMichael, A.J. (1993). Global health watch: monitoring impacts of environmental change, *The Lancet*, Vol. 342, pp.1464-1469, doi:https://doi.org/10.1016/0140-6736(93)92937-O.
- Haines, A., Hanson, C. and Ranganathan, J. (2018). Planetary health watch: integrated monitoring in the Anthropocene epoch, *The Lancet*, 1st April, Vol. 2, Iss. 4, pp.e141-e143, doi: https://doi.org/10.1016/S2542-5196(18)30047-0 [accessed 11th April 2019].
- Hajat, S., Ebi, K.L., Kovats, R.S., Menne, B., Edwards, S. and Haines, A. (2005). The human health consequences of flooding in Europe: a review. In: *Extreme Weather Events and Public Health Responses* (eds) Kirch, W., Menne, B. and R. Bertollini, R., pp.185-197, New York, USA: Springer.
- Hajat, S., Vardoulakis, S., Heaviside, C. and Eggen, B. (2014). Climate change effects on human health: projections of temperature-related mortality for the UK during the 2020s, 2050s and 2080s, *Journal of Epidemiology and Community Health*, Vol. 68, No. 7, pp.641-648, http://dx.doi.org/10.1136/jech-2013-202449 [accessed 11th April 2019].
- Hajjar, R., Newton, P., Adshead, D., Bogaerts, M., Maguire-Rajpaul, V.A., Pinto, L.F.G., McDermott, C.L., Milder, J.C., Wollenberg, E. and Agrawal, A. (2019). Scaling up sustainability in commodity agriculture: transferability of governance mechanisms across the coffee and cattle sectors in Brazil, *Journal of Cleaner Production*, Vol. 206, pp.124-132, https://doi.org/10.1016/j.jclepro.2018.09.102 [accessed 11th April 2019].
- Hale, T. (2019). Can the UK rise to the global leadership challenge on climate, *Green Alliance Blog*, 11th July, https://greenallianceblog.org.uk/2019/07/09/can-the-uk-rise-to-the-global-leadership-challenge-on-climate/ [accessed 11th April 2019].

- Halford, J.C.G., Masic, U., Marsaux, C.F.M., Jones, A.J., Lluch, A., Marciani, L., Mars, M., Vinoy, S., Westerterp-Plantenga, M. and Mela, D.J. (2018). Systematic review of the evidence for sustained efficacy of dietary interventions for reducing appetite or energy intake, *Obesity Reviews,* Vol. 19, No. 10, pp.1329-1339, doi: 10.1111/obr.12712.
- Hall, J. and Wagner, M. (2012). Integrating sustainability into firms' processes - performance effects and the moderating role of business models and innovation, *Business Strategy and the Environment*, Vol. 21, pp.183-196, doi: 10.1002/bse.728.
- Hall, K.D., Ayuketah, A., Brychta, R., Walter, P.J., Yang, S. and Zhou, M. (2019). Ultra-processed diets cause excess calorie intake and weight gain: an inpatient randomized controlled trial of ad libitum food intake, *Cell Metabolism*, Vol. 30, pp.1-11, doi: https://doi.org/10.1016/j.cmet.2019.05.008.
- Hall, M.R. (2015). A transdisciplinary review of the role of economics in life cycle sustainability assessment, *International Journal of Life Cycle Assessment*, Vol. 20, No. 12, pp.1625-1639, doi: 10.1007/s11367-015-0970-z.
- Hallam, R. (2019). *Common sense for the 21st Century: only nonviolent rebellion can now stop climate breakdown and social collapse*, Common Sense For The 21st Century, ISBN-10: 1527246744, https://www.rogerhallam.com/ [accessed 11th April 2019].
- Hallegatte, S. (2012). A framework to investigate the economic growth impact of sea-level rise, *Environmental Research Letters*, Vol. 7, 015604, doi:10.1088/1748-9326/7/1/015604.
- Hallegatte, S. and Rozenberg, J. (2017). Climate change through a poverty lens, *Nature Climate Change*, Vol. 7, pp.250-256, doi:10.1038/nclimate3253.
- Hallett, J., Carey, G., Joyce, A. and Hannelly, T. (2014). The impact of nutritional choices on global warming and policy implications: examining the link between dietary choices and greenhouse gas emissions, *Energy and Emission Control Technologies*, 9th December, Vol. 2, pp.33-43, doi: https://doi.org/10.2147/EECT.S58518 [accessed 11th April 2019].
- Hallstein, E. and Villas-Boas, S.B. (2013). Can household consumers save the wild fish, *Journal of Environmental Economics and Management*, Vol. 66, pp.52-71, http://dx.doi.org/10.1016/j.jeem.2013.01.003 [accessed 11th April 2019].
- Hallström, E., Carlsson-Kanyama, A. and Börjesson, P. (2015). Environmental impact of dietary change: a systematic review, *Journal of Cleaner Production*, Vol. 91, No. 1, pp.1-11, doi.org/10.1016/j.jclepro.2014.12.008.
- Hallström, E., Davis, J., Woodhouse, A. and Sonesson, U. (2018). Using dietary quality scores to assess sustainability of food products and human diets: a systematic review, *Ecological Indicators*, Vol. 93, pp.219-230, https://doi.org/10.1016/j.ecolind.2018.04.071 [accessed 11th April 2019].

- Halpern, B.S., Cottrell, R.S., Blanchard, J.L., Bouwman, L., Froehlich, H.E., Gephart, J.A., Jacobsen, N.A., Kuempel, C.D., McIntyre, P.B., Metian, M., Moran, D.D., Nash, K.L., Többen, J. and Williams, D.R. (2019). Opinion: putting all foods on the same table: achieving sustainable food systems requires full accounting, *Proceedings of the National Academy of Sciences*, Vol. 116, No. 37, pp.18152-18156, doi: 10.1073/pnas.1913308116.
- Hamblin, J., Barbetti, M.J., Stefanova, K., Blakeway, F., Clements, J. and Cowling, W. (2018). Crop breeding to break nexus between bee decline/food production? *Global Food Security*, Vol. 19; pp.56-63, https://doi.org/10.1073/pnas.1913308116 [accessed 11th April 2019].
- Hambling, T., Weinstein, P. and Slaney, D. (2011). A review of frameworks for developing environmental health indicators for climate change and health, *International Journal of Environmental Research and Public Health*, Vol. 8, No. 7, pp.2854–2875, doi:10.3390/ijerph8072854.
- Hamilton, L. and Stampone, M. (2013). 'Blowin' in the wind: short-term weather and belief in anthropogenic climate change, *Weather, Climate, and Society*, Vol. 5, No. 2, pp.112-119, https://doi.org/10.1175/WCAS-D-12-00048.1 [accessed 11th April 2019].
- Hamilton, L., Cutler, M. and Schaefer, A. (2012). Public knowledge and concern about polar-region warming, *Polar Geography*, Vol. 35, No. 2, pp.155-168, doi: 10.1080/1088937X.2012.684155.
- Hamm, M. (2019). Eight ways to halt a global food crisis, *The Conversation*, 8th July, http://theconversation.com/eight-ways-to-halt-a-global-food-crisis-118436 [accessed 11th April 2019].
- Hamman, P., Anquetin, V. and Monicolle, C. (2017). Contemporary meanings of the -sustainable city - a comparative review of the French - and English-language literature, *Sustainable Development*, Vol. 25, No. 4, pp.336-355, https://doi.org/10.1002/sd.1660 [accessed 11th April 2019].
- Hamprecht, J., Corsten, D., Noll, M. and Meier, E. (2005). Controlling the sustainability of food supply chains, *Supply Chain Management: An International Journal*, Vol. 1, No. 1, pp.7-10, doi: 10.1108/13598540510578315.
- Han, H. and Barnett-Loro, C. (2018). To support a stronger climate movement, focus research on building collective power, *Frontiers in Communication*, Vol. 3, doi: 10.3389/fcomm.2018.00055.
- Hancock, T. (1993). Health, human development and the community ecosystem: three ecological models, *Health Promotion International*, Vol. 8, pp.41-47, https://doi.org/10.1093/heapro/8.1.41 [accessed 11th April 2019].
- Hancock, T. (2018). Governance for a healthy, just and sustainable future, *Canadian Medical Association Journal*, June, p.72, doi: 10.1503/cmaj.180588.
- Hand, J. (2018). Simple but not simplistic - can product badges encourage more sustainable consumption, *Food Climate Research Network*, 11th July, https://www.fcrn.org.uk/fcrn-blogs/simple-not-simplistic-can-product-badges-encourage-more-sustainable-consumption [accessed 11th April 2019].
- Haniotis, T. (2019). Opinion paper - beef, climate change and a slice of common sense, *Animal*, Vol. 13, Iss. 9, pp.1785-1787, doi: https://doi.org/10.1017/S1751731119001101.

- Hanjra, M.A. and Qureshi, M.E. (2010). Global water crisis and future food security in an era of climate change, *Food Policy*, Vol. 35, No. 5, pp. 365-377, https://doi.org/10.1016/j.foodpol.2010.05.006 [accessed 11th April 2019].
- Hannah, L. (2015). *Climate change biology*, 2nd ed., London, UK: Elsevier/Academic Press, ISBN: 9780124202184.
- Hannah, L., Donatti, C.I., Harvey, C.A., Alfaro, E., Rodriguez, D.A., Bouroncle, C., Castellanos, E., Diaz, F., Fung, E., Hidalgo, H.G., Imbach, P., Läderach, P., Landrum, J.P. and Solano, A.L. (2017). Regional modeling of climate change impacts on smallholder agriculture and ecosystems in Central America, *Climatic Change*, Vol. 141, No. 1, pp.29-45, https://doi.org/10.1007/s10584-016-1867-y [accessed 11th April 2019].
- Hannah, L., Roehrdanz, P.R., Ikegami, M., Shepard, A.V., Shaw, M.R., Tabord, G., Zhie, L., Marquet, P.A. and Hijmans, R.J. (2013). Climate change, wine, and conservation, *Proceedings of the National Academy of Sciences*, Vol. 110, No. 17, pp.6907-6912, https://doi.org/10.1073/pnas.1210127110 [accessed 11th April 2019].
- Hansen, A. (2018). Meat consumption and capitalist development: the meatification of food provision and practice in Vietnam, *Geoforum*, Vol. 93, pp.57-68, https://doi.org/10.1016/j.geoforum.2018.05.008 [accessed 11th April 2019].
- Hansen, A., Bi, P., Nitschke, M., Ryan, P., Pisaniello, D. and Tucker, G. (2008). The effect of heat waves on mental health in a temperate Australian city, *Environmental Health Perspectives*, Vol. 116, pp.1369-1375, doi: 10.1289/ehp.11339.
- Hansen, J., Johnson, D., Lacis, A., Lebedeff, S., Lee, P., Rind, D. and Russell, G. (1981). Climate impact of increasing atmospheric carbon dioxide, *Science*, Vol. 213, pp.957-966, doi:10.1126/science.213.4511.957.
- Hansen, J., Ruedy, R., Sato, M. and Lo, K. (2010). Global surface temperature change, *Reviews of Geophysics*, Vol. 48, RG4004, https://doi.org/10.1029/2010RG000345 [accessed 11th April 2019].
- Hansen, J., Sato, M. and Ruedy, R. (2012). Perception of climate change, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 109, E2415-2423, https://doi.org/10.1073/pnas.1205276109 [accessed 11th April 2019].
- Hansen, K. (2019). Danish bacon: what happens when you push pigs to the limit? Denmark's industrial pig farms are stunningly productive, but there is another side to their success, *The Guardian*, 30th November, https://www.theguardian.com/environment/2019/nov/30/danish-bacon-what-happens-when-you-push-pigs-to-the-absolute-limit?
- Hansen, M.C.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., Kommareddy, A., Egorov, A., Chini, L., Justice, C.O. and Townshend, J.R.G. (2013). High-resolution global maps of 21st-century forest cover change, *Science*, Vol. 342, pp.850-854, doi: 10.1126/science.1244693.

- Hanson, C. (2013). *Food security, inclusive growth, sustainability and the post-2015 development agenda*, Background research paper submitted to the High Level Panel on the Post-2015 Development Agenda, https://www.post2020hlp.org/ [accessed 11th April 2019].
- Harcombe, Z. (2017). Designed by the food industry for wealth, not health: the 'Eatwell Guide', *British Journal of Sports Medicine*, Vol. 51, Iss. 24, pp.1730-1731, http://dx.doi.org/10.1136/bjsports-2016-096297 [accessed 11th April 2019].
- Hardin, G. (1968). The tragedy of the commons, *Science*, Vol. 162, No. 3859, pp.1243-1248, doi: 10.1126/science.162.3859.1243.
- Harguess, J.M., Crespo, N.C. and Hong, M.Y. (2020). Strategies to reduce meat consumption: a systematic literature review of experimental studies, *Appetite*, Vol. 144, No. 104478, https://doi.org/10.1016/j.appet.2019.104478.
- Harper, S. (2012). Environment, migration and the European demographic deficit, *Environmental Research Letters*, Vol. 7, 015605, doi:10.1088/1748-9326/7/1/015605.
- Harrabin, R. (2018). Is meat's climate impact too hot for politicians? *BBC News*, 14th October, https://www.bbc.co.uk/news/science-environment-45838997 [accessed 11th April 2019].
- Harrabin, R. (2019a). Climate change - Big lifestyle changes 'needed to cut emissions', *BBC News*, 29th August, https://www.bbc.co.uk/news/science-environment-49499521 [accessed 11th April 2019].
- Harrabin, R. (2019b). Climate change: UK government to commit to 2050 target, *BBC News*, 12th June, https://www.bbc.co.uk/news/science-environment-48596775 [accessed 11th April 2019].
- Harrabin, R. (2019c). Climate change: will insect-eating dogs help? *The Guardian*, 10th January, https://www.bbc.co.uk/news/science-environment-46811358 [accessed 11th April 2019].
- Harrabin, R. (2020a). Davos: Trump decries climate 'prophets of doom' with Thunberg in audience, *BBC News*, 21st January, https://www.bbc.co.uk/news/world-europe-51189430 [accessed 11th April 2019].
- Harrabin, R. (2020b). Climate change: UK 'can't go climate neutral before 2050', *BBC News*, 10th March, https://www.bbc.co.uk/news/science-environment-51804212 [accessed 11th April 2019].
- Harray, A.J., Meng, X., Kerr, D.A. and Pollard, C.M. (2018). Healthy and sustainable diets: community concern about the effect of the future food environments and support for government regulating sustainable food supplies in Western Australia, *Appetite*, Vol 125, pp.225-232, doi: 10.1016/j.appet.2018.01.009.
- Harris, E.M. (2009). Neoliberal subjectivities or a politics of the possible: reading for difference in alternative food networks, *Area*, Vol. 41, No. 1, pp.55-63, doi: 10.1111/j.1475-4762.2008.00848.x.
- Harris, F., Moss, C., Joy, E.J.M., Quinn, R., Scheelbeek, P.F.D., Dangour, A.D. and Green, R. (2019). The water footprint of diets: a global systematic review and meta-analysis, *Advances in Nutrition*, 6th September, nmz091, https://doi.org/10.1093/advances/nmz091 [accessed 11th April 2019].

- Harris, K. (2012). *Climate change in UK security policy: implications for development assistance?* Report of the Overseas Development Institute. http://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7554.pdf [accessed 11th April 2019].
- Harris, M. (2019). Amazon fires are causing glaciers in the Andes to melt even faster, *The Conversation*, 28th November, https://theconversation.com/amazon-fires-are-causing-glaciers-in-the-andes-to-melt-even-faster-128023.
- Harrison, K., Moorman, J., Peralta, M. and Fayhee, K. (2017). Food brand recognition and BMI in pre-schoolers, *Appetite*, Vol. 114, pp.329-337, http://dx.doi.org/10.1016/j.appet.2017.03.049 [accessed 11th April 2019].
- Hartling, L., Chisholm, A., Thomson, D. and Dryden, D.M. (2012). A descriptive analysis of overviews of reviews published between 2000 and 2011, *PLoS One*, Vol. 7, e49667, doi: 10.1371/journal.pone.0049667.
- Hartman, M. and Hesse, J.W. (eds)(2014). *Agriculture and food in the 21st century: economic, environmental and social challenges*, Frankfurt, Germany: Peter Lang GmbH, doi: 10.3726/ 978-3-653-03559-9.
- Hartmann, C. and Siegrist, M. (2017). Consumer perception and behaviour regarding sustainable protein consumption: a systematic review, *Trends in Food Science & Technology,* Vol. 61, pp.11-25, https://doi.org/10.1016/j.tifs.2016.12.006 [accessed 15th April 2020].
- Hartmann-Boyce, J., Bianchi, F., Piernas, C., Riches, S.P., Frie, K., Nourse, R. and Jebb, S.A. (2018). Grocery store interventions to change food purchasing behaviors: a systematic review of randomized controlled trials, *The American Journal of Clinical Nutrition,* Vol. 107, No. 6, pp.1004-1016, doi: 10.1093/ajcn/nqy045.
- Harvey, F. (2018). UK 'will have to intervene in market to meet climate obligations', *The Guardian*, 10th October, https://www.theguardian.com/environment/2018/oct/10/uk-will-have-to-intervene-in-market-to-meet-climate-obligations [accessed 11th April 2019].
- Harvey, F. (2019). One climate crisis disaster happening every week, UN warns, *The Guardian*, 7th July, https://www.theguardian.com/environment/2019/jul/07/one-climate-crisis-disaster-happening-every-week-un-warns [accessed 11th April 2019].
- Harvey, H. (2013). Overfishing causes Pacific bluefin tuna numbers to drop 96%, *The Grocer*, 9th January, https://www.theguardian.com/environment/2013/jan/09/overfishing-pacific-bluefin-tuna [accessed 11th April 2019].
- Harwatt, H. (2018). Including animal to plant protein shifts in climate change mitigation policy: a proposed three-step strategy, *Climate Policy*, pp.1-9, https://doi.org/10.1080/14693062.2018.1528965 [accessed 11th April 2019].

- Harwatt, H., Ripple, W.J., Chaudhary, A., Betts, M.G. and Hayek, M.N. (2020). Scientists call for renewed Paris pledges to transform agriculture, *The Lancet Planetary Health*, Vol. 4, January, p.e9, https://doi.org/10.1016/S2542-5196(19)30245-1.
- Hasegawa, T., Fujimori, S., Havlík, P., Valin, H., Bodirsky, B.L., Doelman, J.C., Fellmann, T., Kyle, P., Koopman, J.F.L., Lotze-Campen, H., Mason-D'Croz, D., Ochi, Y., Domínguez, I.P., Stehfest, E., Sulser, T.B., Tabeau, A., Takahashi, K., Takakura, J., van Meijl, H., van Zeist, W-J., Wiebe, K. and Witzke, P. (2018). Risk of increased food insecurity under stringent global climate change mitigation policy, *Nature Climate Change*, Vol. 8, No. 8, pp.699-703, doi: 10.1038/s41558-018-0230-x.
- Hashem, K.M., He, F.J. and MacGregor, G.A. (2016). Systematic review of the literature on the effectiveness of product reformulation measures to reduce the sugar content of food and drink on the population's sugar consumption and health: a study protocol, *BMJ Open*, Vol. 6, No. 6, e011052, doi: 10.1136/bmjopen-2016-011052.
- Hatefi, A. (2017). The costs of reaching the health-related SDGs, *The Lancet*, Vol. 5, December, p.e1183, doi:https://doi.org/10.1016/S2214-109X(17)30415-1.
- Hatfield, J.L. (2016). Increased temperatures have dramatic effects on growth and grain yield of three maize hybrids, *Agricultural & Environmental Letters*, Vol, 1, pp.150006, doi:10.2134/ael2015.10.0006.
- Hatfield, J.L. and Prueger, J.H. (2015). Temperature extremes: effect on plant growth and development, *Weather and Climate Extremes*, Vol. 10, Part A, pp.4-10, https://doi.org/10.1016/j.wace.2015.08.001 [accessed 11th April 2019].
- Hatfield, J.L., Boote, K.J., Kimball, B.A., Ziska, L., Izaurralde, R.C., Ort, D., Thomson, A.M. and Wolfe, D.A. (2011). Climate impacts on agriculture: implications for crop production, *Agronomy Journal*, Vol. 103, No. 2, pp.351-370, doi:10.2134/agronj2010.0303.
- Hauer, M.E. (2017). Migration induced by sea-level rise could reshape the US population landscape, *Nature Climate Change*, Vol. 7, No. 5, doi: 10.1038/nclimate3271.
- Hauk, W. (2020). Brexit could spell the end of globalization, and the global prosperity that came with it, *The Conversation*, 13th January, https://theconversation.com/brexit-could-spell-the-end-of-globalization-and-the-global-prosperity-that-came-with-it-128280
- Hauschild, M. and Potting, J. (2005). *Spatial differentiation in Life Cycle impact assessment - The EDIP2003 methodology*, Environmental News No. 80, Copenhagen, Denmark: The Danish Environmental Protection Agency, https://www2.mst.dk/udgiv/publications/2005/87-7614-579-4/pdf/87-7614-580-8.pdf [accessed 11th April 2019].
- Hausfather, Z. (2017a). Analysis: why scientists think 100% of global warming is due to humans, *Carbon Brief*, 13th December, https://www.carbonbrief.org/analysis-why-scientists-think-100-of-global-warming-is-due-to-humans [accessed 11th April 2019].

- Hausfather, Z. (2017b). Major correction to satellite data shows 140% faster warming since 1998, *Cardon Brief*, 30th June, https://www.carbonbrief.org/major-correction-to-satellite-data-shows-140-faster-warming-since-1998 [accessed 11th April 2019].
- Hausfather, Z. (2018). How well have climate models projected global warming? *Carbon Brief*, 5th October, https://www.carbonbrief.org/analysis-how-well-have-climate-models-projected-global-warming [accessed 11th April 2019].
- Hausfather, Z. (2019a). Analysis - why children must emit eight times less CO_2 than their grandparents, *Carbon Brief*, 10th April, https://www.carbonbrief.org/analysis-why-children-must-emit-eight-times-less-co2-than-their-grandparents [accessed 11th April 2019].
- Hausfather, Z. (2019b). Analysis: why the UK's CO_2 emissions have fallen 38% since 1990, *Carbon Brief*, 4th February, https://www.carbonbrief.org/analysis-why-the-uks-co2-emissions-have-fallen-38-since-1990 [accessed 11th April 2019].
- Hausfather, Z. (2019c). Explainer: how scientists estimate 'climate sensitivity', *Carbon Brief*, 19th June, https://www.carbonbrief.org/explainer-how-scientists-estimate-climate-sensitivity [accessed 11th April 2019].
- Hausfather, Z. (2019d). State of the climate: how the world warmed in 2018, *Carbon Brief*, 17th January, https://www.carbonbrief.org/state-of-the-climate-how-world-warmed-2018 [accessed 11th April 2019].
- Havice, E. and Iles, A. (2015). Shaping the aquaculture sustainability assemblage - revealing the rule-making behind the rules, *Geoforum*, Vol. 58, pp.27-37, https://doi.org/10.1016/j.geoforum.2014.10.008 [accessed 11th April 2019].
- Havlík, P., Leclère, D., Valin, H., Herrero, M., Schmid, E., Soussana, J-F., Müller, C. and Obersteiner, M. (2015). Global climate change, food supply and livestock production systems: a bioeconomic analysis. In: Elbehri, A. (ed) (2015). *Climate change and food systems: global assessments and implications for food security and trade*, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), ISBN 978-92-5-108699-5.
- Hawkes, C. and Parsons, K. (2019). Brief 1. Tackling food systems challenges: the role of food policy, In: *Rethinking food policy: a fresh approach to policy and practice*, London, UK: Centre for Food Policy.
- Hawkes, C. and Watson, F. (2017). *Incentives and disincentives for reducing sugar in manufactured foods – an exploratory supply chain analysis*, Geneva, Switzerland: World Health Organisation.
- Hawkes, C., Friel, S., Lobstein, T. and Lang, T. (2012). Linking agricultural policies with obesity and noncommunicable diseases: a new perspective for a globalising world, *Food Policy*, Vol. 37, No. 3, pp.343-353, doi:10.1016/j.foodpol.2012.02.011.
- Hawkes, C., Ruel, M.T., Salm, L., Sinclair, B. and Branca, F. (2019). Double-duty actions: seizing programme and policy opportunities to address malnutrition in all its forms, *The Lancet*, Vol. 395, No. 10217, doi:https://doi.org/10.1016/S0140-6736(19)32506-1.

- Hawkes, C., Smith, T.G., Jewell, J., Wardle, J., Hammond, R.A., Friel, S., Thow, A.M. and Kain, J. (2015). Smart food policies for obesity prevention, *The Lancet*, Vol. 385, No. 9985, https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)61745-1/abstract?code=lancet-site [accessed 11th April 2019].
- Hawkesworth, S., Dangour, A.D., Johnston, D., Lock, K., Poole, N., Rushton, J., Uauy, R. and Waage, J. (2010). Feeding the world healthily: the challenge of measuring the effects of agriculture on health, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.3083-3097, https://doi.org/10.1098/rstb.2010.0122 [accessed 11th April 2019].
- Hawkins, E., Edwards, T. and McNeall, D. (2014). Pause for thought, *Nature Climate Change*, Vol. 4, pp.154-156, doi:10.1038/nclimate2150.
- Hawkins, I.W. (2019). Chapter 1 - The diet, health, and environment trilemma, *Environmental Nutrition: Connecting Health and Nutrition with Environmentally Sustainable Diets*, pp.3-25, https://doi.org/10.1016/B978-0-12-811660-9.00001-1 [accessed 11th April 2019].
- Hayek, M.N. and Garrett, R.D. (2018). Nationwide shift to grass-fed beef requires larger cattle population, *Environmental Research Letters*, Vol. 13, No. 8, p.084005, doi: https://doi.org/10.1088/1748-9326/aad401 [accessed 11th April 2019].
- Häyhä, T., Lucas, P.L., van Vuuren, D.P., Cornell, S.E. and Hoff, H. (2016). From planetary boundaries to national fair shares of the global safe operating space: how can the scales be bridged, *Global Environmental Change*, Vol. 40, pp.60-72, https://doi.org/10.1016/j.gloenvcha.2016.06.008 [accessed 11th April 2019].
- Hayhow, D.B., Burns, F., Eaton, M.A., Al Fulaij, N., August, T.A., Babey, L., Bacon, L., Bingham, C., Boswell, J., Boughey, K.L., Brereton, T., Brookman, E., Brooks, D.R., Bullock, D.J., Burke, O., Collis, M., Corbet, L., Cornish, N., De Massimi, S., Densham, J., Dunn, E., Elliott, S., Gent, T., Godber, J., Hamilton, S., Havery, S., Hawkins, S., Henney, J., Holmes, K., Hutchinson, N., Isaac, N.J.B., Johns, D., Macadam, C.R., Mathews, F., Nicolet, P., Noble, D.G., Outhwaite, C.L., Powney, G.D., Richardson, P., Roy, D.B., Sims, D., Smart, S., Stevenson, K., Stroud, R.A., Walker, K.J., Webb, J.R., Webb, T.J., Wynde, R. and Gregory, R.D. (2016). *State of Nature 2016*, The State of Nature partnership, https://www.rspb.org.uk/globalassets/downloads/documents/conservation-projects/state-of-nature/state-of-nature-uk-report-2016.pdf [accessed 11th April 2019].
- Hayhow, D.B., Eaton, M.A., Stanbury, A.J., Burns, F., Kirby, W.B., Bailey, N., Beckmann, B., Bedford, J., Boersch-Supan, P.H., Coomber, F., Dennis, E.B., Dolman, S.J., Dunn, E., Hall, J., Harrower, C., Hatfield, J.H., Hawley, J., Haysom, K., Hughes, J., Johns, D.G., Mathews, F., McQuatters-Gollop, A., Noble, D.G., Outhwaite, C.L., Pearce-Higgins, J.W., Pescott, O.L., Powney, G.D. and Symes, N. (2019). *The State of Nature 2019*, The State of Nature partnership, https://nbn.org.uk/wp-content/uploads/2019/09/State-of-Nature-2019-UK-full-report.pdf [accessed 11th April 2019].

- Hazell, J. (2017). *Getting it right from the start - Developing a circular economy for novel materials*, London, UK: The Green Alliance, https://www.green-alliance.org.uk/resources/Novel_Materials.pdf [accessed 11th April 2019].
- Hazen, E.L., Scales, K.L., Maxwell, S.M., Briscoe, D.K., Welch, H., Bograd, S.J., Bailey, H., Benson, S.R., Eguchi, T., Dewar, H., Kohin, S., Costa, D.P., Crowder, L.B. and Lewison, R.L. (2018). A dynamic ocean management tool to reduce bycatch and support sustainable fisheries, *Science Advances*, Vol. 4, No. 5, pp.eaar3001, doi: 10.1126/sciadv.aar3001.
- Hazen, L., Le Cornua, E.L., Zerbe, A., Martone, R., Erickson, A.L. and Crowder, L.B. (2016). Translating sustainable seafood frameworks to assess the implementation of ecosystem-based fisheries management, *Fisheries Research*, Vol. 182, pp.149-157, http://dx.doi.org/10.1016/j.fishres.2015.11.019 [accessed 11th April 2019].
- Head, J. (2017). How do UK dietary guidelines compare for sustainability, *Medact*, 14th February, https://www.medact.org/2017/blogs/uk-dietary-guidelines-compare-sustainability/ [accessed 11th April 2019].
- Headey, D.D. (2015). *From food to nutrition security: the role of food policies*, Washington, USA: The International Food Policy Research Institute.
- Health Council of the Netherlands (2015). *Dutch dietary guidelines 2015: Guidelines for a Healthy Diet - the Ecological Perspective*, The Hague, The Netherlands: Health Council of the Netherlands.
- Health Foundation (2018). *Policies for healthy lives - a look beyond Brexit: a collection of essays curated by the Health Foundation*, London, UK: The Health Foundation.
- Heck, V., Hoff, H., Wirsenius, S., Meyer, C. and Kreft, H. (2018). Land use options for staying within the Planetary Boundaries – Synergies and trade-offs between global and local sustainability goals, *Global Environmental Change*, Vol. 49, pp.73-84, https://doi.org/10.1016/j.gloenvcha.2018.02.004 [accessed 11th April 2019].
- Hedberg, R.C. (2016) The ecology of alternative food landscapes: a framework for assessing the ecology of alternative food networks and its implications for sustainability, *Landscape Research*, Vol. 41, No. 7, pp.795-807, doi: 10.1080/01426397.2015.1074168.
- Hedenus, F., Wirsenius, S. and Johansson, D. (2014). The importance of reduced meat and dairy consumption for meeting stringent climate change targets, *Climatic Change*, Vol. 124, No. 1-2, pp.79-91, https://doi.org/10.1007/s10584-014-1104-5 [accessed 11th April 2019].
- Hedin, B., Katzeff, C., Eriksson, E. and Pargman, D. (2019). A systematic review of digital behaviour change interventions for more sustainable food consumption, *Sustainability*, Vol. 11, No. 9, pp.2638, https://doi.org/10.3390/su11092638 [accessed 15th April 2020].
- Hegerl, G., Zwiers, F., Stott, P. and Kharin, V. (2004). Detectability of anthropogenic changes in annual temperature and precipitation extremes, *Journal of Climate*, Vol. 17, No. 19, pp.3683-3700.

- Hegland, S.J., Nielsen, A., Lazaro, A., Bjerknes, A.L. and Totland, O. (2009). How does climate warming affect plant-pollinator interactions? *Ecology Letters*, Vol. 12, pp.184-195, https://doi-org.ezproxy.mmu.ac.uk/10.1111/j.1461-0248.2008.01269.x [accessed 11th April 2019].
- Heidrich, O. and Reckien, D. (2018). We examined 885 European cities' plans to tackle climate change – here's what we found, *The Conversation*, 2nd May, https://theconversation.com/we-examined-885-european-cities-plans-to-tackle-climate-change-heres-what-we-found-95733 [accessed 11th April 2019].
- Heijungs, R., Huppes, G. and Guinée, J.B. (2010). Life cycle assessment and sustainability analysis of products, materials and technologies: toward a scientific framework for sustainability life cycle analysis, *Polymer Degradation and Stability*, Vol. 95, Iss. 3, pp.422-428, https://doi.org/10.1016/j.polymdegradstab.2009.11.010 [accessed 11th April 2019].
- Heinrich, L. and Krause, T. (2016). Fishing in acid waters – a vulnerability assessment of the Norwegian fishing industry in the face of increasing ocean acidification, *Integrated Environmental Assessment and Management*, Vol. 13, pp.778-789, doi:10.1002/ieam.1843.
- Helgason, K. (2016). The 2030 agenda for sustainable development - recharging multilateral cooperation for the post-2015 era, *Global Policy*, Vol. 7, Iss. 3, pp.431-440, http://hdl.handle.net/10.1111/1758-5899.12352 [accessed 11th April 2019].
- Heller, M.C. and Keoleian, G.A. (2014). Greenhouse gas emission estimates of U.S. dietary choices and food loss, *Journal of Industrial Ecology*, Vol. 19, pp.391-401, doi:10.1111/jiec.12174.
- Heller, M.C., Keoleian, G.A. and Willett, W.C. (2013). Toward a life cycle-based, diet-level framework for food environmental impact and nutritional quality assessment: a critical review, *Environmental Science & Technology*, Vol. 47, pp.12632−12647, dx.doi.org/10.1021/es4025113.
- Hellstrand, S. (2013). Animal production in a sustainable agriculture, *Environment, Development and Sustainability: A Multidisciplinary Approach to the Theory and Practice of Sustainable Development*, Vol. 15, pp.999-1036, doi: 10.1007/s10668-012-9423-z.
- Hellweg, S. and Canals, L.M. (2014). Emerging approaches, challenges and opportunities in life cycle assessment, *Science*, Vol. 344, pp.1109-1113, doi: 10.1126/science.1248361.
- Helm, D. (2015). *Natural capital: valuing the planet*, New Haven, USA: Yale University Press.
- Helm, D. (2019). *Green and prosperous land: a blueprint for rescuing the British countryside*, London, UK: Harper Collins.
- Helm, S., Pollitt, A., Barnett, M., Curran, M. and Craig, Z. (2018). Differentiating environmental concern in the context of psychological adaption to climate change, *Global Environmental Change*, Vol. 48 pp.158-167, doi: 10.1016/j.gloenvcha.2017.11.012.
- Helms, M. (2004). Food sustainability, food security and the environment, *British Food Journal*, Vol. 10, pp.380-387, doi: 10.1108/00070700410531606.

- Helmstedt, K.J., Stokes-Draut, J.R., Larsen, A.E. and Potts, M.D. (2018). Innovating at the food, water, and energy interface, *Journal of Environmental Management*, Vol. 209, pp.17-22, https://doi.org/10.1016/j.jenvman.2017.12.026 [accessed 11th April 2019].
- Henderson, J., House, E., Coveney, J., Meyer, S., Ankeny, R., Ward, P. and Calnan, M. (2013). Evaluating the use of citizens' juries in food policy - a case study of food regulation, *BMC Public Health*, Vol. 13, No.596, http://www.biomedcentral.com/1471-2458/13/596 [accessed 11th April 2019].
- Hendrie, G.A., Ridoutt, B.G., Wiedmann, T.O. and Noakes, M. (2014). Greenhouse gas emissions and the Australian diet–comparing dietary recommendations with average intakes, *Nutrients*, Vol. 6, pp.289-303, doi: 10.3390/nu6010289.
- Hendriks, S.L. (2018). Food policy and nutrition economics in the SDG era, *Agrekon*, Vol. 57, No. 3-4, pp.167-180, doi: 10.1080/03031853.2018.1479974.
- Hendrix, C.S. and Salehyan, I. (2012). Climate change, rainfall, and social conflict in Africa, *Journal of Peace Research*, Vol. 49, pp.35-50, https://www.jstor.org/stable/23141278 [accessed 11th April 2019].
- Henley, J. and Evans, A. (2020). Giant dams enclosing North Sea could protect millions from rising waters, *The Guardian*, 12th February, https://www.theguardian.com/environment/2020/feb/12/giant-dams-could-protect-millions-from-rising-north-sea [accessed 15th February 2020].
- Henneberry, S.R. and Carrasco, C.P.D. (2014). Global food security - emerging economies and diverging food markets, *Journal of Food Distribution Research*, Vol. 45, Iss. 1, pp.29-34.
- Henry, M., Cerrutti, N., Aupinel, P., Decourtye, A., Gayrard, M., Odoux, J-F., Pissard, A., Rüger, C. and Bretagnolle, V. (2015). Reconciling laboratory and field assessments of neonicotinoid toxicity to honeybees, *Proceedings of the Royal Society B*, Vol. 282 pp.20152110, http://dx.doi.org/10.1098/rspb.2015.2110 [accessed 11th April 2019].
- Henry, R.C., Alexander, P., Rabin, S., Anthoni, P., Rounsevell, M.D.A. and Arneth, A. (2019). The role of global dietary transitions for safeguarding biodiversity, *Global Environmental Change*, Vol. 58, 101956, https://doi.org/10.1016/j.gloenvcha.2019.101956 [accessed 11th April 2019].
- Henson, A. (2012). Where does our food come from – Milk, *Countryfile*, September, pp.64-67.
- Henson, A. (2013). Where does our food come from – Strawberries, *Countryfile*, July, pp.42-43.
- Herforth, A. (2016). *Impact assessment of policies to support healthy food environments and healthy diets,* Implementing the Framework for Action of the Second International Conference on Nutrition, October, United Nations System Standing Committee on Nutrition.
- Herforth, A. (2017). *Creating sustainable, resilient food systems for healthy diets*, A Spotlight on the Nutrition Decade, United Nations System Standing Committee on Nutrition.
- Hérick de Sá, T. (2014). Can Coca Cola promote physical activity? *The Lancet*, 14th June, Vol. 383, p.2041.
- Hermann, D., Sauthoff, S. and Mußhoff, O. (2017). Ex-ante evaluation of policy measures to enhance carbon sequestration in agricultural soils, *Ecological Economics*, Vol. 140, pp.241-250, doi: 10.1016/j.ecolecon.2017.05.018.

- Hermansen, J.E. and Kristensen, T. (2011). Management options to reduce the carbon footprint of livestock products, *Animal Frontiers*, Vol. 1, Iss. 1, pp.33-39, https://doi.org/10.2527/af.2011-0008.
- Hermele, K. (2014). *The appropriation of ecological space*, New York, USA: Routledge.
- Hernández, J.L.S. (2009). Alternative food networks - concept, typology and adaptation to the Spanish context, *Boletín de la A.G.E.,* No. 49, pp.375-380.
- Hernandez, M., Robles, M. and Torero, M. (2010). *Fires in Russia, wheat production, and volatile markets: reasons to panic?* Washington, USA: International Food Policy Research Institute.
- Herold, N., Ekstrom, M., Kala, J., Goldie, J. and Evans, J.P. (2018). Australian climate extremes in the 21st century according to a regional climate model ensemble: implications for health and agriculture, *Weather and Climate Extremes*, Vol 20, pp.54-68, https://doi.org/10.1016/j.wace.2018.01.001 [accessed 11th April 2019].
- Heron, T., Martinez, P.F., Prado, P. and Doherty, B. (2019). Brexit and the politics of food and agriculture: in search a post-productivist food future? *EUSA Annual Conference*, Denver, Colorado, USA, 8-11th May.
- Herren, B. and Batello, C. (2015). Ecological approaches to agriculture: how the FAO works to make the world better, *Sustainable Food Trust*, 18th September, https://sustainablefoodtrust.org/articles/ecological-approaches-to-agriculture-how-the-fao-works-to-make-the-world-better/ [accessed 11th April 2019].
- Herrero, M. and Thornton, P.K. (2013). Livestock and global change: emerging issues for sustainable food systems, *Proceedings of the National Academy of Sciences*, Vol. 110, No. 52, pp.20878-20881, doi: 10.1073/pnas.1321844111.
- Herrero, M., Havlík, P., Valin, H., Notenbaert, A., Rufino, M.C., Thornton, P.K., Blümmel, M., Weiss, F., Grace, D. and Obersteiner, M. (2014). Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 110, No. 52, pp.20888–20893, https://doi.org/10.1073/pnas.1308149110 [accessed 11th April 2019].
- Herrero, M., Henderson, B., Havlik, P., Thornton, P.K., Conant, R.T., Smith, P., Wirsenius, S., Hristov, A.N., Gerber, P., Gill, M., Butterbach-Bahl, K., Valin, H., Garnett, T. and Stehfest, E. (2016). Greenhouse gas mitigation potentials in the livestock sector, *National Climate Change*, Vol. 6. pp.452-461, https://doi.org/10.1038/nclimate2925 [accessed 11th April 2019].
- Herrero, M., Thornton, P.K., Power, B., Bogard, J.R., Remans, R., Fritz, S., Gerber, J.S., Nelson, G., See, L., Waha, K., Watson, R.A., West, P.C., Samberg, L.H., van de Steeg, J., Stephenson, E., van Wijk, M. and Havlík, P. (2017). Farming and the geography of nutrient production for human use: a transdisciplinary analysis, *The Lancet Planetary Health*, Vol. 1, No. 1, pp.e33-e42.

- Herrero, M., Thornton, P.K., Mason-D'Croz, D., Palmer, J., Benton, T.G., Bodirsky, B.L., Bogard, J.R., Hall, A., Lee, B., Nyborg, K., Pradhan, P., Bonnett, G.D., Bryan, B.A., Campbell, B.M., Christensen, S., Clark, M., Cook, M.T., de Boer, I.J.M., Downs, C., Dizyee, K., Folberth, C., Godde, C.M., Gerber, J.S., Grundy, M., Havlik, P., Jarvis, A., King, R., Loboguerrero, A.M., Lopes, M.A., McIntyre, C.L., Naylor, R., Navarro, J., Obersteiner, M., Parodi, A., Peoples, M.B., Pikaar, I., Popp, A., Rockström, J., Robertson, M.J., Smith, P., Stehfest, E., Swain, S.M., Valin, H., van Wijk, M., van Zanten, H.H.E., Vermeulen, S., Vervoort, J. and West, P.C. (2020). Innovation can accelerate the transition towards a sustainable food system, *Nature Food*, 1, 5, 266, doi: 10.1038/s43016-020-0074-1.
- Herring, S.C., Hoerling, M.P., Peterson, T.C. and Stott, P.A. (eds) (2014). Explaining extreme events of 2013 from a climate perspective, *Bulletin of the American Meteorological Society*, Vol. 95, No. 9, S1-S96, https://www.ametsoc.org/ [accessed 11th April 2019].
- Hertel, T.W. (2015). Green revolutions past and future implications for food security and the environment, Presentation to the ICAE pre-conference on *Global Food Security Challenges*, Milan, Italy, 7-8th August, doi: 10.1073/pnas.0912953109.
- Hertel, T.W., Burke, M.B. and Lobel, D.B. (2010). The poverty implications of climate-induced crop yield changes by 2030, *Global Environmental Change*, Vol. 20, pp.577-585, doi:10.1016/j.gloenvcha.2010.07.001.
- Hertwich, E.G. and Peters, G.P. (2009). Carbon footprint of nations: a global, trade-linked analysis, *Environmental Science & Technology*, Vol. 43, pp.6414-6420, doi: 10.1021/es803496a.
- Hertz-Picciotto, I., Sass, J.B., Engel, S., Bennett, D.H., Bradman, A., Eskenazi, B., Lanphear, B. and Whyatt, R. (2018). Organophosphate exposures during pregnancy and child neurodevelopment - recommendations for essential policy reforms, *PLoS Med*, Vol. 15, No. 10, pp.e1002671, https://doi.org/10.1371/journal.pmed.1002671 [accessed 11th April 2019].
- Herzog, A., Winckler, C. and Zollitsch, W. (2018). In pursuit of sustainability in dairy farming - a review of interdependent effects of animal welfare improvement and environmental impact mitigation, *Agriculture, Ecosystems and Environment*, Vol. 267, pp.174-187, https://doi.org/10.1016/j.agee.2018.07.029 [accessed 11th April 2019].
- Hess, T. and Sutcliffe, C. (2018). *Increasing resilience to water-related risks in the UK fresh fruit and vegetable system*, https://www.cranfield.ac.uk/research-projects/resilience-to-water-related-risks [accessed 11th April 2019].
- Hess, T., Andersson, U., Mena, C. and Williams, A. (2015). The impact of healthier dietary scenarios on the global blue water scarcity footprint of food consumption in the UK, *Food Policy*, Vol. 50, No. 1, pp.1-10, https://doi.org/10.1016/j.foodpol.2014.10.013 [accessed 11th April 2019].

- Hess, T., Chatterton, J., Daccache, A. and Williams, A. (2016). The impact of changing food choices on the blue water scarcity footprint and greenhouse gas emissions of the British diet: the example of potato, pasta and rice, *Journal of Cleaner Production*, Vol. 112, Part 5, pp.4558-4568, https://doi.org/10.1016/j.jclepro.2015.08.098 [accessed 11th April 2019].
- Hess, T., Lankford, B., Lillywhite, R., Cooper, R., Challinor, A., Sutton, P., Brown, C., Meacham, T., Benton, T. and Noble, A. (2017). *Water use in our food imports*, Global Food Security, https://www.foodsecurity.ac.uk/ [accessed 11th April 2019].
- Hex, N., Bartlett, C., Wright, D., Taylor, M. and Varley, D. (2012). Estimating the current and future costs of Type 1 and Type 2 diabetes in the United Kingdom, including direct health costs and indirect societal and productivity costs, *Diabetic Medicine*, Vol. 29, pp.855-862.
- Heymans, J.J., Mackinson, S., Sumaila, U.R., Dyck, A. and Little, A. (2011). The impact of subsidies on the ecological sustainability and future profits from North Sea fisheries, *PLoS One*, Vol. 6, No. 5, pp.e20239, doi:10.1371/journal.pone.0020239.
- Hickel, J. (2018). The Nobel Prize for climate catastrophe, *Foreign Policy*, 6th December, https://foreignpolicy.com/2018/12/06/the-nobel-prize-for-climate-catastrophe/.
- Hickel, J. and Kallis, G. (2019). Is green growth possible, *New Political Economy*, https://doi.org/10.1080/13563467.2019.1598964 [accessed 11th April 2019].
- Hicks, R. (2018). Are we on track to create a sustainable world by 2050? *Eco-business*, 4th April, https://www.eco-business.com/news/are-we-on-track-to-create-a-sustainable-world-by-2050/ [accessed 11th April 2019].
- Hidayat, N., Offermans, A. and Glasbergen, P. (2018). Sustainable palm oil as a public responsibility?: On the governance capacity of Indonesian standard for sustainable palm oil (ISPO)", *Agriculture and Human Values*, Vol. 35, No. 1, pp.223-242, https://doi.org/10.1007/s10460-017-9816-6 [accessed 11th April 2020].
- Hiederer, R., Ramos, F., Capitani, C., Koeble, R., Blujdea, V., Mulligan, D., Marelli, L., Gomez, O. (2010). *Biofuels: a new methodology to estimate GHG emissions from global land-use change: a methodology involving spatial allocation of agricultural land demand, calculation of carbon stocks and estimation of N_2O emissions*, Luxembourg: Publications Office of the European Union, http://re.jrc.ec.europa.eu/bf-tp [accessed 11th April 2019].
- Higgins, J. and Green, S. (2009). Cochrane handbook for systematic reviews of interventions, Version 5.0.0. In: Higgins, J. and Green, S. (eds). *The Cochrane collaboration*, https://training.cochrane.org/handbook [accessed 15th April 2020].
- Higgins, J. and Thomas, J. (2019). Cochrane handbook for systematic reviews of interventions, Version 6.0. In: Higgins, J. and Thomas, J. (eds) *The Cochrane Collaboration*, https://training.cochrane.org/handbook/current [accessed 15th April 2020].

- Higgins, L.K. (2013). Economic growth and sustainability - are they mutually exclusive? *Elsevier Connect*, 16th May, https://www.elsevier.com/connect/economic-growth-and-sustainability-are-they-mutually-exclusive [accessed 11th April 2019].
- Higgins, V., Dibden, J. and Cocklin, C. (2015). Private agri-food governance and greenhouse gas abatement - constructing a corporate carbon economy, *Geoforum*, Vol. 66, pp.75-84, http://dx.doi.org/10.1016/j.geoforum.2015.09.012 [accessed 11th April 2019].
- Hijmans, R.J. (2003). The effect of climate change on global potato production, *American Journal of Potato Research*, Vol. 80, pp.271-279, https://doi.org/10.1007/BF02855363 [accessed 15th April 2020].
- Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. and Jarvis, A. (2005). Very high resolution interpolated climate surfaces for global land areas, *International Journal of Climatology*, Vol. 25, pp.1965-1978, https://doi.org/10.1002/joc.1276 [accessed 11th April 2019].
- Hilborn, R. (2006). Salmon farming impacts on wild Salmon, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 103, No. 42, p.15277, http://www.jstor.org/stable/30050833 [accessed 11th April 2019].
- Hilborn, R., Banobi, J., Hall, S.J., Pucylowski, T. and Walsworth, T.E. (2018). The environmental cost of animal source foods, *Frontiers in Ecology and the Environment*, Vol. 16, No. 6, pp.329-335, doi: 10.1002/fee.1822.
- Hilborn, R., Fulton, E.A., Green, B.S., Hartmann, K., Tracey, S.R. and Watson, R.A. (2015). When is a fishery sustainable? *Canadian Journal of Fisheries and Aquatic Sciences*, Vol. 72, No. 9, pp.1433-1441, dx.doi.org/10.1139/cjfas-2015-0062.
- Hiles, S.S. (2019). Midwest farms experience toll of climate change on food supply, *Health Progress*, Vol. 100, No. 2, pp.23-27, https://www.chausa.org/publications/health-progress/article/march-april-2019/midwest-farmers-experience-toll-of-climate-change-on-food-supply [accessed 11th April 2019].
- Hill, J.O. (2018). Why aren't we making progress in promoting healthy lifestyles? *Nutrition*, Vol. 55, No. 56, S2-3, https://doi.org/10.1016/j.nut.2018.07.007 [accessed 11th April 2019].
- Hilton, I. (2019). How China’s big overseas initiative threatens global climate progress, *Yale Environment 360*, 3rd January, https://e360.yale.edu/features/how-chinas-big-overseas-initiative-threatens-climate-progress [accessed 11th April 2019].
- Hindle, S. and Humphries, J. (2008). Feeding the masses: plenty, want and the distribution of food and drink in historical perspective, *Economic History Review*, Vol. 61, No. S1, pp.1-4, https://doi.org/10.1111/j.1468-0289.2008.00451.x [accessed 11th April 2019].
- Hinkel, J., Brown, S., Exner, L., Nicholls, R.J., Vafeidis, A.T. and Kebede, A.S. (2012). Sea-level rise impacts on Africa and the effects of mitigation and adaptation: an application of DIVA, *Regional Environmental Change*, Vol. 12, pp.207-224, https://doi.org/10.1007/s10113-011-0249-2 [accessed 11th April 2019].
- Hinkel, J., Jaeger, C., Nicholls, R.J., Lowe, J., Renn, O. and Peijun, S. (2015). Sea-level rise scenarios and coastal risk management, *Nature Climate Change*, Vol. 5, pp.188-190, doi:10.1038/nclimate2505.

- Hinkel, J., Lincke, D., Vafeidis, A.T., Perrette, M., Nicholls, R.J., Tol, R.S. and Levermann, A. (2014). Coastal flood damage and adaptation costs under 21st century sea-level rise, *Proceedings of the National Academy of Sciences*, Vol. 111, pp.3292-3297, https://doi.org/10.1073/pnas.1222469111 [accessed 11th April 2019].
- Hirmas, D.R., Giménez, D., Nemes, A., Kerry, R., Brunsell, N.A. and Wilson, C.J. (2018). Climate-induced changes in continental-scale soil macroporosity may intensify water cycle, *Nature*, Vol. 561, No. 7721, p.100, doi: 10.1038/s41586-018-0463-x.
- Hirsch, A.L., Prestele, R., Davin, E.L., Seneviratne, S.I., Thiery, W. and Verburg, P.H. (2018). Modelled biophysical impacts of conservation agriculture on local climates, *Global Change Biology*, Vol 24, No. 10, pp.4758-4774, doi: 10.1111/gcb.14362.
- Hirschnitz-Garbers, M., Tan, A., Gradmann, A. and Srebotnjak, T. (2016). Key drivers for unsustainable resource use – categories, effects and policy pointers, *Journal of Cleaner Production*, Vol. 132, pp.13-31, https://doi.org/10.1016/j.jclepro.2015.02.038 [accessed 11th April 2019].
- Hirvonen, K., Bai, Y., Headey, D. and Masters, W.A. (2020). Affordability of the EAT–Lancet reference diet: a global analysis, *The Lancet Global Health*, Vol. 8, Iss. 1, pp.e59-e66, doi:https://doi.org/10.1016/S2214-109X(19)30447-4.
- Hishamunda, N., Ridler, N.B., Bueno, P. and Yap, W.G. (2009). Commercial aquaculture in Southeast Asia - some policy lessons, *Food Policy*, Vol. 34, pp.102-107, doi:10.1016/j.foodpol.2008.06.006.
- Hitaj, C., Rehkamp, S., Canning, P. and Peters, C.J. (2019). Greenhouse gas emissions in the United States food system: current and healthy diet scenarios, *Environmental Science & Technology*, Vol. 53, No. 9, pp.5493-5503, doi: 10.1021/acs.est.8b06828.
- Hixson, S.M. and Arts, M.T. (2016). Climate warming is predicted to reduce omega-3, long-chain, polyunsaturated fatty acid production in phytoplankton, *Global Change Biology*, Vol. 22, pp.2744-2755, doi: 10.1111/gcb.13295.
- Hixson, S.M., Parrish, C.C. and Anderson, D.M. (2014). Full substitution of fish oil with camelina (Camelina sativa) oil, with partial substitution of fish meal with camelina meal, in diets for farmed Atlantic salmon (Salmo salar) and its effect on tissue lipids and sensory quality, *Food Chemistry*, Vol. 157, pp.51-61, doi: 10.1016/j.foodchem.2014.02.026.
- HLPE (2011). *Price volatility and food security*, Rome, Italy: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, http://www.fao.org/3/a-mb737e.pdf [accessed 11th April 2019].
- HLPE (2013). *Biofuels and food security*, Rome, Italy: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, http://www.fao.org/3/a-i2952e.pdf [accessed 11th April 2019].

- HLPE (2014a). *Food losses and waste in the context of sustainable food systems*, Rome, Italy: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, http://www.fao.org/3/a-i3901e.pdf [accessed 11th April 2019].
- HLPE (2014b). *Sustainable fisheries and aquaculture for food security and nutrition*, Rome, Italy: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, http://www.fao.org/3/a-i3844e.pdf [accessed 11th April 2019].
- HLPE (2017). *Nutrition and food systems - Summary and Recommendations*, Rome, Italy: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security,
- HLPE (2019). Agroecological and other innovative approaches, Rome, Italy: High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security,
- HM Government (2014). *Elliott Review into the Integrity and Assurance of Food Supply Networks – Final Report*, A National Food Crime Prevention Framework, July, PB 14192, London, UK: HM Government.
- HM Government (2015a). *A secure and prosperous United Kingdom: the national security strategy and strategic defence and security review*, London, UK: HM Government, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/478933/52309_Cm_9161_NSS_SD_Review_web_only.pdf [accessed 11th April 2019].
- HM Government (2015b). *International Development (Official Development Assistance Target) Act 2015*, London, UK: HM Government.
- HM Government (2017a). Industrial strategy - building a Britain fit for the future 2017, London, UK: HM Government.
- HM Government (2017b). Security of UK Food Supply, No. 556, June, London: HM Government.
- HM Government (2017c). UK climate change risk assessment 2017: evidence report, London, UK: HM Government, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf [accessed 11th April 2019].
- HM Government (2018a). *A green future: our 25 year plan to improve the environment*, London, UK: HM Government, https://www.gov.uk/government/publications/25-year-environment-plan [accessed 11th April 2019].
- HM Government (2018b). *Childhood obesity: a plan for action*, London, UK: HM Government, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718903/childhood-obesity-a-plan-for-action-chapter-2.pdf [accessed 11th April 2019].
- HM Government (2018c). *Fisheries Bill (2017-2019),* Bill no. 302 as amended in Committee, Parliament: House of Commons, London, UK: The Stationery Office, https://services.parliament.uk/bills/2017-19/fisheries.html [accessed 11th April 2019].

- HM Government (2019). *Advancing our health: prevention in the 2020s*, Presented to Parliament by the Parliamentary Under Secretary of State for Public Health and Primary Care, July, London, UK: HM Government, www.gov.uk/official-documents [accessed 11th April 2020].
- HM Government (2020). *UK Government Flood Warning Information Service*, https://flood-warning-information.service.gov.uk/long-term-flood-risk/map [accessed 11th April 2020].
- HM Revenue & Customs (2016). *Landfill tax: increase in rates*, London, UK: HM Revenue & Customs, https://www.gov.uk/government/publications/landfill-tax-increase-in-rates/landfill-tax-increase-in-rates [accessed 11th April 2019].
- HM Treasury (2017). *Delivering better outcomes for citizens: practical steps for unlocking public value,* London, UK: HM Treasury, https://www.gov.uk/government/publications/delivering-better-outcomes-for-citizens-practical-steps-for-unlocking-public-value [accessed 11th April 2019].
- HMRC (2020). *UK food trade statistics 2019*, London, UK: HM Revenue & Customs (HMRC) Trade Statistics unit, https://www.uktradeinfo.com/Pages/Home.aspx [accessed 31st March 2020].
- HMSO (2012). *Sustainable Food - Eleventh Report of Session 2010–12*, London, UK: HM Government.
- Hodal, K. (2019). UK accused of 'silently eroding' EU pesticide rules in Brexit laws: analysis finds changes such as removal of blanket ban on hormone-disrupting chemicals, *The Guardian*, 12th June, https://www.theguardian.com/environment/2019/jun/12/uk-accused-silently-eroding-eu-pesticide-rules-brexit-laws [accessed 11th April 2019].
- Hodge, K.L., Levis, J.W., DeCarolis, J.F. and Barlaz, M.A. (2016). Systematic evaluation of industrial, commercial, and institutional food waste management strategies in the United States, *Environmental Science & Technology*, Vol. 50, No. 16, p.8444, doi: 10.1021/acs.est.6b00893.
- Hodson, R. (2017). Food security, *Nature*, Vol. 544, No. 7651, pp.S5, doi: 10.1007/s10393-015-1025-4, http://www.nature.com/articles/544S5a.pdf [accessed 11th April 2019].
- Hoekstra, A. and Chapagain, A. (2008), *Globalization of water*, Malden, USA: Wiley Blackwell.
- Hoekstra, A.Y. (2011). Understanding the water footprint of factory farming, *Farm Animal Voice,* Vol. 180, pp.14-15.
- Hoekstra, A.Y. (2014). Water for animal products - a blind spot in water policy, *Environmental Research Letters*, Vol. 9, pp.091003, doi:10.1088/1748-9326/9/9/091003.
- Hoekstra, A.Y. and Mekonnen, M.M. (2016). Imported water risk: the case of the UK, *Environmental Research Letters*, Vol. 11, No. 5, pp.055002, doi:10.1088/1748-9326/11/5/055002.
- Hoekstra, A.Y. and Wiedmann, T.O. (2014). Humanity's unsustainable environmental footprint, *Science*, Vol. 344, No. 6188, pp.1114-1117, doi: 10.1126/science.1248365.
- Hoekstra, A.Y., Gerbens-Leenes, W. and Meer, T.H. (2009). Reply to Pfister and Hellweg: Water footprint accounting, impact assessment, and lifecycle assessment, *Proceedings of the National Academy of Sciences*, Vol. 106, p.E114, doi: 10.1073/pnas.0909948106.

- Hoffman, D. and Barrett, J. (2010). Benchmarking your supply chain, *Journal of Commerce*, September, Vol. 11, No. 35, pp.30A-33A.
- Hoffmann, I. (2003). Transcending reductionism in nutrition research, *The American Journal of Clinical Nutrition*, Vol. 78, Iss. 3, pp.514S-516S, https://doi.org/10.1093/ajcn/78.3.514S [accessed 11th April 2019].
- Hoffmann, R.C. (1996). Economic development and aquatic ecosystems in medieval Europe, *The American Historical Review*, Vol. 101, No. 3, pp.631-669, doi:10.2307/2169418.
- Hoffmann, R.C. (2005). A brief history of aquatic resource use in medieval Europe, *Helgoland Marine Research*, Vol. 59, pp.22-30, doi:10.1007/s10152-004-0203-5.
- Hoffmann, U. (2011). *Assuring food security in developing countries under the challenges of climate change: key trade and development issues of a fundamental transformation of agriculture*, UNCTAD/OSG/DP/2011/1, Geneva, Switzerland: United Nations Conference on Trade and Development.
- Hofmann, D. (2009). The exponential increase in anthropogenic atmospheric carbon dioxide and its relation to human population growth, *21st Conference on Climate Variability and Change*, Phoenix, Arizona, USA: 11-15th January.
- Holbourn, R., Quinn, T.P., Schindler, D.E. and Rogers, D.E. (2003). Biocomplexity and fisheries sustainability, *Proceedings of the National Academy of Sciences of the United States of America*, pp.6564-6568, Vol. 100, No. 11, www.pnas.org/cgi/doi/10.1073/pnas.1037274100 [accessed 11th April 2019].
- Holden, E. (2019). Carbon emissions up as Trump agenda rolls back climate change work, *The Guardian*, 8th January, https://www.theguardian.com/environment/2019/jan/08/carbon-emissions-trump-agenda-climate-change [accessed 11th April 2019].
- Hollaway, M.J., Arnold, S.R., Challinor, A.J. and Emberson, L.D. (2012). Intercontinental trans-boundary contributions to ozone-induced crop yield losses in the Northern Hemisphere, *Biogeosciences*, Vol. 9, pp.271-292, https://doi.org/10.5194/bg-9-271-2012 [accessed 11th April 2019].
- Hollingsworth, A. (2017). Sustainable diets: the gulf between management strategies and the nutritional demand for fish. In: Leal Filho, W. (ed) *Handbook of Sustainability Science and Research*, Springer, doi: 10.1007/978-3-319-63007-6_44.
- Hollis-Hansen, K., Vermont, L., Zafron, M.L., Seidman, J. and Leone, L. (2019). The introduction of new food retail opportunities in lower-income communities and the impact on fruit and vegetable intake: a systematic review, *Translational Behavioral Medicine*, Vol. 9, No. 5, pp.837-846, doi: 10.1093/tbm/ibz094.
- Holm. P., Ludlow, F., Scherer, C., Travis, C., Allaire, B., Brito, C., Hayes, P.W., Al Matthews, J., Rankin, K.J., Breen, R.J., Legg, R., Lougheed, K. and Nicholls, J. (2019). The North Atlantic fish revolution (ca. AD 1500), *Quaternary Research*, pp.1-15, https://doi.org/10.1017/qua.2018.153 [accessed 11th April 2019].

- Hong, C., Mueller, N.D., Burney, J.A., Zhang, Y., AghaKouchak, A., Moore, F.C., Qin, Y., Tong, D. and Davis, S.J. (2020). Impacts of ozone and climate change on yields of perennial crops in California, *Nature Food*, Vol. 1, pp.166-172, https://doi.org/10.1038/s43016-020-0043-8,
- Hook, L. (2018). Rising sea levels threaten 1.5m English properties, *Financial Times*, 26th October, https://www.ft.com/content/85f18882-d865-11e8-a854-33d6f82e62f8 [accessed 11th April 2019].
- Hook, L. (2019a). Global carbon dioxide emissions hit record high, *Financial Times*, 26th March, https://www.ft.com/content/1a80e2d4-4f0f-11e9-9c76-bf4a0ce37d49 [accessed 11th April 2019].
- Hook, L. (2019b). Record methane levels pose new threat to Paris climate accord, *Financial Times*, 24th May, https://www.ft.com/content/9a3c0514-7d6b-11e9-81d2-f785092ab560 [accessed 11th April 2019].
- Hoolohan, C., Berners-Lee, M., McKinstry-West, J. and Hewitt, C.N. (2013). Mitigating the greenhouse gas emissions embodied in food through realistic consumer choices, *Energy Policy*, Vol. 63, pp.1065-1074, http://dx.doi.org/10.1016/j.enpol.2013.09.046 [accessed 11th April 2019].
- Horgan, G.W., Perrin, A., Whybrow, S. and Macdiarmid, J.I. (2016). Achieving dietary recommendations and reducing greenhouse gas emissions: modelling diets to minimise the change from current intakes, *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 7, No. 13, pp. 46, doi: 10.1186/s12966-016-0370-1.
- Horn, D. (1987). Tiddy Mun's curse and the ecological consequences of land reclamation, *Folklore*, Vol. 98, No. 1, pp.11-15, https://www.jstor.org/stable/1259396 [accessed 15th April 2019].
- Hörtenhuber, S.J., Lindenthal, T. and Zollitsch, W. (2010). Reduction of greenhouse gas emissions from feed supply chains by utilizing regionally produced protein sources - the case of Austrian dairy production, *Journal of the Science of Food and Agriculture*, April, Vol. 91, No. 6, pp.1118-1127, doi: 10.1002/jsfa.4293.
- Horton S., Shekar M., McDonald C., Mahal, A. and Brooks J.K. (2009). *Scaling up nutrition: what will it cost?* Washington, USA: The World Bank, https://siteresources.worldbank.org/ [accessed 11th April 2019].
- Horton, P. (2017). We need radical change in how we produce and consume food, *Food Security*, Vol. 9, Iss. 6, pp.1323-1327, https://doi.org/10.1007/s12571-017-0740-9 [accessed 11th April 2019].
- Horton, P., Banwart, S.A., Brockington, D., Brown, G.W., Bruce, R., Cameron, D., Holdsworth, M., Koh, S.C.L., Ton, J. and Jackson, P. (2017). An agenda for integrated system-wide interdisciplinary agri-food research, *Food Security*, Vol. 9, pp.195-210, doi:10.1007/s12571-017-0648-4.
- Horton, P., Koh, S.C.L. and Shi Guang, V. (2016). An integrated theoretical framework to enhance resource efficiency, sustainability and human health in agri-food systems, *Journal of Cleaner Production*, Vol. 120, pp.164-169, https://doi.org/10.1016/j.jclepro.2015.08.092 [accessed 11th April 2019].
- Horton, R. (2013). Offline: Planetary health—a new vision for the post-2015 era, *The Lancet*, Vol. 382, Iss. 9897, doi: https://doi.org/10.1016/S0140-6736(13)61936-4.

- Horton, R. (2016b). Offline: Planetary health—gains and challenges, *The Lancet*, Vol. 388, Iss. 10059, p.2462, doi: https://doi.org/10.1016/S0140-6736(16)32215-2.
- Horton, R. (2017a). Offline: Planetary health's next frontier—biodiversity, *The Lancet*, Vol. 390, 11th November, p.2132, https://doi.org/10.1016/S0140-6736(17)32843-X [accessed 11th April 2019].
- Horton, R. (2017b). Offline: Planetary health—the great acceleration, *The Lancet*, 11th March, Volume 389, No. 10073, p993, doi: https://doi.org/10.1016/S0140-6736(17)30698-0.
- Horton, R. (2018). Offline: Planetary health—worth everything, *The Lancet*, June, Vol. 391, Iss. 10137, doi: 10.1016/S0140-6736(18)31304-7.
- Horton, R. (2020). Coronavirus is the greatest global science policy failure in a generation: the warnings of doctors and scientists were ignored, with fatal results, *The Guardian*, 9th April, https://www.theguardian.com/commentisfree/2020/apr/09/deadly-virus-britain-failed-prepare-mers-sars-ebola-coronavirus [accessed 15th April, 2020].
- Horton, R. and Lo, S. (2015). Planetary health: a new science for exceptional action, *The Lancet*, Vol. 386, pp.1921-1922, doi: https://doi.org/10.1016/S0140-6736(15)61038-8.
- Horton, R., Beaglehole, R., Bonita, R., Raeburn, J., McKee, M. and Wall, S. (2014). From public to planetary health: a manifesto, *The Lancet*, 6th March, doi: https://doi.org/10.1016/S0140-6736(14)60409-8.
- Horwitz, P. (2015). Governance for sustainability: how are we doing? *Ecohealth*, Vol. 12, No. 2, pp.387-388, doi: 10.1007/s10393-015-1025-4.
- Hou, D., O'Connor, D., Sonne, C. and Sik Ok, Y. (2019). Trade war threatens sustainability, *Science*, Vol. 6447, pp.1242-1242, doi: 10.1126/science.aay3596.
- Houghtaling, B., Serrano, E.L., Kraak, V.I., Harden, S.M., Davis, G.C. and Misyak, S.A. (2019). A systematic review of factors that influence food store owner and manager decision making and ability or willingness to use choice architecture and marketing mix strategies to encourage healthy consumer purchases in the United States, 2005-2017, *The International Journal of Behavioral Nutrition and Physical Activity,* Vol. 16, No. 1, pp. 5-14, https://doi.org/10.1186/s12966-019-0767-8.
- Houghton, R.A., House, J.I., Pongratz, J., van der Werf, G.R., DeFries, R.S., Hansen, M.C., Le Quere, C., and Ramankutty, N. (2012). Carbon emissions from land use and land-cover change, *Biogeosciences*, Vol. 9, pp.5125-5142, doi:10.5194/bg-9-5125-2012.
- Houlton, B.Z., Almaraz, M., Aneja, V., Austin, A.T., Bai, E., Cassman, K.G., Compton, J.E., Davidson, E.A., Erisman, J.W., Galloway, J.N., Gu, B., Yao, G., Martinelli, L.A., Scow, K., Schlesinger, W.H., Tomich, T.P., Wang, C. and Zhang, X. (2019). A world of cobenefits - solving the global nitrogen challenge, *Earth's Future*, Vol. 7, pp.865-872, https://doi.org/10.1029/2019EF001222 [accessed 11th April 2019].
- House of Commons (2012). *Sustainable Food - Government Response to the Committee's Eleventh Report of Session 2010–12*, London, UK: The Stationery Office Limited.

- House of Commons (2013). *Outcomes of the UN Rio+20 Earth Summit*, London, UK: The Stationery Office Limited.
- House of Commons (2015). *Department for International Development's Performance in 2013-2014: the Departmental Annual Report 2013-14 - International Development*, London, UK: The Stationery Office Limited.
- House of Commons (2016). *Food security*, London, UK: The Stationery Office Limited.
- House of Commons (2018). *Agriculture Bill*, HC 292, London, UK: UK Parliament.
- House of Commons Environment, Food and Rural Affairs Committee (2018). *Brexit: Trade in Food*, Third Report of Session 2017–19, London, UK: The Stationery Office Limited, https://publications.parliament.uk/pa/cm201719/cmselect/cmenvfru/348/34802.htm [accessed 11th April 2019].
- House of Commons Environmental Audit Committee (2018). *The Government's 25 Year Plan for the Environment*, 8th Report, HC 803, 24th July, London, UK: House of Commons, https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/803/803.pdf [accessed 11th April 2019].
- House of Commons Environmental Audit Committee (2019). *Sustainable Development Goals in the UK follow up: Hunger, malnutrition and food insecurity in the UK*, Thirteenth Report of Session 2017–19, 10th January, London, UK: House of Commons, https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/1491/1491.pdf [accessed 11th April 2019].
- House of Commons Environmental Audit Committee (2019). *Sustainable Development Goals in the UK follow up - Hunger, malnutrition and food insecurity in the UK*, London, UK: House of Commons,
- House of Lords (2018). *Brexit - food prices and availability*, London, UK: The Stationery Office Limited.
- House of Lords (2019). *Select Committee on Food, Poverty, Health and the Environment call for evidence*, London, UK: The Stationery Office Limited.
- House of Parliament (2016). *Rewilding and ecosystem services*, POST-PN-0537, No. 537, September, London: HM Government, https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0537 [accessed 11th April 2019].
- Houser, T., Hsiang, S.M., Kopp, R.E., Larsen, K., Delgado, M. and Steyer, T. (2015). Labor. In: *Economic Risks of Climate Change: An American Prospectus*, pp.67-74, New York: Columbia University Press, http://www.jstor.org/stable/10.7312/hous17456.14 [accessed 11th April 2019].
- Houses of Parliament (2016). *Rewilding and ecosystem services*, PostNote, No. 537, September, London, UK: Houses of Parliament, https://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-0537#fullreport [accessed 11th April 2019].

- Houses of Parliament (2017). *Security of UK food supply*, PostNote, No. 556, June, London, UK: Houses of Parliament, http://researchbriefings.files.parliament.uk/documents/POST-PN-0556/POST-PN-0556.pdf [accessed 11th April 2019].
- Houses of Parliament (2020). *A resilient UK food system*, PostNote, No. 626, June, London, UK: Houses of Parliament, https://post.parliament.uk/research-briefings/post-pn-0626/ [accessed 26th April 2020].
- Howard, L. (2019). Sustainable consumption - key issues, *Local Environment*, Vol. 24, No. 3, pp.310-311, doi: 10.1080/13549839.2018.1555580.
- Howard, P.H. (2016). *Concentration and power in the food system: who controls what we eat?* New York, USA: Bloomsbury Academic, ISBN-10: 1472581113.
- Howard, R. (2009). Peak oil and strategic resource wars, *The Futurist*, September-October, pp.18-21.
- Howarth, C., Morse-Jones, S., Brooks, K. and Kythreotis, A.P. (2018). Co-producing UK climate change adaptation policy: an analysis of the 2012 and 2017 UK climate change risk assessments, *Environmental Science & Policy*, Vol. 89, pp.412-420, https://doi.org/10.1016/j.envsci.2018.09.010 [accessed 11th April 2019].
- HSCIC (2019). Statistics on obesity, physical activity and diet - England, 2019, Leeds, UK: Health & Social Care Information Centre, https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity-physical-activity-and-diet [accessed 11th April 2019].
- Hsiang, S.M. and Meng, K.C. (2014). Reconciling disagreement over climate-conflict results in Africa, *Proceedings of the National Academy of Science*, Vol. 111, pp.2100-2103, https://doi.org/10.1073/pnas.1316006111 [accessed 11th April 2019].
- Hsiang, S.M., Burke, M. and Miguel, E. (2013). Quantifying the influence of climate on human conflict, *Science*, Vol. 341, pp.1235367, doi: 10.1126/science.1235367.
- Huang, J-K., Wei, W., Cui, Q. and Xie, W. (2017). The prospects for China's food security and imports: will China starve the world via imports? *Journal of Integrative Agriculture*, Vol. 16, Numb. 12, pp.2933-2944, https://doi.org/10.1016/S2095-3119(17)61756-8 [accessed 11th April 2019].
- Huang, Y., Ren, W., Wang, L., Hui, D., Grove, J.H., Yang, X., Tao, B. and Goff, B. (2018). Greenhouse gas emissions and crop yield in no-tillage systems: a meta-analysis, Agriculture, Ecosystems and Environment, Vol. 268, pp.144-153, doi: 10.1016/j.agee.2018.09.002.
- Huan-Niemi, E., Niemi, J. and Niemi, J. (2010). Global food production under alternative scenarios, *International Food and Agribusiness Management Review*, Vol. 13, Iss. 4, pp.117-135, doi: 10.22004/ag.econ.96333.
- Hubeau, M., Marchand, F. and Van Huylenbroeck, G. (2017). Sustainability experiments in the agri-food system: uncovering the factors of new governance and collaboration success, *Sustainability*, Vol. 9, No. 6, p.1027, doi:10.3390/su9061027.

- Hubeau, M., Marchand, F., Coteur, I., Mondelaers, K., Debruyne, L. and Van Huylenbroeck, G. (2017). A new agri-food systems sustainability approach to identify shared transformation pathways towards sustainability, *Ecological Economics*, Vol. 131, pp.52-63, https://doi.org/10.1016/j.ecolecon.2016.08.019 [accessed 11th April 2019].
- Hubert, B., Rosegrant, M., van Boekel, M.A.J.S. and Ortiz, R. (2010). The future of food - scenarios for 2050, *Crop Science*, Vol. 50, pp.S-33–S-50, doi: 10.2135/cropsci2009.09.0530.
- Hudson, M. (2019). Net zero emissions by 2050, says UK government – now what, *The Conversation*, 12th June, https://theconversation.com/net-zero-emissions-by-2050-says-uk-government-now-what-118712 [accessed 11th April 2019].
- Huey, R.B., Carlson, M., Crozier, L., Frazier, M., Hamilton, H., Harley, C., Hoang, A. and Kingsolver, J.G. (2002). Plants versus animals: do they deal with stress in different ways? *Integrative and Comparative Biology*, Vol. 42, Iss. 3, pp.415-423, https://doi.org/10.1093/icb/42.3.415 [accessed 11th April 2019].
- Hughes, N. (2018). Muddled food policy puts UK at bottom of the class, *Food Service Footprint*, 18th November, http://www.foodservicefootprint.com/analysis-muddled-food-policy-puts-uk-at-bottom-of-the-class/ [accessed 11th April 2019].
- Hughes, N. (2019). Feed for thought - why campaigners are trying to make animal feed a mainstream issue in 2019, *Food Service Footprint*, 8th February, https://www.foodservicefootprint.com/feed-for-thought/ [accessed 11th April 2019].
- Hughner, R.S., McDonagh, P., Prothero, A., Shultz C.J. and Stanton, J. (2007). Who are organic food consumers - a compilation and review of why people purchase organic food, *Journal of Consumer Behaviour*, Vol. 6, pp.94-110, doi: 10.1002/cb.210.
- Hugo, G. (2011). Future demographic change and its interactions with migration and climate change, *Global Environmental Change*, Vol. 21, Supplement 1, pp. S21-S33, https://doi.org/10.1016/j.gloenvcha.2011.09.008 [accessed 11th April 2019].
- Hui, A. (2016). Why a new national strategy on food can't satisfy all, *The Globe and Mail*, 23rd October, https://www.theglobeandmail.com/news/national/why-a-new-national-strategy-on-food-cant-satisfyall/article32486906/ [accessed 11th April 2020].
- Hules, M. and Singhba, S.J. (2017). India’s land grab deals in Ethiopia Food security or global politics, *Land Use Policy*, Vol. 60, pp.343-351, http://dx.doi.org/10.1016/j.landusepol.2016.10.035 [accessed 11th April 2019].
- Humes, E. (2016). Sustainability - laying waste, *Nature*, 27th October, Vol. 538, No. 8, p.458, https://doi.org/10.1038/538458a [accessed 11th April 2019].
- Hunt, A.S.P., Wilby, R.L., Dale, N., Sura, K. and Watkiss, P. (2014). Embodied water imports to the UK under climate change, Climate Research, Vol. 59, No. 2, pp.89-101, doi: 10.3354/cr01200.

- Hunt, C. and Premathilake, R. (2018). Prehistoric people started to spread domesticated bananas across the world 6,000 years ago, *The Conversation*, 13th July, https://theconversation.com/prehistoric-people-started-to-spread-domesticated-bananas-across-the-world-6-000-years-ago-99547 [accessed 11th April 2019].
- Hunter, E. and Röös, E. (2016). Fear of climate change consequences and predictors of intentions to alter meat consumption, *Food Policy*, Vol. 62, pp.151-160, https://doi.org/10.1093/biosci/bix010 [accessed 11th April 2019].
- Hunter, M.C., Smith, R.G., Schipanski, M.E., Atwood, L.W. and Mortensen, D. (2017). Agriculture in 2050: recalibrating targets for sustainable intensification, *BioScience*, Vol. 67, No. 4, pp.386-391, https://doi.org/10.1093/biosci/bix010 [accessed 11th April 2019].
- Hutchinson, W.F., Culling, M., Orton, D.C., Hänfling, B., Handley, L., Hamilton-Dyer S., O'Connell, T.C., Richards, M.P. and Barrett J.H. (2015). The globalization of naval provisioning: ancient DNA and stable isotope analyses of stored cod from the wreck of the Mary Rose, AD 1545, *Royal Society Open Science*, Vol. 2, 150199, http://dx.doi.org/10.1098/rsos.150199 [accessed 11th April 2019].
- Hwang, A.D. (2018). 7.5 billion and counting: How many humans can the Earth support? *The Conversation*, 9th July, https://theconversation.com/7-5-billion-and-counting-how-many-humans-can-the-earth-support-98797 [accessed 11th April 2019].
- Hyland, C., Bradman, A., Geron, R., Patton, S., Zakharevic, I., Gunier, R.B. and Klein, K. (2019). Organic diet intervention significantly reduces urinary pesticide levels in U.S. children and adults, *Environmental Research,* April, Vol. 171, pp.568-575, https://doi.org/10.1016/j.envres.2019.01.024 [accessed 11th April 2019].
- Hyland, J.J., Henchion, M., McCarthy, M. and McCarthy, S.N. (2017). The role of meat in strategies to achieve a sustainable diet lower in greenhouse gas emissions: a review, *Meat Science*, Vol. 132, pp.189-195, doi: 10.1016/j.meatsci.2017.04.014.
- Hyseni, L., Bromley, H., Kypridemos, C., O'Flaherty, M., Lloyd-Williams, F., Guzman-Castillo, M., Pearson-Stuttard, J. and Capewell, S. (2017). Systematic review of dietary trans-fat reduction interventions, *Bulletin of the World Health Organization*, Vol. 95, No. 12, pp.821-830G, https://doi.org/10.2471/BLT.16.189795 [accessed 15th April 2020].
- I'Anson Price, R., Dulex, N., Vial, N., Vincent, C. and Grüter, C. (2019). Honeybees forage more successfully without the "dance language" in challenging environments, *Science Advances*, Vol. 5, No. 2, pp.eaat0450, doi: 10.1126/sciadv.aat0450.
- Iaccarino Idelson, P., Scalfi, L. and Valerio, G. (2017). Adherence to the Mediterranean Diet in children and adolescents: a systematic review, *Nutrition, Metabolism and Cardiovascular Diseases*, Vol. 27, No. 4, pp.283-299, doi: 10.1016/j.numecd.2017.01.002.

- IAP (2018). *Opportunities for future research and innovation on food and nutrition security and agriculture - The InterAcademy Partnership's global perspective*, Synthesis by IAP based on four regional academy network studies, Trieste: InterAcademy Partnership.
- ICAO (2017). *Civil Aviation Statistics of the World*, International Civil Aviation Organization, http://www.icao.int/sustainability/Pages/Statistics.aspx [accessed 11th April 2019].
- ICCT (2018). Effects of battery manufacturing on electric vehicle life-cycle ghg emissions, Washington, USA: International Council on Clean Transportation, https://theicct.org/sites/default/files/publications/EV-life-cycle-GHG_ICCT-Briefing_09022018_vF.pdf [accessed 11th April 2019].
- IDF (2010). *A common carbon footprint approach for dairy: The IDF guide to standard lifecycle assessment methodology for the dairy sector*, Brussels: Bulletin of the International Dairy Federation, http://www.ukidf.org/documents/bulletin445.pdf [accessed 11th April 2019].
- IEA (2017). *Obesity and the public purse: weighing up the true cost to the taxpayer*, IEA Discussion Paper No.80, London, UK: The Institute of Economic Affairs, https://iea.org.uk/wp-content/uploads/2017/01/Obesity-and-the-Public-Purse-PDF.pdf [accessed 11th April 2019].
- IFFO (2016). *Responding to our critics,* London, UK: International Fishmeal and Fish oil Organisation, http://www.iffo.net [accessed 11th April 2019].
- IFOAM (2017). *Organic Farming, climate change mitigation and beyond reducing the environmental impacts of EU agriculture*, Brussels, Belgium: International Federation of Organic Agriculture Movement (IFOAM EU).
- IFOAM (2018). *Factsheets*, Brussels, Belgium: International Federation of Organic Agriculture Movement (IFOAM EU), https://www.ifoam-eu.org/en/library-2 [accessed 11th April 2019].
- IFPRI (2015). *Global nutrition report 2015: actions and accountability to advance nutrition and sustainable development*, Washington, USA: International Food Policy Research Institute.
- IFPRI (2018). *Global nutrition report 2018: shining a light to spur action on nutrition*, Washington, USA: International Food Policy Research Institute.
- IFZ (2010). *Local food systems in Europe - case studies from five countries and what they imply for policy and practice*, Case studies from five countries and what they imply for policy and practice, Facilitating Alternative Agro-Food Networks,
- IGD (2012). *The business case for reducing emissions,* Letchmore Heath, UK: Institute of Grocery Distribution.
- IGD (2013). *Environmental impact of nutrition guidance: a preliminary study*, A working group report, Letchmore Heath, UK: Institute of Grocery Distribution.
- IGD (2013). *Sustainable diets report*, Letchmore Heath, UK: Institute of Grocery Distribution.
- IGD (2014). *Trading relationships in 2014/15*, Letchmore Heath: Institute of Grocery Distribution.
- IGD (2015). *Feeding Britain's future*, Letchmore Heath, UK: Institute of Grocery Distribution.

- IGD (2015). *Reducing wasted miles*, Letchmore Heath, UK: Institute of Grocery Distribution.
- IGD (2018). *Shoppers of the future*, Letchmore Heath, UK: Institute of Grocery Distribution.
- IGD (2019). Global retail trends 2019: five trends we predict will reshape retail, Letchmore Heath, UK: Institute of Grocery Distribution, https://www.igd.com/articles/article-viewer/t/igd-predicts-five-trends-set-to-shape-retail-in-2019/i/20597 [accessed 11th April 2019].
- IGEL (2013). *The Nexus of Food, Energy and Water*, University of Pennsylvania: Initiative for Global Environmental Leadership (IGEL).
- Iglesias, A., Quiroga, S. and Diz, A. (2011). Looking into the future of agriculture in a changing climate, *European Review of Agricultural Economics*, Vol. 38, No. 3, pp.427-447.
- Igumbor, E.U., Sanders, D., Puoane, T.R., Tsolekile, L., Schwarz, C., Purdy, C., Swart, R., Durão, S. and Hawkes, C. (2012) “Big food,” the consumer food environment, health, and the policy response in South Africa, *PLoS Med*, Vol. 9, No. 7, e1001253, https://doi.org/10.1371/journal.pmed.1001253 [accessed 11th April 2019].
- IISD (2013). *The EU Biofuel Policy and Palm Oil - cutting subsidies or cutting rainforest*, Geneva, Switzerland: International Institute for Sustainable Development.
- IISD (2016). *Annual report 2015-2016*, Geneva, Switzerland: International Institute for Sustainable Development.
- IISD (2017). *Equity and a healthy planet: IISD Annual Report 2016-2017*, Geneva, Switzerland: International Institute for Sustainable Development.
- IISD (2018). *A Force for Action: IISD Annual Report 2017-2018*, Geneva, Switzerland: International Institute for Sustainable Development.
- Iizuk, M. and Katz, J. (2015). Globalisation, sustainability and the role of of institutions - the case of the Chilean Salmon, *Tijdschrift voor Economische en Sociale Geografie*, Vol. 106, No. 2, pp.140-153, doi:10.1111/tesg.12132.
- Iizumi, T. and Ramankutty, N. (2015). How do weather and climate influence cropping area and intensity? *Global Food Security*, Vol. 4, pp.46-50, https://doi.org/10.1016/j.gfs.2014.11.003 [accessed 11th April 2019].
- Ilbery, B. and Maye, D. (2005). Food supply chains and sustainability - evidence from specialist food producers in the Scottish - English borders, *Land Use Policy*, Vol. 22, pp.331-344, https://doi.org/10.1016/j.landusepol.2004.06.002 [accessed 11th April 2019].
- Ilea, R. (2008). Intensive livestock farming: global trends, increased environmental concerns, and ethical solutions, *Journal of Agricultural and Environmental Ethics*, Vol. 22, No. 2, pp.153-167, doi:10.1007/s10806-008-9136-3.
- Imamura, F., Micha, R., Khatibzadeh, S., Fahimi, S., Shi, P., Powles, J. and Mozaffarian, D. (2015). Dietary quality among men and women in 187 countries in 1990 and 2010: a systematic assessment, *Lancet Global Health*, Vol. 3, pp.e132-e142, doi: 10.1016/S2214-109X(14)70381-X.

- IME (2013). *Global food - waste not, want not*, London, UK: Institution of Mechanical Engineers.
- Imenda, S. (2014). Is there a conceptual difference between theoretical and conceptual frameworks? Journal of Social Sciences, Vol. 38, No. 2, pp.185-195.
- IMF (2010). *World economic outlook - rebalancing growth*, Washington, USA: International Monetary Fund.
- IMF (2012). *Policy options for riding out food, fuel price spikes*, Washington, USA: International Monetary Fund.
- IMF (2014). Conference debates how to manage food price volatility, Washington, USA: International Monetary Fund.
- Immerzeel, W.W., Van Beek, L.P.H., Konz, M., Shrestha, A.B., and Bierkens, M.F.P. (2011). Hydrological response to climate change in a glacierized catchment in the Himalayas, *Climate Change*, Vol. 110, pp.721-736, https://doi.org/10.1007/s10584-011-0143-4.
- *Independent, The* (2019). Tonnes of antibiotics still used in UK chicken farms raising fears over drug resistant diseases, investigation finds, *The Independent*, 31st March, https://www.independent.co.uk/news/uk/home-news/antibiotics-chicken-uk-farms-drug-resistance-poultry-countryfile-a8847326.html [accessed 11th April 2019].
- iNews (2019). Toxic air will shorten children's lives by 20 months, study reveals Egypt had the highest loss to life expectancy with nearly two years, iNews, 3rd April, https://inews.co.uk/news/environment/toxic-air-shorten-childrens-lives-20-months-study-635560 [accessed 11th April 2019].
- Ingram, J. (2011). A food systems approach to researching food security and its interactions with global environmental change, *Food Security*, Vol. 3, pp.417-431, https://doi.org/10.1007/s12571-011-0149-9 [accessed 11th April 2019].
- Ingram, J. and Zurek, M. (2018). Food systems approaches for the future. In: *Agriculture & Food Systems to 2050*, pp.547-567, https://doi.org/10.1142/9789813278356_0016 [accessed 15th April 2019].
- Ingram, J., Dyball, R., Howden, M., Vermeulen, S., Garnett, T., Redlingshöfer, B., Guilbert, S. and Porter, J.R. (2016). Food security, food systems, and environmental change, *The Solutions Journal*, Vol. 7, No. 3, pp.63-73, doi: 10.1007/s12571-011-0149-9.
- Ingram, J., Zurek, M., Sykes, R. and O'Kane, E. (2019). *Exploring the resilience of the UK food system in a global context*, GFS-FSR Food Systems Group, Oxford, UK: University of Oxford Environmental Change Institute, www.foodsecurity.ac.uk [accessed 11th April 2019].

- Ingram, J.S.I., Wright, H.L., Foster, L., Aldred, T., Barling, D., Benton, T.G., Berryman, P.M., Bestwick, C.S., Bows-Larkin, A., Brocklehurst, T.F., Buttriss, J., Casey, J., Collins, H., Crossley, D.S., Dolan, C.S., Dowler, E., Edwards, R., Finney, K.J., Fitzpatrick, J.L., Fowler, M., Garrett, D.A., Godfrey, J.E., Godley, A., Griffiths, W., Houlston, E.J., Kaiser, M.J., Kennard, R., Knox, J.W., Kuyk, A., Linter, B.R., Macdiarmid, J.I., Martindale, W., Mathers, J.C.,. McGonigle, D.F., Mead, A., Millar, S.J., Miller, A., Murray, C., Norton, I.T., Parry, S., Pollicino, M., Quested, T.E., Tassou, S., Terry, L.A., Tiffin, R., van de Graaf, P., Vorley, W., Westby, A. and Sutherland, W.J. (2013). Priority research questions for the UK food system, *Food Security*, Vol. 5, pp.617-636, https://doi-org.ezproxy.mmu.ac.uk/10.1007/s12571-013-0294-4 [accessed 11th April 2019].
- Inman, A., Winter, M., Wheeler, R., Vrain, E., Lovett, A., Collins, A., Jones, I., Johnes, P. and Cleasby, W. (2018). An exploration of individual, social and material factors influencing water pollution mitigation behaviours within the farming community, *Land Use Policy*, Vol. 70, pp. 16-26. https://doi.org/10.1016/j.landusepol.2017.09.042 [accessed 11th April 2019].
- Institute for Government (2015). *Arm's-length bodies*, London, UK: Institute for Government, https://www.instituteforgovernment.org.uk/ [accessed 11th April 2019].
- Institute of Food Science and Technology (2017). *Sustainable food system framework: a focus on food sustainability*, London, UK: The Institute of Food Science and Technology, https://www.ifst.org/sites/default/files/IFST%20Sustainable%20Food%20System%20Framework.pdf [accessed 11th April 2019].
- Institution of Mechanical Engineers (2013). *Global food: waste not, want not*, London, UK: Institution of Mechanical Engineers, pp.1-35, http://www.rozvojovka.cz/download/docs/121_analyza-o-plytvani-potravinami-ve-svete.pdf [accessed 25th January 2019].
- International Development Committee (2013). Global food security: Government response to the Committee's First Report of Session 2013-14, Second Special Report of Session 2013–14, London, UK: House of Commons International Development Committee.
- International Grains Council (2020). *Market information on grains, rice and oilseeds*, London, UK: International Grains Council, https://www.igc.int [accessed 15th April 2020].
- International Panel of Experts on Sustainable Food Systems (2016). *From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems*, Brussels, Belgium: IPES-Food.
- International Panel of Experts on Sustainable Food Systems (2017). *Too big to feed: exploring the impacts of mega-mergers, consolidation and concentration of power in the agri-food sector*, London, UK: IPES-Food, http://www.ipes-food.org/_img/upload/files/Concentration_ExecSummary.pdf [accessed 11th April 2019].
- International Sustainability Unit (2011). *What price resilience - towards sustainable and secure food systems*, London, UK, Prince of Wales' Charities International Sustainability Unit.

- Iocola, I., Campanelli, G., Diacono, M., Leteo, F., Montemurro, F., Persiani, A. and Canali, S. (2018). Sustainability assessment of organic vegetable production using a qualitative multi-attribute model, *Sustainability*, Vol. 10, No. 10, pp.3820, https://doi.org/10.3390/su10103820 [accessed 11th April 2020].
- IOM (2014). *Sustainable diets: food for healthy people and a healthy planet*, Institute of Medicine workshop summary, Washington, USA: The National Academies Press.
- Iowa State University (2019). *Database comparisons*, Ames, USA: Iowa State University of Science and Technology, https://instr.iastate.libguides.com/comparisons [accessed 15th April 2020].
- IPBES (2016a). *The methodological assessment report of the intergovernmental science - policy platform on biodiversity and ecosystem services on scenarios and models of biodiversity and ecosystem services*, Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
- IPBES (2016b). *Thematic assessment on pollinators, pollination and food production*, Annex to document IPBES/4/INF/1/Rev.1, Bonn, Germany: Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services, https://www.ipbes.net/assessment-reports/pollinators [accessed 11th April 2019].
- IPBES (2017). *The assessment report on pollinators, pollination and food production of the intergovernmental science-policy platform on biodiversity and ecosystem services*, Intergovernmental Science: Policy Platform on Biodiversity and Ecosystem Services (IPBES), www.ipbes.net/system/tdf/downloads/ pdf/individual_chapters_pollination_20170305. pdf?file=1&type=node&id=15248 [accessed 11th April 2019].
- IPBES (2018a). Climate change/biodiversity loss: inseparable threats to humanity that must be addressed together: models foresee 10 to 30-fold rise in agricultural land devoted to bioenergy, *Science Daily*, 15th November, www.sciencedaily.com/releases/2018/11/181115144949.htm [accessed 11th April 2019].
- IPBES (2018b). *Summary for policymakers of the thematic assessment of land degradation and restoration*, Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
- IPBES (2018c). *Thematic assessment on pollinators, pollination and food production*, Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
- IPBES (2019). *The global assessment report on biodiversity and ecosystem services: summary for policymakers*, Bonn, Germany: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, https://ipbes.net/sites/default/files/inline/files/ipbes_global_assessment_report_summary_for_policymakers.pdf [accessed 11th April 2019].
- IPCC (2006). *IPCC guidelines for national greenhouse gas inventories*, IGES, Japan, https://www.ipcc-nggip.iges.or.jp/public/2006gl/ [accessed 11th April 2019].
- IPCC (2007a). *Projections of future changes in climate*, Geneva, Switzerland: Intergovernmental Panel on Climate Change.

- IPCC (2007b). *The physical science basis*, Contribution of Working Group I to the Fourth Assessment Report of the IPCC, Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2013a). *Climate change 2013: the physical science basis*, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (eds) T.F. Stocker, D. Qin, G.K. Plattner, M. Tignor, S.K. Allen, *et al.*. Cambridge, UK/New York: Cambridge University Press.
- IPCC (2013b). *Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*, Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2014a). *Climate Change 2014 summary*, Climate Change 2014: Impacts, Adaptation, and Vulnerability, Summary for Policymakers, Geneva, Switzerland: Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/ar5/wg2/ [accessed 11th April 2019].
- IPCC (2014b). *Climate change 2014: impacts, adaptation, and vulnerability, summary for policymakers*, Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2014c). *Climate change 2014: impacts, adaptation, and vulnerability, part a: global and sectoral aspects*, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (eds) C.B. Field, V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, *et al*.. Cambridge, UK/New York: Cambridge University Press.
- IPCC (2014d). *Climate change 2014: synthesis report*, Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, ed. RK Pachauri, LA Meyer, Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2014e). *Summary for policymakers*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability, Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)], Cambridge, United Kingdom and New York, USA: Cambridge University Press.
- IPCC (2018a). *Global Warming of 1.5°C: an IPCC Special Report*, Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2018b). Summary for Policymakers. In: *Global warming of 1.5°C. An IPCC Special Report on the impact of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P. R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. Geneva, Switzerland: World Meteorological Organization.

- IPCC (2019a). *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)], Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2019b). *IPCC special report on the ocean and cryosphere in a changing climate* [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)], Geneva, Switzerland: Intergovernmental Panel on Climate Change.
- IPCC (2019c). *Global warming of 1.5°C: summary for policymakers*, Geneva, Switzerland: Intergovernmental Panel on Climate Change, https://www.ipcc.ch/site/assets/uploads/sites/2/2018/07/SR15_SPM_High_Res.pdf [accessed 11th April 2019].
- IPES (2015). *Food and the new science of sustainable food systems - who shapes food systems, and who has a say in how they are reformed*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems.
- IPES (2015). *The new science of sustainable food systems – overcoming barriers to food systems reform*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems.
- IPES (2016). *From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems.
- IPES (2017). *Too big to feed: exploring the impacts of mega-mergers, consolidation and concentration of power in the agri-food sector*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems-Food.
- IPES (2017). *Unravelling the Food–Health Nexus - Addressing practices, political economy, and power*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems, http://www.ipes-food.org/images/Reports/Health_FullReport.pdf [accessed 11th April 2019].
- IPES (2018). *Breaking away from industrial food and farming systems - seven case studies of agroecological transition*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems.
- IPES (2019a). *Industry sponsored science clouding the picture of how food systems impact health*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems.
- IPES (2019b). *Towards a Common Food Policy for the EU: the policy reform and realignment that is required to build sustainable food systems in Europe*, Brussels, Belgium: International Panel of Experts on Sustainable Food Systems, http://www.ipes-food.org/_img/upload/files/CFP_FullReport.pdf [accessed 11th April 2019].

- Ipsos MORI (2014). *Changing climate, changing diets*, Global Survey for Chatham House [data tables], October 2014.
- Ipsos MORI (2018). *Diet and climate change*, https://www.ipsos.com/ipsos-mori/en-uk/diet-and-climate-change, [accessed 11th April 2019].
- Irani, Z. and Sharif, A.M. (2016). Sustainable food security futures: perspectives on food waste and information across the food supply chain, *Journal of Enterprise Information Management*, Vol. 29, Iss. 2, pp.171-178, https://doi.org/10.1108/JEIM-12-2015-0117 [accessed 11th April 2019].
- Ireland, R. and Ashton, J.R. (2017). Happy corporate holidays from Coca-Cola - selling sugary drinks at Christmas, *British Medical Journal*, Vol. 356, pp.i6833, doi: 10.1136/bmj.i6833.
- Irshad, A. (2012). Food security in changing weather pattern, *Economic Review*, Vol. 43, No. 9/10, September-October, pp.8-9, https://www.dawn.com/news/751458 [accessed 11th April 2019].
- Islam, S. (2014). *Confronting the blue revolution: industrial aquaculture and sustainability in the global south*, Toronto: University of Toronto, ISBN: 9781442614406.
- ISO (2018). *International Standards protecting our planet: ISO standards for the environment*, Geneva, Switzerland: International Organization for Standardization, https://www.iso.org/protecting-our-planet.html [accessed 11th April 2019].
- ISSA (2014). *Megatrends and social security: climate change and natural resource scarcity*, Geneva, Switzerland: International Social Security Association, ISBN 978-92-843-0188-1.
- ISSF (2013). *Strategic plan for 2013-2017*, McLean, Virginia, USA: International Seafood Sustainability Foundation.
- ISSF (2018). *Strategic Plan for 2018–2022*, Washington, USA: International Seafood Sustainability Foundation, https://iss-foundation.org/strategic-plan/ [accessed 11th June, 2020].
- ISU (2011). *What price resilience? Towards sustainable and secure food systems*, London, UK: Prince of Wales' Charities International Sustainability Unit, http://pcfisu.org/wpcontent/uploads/pdfs/TPC0632_Resilience_report_WEB11_07_SMALLER.pdf [accessed 11th April 2019].
- ITC (2012). *Product carbon footprinting standards in the agri-food sector*, Geneva, Switzerland: International Trade Centre.
- IUFN (2015). *Measuring impact of city region food systems*, International Urban Food Network.
- Ivanic, M. and Martin, W. (2008). *Implications of higher global food prices for poverty in low-income countries*, *Agricultural Economics*, Vol. 39, Supplement, pp.405-416, doi: 10.1111/j.1574-0862.2008.00347.x
- Ivanova, D., Barrett, J., Wiedenhofer, D., Macura, B., Callaghan, M.W. and Creutzig, F. (2020). Quantifying the potential for climate change mitigation of consumption options, *Environmental Research Letters*, (accepted manuscript), doi: https://doi.org/10.1088/1748-9326/ab8589.

- Ivanova, D., Vita, G., Steen-Olsen, K., Stadler, K., Melo, K.C., Wood, R. and Hertwich, E.G. (2018). Mapping the carbon footprint of EU regions, *Environmental Research Letters*, Vol. 12, No. 5, 054013, https://doi.org/10.1088/1748-9326/aa6da9 [accessed 11th April 2019].
- Izaurralde, R.C., Thomson, A.M., Morgan, J.A., Fay, P.A., Polley, H.W. and Hatfield, J.L. (2011). Climate impacts on agriculture: implications for forage and rangeland production, *Agronomy Journal*, Vol. 103, pp.371-381, doi: 10.2134/agronj2010.0304.
- Izraelov, M. and Silber, J. (2019). An assessment of the global food security index, *Food Security*, Vol. 11, No. 5, pp.1135-1152, https://doi-org.dblibweb.rdg.ac.uk/10.1007/s12571-019-00941-y [accessed 11th April 2020].
- Jackson, K. and Shepotylo, O. (2018). The five alternatives to EU single market and customs union would all make UK poorer, *The Conversation*, 26th February, https://theconversation.com/the-five-alternatives-to-eu-single-market-and-customs-union-would-all-make-uk-poorer-92228 [accessed 11th April 2019].
- Jackson, T. (2009). *Prosperity without growth: economics for a finite planet*, London, UK: Earthscan.
- Jackson, T. (2016). *Prosperity without growth: foundations for the economy of tomorrow*, 2nd Edition, London, UK: Earthscan, ISBN 978-1138935419.
- Jackson, T. (2019a). 2050 is too late – we must drastically cut emissions much sooner, *The Conversation*, 15th September, https://theconversation.com/2050-is-too-late-we-must-drastically-cut-emissions-much-sooner-121512 [accessed 11th April 2019].
- Jackson, T. (2019b). *Zero carbon sooner—the case for an early zero carbon target for the UK*, CUSP Working Paper Series No. 18, Guildford, UK: Unvesity of Surrey Centre for the Understanding of Sustainable Prosperity, https://www.cusp.ac.uk/themes/aetw/zero-carbon-sooner/ [accessed 11th April 2019].
- Jacob, D., Kotova, L., Teichmann, C., Sobolowski, S.P., Vautard, R., Donnelly, C., Koutroulis, A.G., Grillakis, M.G., Tsanis, I.K., Damm, A., Sakalli, A. and Van Vliet, M.T.H. (2018). Climate impacts in Europe under +1.5°c global warming, *Earth's Future*, Vol. 6, No. 2, pp.264-285, https://www.carbonbrief.org/daily-brief/warming-breach-1-5c-within-five-years-says-uk-met-office [accessed 11th April 2019].
- Jaggard, K.W., Qi, A. and Ober, E.S. (2010). Possible changes to arable crop yields by 2050, *Philosophical Transactions of the Royal Society B*, Vol. 365, pp.2835–2851, Iss. 1554, doi: 10.1098/rstb.2010.0153365 2010.
- Jahn, A. (2018). Reduced probability of ice-free summers for 1.5°C compared to 2°C warming, *Nature Climate Change*, Vol. 8, pp.409-413, doi:10.1038/s41558-018-0127-8.
- Jambeck, J.R., Geyer, R., Wilcox, C., Siegler, T.R., Perryman, M., Andrady, A., Narayan, R. and Law, K.L. (2015). Plastic waste inputs from land into the ocean, *Science*, 13th February, Vol. 347, Iss. 6223, pp.768-769, doi: 10.1126/science.1260352.
- James, S.J. and James, C. (2010). The food cold-chain and climate change, *Food Research International*, Vol. 43, pp.1944-1956, https://doi.org/10.1016/j.foodres.2010.02.001 [accessed 11th April 2019].

- James, S.W., Friel, S., Lawrence, M.A., Hoek, A.C. and Pearson, D. (2017). Inter-sectoral action to support healthy and environmentally sustainable food behaviours: a study of sectoral knowledge, governance and implementation opportunities, *Sustainability Science*, Vol. 13, pp.465-477, https://doi.org/10.1007/s11625-017-0459-8 [accessed 11th April 2019].
- Jamie Oliver Food Foundation. (2017). A report on the food education learning landscape, http://www.akofoundation.org/wp-content/uploads/2017/11/2_0_fell-report-final.pdf [accessed 11th April 2019].
- Janetos, A. (2017). What if several of the world's biggest food crops failed at the same time? *The Conversation*, 5th June, https://theconversation.com/what-if-several-of-the-worlds-biggest-food-crops-failed-at-the-same-time-74017 [accessed 11th April 2019].
- Janetos, A., Justice, C., Obersteiner, M., Glauber, J. and Mulhern, W. (2017). The risks of multiple breadbasket failures in the 21st century: a science research agenda, Boston, USA: The Frederick S. Pardee Center for the Study of the Longer-Range Future, March, http://www.bu.edu/pardee/files/2017/03/Multiple-Breadbasket-Failures-Pardee-Report.pdf [accessed 11th April 2019].
- Jankowicz, M. (2020). Lisa Nandy: UK should not sign US trade deal if Trump quits Paris Agreement, *The New European*, 15th January, https://www.theneweuropean.co.uk/top-stories/lisa-nandy-donald-trump-climate-change-1-6467622 [accessed 11th April 2019].
- Jarmul, S., Liew, Z., Haines, A. and Scheelbeek, P. (2019). Climate change mitigation in food systems: the environmental and health impacts of shifting towards sustainable diets, a systematic review protocol, *Wellcome Open Research*, Vol. 4, No. 205, https://doi.org/10.12688/wellcomeopenres.15618.1.
- Jat, M.L., Dagar, J.C., Sapkota, T.B., Yadvinder-Singh, G.B., Ridaura, S., Saharawat, Y.S., Sharma, R.K., Tetarwal, J.P., Jat, R.K., Hobbs, H. and Stirling, C. (2016). Climate change and agriculture: adaptation strategies and mitigation opportunities for food security in South Asia and Latin America, *Advances in Agronomy*, Vol. 137, pp.127-235, https://doi.org/10.1016/bs.agron.2015.12.005 [accessed 11th April 2019].
- Jay, M. and Marmot, M.G. (2009). Health and climate change, *The Lancet*, Vol. 374, Iss. 9694, pp.961-962, doi: 10.1016/S0140-6736(09)61603-2.
- JBI (2015). Joanna Briggs Institute Reviewers' Manual: 2015 edition/Supplement. Adelaide, South Australia: The Joanna Briggs Institute; 2015.
- JBI (2019). *Methodology for JBI umbrella reviews*, Adelaide, Australia: Joanna Briggs Institute [accessed 11th June, 2020].
- JBI (2020). Who are we? Joanna Briggs Institute, Adelaide, Australia: University of Adelaide, https://joannabriggs.org/ [accessed 15th April 2020].

- Jenking, A. (2018). Food security: vertical farming sounds fantastic until you consider its energy use, *The Conversation*, 10th September, https://theconversation.com/food-security-vertical-farming-sounds-fantastic-until-you-consider-its-energy-use-102657 [accessed 11th April 2019].
- Jensen, B.B. (1996). Methanogenesis in monogastric animals, *Environmental Monitoring and Assessment*, Vol. 42, Iss. 1-2, pp.99-112, doi: 10.1007/BF00394044.
- Jensen, F., Nielsen, M. and Nielsen, R. (2014). Increased competition for aquaculture from fisheries: does improved fisheries management limit aquaculture growth? *Fisheries Research*, Vol. 159, pp.25-33, http://dx.doi.org/10.1016/j.fishres.2014.05.004 [accessed 11th April 2019].
- Jespersen, L., Griffiths, M. and Wallace, C.A. (2017). Comparative analysis of existing food safety culture evaluation systems, *Food Control*, Vol 79, pp.371-379, https://doi.org/10.1016/j.foodcont.2017.03.037 [accessed 11th April 2019].
- Jevrejeva, S., Jackson, L.P., Grinsted, A., Lincke, D. and Marzeion, B. (2018). Flood damage costs under the sea-level rise with warming of 1.5°C and 2°C, *Environmental Research Letters*, Vol. 13, No. 7, pp.074014, doi: 10.1088/1748-9326/aacc76.
- Jevrejeva, S., Jackson, L.P., Riva, R.E.M., Grinsted, A. and Moore, J.C. (2016). Coastal sea-level rise with warming above 2°C, *Proceedings of the National Academy of Sciences*, Vol. 113, No. 47, pp.13342-13347, doi: 10.1073/pnas.1605312113.
- Jia, P., Luo, M., Li, Y., Zheng, J-S., Qian Xiao, Q. and Luo, J. (2019). Fast-food restaurant, unhealthy eating, and childhood obesity: a systematic review and meta-analysis, *Obesity Reviews*, pp.1-27, doi: 10.1111/obr.12944.
- Jitendra, A., Thorogood, E. and Hadfield-Spoor, M. (2017). *Early warnings: universal credit and food banks*, Salisbury, UK: Trussell Trust.
- Jitendra, A., Thorogood, E. and Hadfield-Spoor, M. (2018). *Left behind: is universal credit truly universal?* Salisbury, UK: Trussell Trust.
- JNCC (2019). *Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland*, Peterborough, UK: Joint Nature Conservation Committee, http://jncc.defra.gov.uk/page-7731 [accessed 11th April 2019].
- Jóhannesson, G.T. (2004). *Troubled waters: cod war, fishing disputes, and Britain's fight for the freedom of the high seas, 1948-1964*, Studia Atlantica 11, North Atlantic Fisheries History Association, http://qmro.qmul.ac.uk/xmlui/handle/123456789/1834 [accessed 11th April 2019].
- Johnson, B.J., Zarnowiecki, D., Hendrie, G.A., Mauch, C.E. and Golley, R.K. (2018). How to reduce parental provision of unhealthy foods to 3- to 8-year-old children in the home environment? A systematic review utilizing the behaviour change wheel framework, *Obesity Reviews*, Vol. 19, No.10, pp.1359-1370, doi: 10.1111/obr.12702.
- Johnson, J. (2018). Sustainability, John Johnson reminds that sustainability is a process, not an endpoint, *National Provisioner*, Vol. 232, No. 8, pp.18-20.

- Johnson, J.A., Runge, C.F., Senauer, B. and Polasky, B. (2016). Global food demand and carbon-preserving cropland expansion under varying levels of intensification, *Land Economics*, Vol. 92, No. 4, pp.579-592, doi: https://doi.org/10.1101/300632.
- Johnston, A.E. (2017). Changes in soil organic matter over 70 years in continuous arable and ley - arable rotations on a sandy loam soil in England, *European Journal of Soil Science*, Vol. 68, No. 3, pp.305-316, doi: 10.1111/ejss.12415.
- Johnston, I. (2017). MIT climate scientists turn on their former colleague after he tells Donald Trump to tear up Paris Agreement, *The Independent*, 9th March, https://www.independent.co.uk/environment/mit-scientists-letter-donald-trump-climate-change-global-warming-real-richard-lindzen-a7620386.html [accessed 11th April 2019].
- Johnston, J., Szabo, M. and Rodney, A. (2011). Good food, good people: understanding the cultural repertoire of ethical eating, *Journal of Consumer Culture*, Vol. 11, No. 3, pp.293-318, https://doi.org/10.1177/1469540511417996 [accessed 11th April 2019].
- Johnston, J.L., Fanzo, J.C. and Cogill, B. (2014). Understanding sustainable diets: a descriptive analysis of the determinants and processes that influence diets and their impact on health, food security, and environmental sustainability, *Advances in Nutrition*, Vol. 5, pp.418-429, doi: 10.3945/an.113.005553.
- Jones, A. and Steffen, W. (2015). Our climate is like reckless banking before the crash – it's time to talk about near-term collapse, *The Conversation*, 6th December, https://theconversation.com/our-climate-is-like-reckless-banking-before-the-crash-its-time-to-talk-about-near-term-collapse-128374 [accessed 11th April 2019].
- Jones, A.D, Hoey, L., Blesh, J., Miller, L., Green, A. and Shapiro, L.F. (2016). A systematic review of the measurement of sustainable diets, *Advances in Nutrition*, Vol. 7, Iss. 4, pp.641-664, https://doi.org/10.3945/an.115.011015 [accessed 11th April 2019].
- Jones, A.D., Fink Shapiro, L. and Wilson, M.L. (2015). Assessing the potential and limitations of leveraging food sovereignty to improve human health, *Frontiers of Public Health*, Vol. 3, No.263, pp.1-10, doi: 10.3389/fpubh.2015.00263.
- Jones, A.D., Ngure, F.M., Pelto, G. and Young, S.L. (2013). What are we assessing when we measure food security? A compendium and review of current metrics, *American Society of Nutrition Advances in Nutrition*, pp.481-505, doi:10.3945/an.113.004119.
- Jones, A.J. (2017). Critical review of the emerging research evidence on agricultural biodiversity, diet diversity, and nutritional status in low- and middle-income countries, *Nutrition Reviews*, Vol. 75, No. 10, pp.769-782, doi: 10.1093/nutrit/nux040.
- Jones, A.W. and Hiller, B. (2015). *Review of the responses to food production shocks*, UK-US Taskforce on Extreme Weather and Global Food System Resilience.
- Jones, A.W. and Phillips, A, (2016). Historic food production shocks: quantifying the extremes, *Sustainability*, Vol. 8, No. 5, pp.427-436.

- Jones, A.W., Allen, I., Silver, N., Howarth, C., Cameron, C. and Caldecott, B. (2013). Resource constraints: the evidence and scenarios, The Actuarial Profession
- Jones, K., Friedlander, A., Halpern, B., Kuempel, C., Klein, C., Grantham, H., Possingham, H., Watson, J., Shumway, N. and Venter, O. (2018). New map shows that only 13% of the oceans are still truly wild, *The Conversation*, 1st August, https://theconversation.com/new-map-shows-that-only-13-of-the-oceans-are-still-truly-wild-100820 [accessed 11th April 2019].
- Jones, N.R.V., Tong, T.Y.N. and Monsivais, P. (2018). Meeting UK dietary recommendations is associated with higher estimated consumer food costs: an analysis using the National Diet and Nutrition Survey and consumer expenditure data, 2008–2012, *Public Health Nutrition*, Vol. 21, pp.948-956, doi: https://doi.org/10.1017/S1368980017003275.
- Jones, P. and Bhatia, R. (2011). Supporting equitable food systems through food assistance at farmers' markets, *American Journal of Public Health*, May, Vol. 101, No. 5, pp.781-783.
- Jones, P., Comfort, D. and Hillier, D. (2018). Common ground: the sustainable development goals and the marketing and advertising industry, *Journal of Public Affairs*, Vol. 18, No. 2, pp.Na-Na, https://doi.org/10.1002/pa.1619 [accessed 11th April 2019].
- Jones, P., Comfort, D., Hillier, D. and Eastwood, I. (2005). Retailers and sustainable development in the UK, *International Journal of Retail & Distribution Management*, Vol. 33, No. 3, pp.207-214, doi: 10.1108/09590550510588370.
- Jones, P., Hillier, D. and Comfort, D. (2014). Assurance of the leading UK food retailers' corporate social responsibility - sustainability reports, *Corporate Governance*, Vol. 14, Iss. 1, pp.130-138, https://doi.org/10.1108/CG-03-2011-0027 [accessed 11th April 2019].
- Jordan, M. (2019). The challenge of making UK ruminant production sustainable, *Food Climate Research Network*, 7th May, https://fcrn.org.uk/fcrn-blogs/challenge-making-uk-ruminant-production-sustainable [accessed 11th April 2019].
- Jørgensen, P.S., Aktipis, A., Brown, Z., Carrière, Y., Downes, S., Dunn, R.R., Epstein, G., Frisvold, G.B., Hawthorne, D., Gröhn, Y.T., Tikaramsa Gujar, G.T., Jasovský, D., Klein, E.Y., Klein, F., Lhermie, G., Mota-Sanchez, D., Omoto, C., Schlüter, M., Scott, H.M., Wernli, D. and Carroll, S.P. (2018). Antibiotic and pesticide susceptibility and the Anthropocene operating space, *Nature Sustainability*, Vol. 1, No. 11, pp.632-641, https://doi.org/10.1038/s41893-018-0164-3 [accessed 11th April 2019].
- Josling, T., Blandford, D. and Hassapoyannes, K. (2019). *Global challenges for future food and agricultural policies*, Volume 1, January, World Scientific Series in Grand Public Policy Challenges of the 21st Century. https://doi.org/10.1142/10860 [accessed 11th April 2019].
- *Journal of Food Science* (2018). The role of food science in the food system, *Journal of Food Science*, Vol 83, No. 11, pp.2691-2691, https://doi-org.ezproxy.mmu.ac.uk/10.1111/1750-3841.13906 [accessed 11th April 2019].

- Joyce, A., Hallett, J., Hannelly, T. and Carey, G. (2014). The impact of nutritional choices on global warming and policy implications: examining the link between dietary choices and greenhouse gas emissions, *Energy and Emission Control Technologies*, Vol. 2, pp.33-43, doi: 10.2147/EECT.S58518.
- JPI (2017). Food and Nutrition Security - a multi-disciplinary integrative food system approach, https://www.jpi-oceans.eu/food-and-nutrition-security [accessed 11th April 2019].
- Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L. and Schösler, H. (2016). Transition towards circular economy in the food system, *Sustainability*, Vol. 8, No. 1, pp.69, https://doi.org/10.3390/su8010069 [accessed 11th April 2019].
- Jurgilevich, A., Räsänen, A., Groundstroem, F. and Juhola, S. (2017). A systematic review of dynamics in climate risk and vulnerability assessments, *Environmental Research Letters*, Vol. 12 No. 1, 013002, doi: 10.1088/1748-9326/aa5508.
- Kadir, M.K.A., Hines, E.L., Qaddoum, K., Collier, R., Dowler, E., Grant, W., Leeson, M., Iliescu, D., Subramanian, A., Richards, K., Merali, Y. and Napier, R. (2013). Food security risk level assessment: a fuzzy logic-based approach, *Applied Artificial Intelligence*, Vol. 27, pp.50-61, doi: 10.1080/08839514.2013.747372.
- Kahil, T., Parkinson, S., Satoh, Y., Greve, P., Burek, P., Veldkamp, T.I.E., Burtscher, R., Byers, E., Djilali, N., Fischer, G., Krey, V., Langan, S., Riahi, K., Tramberend, S. and Wada, Y.A. (2018). Continental-scale hydroeconomic model for integrating water-energy-land nexus solutions, *Water Resources Research*, Vol. 54, pp.7511-7533, doi: 10.1029/2017WR022478.
- Kahn, L.H. (2013). Protecting the environment in the Anthropocene, *Bulletin of the Atomic Scientists*, 22nd December, https://thebulletin.org/2013/12/protecting-the-environment-in-the-anthropocene/# [accessed 11th April 2019].
- Kahn, L.H., Kaplan, B., Monath, T., Woodall, J. and Conti, L. (2014). A manifesto for planetary health, *The Lancet*, 26th April, Vol. 383, No. 9927, pp.1459-1459, doi:https://doi.org/10.1016/S0140-6736(14)60710-8.
- Kaiser, J. (2005). Fish farm hazards, *Science*, Vol. 308, 8 April, p.195.
- Kakraliya, S.K., Jat, H.S., Singh, I., Sapkota, T.B., Singh, L.K., Sutaliya, J.M., Sharma, P.C., Jat, R.D., Choudhary, M., Lopez-Ridaura, S. and Jat, M.L. (2018). Performance of portfolios of climate smart agriculture practices in a rice-wheat system of western Indo-Gangetic plains*, Agricultural Water Management*, Vol. 202, pp.122-133, doi: /10.1016/j.agwat.2018.02.020.
- Kalfagianni, A. and Pattberg, P. (2013). Fishing in muddy waters: exploring the conditions for effective governance of fisheries and aquaculture, *Marine Policy*, Vol. 38, pp.124-132, https://doi.org/10.1016/j.marpol.2012.05.028 [accessed 11th April 2019].
- Kalshoven, K. and Meijboom, F.L.B. (2013). Sustainability at the crossroads of fish consumption and production ethical dilemmas of fish buyers at retail organizations in The Netherlands, *Journal of Agricultural Environmental Ethics*, Vol. 26, pp.101-117, doi: 10.1007/s10806-011-9367-6.

- Kamali, F.P., Borges, J.A.R., Meuwissen, M.P.M., de Boer, I.J.M. and Lansink, A.G.J.M. (2017). Sustainability assessment of agricultural systems: the validity of expert opinion and robustness of a multi-criteria analysis, *Agricultural Systems*, Vol. 157, pp.118-128, https://doi.org/10.1016/j.agsy.2017.07.013 [accessed 11th April 2019].
- Kamm, O. (2020). Food prices are rising and British households will feel the squeeze, *The Times*, 15th May, p.37, https://www.thetimes.co.uk/article/food-prices-are-rising-and-british-households-will-feel-the-squeeze-cklbdxz6n [accessed 15th May 2020].
- Kamp, A. and Østergård, H. (2016). Environmental sustainability assessment of fruit cultivation and processing using fruit and cocoa residues for bioenergy and compost: case study from Ghana, *Journal of Cleaner Production*, Vol. 129, pp.329-340, https://doi.org/10.1016/j.jclepro.2016.04.065 [accessed 11th April 2020].
- Kampers, F. and Fresco, L. (2017). *Food transitions 2030*: *How to achieve the transitions to a sustainable, affordable, trustworthy and high-quality food system in the next decade or two that will fulfil the needs of a diverse and growing world population*, Wageningen, The Netherlands: Wageningen University, https://www.wur.nl/upload_mm/a/6/0/c2f49059-642e-4699-8be5-286ebb776557_FoodTransitions2030-A5-LR.pdf [accessed 11th April 2019].
- Kanemoto, K., Moran, D., Shigetomi, Y., Reynolds, C. and Kondo, Y. (2019). Meat consumption does not explain differences in household food carbon footprints in Japan, *One Earth*, Vol. 1, No. 4, pp.464-471, https://doi.org/10.1016/j.oneear.2019.12.004.
- Kang, J. and Clifton, E.C. (2018). Quantitative analysis of food science trends, *Journal of Food Science*, Vol. 83, Iss. 10, https://doi-org.ezproxy.mmu.ac.uk/10.1111/1750-3841.13902 [accessed 11th April 2019].
- Kang, J., Khan, S. and Ma, X. (2009). Climate change impacts on crop yield, crop water productivity and food security: a review, *Progress in Natural Science*, Vol. 19, No. 12, pp.1665-1674, https://doi.org/10.1016/j.pnsc.2009.08.001 [accessed 11th April 2019].
- Kantor, C., Mclean, E. and Kantor, M. (2017). Climate change influence on agriculture and the water-energy-food nexus in Central and Eastern European Countries, *Notulae Scientia Biologicae*, Vol. 9, No. 4, doi: dx.doi.org/10.15835/nsb9410193.
- Kaput, J., Perozzi, G., Radonjic, M. and Virgili, F. (2017). Propelling the paradigm shift from reductionism to systems nutrition, *Genes & Nutrition*, Vol. 12, No. 3, doi:10.1186/s12263-016-0549-8.
- Karabulut, A.A., Crenna, E., Sala, S. and Udias, A. (2018). A proposal for integration of the ecosystem-water-food-land-energy (EWFLE) nexus concept into life cycle assessment: a synthesis matrix system for food security, *Journal of Cleaner Production*, Vol. 172, pp.3874-3889, https://doi.org/10.1016/j.jclepro.2017.05.092 [accessed 11th April 2019].

- Karimi, V., Karami, E. and Keshavarz, M. (2018). Climate change and agriculture: impacts and adaptive responses in Iran, *Journal of Integrative Agriculture*, Vol. 17, No. 1, pp.1-15, https://doi.org/10.1016/S2095-3119(17)61794-5 [accessed 11th April 2019].
- Karlsen, A. and Engelseth, P. (2008). Corporate merger and developing information connectivity in a pelagic fish network - a case study, *8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, The Netherlands.
- Karlsson, J.O. and Röös, E. (2019). Resource-efficient use of land and animals—environmental impacts of food systems based on organic cropping and avoided food-feed competition, *Land Use Policy*, Vol. 85, pp.63-72, https://doi.org/10.1016/j.landusepol.2019.03.035 [accessed 11th April 2019].
- Kastenhofer, K., Bechtold, U. and Wilfing, H. (2011). Sustaining sustainability science: the role of established inter-disciplines, *Ecological Economics*, Vol. 70, Iss. 4, pp.835-843, https://doi.org/10.1016/j.ecolecon.2010.12.008 [accessed 11th April 2019].
- Kastens, J.H., Brown, J.C., Coutinho, A.C., Bishop, C.R. and Esquerdo, J.C.D.M. (2017). Soy moratorium impacts on soybean and deforestation dynamics in Mato Grosso, Brazil, *PLoS One*, Vol. 12, No. 4, pp.e0176168, https://doi.org/10.1371/journal.pone.0176168 [accessed 11th April 2019].
- Kastner, T., Rivas, M., Koch, W. and Nonhebel, S. (2012). Global changes in diets and the consequences for land requirements for food, *Proceedings of the National Academy of Sciences*, Vol. 109, No. 18, pp.6868-6872, https://doi.org/10.1073/pnas.1117054109 [accessed 11th April 2019].
- Kates, R.W., Clark, W.C., Corell, R., Hall, J.M., Jaeger, C.C., Lowe, I., McCarthy, J.J., Schellnhuber, H.J., Bolin, B., Dickson, N.M., Faucheux, S., Gallopin, G.C., Grübler, A., Huntley, B., Jäger, J., Jodha, N.S., Kasperson, R.E., Mabogunje, A., Matson, P., Mooney, H., Moore, B., O'Riordan, T. and Svedin, U. (2001). Sustainability science, Science, Vol. 292, Iss. 5517, pp. 641-642, doi: 10.1126/science.1059386.
- Katz, D.L. and Meller, S. (2014). Can we say what diet is best, *Annual Review of Public Health*, Vol. 35, pp.83-103, doi: 10.1146/annurev-publhealth-032013-182351.
- Katz, R.L., López, L.M., Annelli, J.F., Arthur, R.R., Carroll, D., Chapman, L.W., Cole, K., Gay, C.G., Lowe, D.L., Resnick, G. and Russell, K.L. (2011). U.S. government efforts to build global defense capacity, *BMC Public Health*, Vol. 10, Suppl. 1, S13, http://www.biomedcentral.com/1471-2458/10/S1/S13 [accessed 11th April 2019].
- Kauffman, C.M. and Martin, P.L. (2017). Can rights of nature make development more sustainable? Why some Ecuadorian lawsuits succeed and others fail, *World Development*, Vol. 92, pp.130-142, https://doi.org/10.1016/j.worlddev.2016.11.017 [accessed 11th April 2019].
- Kaur, A., Lewis, T., Lipkova, V., Fernando, S., Rayner, M., Harrington, R.A., Waterlander, W. and Scarborough, P. (2020). A systematic review, and meta-analysis, examining the prevalence of price promotions on foods and whether they are more likely to be found on less-healthy foods, *Public Health Nutrition*, Vol. 23, Iss. 8, pp.1281-1296, doi: 10.1017/S1368980019004129.

- Kaur, A., Scarborough, P.and Rayner, M. (2017). A systematic review, and meta-analyses, of the impact of health-related claims on dietary choices, *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 14, No. 93, doi: 10.1186/s12966-017-0548-1.
- Kawarazuka, N. and Béné, C. (2011). The potential role of small fish species in improving micronutrient deficiencies in developing countries: building evidence, *Public Health Nutrition*, Vol. 14, pp.1927-1938, doi: 10.1017/S1368980011000814.
- Keane, B. (2018). Meat-free diets could cut our 'water footprint' in half, say scientists, *The Conservation*, 10th September, https://theconversation.com/meat-free-diets-could-cut-our-water-footprint-in-half-say-scientists-102926 [accessed 11th April 2019].
- Kearney, J. (2010). Food consumption trends and drivers, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2793-2807, doi:10.1098/rstb.2010.0149.
- Keating, B.A., Herrero, M., Carberry, P.S., Gardner, J. and Cole, M.B. (2014). Food wedges: framing the global food demand and supply challenge towards 2050, *Global Food Security*, Vol. 3, Iss. 3-4, pp.125-132, https://doi.org/10.1016/j.gfs.2014.08.004 [accessed 11th April 2019].
- Kehoe, L. (2019). Make EU trade with brazil sustainable, *Science*, Vol. 6438, pp.341-341, doi: 10.1126/science.aaw8276.
- Kemper, L. and Partzsch, L. (2018). A water sustainability framework for assessing biofuel certification schemes: does European hybrid governance ensure sustainability of palm oil from Indonesia, *Journal of Cleaner Production*, Vol. 192, pp.835-843, doi: 10.1016/j.jclepro.2018.05.053.
- Kendall, H.W. (1992). *World scientists warning to humanity*, Cambridge, USA: Union of Concerned Scientists, www.ucsusa.org [accessed 11th April 2019].
- Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A. and Legg, T. (2018). State of the UK climate 2017, *International Journal of Climatology*, Vol. 38, No. S2, https://rmets-onlinelibrary-wiley-com.idpproxy.reading.ac.uk/doi/pdfdirect/10.1002/joc.5798 [accessed 11th April 2019].
- Kendrovski, V. and Schmoll, O. (2019). Priorities for protecting health from climate change in the WHO European Region: recent regional activities, *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*, Vol. 62, No. 5, pp.537-545, doi: 10.1007/s00103-019-02943-9.
- Kennedy, G., Stoian, D., Hunter, D., Kikulwe, E. and Termote, C. (2017). *Food biodiversity for healthy, diverse diets*, Rome, Italy: Bioversity International.
- Kent, C. and Lewis, K. (2016). *The impact of weather extremes on agricultural commodity prices*, Avoid2, 9th March, https://www.avoid.uk.net/2016/03/the-impact-of-weather-extremes-on-agricultural-commodity-prices-f3/ [accessed 11th April 2019].
- Kent, C., Pope, E., Thompson, V., Lewis, K., Scaife, A.A. and Dunston, N. (2017). Using climate model simulations to assess the current climate risk to maize production, *Environmental Research Letters*, Vol. 12, 054012, https://doi.org/10.1088/1748-9326/aa6cb9 [accessed 11th April 2019].

- Kerins, C., McSharry, J., Hayes, C., Perry, I.J., Geaney, F. and Kelly, C. (2018). Barriers and facilitators to implementation of menu labelling interventions to support healthy food choices: a mixed methods systematic review protocol, *Systematic Reviews*, Vol. 7, No. 88, https://doi.org/10.1186/s13643-018-0752-3.
- Kestin, S. (2017). Issues in fisheries and aquaculture: sustainability and fish welfare. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.186-213, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Keulemans, W., Bylemans, D. and De Coninck, B. (2019). *Farming without plant protection products*, Brussels: European Parliament Research Service, https://www.europarl.europa.eu/cmsdata/185760/EPRS_IDA(2019)634416_EN.pdf [accessed 11th April 2019].
- Kevan, P.G., Kapongo, J-P., Al-mazra'awi, M. and Shipp, L. (2008). Honey bees, bumble bees and biocontrol: new alliances between old friends. In: Rosalind, R., James, R.R. and Pitts-Singer, T.L. (eds) *Bee pollination in agricultural ecosystems*, Oxford, UK: Oxford University Press, doi:10.1093/acprof:oso/9780195316957.001.0001.
- Key, T., Appleby, P. and Rosell, M. (2006). Health effects of vegetarian and vegan diets, *Proceedings of the Nutrition Society*, Vol. 65, No. 1, pp.35-41, doi:10.1079/PNS2005481.
- Khalilian, S., Froese, R., Proelss, A. and Requate, T. (2010). Designed for failure - a critique of the Common Fisheries Policy of the European Union, *Marine Policy*, Vol. 34, Iss. 6, pp.1178-1182, doi:10.1016/j.marpol.2010.04.001.
- Khan S.S., Timotijevic, L., Newton, R., Coutinho, D., Llerena, J.L., Ortega, S., Benighaus, L., Hofmaier, C., Xhaferri, Z., Boer, A., Urban, C., Strähle, M., Da Pos, L., Neresini, F., Raats, M.M. and Hadwiger, K. (2016). The framing of innovation among European research funding actors - assessing the potential for 'responsible research and innovation' in the food, *Food Policy*, Vol. 62, pp.78-87, https://doi.org/10.1016/j.foodpol.2016.04.004 [accessed 11th April 2019].
- Khan, I.A. (2008). How to achieve food security, *Economic Review*, Vol. 11, pp.13-15.
- Khan, J. and Powell, T. (2012). *Land use in the UK*, file:///C:/Users/User/Downloads/landuseintheuk_tcm77-316028.pdf [accessed 11th April 2019].
- Khanal, A.R. and Mishra, A.K. (2017). Enhancing food security: food crop portfolio choice in response to climatic risk in India, *Global Food Security*, Vol. 12, pp.22-30, https://doi.org/10.1016/j.gfs.2016.12.003 [accessed 11th April 2019].
- Khangura, S., Konnyu, K., Cushman, R., Grimshaw, J. and Moher, M. (2012). Evidence summaries: the evolution of a rapid review approach, *Systematic Reviews*, Vol. 1, pp.10-18, doi: https://doi.org/10.1186/2046-4053-1-10 [accessed 15th April 2020].

- Khanna, S.K. (2016). Understanding the impact of globalization on food preferences, dietary patterns, and health, *Ecology of Food and Nutrition*, Vol. 55, No. 4, pp.339-340, doi: 10.1080/03670244.2016.1213557.
- Khanna, S.K. (2019). Dietary transition, food security, and health promotion, *Ecology of Food and Nutrition*, Vol. 58, No. 3, pp.187-188, doi: 10.1080/03670244.2019.1619245.
- Kharas, H. (2011). The challenge of high and rising food prices, *Brown Journal of World Affairs*, Fall/Winter, Vol. xviii, Iss. I, pp.97-106.
- Khatun, R., Reza, M.I.H., Moniruzzaman, M. and Yaakob, Z. (2017). Sustainable oil palm industry - the possibilities, *Renewable and Sustainable Energy Reviews*, Vol. 76, pp.608-619, http://dx.doi.org/10.1016/j.rser.2017.03.077 [accessed 11th April 2019].
- Khoury, C.K., Bjorkman, A.D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., Rieseberg, L.H. and Struik, P.C. (2014). Increasing homogeneity in global food supplies and the implications for food security, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 111, No. 11, pp.4001-4006, https://doi.org/10.1073/pnas.1313490111 [accessed 11th April 2019].
- Kickbusch, I. (2010). *The food system: a prism of present and future challenges for health promotion and sustainable development - triggering the debate*, White Paper, Bern, Switzerland: Promotion Santé Suisse.
- Kidd, C.V. (1992). The evolution of sustainability, *Journal of Agricultural and Environmental Ethics*, Vol. 5, pp.1-26, https://doi.org/10.1007/BF01965413 [accessed 11th April 2019].
- Kiff, L., Wilkes, A. and Tennigkeit, T. (2016). *The technical mitigation potential of demand-side measures in the agri-food sector: a preliminary assessment of available measures*, CCAFS Report No. 15. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), www.ccafs.cgiar.org [accessed 11th April 2019].
- Kijne, J.W. (2013). Hugh Turral, Jacob Burke and Jean-Marc Faurès: climate change, water and food security, *Irrigation Science*, Vol. 31, No. 3, pp. 179-182, doi: 10.1007/s00271-011-0305-1.
- Kim, B.F., Santo, R.E., Scatterday, A.P., Fry, J.P., Synk, C.M., Cebron, S.R., Mekonnen, M.M., Hoekstra, A.Y., de Pee, S., Bloem, M.W., Neff, R.A. and Nachman, K.E. (2019). Country-specific dietary shifts to mitigate climate and water crises, *Global Environmental Change*, 7th August 2019, 101926, https://doi.org/10.1016/j.gloenvcha.2019.05.010 [accessed 11th April 2019].
- King, A.D. and Harrington, L.J. (2018). The inequality of climate change from 1.5 to 2°C of global warming, *Geophysical Research Letters*, Vol. 45, No. 10, pp.5030-5033, doi: 10.1029/2018GL078430.
- King, D., Schrag, D., Dadi, Z., Ye, Q. and Ghosh, A. (2015). *Climate change: a risk assessment*, Cambridge, UK: University of Cambridge Centre for Science and Policy.
- King, J.C. (2007). An evidence-based approach for establishing dietary guidelines, *Journal of Nutrition*, Vol. 137, pp.480-483, doi: 10.1093/jn/137.2.480.

- King, L.C. and van den Bergh, J.C.J.M. (2019). Normalisation of Paris agreement NDCs to enhance transparency and ambition, *Environmental Research Letters*, Vol. 14, 084008, https://doi.org/10.1088/1748-9326/ab1146 [accessed 11th April 2019].
- King, M. (2019). Climate Action, food and farming - a seismic shift for the NFU, *A New Nature Blog*, https://anewnatureblog.com/2019/09/23/climate-action-food-and-farming-a-seismic-shift-for-the-nfu/ [accessed 11th April 2019].
- Kirezieva, K., Jacxsens, L., Van Boekel, M. and Luning, P. (2015). Towards strategies to adapt to pressures on safety of fresh produce due to climate change, *Food Research International*, Vol. 68, pp.94-107, https://doi.org/10.1016/j.foodres.2014.05.077 [accessed 11th April 2019].
- Kirkaldy, L. (2019). Climate change putting Scotland's most iconic species at risk, report warns, *Hollyrood*, 3rd January, https://www.holyrood.com/news/view,climate-change-putting-scotlands-most-iconic-species-at-risk-report-warns_9701.htm [accessed 11th April 2019].
- Kirkhorn, S. and Schenker, M.B. (2001). Human health effects of agriculture: physical diseases and illnesses, N.A.S. Database, AHS-NET, http://nasdonline.org/1827/d001772/human-health-effects-of-agriculture-physical-diseases-and.html [accessed 11th April 2019].
- Kirkpatrick, S.I., Reedy, J., Butler, E.N., Dodd, K.W., Subar, A.F., Thompson, F.E. and McKinnon, R.A. (2014). Dietary assessment in food environment research: a systematic review, *American Journal of Preventive Medicine*, Vol. 46, Iss. 1, pp.94-102, doi: 10.1016/j.amepre.2013.08.015.
- Kirwan, J. and Maye, D. (2013). Food security framings within the UK and the integration of local food systems, *Journal of Rural Studies*, Vol. 29, pp.91-100, https://doi.org/10.1016/j.jrurstud.2012.03.002 [accessed 11th April 2019].
- Kirwan, J., Slee, B. and Vorley, B. (2006). *Marketing sustainable agriculture - an analysis of the potential role of new food supply chains in sustainable rural development*, Macro-level analysis of food supply chain dynamics and diversity - National report – UK, SUS-CHAIN report no. 8.2, https://cordis.europa.eu/project/id/QLK5-CT-2002-01349 [accessed 11th April 2019].
- Kitzes, J., Galli, A., Bagliani, M., Barrett, J., Dige, G., Ede, S., Erb, K., Giljum, S., Haberl, H., Hails, C., Jolia-Ferrier, L., Jungwirth, S., Lenzen, M., Lewis, K., Loh, J., Marchettini, N., Messinger, H., Milne, K., Moles, R., Monfreda, C., Moran, D., Nakano, K., Pyhälä, A., Rees, W., Simmons, C., Wackernagel, M., Wada, Y., Walsh, C. and Wiedmann, T. (2009). A research agenda for improving national Ecological Footprint accounts, *Ecological Economics*, Vol. 68, No. 7, pp.1991-2007.
- Kjellstrom, T., Briggs, D., Freyberg, C., Lemke, B., Otto, M. and Hyatt, O. (2016). Heat, human performance, and occupational health: a key issue for the assessment of global climate change impacts, *Annual Review of Public Health*, Vol. 37, pp.97-112, https://doi.org/10.1146/annurev-publhealth-032315-021740 [accessed 11th April 2019].

- Klauer, B., Manstetten, R., Petersen, T. and Schiller, J. (2013). The art of long-term thinking - a bridge between sustainability science and politics, *Ecological Economics*, Vol. 93, pp.79-84, http://dx.doi.org/10.1016/j.ecolecon.2013.04.018 [accessed 11th April 2019].
- Klein, A-M., Vaissière, B.S., Cane, J.H., Steffan-Dewenter, I., Cunningham, S.A., Kremen, C. and Tscharntke, T. (2007). Importance of pollinators in changing landscapes for world crops, *Proceedings of the Royal Society B*, Vol. 274, pp.303-313, doi:10.1098/rspb.2006.3721.
- Klein, H.S. and Luna, F.V. (2018). *Feeding the world: Brazil's transformation into a modern agricultural economy*, Cambridge, UK: Cambridge University Press, ISBN: 978-1-108-46097-2.
- Kliem, K.E. and Givens, D.I. (2011). Dairy products in the food chain - their impact on health, *Annual Review of Food Science and Technology*, Vol. 2, pp.21-36, doi: 10.1146/annurev-food-022510-133734.
- Kline, S. (2011). *Globesity, food marketing, and family life styles*, Palgrave Macmillan, ISBN 978-0-230-53740-8.
- Klümper, W. and Qaim, M. (2014). A meta-analysis of the impacts of genetically modified crops, *PLoS One*, Vol. 9, No. 11, e111629, http://dx.doi.org/10.1371/journal.pone.0111629 [accessed 11th April 2020].
- Knapp, S. and van der Heijden, M.G.A. (2018). A global meta-analysis of yield stability in organic and conservation agriculture, *Nature Communications*, Vol. 9, No. 3632, doi: 10.1038/s41467-018-05956-1.
- Kneafsey, M., Dowler, E., Lambie, H., Inman, A. and Collier, R. (2012). Consumers and food security: uncertain or empowered? *Journal of Rural Studies*, Vol. 28, pp.1-12, https://doi.org/10.1016/j.jrurstud.2012.05.005 [accessed 11th April 2019].
- Kneafsey, M., Lambie, H., Dowler, E. and Inman, A. (2008). *Mapping local food webs*, Coventry, UK: Sustainable Regeneration Futures Institute, https://www.cpre.org.uk/wp-content/uploads/2019/11/mapping_local_food_webs_toolkit_1.pdf [accessed 11th April 2019].
- Knickel, K., Ashkenazy, A., Chebach, T. and Parrot, N. (2017). Agricultural modernization and sustainable agriculture: contradictions and complementarities, *International Journal of Agricultural Sustainability*, Vol. 15, No. 5, pp.575-592, https://doi.org/10.1080/14735903.2017.1373464 [accessed 11th April 2019].
- Knight, D.M. (2017). The green economy as a sustainable alternative? *Anthropology Today*, Vol. 33, No. 5, pp.28-31, https://doi.org/10.1111/1467-8322.12382 [accessed 11th April 2019].
- Knight, J. (2015). Anthropocene futures - resources and sustainability, *The Anthropocene Review*, pp.1-7, doi:10.1177/2053019615569318.
- Knight, S., Whitmore, A., Tiffin, R., Ang, F., Areal, F., Ramsden, S., Firbank, L., Lee, M., Sutherland, B., Dicks, L., Moorby, J., Drummond, C., Midmer, A., Parker, C. and Preston, J. (2014). *Integrated farm management for improved economic, environmental and social performance* (LM0201), Sustainable Intensification Research Platform, London, UK: Department for Environment, Food and Rural Affairs.

- Knoope, M.M.J., Balzer, C.H. and Worrell, E. (2019). Analysing the water and greenhouse gas effects of soya bean-based biodiesel in five different regions, *GCB Bioenergy*, Vol. 11, No. 2, pp.381-399, https://doi.org/10.1111/gcbb.12558 [accessed 11th April 2020].
- Knorr (2019). *50 foods for healthier people and a healthier planet*, WWF and Knorr, https://www.wwf.org.uk/sites/default/files/2019-02/Knorr_Future_50_Report_FINAL_Online.pdf [accessed 11th April 2019].
- Knox, J., Daccache, A., Hess, T. and Haro, D. (2016). Meta-analysis of climate impacts and uncertainty on crop yields in Europe, *Environmental Research Letters*, Vol. 11, No. 11, 113004, doi: 10.1088/1748-9326/11/11/113004.
- Knox, J., Hess, T., Daccache, A. and Wheeler, T. (2012). Climate change impacts on crop productivity in Africa and South Asia, *Environmental Research Letters*, Vol. 7, pp.034032, doi:10.1088/1748-9326/7/3/034032.
- Knox, J., Morris, J. and Hess, T. (2010). Identifying future risks to UK agricultural crop production: putting climate change in context, *Outlook on Agriculture*, Vol. 39, No. 4, pp.249-256, doi: 10.5367/oa.2010.0015249.
- Knox, J.W., Daccache, A., Weatherhead, E.K. and Stalham, M. (2011). *Climate change impacts on the UK potato industry*, Ref: R404, Report No. 2011/3, The Potato Council, Kenilworth, UK: Agriculture and Horticulture Development Board.
- Knuppel, A., Papier, K., Key, T.J. and Travis, R.C. (2019). EAT-Lancet score and major health outcomes: the EPIC-Oxford study, *The Lancet*, 20–26th July, Vol. 394, Iss. 10194, pp.213-214, https://doi.org/10.1016/S0140-6736(19)31236-X [accessed 11th April 2019].
- Köble, R. (2014). The Global Nitrous Oxide Calculator (GNOC) Online Tool Manual v. 1.2., Ispra, Italy, http://gnoc.jrc.ec.europa.eu/ [accessed 11th April 2019].
- Koehring, M. (2018). The emergence of "ocean risk" and how to tackle it, *The Economist Intelligence Unit*, 23rd May, https://eiuperspectives.com/sustainability/emergence-ocean-risk-and-how-tackle-it.
- Kolbert, E. (2014). *The sixth extinction: an unnatural history*, London, UK: Bloomsbury, ISBN-10: 1408851210.
- Kolding, J., Bundy, A., van Zwieten, P.A.M. and Plank, M.J. (2016). Fisheries, the inverted food pyramid, *Ices Journal of Marine Science*, Vol. 73, No. 6, pp.1697-1713, doi:10.1093/icesjms/fsv225.
- Komiyama, H. and Takeuchi, K. (2006). Sustainability science: building a new discipline, *Sustainable Science*, Vol. 1, No. 1, https://doi.org/10.1007/s11625-006-0007-4 [accessed 11th April 2019].
- Koneswaran, G. and Nierenberg, D. (2008). Global farm animal production and global warming: impacting and mitigating climate change, *Environmental Health Perspectives*, Vol. 116, No. 5, pp.578-582, doi: 10.1289/ehp.11034.

- Kopnina, H. (2017). Sustainability: new strategic thinking for business, *Environment Development and Sustainability*, Vol. 19, No. 1, pp.27-43, https://doi.org/10.1007/s10668-015-9723-1 [accessed 11th April 2019].
- Kopp, R.E., DeConto, R.M., Bader, D.A., Hay, C.C., Horton, R.M., Kulp, S., Oppenheimer, M., Pollard, D. and Strauss, B.H. (2017). Evolving understanding of antarctic ice-sheet physics and ambiguity in probabilistic sea-level projections, *Earth's Future*, Vol. 5, https://doi.org/10.1002/2017EF000663 [accessed 11th April 2019].
- Kopp, R.E., Horton, R.M., Little, C.M., Mitrovica, J.X., Oppenheimer, M., Rasmussen, D.J., Strauss, B.H. and Tebaldi, C. (2014). Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites, *Earth's Future*, Vol. 2, pp.383-406, doi:10.1002/2014EF000239.
- Korale-Gedara, P.M., Ratnasiri, S. and Bandara, J. (2012). Soaring food prices and food security - does the income effect matter, *Applied Economics Letters*, Vol. 19, pp.1807-1811, http://dx.doi.org/10.1080/13504851.2012.667538 [accessed 11th April 2019].
- Koricheva, J. (2018). Neonicotinoid ban - how meta-analysis helped show pesticides do harm bees, *The Conversation*, 30th April, https://theconversation.com/neonicotinoid-ban-how-meta-analysis-helped-show-pesticides-do-harm-bees-94180 [accessed 11th April 2019].
- Kosoy, N., Brown, P.G., Bosselmann, K., Duraiappah, A., Mackey, B., Martinez-Alier, J., Rogers, D. and Thomson, R. (2012). Pillars for a flourishing Earth: planetary boundaries, economic growth delusion and green economy, *Current Opinion in Environmental Sustainability*, Vol. 4, Iss. 1, pp.74-79, https://doi.org/10.1016/j.cosust.2012.02.002 [accessed 11th April 2019].
- Kotch, A. (2018). Corn syrup lobbyist is helping set USDA dietary guidelines, *International Business Times,* 2nd February, http://www.ibtimes.com/political-capital/corn-syrup-lobbyist-helping-set-usda-dietary-guidelines-2649307 [accessed 11th April 2019].
- Kotir, J.H. (2011). Climate change and variability in Sub-Saharan Africa: a review of current and future trends and impacts on agriculture and food security, *Environment, Development and Sustainability*, Vol. 13, No. 3, pp. 587-605, doi: 10.1007/s10668-010-9278-0.
- Koufteros, X. and Lu, G. (2017). Food supply chain safety and security: a concern of global importance, *Journal of Marketing Channels*, Vol. 24, No. 3-4, pp.111-114, doi:10.1080/1046669X.2017.1393227.
- Kougioumoutzi, E. (2016). *UN Sustainable Development Goals and the UK food retail and manufacturing business*, Global Food Security Workshop on 22nd April 2016, London, Global Food Security programme, Swindon, UK: Biotechnology and Biological Sciences Research Council (BBSRC), www.foodsecurity.ac.uk [accessed 11th April 2019].
- Kovach, J., Petzoldt, R. and Harman, G.E. (2000). Use of honey bees and bumble bees to disseminate trichoderma harzianum 1295-22 to strawberries for botrytis control, *Biological Control*, Vol. 18, pp.235-242, doi:10.1006/bcon.2000.0839.

- Kovats, S. (eds.)(2015). *Health: climate change impacts report card*, London School of Hygiene and Tropical Medicine: Living With Environmental Change (LWEC) Partnership, ISBN 978-0-9928679-8-0.
- Kovazhenkov, M.A., Fedotova, G.V., Kulikova, N.N., Sultanova, M.K., Mandrik, (2019). Search for new economic solutions of the problem of food security, *Studies in Computational Intelligence*, Vol. 826, No. 1, pp.1011-1022, doi: 10.1007/978-3-030-13397-9_105.
- Kraak, V.I., Swinburn, B., Lawrence, M. and Harrison, P. (2011). The accountability of public private partnerships with food, beverage and quick-serve restaurant companies to address global hunger and the double burden of malnutrition, *United Nations System Standing Committee on Nutrition: News*, Vol. 3, pp.11-24, doi:10.1017/S1368980014000093.
- Kramer, G.F.H., Tyszler, M., van't Veer, P. and Blonk, H. (2017). Decreasing the overall environmental impact of the Dutch diet - how to find healthy and sustainable diets with limited changes, *Public Health Nutrition*, pp.1-11, doi:10.1017/S1368980017000349
- Krapivin, V.F., Varotsos, C.A. and Soldato, V.Y. (2017). The earth's population can reach 14 billion in the 23rd century without significant adverse effects on survivability, *International Journal of Environmental Research and Public Health*, Vol. 14, p.885, doi:10.3390/ijerph14080885.
- Krayenhoff, E.S., Moustaoui, M., Broadbent, A.M., Gupta, V. and Georgescu, M. (2018). Diurnal interaction between urban expansion, climate change and adaptation in US cities, *Nature Climate Change*, Vol. 8, pp.1097-1103, https://doi.org/10.1038/s41558-018-0320-9 [accessed 11th April 2019].
- Krebs, J. (2013) *Managing the land in a changing climate*, Adaptation Sub-Committee Progress Report, London, UK: Committee opn Climate Change.
- Krebs, J. and Haigh, J. (2018). Further, faster, deeper: the UK needs a more ambitious Climate Change Act, *The Conversation*, 29th March, https://theconversation.com/further-faster-deeper-the-uk-needs-a-more-ambitious-climate-change-act-93218 [accessed 11th April 2019].
- Kreit, B., Avery, M. and Falcon, R. (2011). *Four futures of food: global food outlook alternative scenarios briefing*, Institute for the Future (IFIF), http://www.iftf.org/our-work/global-landscape/global-food-outlook/four-futures-of-food/ [accessed 11th April 2019].
- Kremen, C. and Merenlender, A.M. (2018). Landscapes that work for biodiversity and people, *Science*, Vol. 362, Iss. 6412, pp.eaau6020, doi: 10.1126/science.aau6020.
- Kretschmer, B., Allen, B., Kieve, D. and Smith, C. (2013). The sustainability of advanced biofuels in the EU: assessing the sustainability of wastes, residues and other feedstocks set out in the European Commission's proposal on Indirect Land-use change (ILUC). Biofuel ExChange briefing No 3., London, UK: Institute for European Environmental Policy (IEEP).
- Kriflik, L.S. and Yeatman, H. (2005). Food scares and sustainability: a consumer perspective, *Health, Risk & Society*, Vol. 7, No. 1, pp.11-24, doi: 10.1080/13698570500042439.
- Kripke, G. (2015). Food fight: what the debate about food security means at the WTO, *Canadian Food Studies,* Vol. 2, No. 2, pp.77-87, doi: 10.15353/cfs-rcea.v2i2.118.

- Krishna Bahadur, K.C., Dias, G.M., Veeramani, A., Swanton, C.J., Fraser, D., Steinke, D., Lee, E., Wittman, H., Dunfield, K., McCann, K., Anand, M., Campbell, M., Rooney, N., Raine, N.E., Van Acker, R., Hanner, R., Pascoal, S., Sharif, S., Benton, T.G. and Fraser, E.D.G. (2018). When too much isn't enough: does current food production meet global nutritional needs? *PLoS One*, Vol. 13, No. 10, pp.e0205683, https://doi.org/10.1371/journal.pone.0205683 [accessed 11th April 2019].
- Krishna, P. (2017). Climate smart agriculture holds key to food security: World Bank, *Business World*, 29th August, http://www.businessworld.in/article/Climate-Smart-Agriculture-Holds-Key-To-Food-Security-World-Bank/29-08-2017-124985/ [accessed 11th April 2019].
- Kritee, K., Nair, D., Zavala-Araiza, D., Proville, J., Rudek, J., Adhya, T.K., Loecke, T., Esteves, T., Balireddygari, S., Dava, O. and Ram, K. (2018). High nitrous oxide fluxes from rice indicate the need to manage water for both long-and short-term climate impacts, *Proceedings of the National Academy of Sciences*, Vo. 115, No. 39, pp.9720-9725, www.pnas.org/cgi/doi/10.1073/pnas.1809276115 [accessed 11th April 2019].
- Krkošek, M., Lewis, M.A. and Volpe, J.P. (2005). Transmission dynamics of parasitic sea lice from farm to wild salmon, *Proceedings. Biological sciences*, Vol. 272, No. 1564, pp.689-696, https://doi.org/10.1098/rspb.2004.3027 [accessed 15th June 2020].
- Król, A., Księżak, J., Kubińska, E. and Rozakis, S. (2018). Evaluation of sustainability of maize cultivation in Poland: a prospect theory—PROMETHEE approach, *Sustainability*, Vol. 10, No. 11, pp.4263, https://doi.org/10.3390/su10114263 [accessed 11th April 2020].
- Kromdijk, J., Głowacka, K., Leonelli, L., Gabilly, S.T., Iwai, M., Niyogi, K.K. and Long, S.P. (2016). Improving photosynthesis and crop productivity by accelerating recovery from photoprotection, *Science*, Vol. 354, pp.857-861, doi: 10.1126/science.aai8878.
- Kromhout, D., Spaaij, C., de Goede, J. and Weggemans, R.M. (2016). The 2015 Dutch food-based dietary guidelines, *European Journal of Clinical Nutrition*, Vol. 70, pp.869-878, doi: 10.1038/ejcn.2016.52.
- Kroodsma, D.A., Mayorga, J., Hochberg, T., Miller, N.A., Boerder, K., Ferretti, F., Wilson, A., Bergman, B., White, T.D., Block, B.A., Woods, P., Sullivan, B., Costello, C. and Worm, B. (2018). Tracking the global footprint of fisheries, *Science*, Vol. 359, Iss. 6378, pp.904-908, doi: 10.1126/science.aao5646.
- Kruk, M.E., Gage, A.D., Arsenault, C., Jordan, K., Leslie, H.H. and Roder-DeWan, S., Adeyi, O., Barker, P., Daelmans, B., Doubova, S.V., English, M., Elorrio, E.G., Guanais, F., Gureje, O., Hirschhorn, L.R., Jiang, L., Kelley, E., Lemango, E.T., Liljestrand, J., Malata, A., Marchant, T., Matsoso, M.P., Meara, J.G., Mohanan, M., Ndiaye, Y., Norheim, O.F., Reddy, K.S., Rowe, A.K., Salomon, J.A., Thapa, G., Twum-Danso, N.A.Y. and Pate, M. (2018). High-quality health systems in the Sustainable Development Goals era: time for a revolution, *Lancet: Global Health*, Vol. 6, No. 11, pp.e1196-e1252, doi:https://doi.org/10.1016/S2214-109X(18)30386-3.

- Krystallis, A., Grunert, K.G., de Barcellos, M.D., Perrea, T. and Verbeke, W. (2012). Consumer attitudes towards sustainability aspects of food production - insights from three continents, *Journal of Marketing Management*, Vol. 28, Iss. 3-4, pp.334-372, doi: 10.1080/0267257X.2012.658836.
- Krznaric, R. (2019). Why we need to reinvent democracy for the long-term, *BBC Future*, 19th March, http://www.bbc.com/future/story/20190318-can-we-reinvent-democracy-for-the-long-term [accessed 11th April 2019].
- Krzywoszynska, A. (2019). IPCC's land report shows the problem with farming based around oil, not soil, *The Conversation*, 8th August, https://theconversation.com/ipccs-land-report-shows-the-problem-with-farming-based-around-oil-not-soil-121643 [accessed 11th April 2019].
- Kucukvar, M., Onat, N.C., Abdella, G.M. and Tatari, O. (2019). Assessing regional and global environmental footprints and value added of the largest food producers in the world, *Resources, Conservation, and Recycling*, Vol. 144, pp.187-197, https://doi.org/10.1016/j.resconrec.2019.01.048 [accessed 11th April 2019].
- Kuehn, K. and Mclntire, L. (2014). Sustainability a CFO can love, *Harvard Business Review*, April, pp.66-74, https://hbr.org/2014/04/sustainability-a-cfo-can-love [accessed 11th April 2019].
- Kugelman, M. and Levenstein, S.L. (2014). *The global farms race, land grabs, agricultural investments, and the scramble for food security*, Washington, USA: Island Press.
- Kulak, M., Nemecek, T., Frossard, E., Chable, V. and Gaillard, G. (2015). Life cycle assessment of bread from several alternative food networks in Europe, *Journal of Cleaner Production*, Vol. 90, pp.104-113, https://doi.org/10.1016/j.jclepro.2014.10.060 [accessed 11th April 2019].
- Kulp, S.A. and Strauss, B.H. (2019). New elevation data triple estimates of global vulnerability to sea-level rise and coastal flooding, *Nature Communications*, Vol. 10, 4844, https://doi.org/10.1038/s41467-019-12808-z [accessed 11th April 2019].
- Kuma, T., Dereje, M., Hirvonen, K., Hirvonen, K. and Minten, B. (2019). Cash crops and food security: evidence from Ethiopian smallholder coffee producers, *The Journal of Development Studies*, Vol. 55, No. 6, pp.1267-1284, https://doi.org/10.1080/00220388.2018.1425396 [accessed 11th April 2020].
- Kumar, M.S. (2014). Sustainable management of fisheries and aquaculture for food security and nutrition - policies requirements and actions, *Agricultural Research*, Vol. 3, No. 2, pp.97-103, doi: 10.1007/s40003-014-0111-0.
- Kumar, P. (ed)(2010). *The economics of ecosystems and biodiversity*, London, UK: Earthscan, doi: https://doi.org/10.4324/9781849775489 [accessed 11th April 2019].
- Kumar, R.P., Singh, M., Kalra, N., Chopra, U.K., Narang, M.S., Sharma, A., Rai, H.K., Chakraborty, D., Sahoo, R.N., Tomar, R.K., Sehgal, V.K. and Garg, R.N. (2005). Simulating the effect of climate change on yield of crops, *Journal of Agricultural Physics*, Vol. 5, No. I, pp.46-56.

- Kumar, S., Chen, W., and Novak S. (2017). Trait stacking in modern agriculture: application of genome editing tools, *Emerging Topics in Life Sciences*, Vol. 1, No. 2, pp.151-160, https://doi.org/10.1042/ETLS20170012 [accessed 11th April 2019].
- Kumar, V., Jat, H.S., Sharma, P.C., Gathala, M.K., Malik, R.K. and Kamboj, B. (2018). Can productivity and profitability be enhanced in intensively managed cereal systems while reducing the environmental footprint of production? Assessing sustainable intensification options in the breadbasket of India, *Agriculture Ecosystems and Environment*, Vol. 252, pp.132-147, https://doi.org/10.1016/j.agee.2017.10.006 [accessed 11th April 2019].
- Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O. and Ward, P.J. (2012). Lost food, wasted resources: global food supply chain losses and their impacts on freshwater, cropland, and fertiliser use, *Science of the Total Environment*, Vol. 438, pp.477-489, doi: 10.1016/j.scitotenv.2012.08.092.
- Kummu, M., Fader, M., Gerten, D., Guillaume, J.H.A., Jalava, M., Jägermeyr, J., Pfister, S., Porkka, M., Siebert, S. and Varis, O. (2017). Bringing it all together: linking measures to secure nations' food supply, *Current Opinion in Environmental Sustainability*, Vol. 29, pp.98-117, https://doi.org/10.1016/j.cosust.2018.01.006 [accessed 11th April 2019].
- Kundu, K.K., Siwach, M., Singh, B. and Archana, K. (2017). Impact of climate change on Indian agriculture: challenges and opportunities, *Annals of Biology*, Vol. 33, No. 2, pp.287-294.
- Kunin, W.E. (2019). Robust evidence of declines in insect abundance and biodiversity, *Nature*, Vol. 574, pp.641-642, doi: 10.1038/d41586-019-03241-9.
- Kuruppu, N. and Capon, A. (2016). Climate change and health, *The Lancet*, Vol. 387, Iss. 10017, p.430, doi: https://doi.org/10.1016/S0140-6736(16)00170-7 [accessed 11th April 2019].
- Kuyper, E.M., Engle-Stone, R., Arsenault, J.E., Arimond, M., Adams, K.P. and Dewey, K.G. (2017). Dietary gap assessment: an approach for evaluating whether a country's food supply can support healthy diets at the population level, *Public Health Nutrition*, Vol. 20, No. 13, pp.2277–2288, doi: 10.1017/S1368980017001173.
- Kvalvik, I., Noestvold, B.H. and Young, J.A. (2014). National or supranational fisheries sustainability certification schemes, *Marine Policy*, Vol. 46, pp.137-142, http://dx.doi.org/10.1016/j.marpol.2014.01.015 [accessed 11th April 2019].
- Kwon, J., Cameron, A.J., Hammond, D., White, C.M., Vanderlee, L., Bhawra, J. and Sacks, G. (2019). A multi-country survey of public support for food policies to promote healthy diets: findings from the International Food Policy Study, *BMC Public Health*, Vol. 19, No. 1, pp.1205-1210, doi: http://dx.doi.org/10.1186/s12889-019-7483-9 [accessed 11th April 2020].
- Kwon, O. (2019). A big picture view of precision nutrition: from reductionism to holism, *Journal of Nutrition and Health*, Vol. 52, No. 1, pp.1-5, https://doi.org/10.4163/jnh.2019.52.1.1 [accessed 11th April 2019].

- Kyle, B. (1958). Towards a classification for social science literature, *American Documentation*, Vol. 9, Iss. 3, pp.168-183, doi:10.1002/asi.5090090303.
- Kyutoku, Y., Minami, Y., Koizumi, T., Okamoto, M., Kusakabe, Y. and Dan, I. (2012). Conceptualization of food choice motives and consumption among Japanese in light of meal, gender, and age effects, *Food Quality and Preference*, Vol. 24, pp.213-217, doi:10.1016/j.foodqual.2011.10.002.
- Labonté, M.-E., Poon, T., Gladanac, B., Ahmed, M., Franco-Arellano, B., Rayner, M. and L'Abbé, M.R. (2018). Nutrient profile models with applications in government-led nutrition policies aimed at health promotion and non-communicable disease prevention: a systematic review, *Advances in Nutrition*, Vol. 9, No. 6, pp.741-788, doi: 10.1093/ADVANCES/NMY045.
- Laborde, D., Martin, W. and Vos, R. (2020). *Poverty and food insecurity could grow dramatically as COVID-19 spreads*, International Food Policy Research Institute, Washington, USA: International Food Policy Research Institute.
- Lacour, C., Seconda, L., Allès, B., Hercberg, S., Langevin, B., Pointereau, P., Lairon, D., Baudry, J. and Kesse-Guyot, E. (2018). Environmental impacts of plant-based diets: how does organic food consumption contribute to environmental sustainability? *Frontiers in Nutrition*, Vol. 5, No. 8, doi: 10.3389/fnut.2018.00008.
- Lacquet, J.L. and Pauly, D. (2007). The rise of seafood awareness campaigns in an era of collapsing fisheries, *Marine Policy*, Vol. 31, pp.308-313, doi:10.1016/j.marpol.2006.09.003.
- Lade, S.J., Steffen, W., de Vries, W., Carpenter, S.R., Donges, J.F., Gerten, D., Hoff, H., Newbold, T., Richardson, K. and Rockström, J. (2019). Human impacts on planetary boundaries amplified by Earth system interactions, *Nature Sustainability*, doi: 10.1038/s41893-019-0454-4.
- Läderach, P., Martinez-Valle, A., Schroth, G. and Castro, N. (2013). Predicting the future climatic suitability for cocoa farming of the world's leading producer countries, Ghana and Côte d'Ivoire, *Climatic Change*, Vol. 119, pp.841-854, doi: 10.1007/s10584-013-0774-8.
- Ladha, J.K., Dawe, D., Pathak, H., Padre, A.T., Yadav, R.L., Singh, B., Singh, Y., Singh, Y., Singh, P., Kundu, A.L., Sakal, R., Ram, N., Regmi, A.P., Gami, S.K., Bhandari, A.L., Amin, R., Yadav, C.R., Bhattarai, E.M., Das, S., Aggarwal, H.P., Gupta, R.K. and Hobbs, P.R. (2003). How extensive are yield declines in long-term rice-wheat experiments in Asia? *Field Crops Research*, Vol. 81, No. 2-3, pp.159-180, doi: 10.1016/S0378-4290(02)00219-8.
- Ladha, J.K., Rao, A.N., Raman, A.K., Padre, A.T., Dobermann, A., Gathala, M., Kumar, V., Saharawat, Y., Sharma, S., Piepho, H.P., Alam, M.M., Liak, R., Rajendran, R., Reddy, C.K., Parsad, R., Sharma, P.C., Singh, S.S., Saha, A. and Noor, S. (2016). Agronomic improvements can make future cereal systems in South Asia far more productive and result in a lower environmental footprint, *Global Change Biology*, Vol. 22, pp.1054-1074, doi:10.1111/gcb.13143.

- Lake, I., Abdelhamid, A. and Hooper, L. (2010). *Food and climate change: a review of the effects of climate change on food within the remit of the Food Standards Agency*, London, UK: Food Standards Agency, https://www.food.gov.uk/research/research-projects/food-and-climate-change-a-review-of-the-effects-of-climate-change-on-food-within-the-remit-of-the-food-standards-agency [accessed 11th April 2019].
- Lake, I.R., Hooper, L., Abdelhamid, A., Bentham, G., Boxall, A.B., Draper, A., Fairweather-Tait, S., Hulme, M., Hunter, P.R., Nichols, G., Waldron, K.W. (2012). Climate change and food security: health impacts in developed countries, *Environmental Health Perspectives*, Vol. 120, No. 11, pp.1520-1526, doi: 10.1289/ehp.1104424.
- Lake, Q., MacAlister, J., Gitsham, M. and Page, N. (2015). *Corporate approaches to addressing modern slavery in supply chains - a snapshot of current practice*, London, UK: Ashridge Centre for Business and Sustainability / Ethical Trading Initiative, https://www.christianaid.org.uk/sites/default/files/2017-09/Salt-corporate_approaches_to_addressing_modern_slavery.pdf [accessed 11th April 2019].
- Lal, R. (2004). Soil carbon sequestration impacts on global climate change and food security, *Science*, Vol. 304, No. 1623, No. 5677, pp.1623-1627, doi: 10.1126/science.1097396.
- Lal, R. (2013). Food security in a changing climate, *Ecohydrology & Hydrobiology*, Vol. 13, pp.8-21, http://dx.doi.org/10.1016/j.ecohyd.2013.03.006 [accessed 11th April 2019].
- Lal, R. (2018). Digging deeper: a holistic perspective of factors affecting soil organic carbon sequestration in agroecosystems, *Global Change Biology*, Vol. 24, pp.3285-3301, doi:10.1111/gcb.14054.
- Lal, R. and Stewart, B.A. (2011). *Food security and soil quality*, Boca Raton, FL, USA: CRC Press, ISBN 978-1-4398-0057-7.
- Lam, M.E. and Pitcher, T.J. (2012). Fish commoditization – sustainability strategies to protect living fish, *Bulletin of Science, Technology & Society*, Vol. 32, No. 1, pp.31-40, doi: 10.1177/0270467612444583.
- Lam, V.W.Y., Cheung, W.W.L., Reygondeau, G. and Sumaila, U.R. (2016). Projected change in global fisheries revenues under climate change, *Scientific Reports*, Vol. 6, No. 32607, doi: 10.1038/srep32607.
- Lambek, N. (2015). The right to food: reflecting on the past and future possibilities—Synthesis paper, *Canadian Food Studies*, Vol. 2, No. 2, pp.68-74, doi: 10.15353/cfs-rcea.v2i2.112.
- Lambert, A. (2018). PHA survey: still too much sugar, too little fibre in UK diet, *New Food*, 20th March, https://www.newfoodmagazine.com/news/65540/pha-survey-still-too-much-sugar-too-little-fibre-in-uk-diets/ [accessed 11th April 2019].
- Lambie-Mumford, H. and O'Connell, R. (2015). *Food, poverty and policy - evidence base and knowledge gaps*, Report of the BSA Food Study Group-SPERI event, 30th June, Sheffield, UK: Sheffield Political Economy Research Institute.
- Lambin, E.F. (2012). Global land availability - Malthus versus Ricardo, *Global Food Security*, Vol. 1, pp.83-87, http://dx.doi.org/10.1016/j.gfs.2012.11.002 [accessed 11th April 2019].

- Lambin, E.F. and Meyfroidt, P. (2011). Global land-use change, economic globalization, and the looming land scarcity, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 108, No. 9, pp.3465-3472, https://doi.org/10.1073/pnas.1100480108 [accessed 11th April 2019].
- Lamine, C. and Dawson, J. (2018). The agroecology of food systems: reconnecting agriculture, food, and the environment, *Agroecology and Sustainable Food Systems*, Vol. 42, No. 6, pp.629-636, https://doi.org/10.1080/21683565.2018.1432517 [accessed 11th April 2019].
- Lamine, C., Darnhofer, I. and Marsden, T.K. (2019). What enables just sustainability transitions in agrifood systems? An exploration of conceptual approaches using international comparative case studies, *Journal of Rural Studies*, Vol. 68, pp.144-146, https://doi.org/10.1016/j.jrurstud.2019.03.010 [accessed 11th April 2019].
- Lammers, M. and Kok, L. (2013). *Cost-benefit analysis of dietary treatment*, Amsterdam, The Netherlands: SEO Economic Research.
- Lan, L., Sain, G., Czaplicki, S., Guerten, N., Shikuku, K.M., Grosjean, G. and Läderach, P. (2018). Farm-level and community aggregate economic impacts of adopting climate smart agricultural practices in three mega environments, *PLoS One*, Vol. 13, No. 11, p.e0207700, https://doi.org/10.1371/journal.pone.0207700 [accessed 11th April 2019].
- *Lancet*, *The* (2014). Climate change and health—action please, not words, *The Lancet*, Vol. 384, Iss. 9948, p.1071, doi:https://doi.org/10.1016/S0140-6736(14)61656-1.
- *Lancet*, The (2016a). Climate and health joining up the pieces, scaling up the action, *The Lancet*, 18th October, http://dx.doi.org/10.1016/S0140-6736(16)31852-9 [accessed 11th April 2019].
- *Lancet, The* (2016c). The perfect storm: climate change and its health consequences, *The Lancet*, Vol. 387, Iss. 10026, p.1348, doi:https://doi.org/10.1016/S0140-6736(16)30117-9.
- *Lancet*, *The* (2017a). Food industry must act to safeguard the future of antibiotics, *The Lancet*, Vol. 390, 18th November, doi:https://doi.org/10.1016/S0140-6736(17)32900-8.
- *Lancet*, *The* (2017b). Our polluted planet, *The Lancet*, Vol. 389, No. 10071, 764, doi: https://doi.org/10.1016/S0140-6736(17)30580-9 [accessed 11th April 2019].
- *Lancet, The* (2017c). Sustainable food for a sustainable planet, *The Lancet*, Planetary Health, Vol 1, July, e123, doi:https://doi.org/10.1016/S2542-5196(17)30066-9.
- *Lancet*, *The* (2018a). Food security in the Middle East and North Africa, *The Lancet*, 14th July, Vol. 392, No. 10142, p.96, doi:https://doi.org/10.1016/S0140-6736(18)31563-0.
- *Lancet, The* (2018b). Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related Sustainable Development Goals for 195 countries and territories: a systematic analysis for the Global Burden of Disease Study 2017, *The Lancet*, Vol. 392, No. 10159, pp.2091-2138, https://doi.org/10.1016/S0140-6736(18)32281-5 [accessed 11th April 2019].
- *Lancet, The* (2018c). The Lancet Taskforce on NCDs and economics, *The Lancet*, 4th April, https://www.thelancet.com/series/Taskforce-NCDs-and-economics [accessed 11th April 2019].

- *Lancet, The* (2018d). Turning climate change legislation into public health policy, *The Lancet*, Vol. 391, 10133, pp.1865, https://www.thelancet.com/series/Taskforce-NCDs-and-economics [accessed 11th April 2019].
- *Lancet*, *The* (2018e). We need to talk about meat (editorial), *The Lancet*, 24th November, Vol. 392, Iss. 10161, p.2237, doi:https://doi.org/10.1016/S0140-6736(18)32971-4.
- *Lancet*, *The* (2019a). Editorial: a Brexit general election: the wrong question, *The Lancet*, Vol. 394, Iss. 10210, p.1686, 9th November, doi:https://doi.org/10.1016/S0140-6736(19)32718-7.
- *Lancet, The* (2019b). Globally, one in five deaths are associated with poor diet, *ScienceDaily*, 3rd April, www.sciencedaily.com/releases/2019/04/190403193702.htm [accessed 11th April 2019].
- *Lancet, The* (2019c). Planetary health in the Anthropocene, *The Lancet*, June, Vol. 393, Iss. 10188, doi:https://doi.org/10.1016/S0140-6736(19)31323-6.
- *Lancet*, *The* (2019d). Net zero by 2050 in the UK, *The Lancet*, Vol. 393, 11th May, p.1911, doi:https://doi.org/10.1016/S0140-6736(19)31004-9.
- *Lancet*, *The* (2020). A future direction for tackling malnutrition, *The Lancet*, Vol. 395, Iss. 10217, p.2, doi:https://doi.org/10.1016/S0140-6736(19)33099-5.
- Landauer, M., Juhola, S. and Soderholm, M. (2015). Inter-relationships between adaptation and mitigation: a systematic literature review, *Climatic Change*, Vol. 131, No. 4, pp.505-517, doi: 10.1007/s10584-015-1395-1.
- Landholm, D.M., Holsten, A., Martellozzo, F., Reusser, D.E. and Kropp, J.P. (2019). Climate change mitigation potential of community-based initiatives in Europe, *Regional Environmental Change*, Vol. 19, No. 4, pp.927-938, doi: 10.1007/s10113-018-1428-1.
- Landires, I., Nuñez-Samudio, V.N., Apraez-Ippolito, G. and Castrod, G. (2018). Planetary health: a new sociopolitical framework is urgently needed, *The Lancet*, 24–30th March, Vol.391, Iss. 10126, p.1158, https://doi.org/10.1016/S0140-6736(18)30685-8 [accessed 11th April 2019].
- Landler, M. and Sengupta, S. (2020). Trump and the teenager: a climate showdown at Davos, *New York Times*, 21st January, https://www.nytimes.com/2020/01/21/climate/greta-thunberg-trump-davos.html [accessed 11th April 2019].
- Landon, J. and Mwatsama, M. (2018). *Fresh start: a framework for health and sustainable diets in the UK – recommendations for action*, London, UK: UK Health Forum, http://ukhealthforum.org.uk/ [accessed 11th April 2019].

- Landrigan, P.J., Fuller, R., Acosta, N.J.R., Adeyi, O., Arnold, R., Basu, N., Baldé, A.B., Bertollini, R., Bose-O'Reilly, S., Ivey Boufford, J., Breysse, P.N., Chiles, T., Mahidol, C., Coll-Seck, A.M., Cropper, M.L., Fobil, J., Fuster, V., Greenstone, M., Haines, A., Hanrahan, D., Hunter, D., Khare, M., Krupnick, A., Lanphear, B., Lohani, B., Martin, K., Mathiasen, K.V., McTeer, M.A., Murray, C.J.L., Ndahimananjara, J.D., Perera, F., Potočnik, J., Preker, J.S., Ramesh, J., Rockström, J., Salinas, C., Samson, L.D., Sandilya, K., Sly, P.D., Smith, K.R., Steiner, A., Stewart, R.B., Suk, W.A., van Schayck, O.C.P., Yadama, G.N., Yumkella, K. and Zhong, M. (2018). The Lancet Commission on pollution and health, *The Lancet*, Vol. 391, pp.462-512, http://dx.doi.org/10.1016/S0140-6736(17)32345-0 [accessed 11th April 2019].
- Landworkers' Alliance (2017a). *A new deal for horticulture*, https://landworkersalliance.org.uk/wp-content/uploads/2017/10/Screen-Shot-2017-10-30-at-13.35.41-1.png [accessed 11th April 2019].
- Landworkers' Alliance (2017b). Recommendations for post-Brexit agricultural policy, https://landworkersalliance.org.uk/publications/ [accessed 11th April 2019].
- Landzettel, M. (2018). Watergate 2.0 – Down stream consequences of industrial agriculture in the US Midwest, *The Sustainable Food Trust*, 5th October, https://sustainablefoodtrust.org/articles/watergate-2-0-down-stream-consequences-of-industrial-agriculture-in-the-us-midwest/ [accessed 11th April 2019].
- Landzettel, M. (2019). Net zero carbon - how to make sustainable farming pay, 26th July, https://sustainablefoodtrust.org/articles/net-zero-carbon-how-to-make-sustainable-farming-pay/ [accessed 11th April 2019].
- Lane, A. and Jarvis, A. (2007). Changes in climate will modify the geography of crop suitability: agricultural biodiversity can help with adaptation, *Journal of the Semi-Arid Tropics*, Vol. 4, pp.1-12, https://cgspace.cgiar.org/handle/10568/43252 [accessed 11th April 2019].
- Lane, E. (2013). Horsemeat scandal: can brands like Findus recover, *BBC News*, 12th February, https://www.bbc.co.uk/news/business-21413966 [accessed 11th April 2019].
- Lane, R. (2019). Corinna Hawkes: champion of effective food policy, *The Lancet*, Vol. 395, Iss. 10217, p.22, doi:https://doi.org/10.1016/S0140-6736(19)33096-X.
- Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M. and Thomas, C.J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges, *Sustainability Science*, Vol. 7, pp.25-43, https://doi.org/10.1007/s11625-011-0149-x.
- Lang, T. (1999). The complexities of globalization: the UK as a case study of tensions within the food system and the challenge of food policy, *Agriculture and Human Values*, Vol. 16, No. 2, pp.169-185, doi: 10.1023/A:1007542605470.
- Lang, T. (2004) *Food industrialisation and power - implications for governance*, Gatekeeper Series No. 114, London, UK: International Institute for Environment and Development.
- Lang, T. (2005). Food control or food democracy? Re-engaging nutrition with society and environment, *Public Health Nutrition*, Vol. 8, No. 6A, pp.730-737, doi: 10.1079/phn2005772.

- Lang, T. (2009). Reshaping the food system for ecological public health, *Journal of Hunger & Environmental Nutrition*, Vol. 4*, No.* 3, pp.315-335, doi: 10.1080/19320240903321227.
- Lang, T. (2010). Crisis - what crisis - the normality of the current food crisis, *Journal of Agrarian Change*, Vol. 10, No. 1, January, pp.87-97, doi: 10.1111/j.1471-0366.2009.00250.x.
- Lang, T. (2014a). Good food needs good wages, *The Grocer*, 14th September, p.21.
- Lang, T. (2014b). Sustainable diets - hairshirts or a better food future, *Development*, Vol. 57, No. 2, pp.240-256, doi:10.1057/dev.2014.73.
- Lang, T. (2014c). *Sustainable diets - integrity has a sustainability dimension, too*, The Institute of Food Safety, Integrity & Protection (TiFSiP), 7th January, https://www.fcrn.org.uk/research-library/blog-post-timothy-lang-%E2%80%9Csustainable-diets-integrity-has-sustainability-dimension [accessed 11th April 2019].
- Lang, T. (2017a). Buying British can't save beef from a sustainability crisis, *The Times*, 17th July, https://www.thetimes.co.uk/article/buying-british-can-t-save-beef-from-a-sustainability-crisis-krwlmc8fp [accessed 11th April 2019].
- Lang, T. (2017b). *Re-fashioning food systems with sustainable diet guidelines - towards a SDG2 strategy*, report for Friends of the Earth, London, UK: City University Centre for Food Policy, http://foodresearch.org.uk/wp-content/uploads/2017/03/Sustainable_diets_January_2016_final.pdf [accessed 11th April 2019].
- Lang, T. (2017c). Sustainable diets - rational goal, irrational consumers, 11th April, http://www.fcrn.org.uk/fcrn-blogs/tim-lang/sustainable-diets-rational-goal-irrational-consumers.
- Lang, T. (2017d). Sustainable sustenance, 15th August, http://boroughmarket.org.uk/articles/sustainable-sustenance [accessed 11th April 2019].
- Lang, T. (2017e). Why consumers need help to shift to sustainable diets, *The Conversation*, 18th April, https://theconversation.com/why-consumers-need-help-to-shift-to-sustainable-diets-75934 [accessed 11th April 2019].
- Lang, T. (2017f). Meat and policy: charting a course through the complexity. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.317-334, London, UK: Routledge, https://doi.org/10.4324/9781315562032[accessed 11th April 2020].
- Lang, T. (2018). The new Agriculture Bill has no vision for food, *Green Alliance*, 18th September, https://greenallianceblog.org.uk/2018/09/18/the-new-agriculture-bill-has-no-vision-for-food/ [accessed 15th August 2019].
- Lang, T. (2019a). Food as spectacle, *The Lancet*, Vol. 394, Iss. 10203, 21–27th September, pp.999-1000, https://doi.org/10.1016/S0140-6736(19)32097-5 [accessed 11th April 2019].
- Lang, T. (2019b). No-deal food planning in UK Brexit, *The Lancet*, Vol. 7, No. 394, 10201, pp.814-815, doi: 10.1016/S0140-6736(19)31769-6.

- Lang, T. (2019c). Food fights: the politicization of what we eat, *The Times Literary Supplement*, 20th December, https://www.the-tls.co.uk/articles/food-fights/ [accessed 15th January, 2020].
- Lang, T. (2020). *Feeding Britain: our food problems and how to fix them*, London, UK: Pelican, ISBN-10: 0241404800.
- Lang, T. and Barling, D. (2012). Food security and food sustainability - reformulating the debate, *The Geographical Journal*, Vol. 178, No. 4, December, pp.313-326, doi: 10.1111/j.1475-4959.2012.00480.x.
- Lang, T. and Barling, D. (2013a). Nutrition and sustainability - an emerging food policy discourse, *Proceedings of the Nutrition Society*, Vol. 72, pp.1-12, doi:10.1017/S002966511200290X.
- Lang, T. and Barling, D. (2013b). UK food policy - can we get it on the right track? *Food Ethics Council*, Vol. 8, Iss. 3, pp.6-8, https://www.foodethicscouncil.org/learn/ [accessed 11th April 2019].
- Lang, T. and Mason, P. (2017). Sustainable diet policy development: implications of multi-criteria and other approaches, 2008-2017, *Proceedings of the Nutrition Society*, Vol. 77, Iss. 3, pp.331-346, doi: 10.1017/S0029665117004074.
- Lang, T. and McKee, M. (2018). Brexit poses serious threats to the availability and affordability of food in the United Kingdom, *Journal of Public Health*, Vol. 40, No. 4, pp.e608-e610, doi:10.1093/pubmed/fdy073.
- Lang, T. and Millstone, E.P. (2019). Post-Brexit food standards, *The Lancet*, 8th March, Vol. 393, Iss. 10177, p.1199, doi: https://doi.org/10.1016/S0140-6736(19)30540-9.
- Lang, T. and Rayner, G. (2012). Ecological public health: the 21st century's big idea? An essay by Tim Lang and Geof Rayner, *British Medical Journal*, Vol. 345, pp.345-349.
- Lang, T. and Schoen, V. (2016). *Food, the UK and the EU - Brexit or Bremain*, 8th March, Food Research Collaboration Policy Brief.
- Lang, T. and Ingram, J. (2014). Food security twists and turns: why food systems need complex governance. In: O'Riordan, T. and Lenton, T. (eds.) *Addressing tipping points for a precarious future* (pp. 81-103), British Academy Scholarship, ISBN 9780197265536.
- Lang, T., Barling, D. and Caraher, M. (2009). Food policy: integrating health, environment and society, Oxford, UK: Oxford University Press.
- Lang, T., Millstone, E. and Marsden, T. (2017). *A Food Brexit: time to get real – A Brexit Briefing*, Brighton, UK: University of Sussex Science Policy Research Unit.
- Lang, T., Millstone, E., Lewis, T. and Marsden, T. (2018a). *Feeding Britain - food security after Brexit*, London, UK: City University Food Research Collaboration.
- Lang, T., Millstone, E., Lewis, T. and McFarlane, G. (2018b). *Why Local Authorities should prepare Food Brexit Plans*, FRC Food Brexit Policy Briefing, London, UK: City University Food Research Collaboration.

- Lang, T., Millstone, E.P., and Marsden, M. (2020). Coronavirus has exposed UK government's failure to implement a long-term food plan, *The Conversation*, 23rd April, https://theconversation.com/coronavirus-has-exposed-uk-governments-failure-to-implement-a-long-term-food-plan-136911
- Lang, T., Wu, M. and Caraher, M. (2010). Meat and policy: charting a course through the complexity. In: Webster, J., D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 1st edition, pp.254-274, London, UK: Routledge.
- Langellier, B.A., Bilal, U., Montes, F., Meisel, J.D., Cardoso, L.D.O. and Hammond, R.A. (2019). Complex systems approaches to diet: a systematic review, *American Journal of Preventive Medicine*, Vol. 57, No. 2, pp.273-281, doi: 10.1016/j.amepre.2019.03.017.
- Lanz, B., Dietz, S. and Swanson, T. (2018). The expansion of modern agriculture and global biodiversity decline: an integrated assessment*, Ecological Economics,* Vol. 144, pp.260-277, https://doi.org/10.1016/j.ecolecon.2017.07.018 [accessed 11th April 2019].
- Lappé, F.M. (1971). *Diet for a small planet*, New York, USA: Ballantine Books, ISBN-10: 0345321200.
- Lara Silva, V. and Sanjuan, N. (2019). Opening up the black box: a systematic literature review of life cycle assessment in alternative food processing technologies, *Journal of Food Engineering*, Vol. 250, pp.33-45, https://doi.org/10.1016/j.jfoodeng.2019.01.010.
- Lara, L.J. and Rostagno, M.H. (2013). Impact of heat stress on poultry production, *Animals*, Vol. 3, pp.356-369, doi: 10.3390/ani3020356.
- Larsson, N. (2017). The last place on Earth: how Sumatra's rainforest is being cleared for palm oil, *The Guardian*, 28th September, https://www.theguardian.com/sustainable-business/2017/sep/28/last-place-on-earth-deforestation-palm-oil-threat-leuser-rainforest?CMP=ema-1706&CMP= [accessed 11th April 2019].
- Lassen, A.D., Christensen, L.M. and Trolle, E. (2020). Development of a Danish adapted healthy plant-based diet based on the Eat-Lancet reference diet, *Nutrients*, Vol. 12, No. 3, pp.738, doi: 10.3390/nu12030738.
- Lassen, B., Schaper, C., Spiller, A., Theuvsen, L. and Wocken, C. (2008). *Risk management on dairy farms: an empirical analysis*, Sub-theme: Leadership and Entrepreneurship, Goettingen, Germany: Department of Agricultural Economics and Rural Development, August University Goettingen.
- Laurance, J. (2012). Scientists warn of sperm count crisis, *The Independent*, 5th December, https://www.independent.co.uk/news/science/scientists-warn-of-sperm-count-crisis-8382449.html [accessed 11th April 2019].
- Lawrence, D. and Vandecar, K. (2015). Effects of tropical deforestation on climate and agriculture, *Nature Climate Change*, Vol. 5, pp.27-36, https://doi.org/10.1038/nclimate2430 [accessed 11th April 2019].

- Lawrence, F. (2005). Force Fed - how our newly industrialised food system leads to environmental and human degradation, Working to eliminate the dangers of toxic pesticides, Rachel Carson Memorial Lecture 2004,
- Lawrence, F. (2018). The brilliant Pret a Manger marketing con we want to fall for, *The Guardian*, 12th October, https://www.theguardian.com/commentisfree/2018/oct/12/pret-a-manger-marketing [accessed 11th April 2019].
- Lawrence, F. (2019). The way we eat is killing us - and the planet, *The Guardian*, 28th January, https://www.theguardian.com/commentisfree/2019/jan/28/global-food-killing-humans-planet-climate-change-obesity [accessed 11th April 2019].
- Lawrence, G. (2017). Re-evaluating food systems and food security: a global perspective, *Journal of Sociology*, Vol. 53, No. 4, pp.774-796, https://doi.org/10.1177/1440783317743678 [accessed 11th April 2019].
- Lawrence, M., Burlingame, B., Caraher, M., Holdsworth, M., Neff, R. and Timotijevic, L. (2015a). Public health nutrition and sustainability, *Public Health Nutrition*, Vol. 18, pp.2287-2292, doi:10.1017/S1368980015002402.
- Lawrence, M.A. and Baker, P.I. (2019). Ultra-processed food and adverse health outcomes, *British Medical Journal*, l2289, doi: 10.1136/bmj.l2289.
- Lawrence, M.A. and McNaughton, S.A. (2019). Vegetarian diets and health, *British Medical Journal*, 4th September, Vol. 366, No. l5272, doi: 10.1136/bmj.l5272.
- Lawrence, M.A., Baker, P.I., Pulker, C.E. and Pollard, C.M. (2019). Sustainable, resilient food systems for healthy diets: the transformation agenda, *Public Health Nutrition*, Vol. 22, Iss. 16, pp.1-2920, doi: 10.1017/S1368980019003112.
- Lawrence, M.A., Friel, S., Wingrove, K., James, S.W. and Candy, S. (2015b). Formulating policy activities to promote healthy and sustainable diets, *Public Health Nutrition*, Vol. 18, No. 13, pp.2333-2340, doi:10.1017/S1368980015002529.
- Lawther, I. (2015). Land grabbing: new actors in a longstanding process—Synthesis paper, *Canadian Food Studies*, Vol. 2, No. 2, pp.250-255, doi: 10.15353/cfs-rcea.v2i2.124.
- Laybourn-Langton, L., Rankin, L. and Baxter, D. (2019). *This is a crisis: facing up to the age of environmental breakdown*, London, UK: Institute for Public Policy Research, www.ippr.org/research/publications/age-of-environmental-breakdown [accessed 11th April 2019].
- Laybourn-Langton, L. and Stott, R. (2021). President Biden’s leadership on climate must be supported and applauded by health professionals, *BMJ Opinion*, 22nd April, https://blogs.bmj.com/bmj/2021/04/22/president-bidens-leadershipon-climate-must-be-supported-and-applauded-by-health-professionals [accessed 11th May 2021].
- Layman, D.K. (2018). Assessing the role of cattle in sustainable food systems, *Nutrition Today*, Vol. 53, No. 4, pp.160-165, doi: 10.1097/NT.0000000000000286.

- Lazard, J., Rey-Valette, H., Aubin, J., Mathé, S., Chia, E., Caruso, D., Mikolasek, O., Blancheton, J.P., Legendre, M., René, F., Levang, P., Slembrouck, J., Morissens, P. and Clément, O. (2014) Assessing aquaculture sustainability: a comparative methodology, *International Journal of Sustainable Development & World Ecology*, Vol. 21, No. 6, pp.503-511, doi: 10.1080/13504509.2014.964350.
- Lazzarinia, G.A., Visschers, V.H.M. and Siegrist, M. (2017). Our own country is best - factors influencing consumers' sustainability perceptions of plant-based foods, *Food Quality and Preference*, Vol. 60, pp.165-177, http://dx.doi.org/10.1016/j.foodqual.2017.04.008 [accessed 11th April 2019].
- LBP (2011). *Lincolnshire Biodiversity Action Plan 2011-2020*, 3rd edition, Horncastle, UK: Lincolnshire Biodiversity Partnership.
- LCC (2019). *Coastal flood risk*, Lincoln, UK: Lincolnshire County Council, https://www.lincolnshire.gov.uk/residents/environment-and-planning/flood-risk-management/coastal-flood-risk/112427.article [accessed 11th April 2019].
- Le Bris, A., Mills, K.E., Wahle, R.A., Chen, Y., Alexander, M.A., Allyn, A.J., Schuetz, J.G., Scott, J.D. and Pershing, A.J. (2018). Climate vulnerability and resilience in the most valuable North American fishery, *Proceedings of the National Academy of Sciences of the United States of America*, 201711122, doi.org/10.1073/pnas.1711122115.
- Le Mouël, C. and Forslund, A. (2017). How can we feed the world in 2050? A review of the responses from global scenario studies, *European Review of Agricultural Economics*, Vol. 44, Iss, 4, pp.541–591, https://doi.org/10.1093/erae/jbx006 [accessed 15th April 2019].
- Le Quéré, C., Jackson, R.B., Jones, M.W., Smith, A.J.P., Abernethy, S., Andrew, R.M., De-Gol, A.J., Willis, D.R., Shan, Y., Canadell, J.G., Friedlingstein, P., Creutzig, F. and Peters, G.P. (2020). Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement, *Nature Climate Change*, https://doi.org/10.1038/s41558-020-0797-x [accessed 15th May 2020].
- Leach, B., Lefort, R. and Mendick, R. (2009). Britain must produce more food, government to warn, *The Telegraph*, 13th September, http://www.telegraph.co.uk/earth/agriculture/food/6924216/Britain-must-produce-more-food-government-to-warn.html [accessed 11th April 2019].
- Leach, M., Raworth, K. and Rockström, J. (2013). Between social and planetary boundaries: navigating pathways in the safe and just space for humanity, *World Social Science Report 2013*, Paris, France: Organisation for Economic Cooperation and Development, pp.84-89, https://doi.org/10.1787/9789264203419-en [accessed 11th April 2019].
- Leahy, S. (2018). Climate change impacts worse than expected, global report warns, The Intergovernmental Panel on Climate Change says the world is headed for painful problems sooner than expected, as emissions keep rising, *National Geographic*, 7th October, https://www.nationalgeographic.com/environment/2018/10/ipcc-report-climate-change-impacts-forests-emissions/ [accessed 11th April 2019].

- Leahy, S. (2019). We have too many fossil-fuel power plants to meet climate goals, *National Geographic*, 1st July, https://www.nationalgeographic.com/environment/2019/07/we-have-too-many-fossil-fuel-power-plants-to-meet-climate-goals/ [accessed 11th April 2019].
- Leake, J. (2018). Cheers! It's dry January all year, *The Sunday Times*, 14th January, https://www.thetimes.co.uk/article/cheers-its-dry-january-all-year-cxs9xjpf0 [accessed 11th April 2019].
- Leakey, A.D.B. (2009). Rising atmospheric carbon dioxide concentration and the future of C4 crops for food and fuel, *Proceedings of the Royal Society*, B, Vol. 276, pp.2333-2343, doi:10.1098/rspb.2008.1517.
- Leakey, A.D.B., Ainsworth, E.A., Bernacchi, C.J., Rogers, A., Long, S.P. and Ort, D.R. (2009). Elevated CO_2 effects on plant carbon, nitrogen, and water relations: six important lessons from FACE, *Journal of Experimental Botany*, Vol. 60, pp.2859-2876, doi:10.1093/jxb/erp096.
- Leal Filho, W. and Consorte McCrea, A. (eds)(2019). *Sustainability and the humanities*, New York, USA: Springer International Publishing, ISBN 978-3-319-95336-6.
- Leat, P. and Revoredo-Giha, C. (2013). Risk and resilience in agri-food supply chains the case of the ASDA PorkLink supply chain in Scotland, *Supply Chain Management: An International Journal*, Vol. 1, No. 2, pp.219-231, doi: 10.1108/13598541311318845.
- Lebacq, T., Baret, P.V. and Stilmant, D. (2012). Sustainability indicators for livestock farming: a review, *Agronomy for Sustainable Development*, Vol. 33, pp.311-327, doi: 10.1007/s13593-012-0121-x.
- Lee, J.H., Ralston, R.A. and Truby, H. (2011). Influence of food cost on diet quality and risk factors for chronic disease: a systematic review, *Nutrition & Dietetics*, Vol. 68, Iss. 4, pp.248-261, https://doi.org/10.1111/j.1747-0080.2011.01554.x.
- Lee, J.S., Koh, L.P. and Wilcove, D.S. (2016). Junking tropical forests for junk food? *Frontiers in Ecology and the Environment*, Vol. 14, No. 7, pp.355-356, https://doi.org/10.1002/fee.1300 [accessed 11th April 2019].
- Lee, K. and Shavitt, S. (2009). Can McDonald's food ever be considered healthful, *Journal of Marketing Research*, Vol. XLVI, April, pp.222-233, https://doi.org/10.1509/jmkr.46.2.222 [accessed 11th April 2019].
- Lee, S., McLaughlin, R., Harnly, M., Gunier, R. and Kreutzer, R. (2002). Community exposures to airborne agricultural pesticides in California - ranking of inhalation risks, *Environmental Health Perspectives*, Vol. 110, No. 12, pp.1175-1184, doi: 10.1289/ehp.021101175.
- Leech, M. (2013). Health is central to the industry's future, *The Grocer*, 26th January, p.24.
- Legg, W. and Davis, J. (2015). Agriculture, forestry, land use and greenhouse gas emissions, *EuroChoices*, Vol. 14, No. 2, pp.24-25, doi:10.1111/1746-692X.12087.
- Lehretz, G.G., Sonnewald, S., Hornyik, C., Corral, J.M. and Sonnewald, U. (2019). Post-transcriptional Regulation of FLOWERING LOCUS T Modulates Heat-Dependent Source-Sink Development in Potato, *Current Biology*, doi: 10.1016/j.cub.2019.04.027.
- Leifeld, J. (2012). How sustainable is organic farming, *Agriculture, Ecosystems and Environment*, Vol. 150, pp.121-122, doi:10.1016/j.agee.2012.01.020.

- Leigh, J. and Lorkowski, S. (2018). Global, regional and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017, *The Lancet*, Vol. 392, pp.1923-1994, doi:https://doi.org/10.1016/S0140-6736(18)32225-6.
- Leiserowitz, A., Maibach, E., Roser-Renouf, C., Rosenthal, S., Cutler, M. and Kotcher, J. (2018). Climate change in the American mind, *Yale program on climate change communication*, https://climatecommunication.yale.edu/publications/climate-change-american-mind-march-2018/ [accessed 11th April 2019].
- Leisinger, K. (2015). Business needs to embrace sustainability targets, *Nature*, Vol. 528, 10th December, p.165, https://www.nature.com/news/business-needs-to-embrace-sustainability-targets-1.18968 [accessed 11th April 2019].
- Lélé, S.M. (1991). Sustainable development: a critical review, *World Development*, Vol. 19, pp.607-621, https://doi.org/10.1016/0305-750X(91)90197-P [accessed 11th April 2019].
- Leng, G. and Hall, J. (2019). Crop yield sensitivity of global major agricultural countries to droughts and the projected changes in the future, *Science of The Total Environment*, Vol. 654, pp.811-821, https://doi.org/10.1016/j.scitotenv.2018.10.434 [accessed 11th April 2019].
- Lenné, J.M. and Wood, D. (2011). *Agrobiodiversity management for food security: a critical review*, Wallingford, UK: CABI.
- Lennox, L., Maher, L. and Reed, J. (2018). Navigating the sustainability landscape: a systematic review of sustainability approaches in healthcare, *Implementation Science*, Vol. 13, No. 27, https://doi.org/10.1186/s13012-017-0707-4 [accessed 11th April 2019].
- Lenton, T.M. and Ciscar, J-C. (2013). Integrating tipping points into climate impact assessments, *Climatic Change*, Vol. 117, pp.585-597, https://doi.org/10.1007/s10584-012-0572-8 [accessed 11th April 2019].
- Lenton, T.M. and Schellnhuber, H.J. (2007). Tipping the scales, *Nature Reports Climate Change*, Vol. 1, pp.97-98, doi:https://doi.org/10.1038/climate.2007.65 [accessed 11th April 2019].
- Lenton, T.M., Held, H., Kriegler, E., Hall, J.W., Lucht, W., Rahmstorf, S. and Schellnhuber, H.J. (2008). Tipping elements in the Earth's climate system, *Proceedings of the National Academy of Sciences*, Vol. 105, No. 6, pp.1786-1793, doi: 10.1073/pnas.0705414105.
- Lenton, T.M., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W. and Schellnhuber, H.J. (2019). Climate tipping points — too risky to bet against, *Nature*, Vol. 575, No. 7784, pp.592-595, doi: 10.1038/d41586-019-03595-0.
- Leroy, F. and Cohen, M. (2019). EAT-Lancet Commission's controversial campaign, *European Food Agency News*, 1st November, https://www.efanews.eu/item/6053 [accessed 15th April 2020].

- Lesiv, M., Laso Bayas, J.C., See, L., Duerauer, M., Dahlia, D., Durando, N., Hazarika, R., Sahariah, P.K., Vakolyuk, M., Blyshchyk, V., Bilous, A., Perez-Hoyos, A., Gengler, S., Prestele, R., Bilous, S., Hassan Akhtar, I., Singha, K., Choudhury, S.B., Chetri, T., Malek, Ž., Bungnamei, K., Saikia, A., Sahariah, D., Narzary, W., Danylo, O., Sturn, T., Karner, M., McCallum, I., Schepaschenko, D., Moltchanova, E., Fraisl, D., Moorthy, I. and Fritz, S. (2018). Estimating the global distribution of field size using crowdsourcing, *Global Change Biology*, 00, pp.1-13, https://doi.org/10.1111/gcb.14492 [accessed 11th April 2019].
- Lesk, C., Rowhani, P. and Ramankutty, N. (2016). Influence of extreme weather disasters on global crop production, *Nature*, Vol. 529, pp.84-87, https://doi.org/10.1038/nature16467 [accessed 15th April 2020].
- Levidow, L. (2010). Policy frameworks - facilitating or hindering local food systems, *Local food systems: pratices and strategies workshop*, 22nd February, Brussels.
- Levidow, L. (2013). EU criteria for sustainable biofuels: accounting for carbon, depoliticising plunder, *Geoforum*, Vol. 44, pp.211-223, http://dx.doi.org/10.1016/j.geoforum.2012.09.005 [accessed 11th April 2019].
- Levin, K. and Rich, D. (2017). *Turning points trends countries reaching peak greenhouse gas emissions over time*, Working Paper, Washington, USA: World Resources Institute, http://www.wri.org/publication/turning-points [accessed 11th April 2019].
- Levitt, T. (2019). EU ignoring climate crisis with livestock farm subsidies, campaigners warn: billions of euros spent on supporting climate-intensive meat and dairy farms, which have shown no drop in emissions since 2010, *The Guardian*, 22nd May, https://www.theguardian.com/environment/2019/may/22/eu-ignoring-climate-crisis-with-livestock-farm-subsidies-campaigners-warn [accessed 11th April 2019].
- Levitt, T. and Thomas, A. (2014). The end of the line: how a film changed the way we eat fish, *The Guardian*, 18th February, https://www.theguardian.com/environment/2011/feb/18/end-line-film-fish [accessed 11th April 2019].
- Levkoe, C.Z. and Sheedy, A. (2017). A people-centred approach to food policy making: lessons from Canada's People's Food Policy project, *Journal of Hunger & Environmental Nutrition*, Vol. 14, No. 3, pp.318-338, doi: 10.1080/19320248.2017.1407724.
- Levkoe, C.Z., Brem-Wilson, J. and Anderson, C.R. (2018). People, power, change: three pillars of a food sovereignty research praxis, *The Journal of Peasant Studies*, Vol. 46, No. 7, pp.1389-1412, doi: 10.1080/03066150.2018.1512488.
- Lewandowska, A.M., Boyce, D.G., Hofmann, M., Matthiessen, B., Sommer, U. and Worm, B. (2014). Effects of sea surface warming on marine plankton, *Ecology Letters*, Vol. 17, pp.614-623, doi: 10.1111/ele.12265.

- Lewandowsky, S., Cowtan, K., Risbey, J.S., Mann, M.E., Steinman, B.A., Oreskes, N. and Rahmstorf, S. (2018). The ‘pause’ in global warming in historical context: (II). Comparing models to observations, *Environmental Research Letters*, Vol. 13, No. 12, pp.123007, doi: 10.1088/1748-9326/aaf372.
- Lewis, M. and Lee, A. (2016). Costing 'healthy' food baskets in Australia - A systematic review of food price and affordability monitoring tools, protocols and methods, *Public Health Nutrition*, Vol. 19, No. 16, pp.2872-2886, doi: 10.1017/S1368980016002160.
- Lewis, S.L. (2019). *A green new deal for nature*, Common-Wealth-Land-GND, https://www.common-wealth.co.uk/project-streams/green-new-deal [accessed 11th April 2019].
- Lewis, S.L., Wheeler, C., Mitchard, E. and Koch, A. (2019). Restoring natural forests is the best way to remove atmospheric carbon, *Nature*, Vol. 568, pp.25-28, doi: 10.1038/d41586-019-01026-8.
- Li, D., Wang, X., Kai-Chan, H. and Manzini, R. (2014). Sustainable food supply chain management, *International Journal of Production Economics*, Vol. 152, pp.1-8, http://dx.doi.org/10.1016/j.ijpe.2014.04.003 [accessed 11th April 2019].
- Li, G., Zhao, Y. and Cui, S. (2013). Effects of urbanization on arable land requirements in China based on food consumption patterns, *Food Security*, Vol. 5, pp.439-449, doi:10.1007/s12571-013-0265-9.
- Li, H., Wu, T., Wang, X. and Qi, Y. (2016). The greenhouse gas footprint of China's food system: an analysis of recent trends and future scenarios, *Journal of Industrial Ecology*, Vol. 20, pp.803-817, doi:10.1111/jiec.12323.
- Li, L., Pegg, R.B., Eitenmiller, R.R., Ji-Yeon Chun, J-Y. and Kerrihard, A.L. (2017). Selected nutrient analyses of fresh, fresh-stored, and frozen fruits and veg, *Journal of Food Composition and Analysis*, Vol. 59, pp.8-17, http://dx.doi.org/10.1016/j.jfca.2017.02.002 [accessed 11th April 2019].
- Li, M., Hinnov, L.A., Huang, C. and Ogg, J.G. (2018). Sedimentary noise and sea levels linked to land–ocean water exchange and obliquity forcing, *Nature Communications*, Vol. 9, No. 1, 1004, doi: 10.1038/s41467-018-03454-y
- Li, T. (2013). Analysis of different competitive strategy's impact on the pricing of food supply chain, *Information Technology Journal*, Vol. 12, Iss. 19, pp.5080-5084, doi:10.3923/itj.2013.5080.5084.
- Li, X-R., Deb, J., Kumar, S.V. and Østergaard, L. (2018). Temperature modulates tissue-specification program to control fruit dehiscence in brassicaceae, *Molecular Plant*, Vol. 11, No. 4, pp.598-606, doi: 10.1016/j.molp.2018.01.003.
- Li, Y.P., Ye W., Wang M., Yan X.D. (2009). Climate change and drought: a risk assessment of crop-yield impacts*, Climate Research*, Vol. 39, pp.31-46, doi: https://doi.org/10.3354/cr00797.
- Liberato, S.C., Bailie, R. and Brimblecombe, J. (2014). Nutrition interventions at point-of-sale to encourage healthier food purchasing: a systematic review, *BMC public health,* Vol. 14, No. 1, pp.919, https://doi.org/10.1186/1471-2458-14-919 [accessed 15th April 2020].

- Liedke, A., Deimling, S., Rehl, T., Bos, U., Brandstetter, C.P. and Baitz, M. (2014). Feed and food databases in LCA - an example of implementation, *Proceedings of the 9th International Conference on Life Cycle Assessment in the Agri-Food Sector*, 8th-10th October 2014, San Francisco, USA. ACLCA, Vashon, WA, USA, ISBN: 978-0-9882145-7-6.
- Lightfoot, W., Burke, J., Craig-Harvey, N., Dupont, J., Howard, R., Lowe, R., Norrie, R. and Taylor, M. (2017). *Farming tomorrow: British agriculture after Brexit*, Policy Exchange, https://policyexchange.org.uk/wp-content/uploads/2017/07/Farming_Tomorrow.pdf [accessed 11th April 2019].
- Likić-Brborić, B. (2018). Global migration governance, civil society and the paradoxes of sustainability, *Globalizations*, Vol. 15, No. 6, pp.762-778, https://doi.org/10.1080/14747731.2018.1503841 [accessed 11th April 2019].
- Lim, C.I. and Biswas, W. (2019). Sustainability assessment for crude palm oil production in Malaysia using the palm oil sustainability assessment framework, *Sustainable Development*, Vol. 27, No. 3, pp.253-269, https://doi.org/10.1002/sd.1872 [accessed 11th April 2020].
- Lim, F.K.S., Carrasco, L.R., McHardy, J. and Edwards, D.P. (2017). Perverse market outcomes from biodiversity conservation interventions, *Conservation Letters*, Vol. 10, Iss. 5, pp.506-516, https://doi.org/10.1111/conl.12332 [accessed 11th April 2019].
- Lim, V., Stubbs, J.W., Nahar, N., Amarasena, Chaudry, Z.U., Weng, S.C.K., Mayosi, B., van der Spuy, Z., Liang, R., Lai, K.N., Metz, G., Fitzgerald, G.W.N., Williams, B., Douglas, N., Donohoe, J., Darnchaivijir, S., Coker, P. and Gilmore, I. (2009). Politicians must heed health effects of climate change, *The Lancet*, Vol. 374, Iss. 9694, p.973, doi:https://doi.org/10.1016/S0140-6736(09)61641-X.
- Limetz, V., Stubbs, J.W., Nahar, N., Amarasena, N., Chaudry, Z.U., Weng, S.C.K., Bongani Mayosi, B., van der Spuy, Z., Liang, R., Lai, K.N., rey Metz, G., Fitzgerald, G.W.N., Williams, B., Douglas, N., Donohoe, J., Darnchaivijir, S., Coker, P. and Gilmore, I. (2009). Politicians must heed health effects of climate change, *The Lancet*, Vol. 374, 19th September, p.973, doi:10.1016/S0140-6736(09)61641-X.
- Lin, B.B. (2011). Resilience in agriculture through crop diversification - adaptive management for environmental change, *BioScience*, Vol. 61, pp.183-193, doi:10.1525/bio.2011.61.3.4.
- Lin, M. and Huybers, P. (2012). Reckoning wheat yield trends, *Environment Research Letters*, Vol. 7, pp.024016, doi:10.1088/1748-9326/7/2/024016.
- Lindgren, E., Harris, F., Dangour, A.D., Gasparatos, A. and Hiramatsu, M. (2018). Sustainable food systems - a health perspective, *Sustainability Science*, Vol. 13, No. 6, pp.1505-1517,
- Lindgren, E., Harris, F., Dangour, A.D., Gasparatos, A., Hiramatsu, M., Javadi, F., Loken, B., Murakami, T., Scheelbeek, P. and Haines, A. (2018). Sustainable food systems—a health perspective, *Sustainability Science,* Vol. 13, pp.1505-1517, doi:10.1007/s11625-018-0586-x.

- Lindsay, R. (2019). Carbon farming: how agriculture can both feed people and fight climate change, *The Conversation*, 26th February, https://theconversation.com/carbon-farming-how-agriculture-can-both-feed-people-and-fight-climate-change-111593 [accessed 11th April 2019].
- Lindzen, R. S. (2012, January 27). No need to panic about global warming, *Wall Street Journal*, 27th January, https://www.wsj.com/articles/no-need-to-panic-about-global-warming-1386195856 [accessed 11th April 2019].
- Lipinski, B., Lomax, B., Kitinoja, L., Waite, R. and Searchinger, T. (2013). *Reducing food loss and waste: creating a sustainable food future installment two*, Washington, USA: World Resources Institute, http://www.worldresourcesreport.org [accessed 11th April 2019].
- Lipper, L., Thornton, P., Campbell, B., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T., Sen, P., Sessa, R., Shula, R., Tibu, A. and Torquebiau, E. (2014). Climate-smart agriculture for food security, *Nature Climate Change*, Vol. 4, No. 12, pp.1068-1072, https://doi.org/10.1038/nclimate2437 [accessed 11th April 2019].
- Lipper, L., Thornton, P., Campbell, B.M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T., Sen, P.T., Sessa, R., Shula, R., Tibu, A. & Torquebiau, E.F. (2015). Corrigendum: climate-smart agriculture for food security, *Nature Climate Change*, Vol. 5, No. 4, pp.386-386, https://doi.org/10.1038/nclimate2586 [accessed 11th April 2019].
- Little, A.D. (2013). *Mapping current innovation and emerging R&D needs in the food and drink industry required for sustainable economic growth*, Report to Defra, London, UK: Arthur D. Little Limited, www.adlittle.co.uk [accessed 11th April 2019].
- Liu, D., Liberton, M., Yu, J., Pakrasi, H.B. and Bhattacharyya-Pakrasi, M. (2018). Engineering nitrogen fixation activity in an oxygenic phototroph, *mBio*, Vol. 9, No. 3, e01029-18, doi: 10.1128/mBio.01029-18.
- Liu, J., Hertel, T.W., Lammers, R.B., Prusevich, A., Baldos, U.L.C., Grogan, D.S. and Frolking, S. (2017). Achieving sustainable irrigation water withdrawals: global impacts on food security and land use, *Environmental Research Letters*, Vol. 12, No. 10, 104009, doi: 10.1088/1748-9326/aa88db.
- Liu, Y., Pan, X. and Li, J. (2015). Current agricultural practices threaten future global food production, *Journal of Agriculture and Environmental Ethics*, Vol. 28, pp.203-216, doi: 10.1007/s10806-014-9527-
- Liu, Y., Wang, S. and Chen, B. (2019). Water–land nexus in food trade based on ecological network analysis, *Ecological Indicators*, Vol. 97, pp.466-475, https://doi.org/10.1016/j.ecolind.2018.10.042 [accessed 11th April 2019].
- Liversey. F., Frau, I., Oughton, D. and Featherstone, C. (2010). *Future scenarios for UK food and drink industry*, Cambridge, UK: University of Cambridge, http://www.fdf.org.uk/corporate_pubs/IFM_report2_Sep2010.pdf [accessed 11th April 2019].

- Livesey, F., Frau, F., Oughton, D. and Featherston, C. (2010). *Future scenarios for the UK food and drink industry*, Cambridge, UK: University of Cambridge / Institute of Manufacturing, http://www.fdf.org.uk/corporate_pubs/IFM_report2_Sep2010.pdf [accessed 15th April, 2019].
- LLEP (2019). *Growth in the agri-food sector in Greater Lincolnshire is important not only locally but for the whole of the UK*, Lincoln, UK: Greater Lincolnshire Local Enterprise Partnership, https://www.greaterlincolnshirelep.co.uk/priorities-and-plans/sectors/agri-food-sector/ [accessed 11th April 2019].
- Lloret, J., Rätz, H-J., Lleonart, J. and Demestre, M. (2015). Challenging the links between seafood and human health in the context of global change, *Journal of the Marine Biological Association of the United Kingdom*, Vol. 96, pp.29-42, https://doi.org/10.1017/S0025315415001988 [accessed 11th April 2019].
- Llovel, W., Willis, J., Landerer, F.W. and Fukumori, I. (2014). Deep-ocean contribution to sea level and energy budget not detectable over the past decade, *Nature Climate Change*, Vol. 4, pp.1031-1035, doi:10.1038/nclimate2387.
- Lloyd, T.A., McCorriston, S. and Morgan, C.W. (2015). Food inflation in the EU: contrasting experience and recent insights. In: McCorriston, S. (ed) *Food price dynamics and price adjustment in the EU*, Oxford, UK: Oxford University Press.
- Lloyd, W.F. (1833). *Two lectures on the checks to population*, Oxford, UK: S. Collingwood.
- Lloyds (2015). *Food system shock: the insurance impact of acute disruption to global food supply*, June, London, UK: Lloyds of London, https://www.lloyds.com/news-and-risk-insight/risk-reports/library/society-and-security/food-system-shock [accessed 11th April 2019].
- Lobell, B.D. and Tebaldi, C. (2014). Getting caught with our plants down - the risks of a global crop yield slowdown from climate trends in the next two decades, *Environmental Research Letters*, Vol. 9, pp.074003, doi:10.1088/1748-9326/9/7/074003.
- Lobell, D., Schlenker, W. and Costa-Robert, J. (2011). Climate trends and global crop production since 1980, *Science*, Vol. 333, No. 6042, pp.616-620, doi: 10.1126/science.1204531.
- Lobell, D.B. (2014). Climate change adaptation in crop production: beware of illusions, *Global Food Security*, Vol. 3, pp.72-76, https://doi.org/10.1016/j.gfs.2014.05.002 [accessed 11th April 2019].
- Lobell, D.B. and Asseng, S. (2017). Comparing estimates of climate change impacts from process-based and statistical crop models, *Environmental Research Letters*, Vol. 12, No. 1, 015001, doi: 10.1088/1748-9326/aa518a.
- Lobell, D.B. and Burke, M.B. (2008). Why are agricultural impacts of climate change so uncertain? The importance of temperature relative to precipitation, *Environmental Research Letters*, Vol. 3, No. 3, pp.034007, doi:10.1088/1748-9326/3/3/034007.
- Lobell, D.B. and Field, C.B. (2007). Global scale climate-crop yield relationships and the impacts of recent warming, *Environmental Research Letters*, Vol. 2, 004000, doi:10.1088/1748-9326/2/1/014002.

- Lobell, D.B. and Gourdji, S.M. (2012). The influence of climate change on global crop productivity, *Plant Physiology*, Vol. 160, pp.1686–1697, doi: https://doi.org/10.1104/pp.112.208298.
- Lobell, D.B., Burke, M.B., Tebaldi, C., Mastrandrea, M.D., Falcon, W.P. and Naylor, R.L. (2008). Prioritizing climate change adaptation needs for food security in 2030, *Science*, Vol. 319, No. 5863, pp.607-610, https://www-jstor-org.mmu.idm.oclc.org/stable/20053254 [accessed 11th April 2019].
- Lobell, D.B., Cassman, K.G. and Field, C.B. (2009). Crop yield gaps: their importance, magnitudes, and causes, *Annual Review of Environment and Resources*, Vol. 34, pp.179-204, https://doi.org/10.1146/annurev.environ.041008.093740 [accessed 11th April 2019].
- Lobell, D.B., Hammer, G.L., McLean, G., Messina, C., Roberts, M.J. and Schlenker, W. (2013). The critical role of extreme heat for maize production in the United States, *Nature Climate Change*, Vol. 3, pp.497-501, https://doi.org/10.1038/nclimate1832 [accessed 11th April 2019].
- Lobell, D.B., Schlenker, W. and Costa-Roberts, J. (2011). Climate trends and global crop production since 1980, *Science*, Vol. 333, Iss. 6042, pp.616-620, doi: 10.1126/science.1204531.
- Lobly M., Butler A. and Winter M. (2010). Local organic food for local people - organic marketing strategies in England and Wales, *Regional Studies*, Vol. 47, No. 2, pp.216-228, doi: 10.1080/00343404.2010.546780.
- Loboguerrero, A.M., Campbell, B.M., Cooper, P.J.M., Hansen, J.W., Rosenstock, T. and Wollenberg, E. (2019). Food and earth systems: priorities for climate change adaptation and mitigation for agriculture and food systems, *Sustainability*, Vol. 11, No. 5, pp.1372, https://doi.org/10.3390/su11051372 [accessed 11th April 2019].
- Lock, K., Smith, R.D., Dangour, A.D., Keogh-Brown, M., Pigatto, G., Hawkes, C., Fisberg, R.M. and Chalabi, Z. (2010). Health, agricultural, and economic effects of adoption of healthy diet recommendations, *The Lancet*, Vol. 376, pp.1699-1709, doi:https://doi.org/10.1016/S0140-6736(10)61352-9.
- Lockwood, M. (2018). Right-wing populism and the climate change agenda: exploring the linkages, *Environmental Politics*, Vol. 27, Iss. 4, pp.712-732, https://doi.org/10.1080/09644016.2018.1458411.
- Loder, E. (2015). Big food, big pharma - is science for sale, *BMJ*, Vol. 350, h795, doi: 10.1136/bmj.h795.
- Loetscher, S. and Kreis, L. (2018). *Business model innovation for sustainability: a whitepaper by WWF Switzerland and Impact Hub Zürich*, Zurich, Switzerland: WWF Switzerland, https://www.wwf.ch/sites/default/files/doc-2018-11/2018_11_Busniness_Model_Innovation.pdf [accessed 11th April 2019].
- Lohrberg, F. (2019). Urban agriculture forms in Europe: tools for governance and planning of agrarian landscape, *GeoJournal Library*, Vol 124, pp.133-148, doi: 10.1007/978-3-319-95576-6_9.
- Loladze, I. (2014). Hidden shift of the ionome of plants exposed to elevated CO_2 depletes minerals at the base of human nutrition, *eLife*, Vol. 3, pp.e02245, doi: 10.7554/eLife.02245.

- Lomborg, B. (2019). Don't let vegetarian environmentalists shame you for eating meat. Science is on your side, https://eu.usatoday.com/story/opinion/voices/2019/07/25/vegetarianism-climate-change-meat-vegan-livestock-column/1804090001/ [accessed 11th April 2019].
- London Child Obesity Taskforce (2019). *Every child a healthy weight - ten ambitions for London*, London, UK: Greater London Authority, https://www.sustainweb.org/gffl/every_child_a_healthy_weight/ [accessed 11th April 2019].
- London Food Board (2018). *The London Food Strategy*, London, UK: Greater London Authority.
- Long, S. (2019). Climate change and population growth are making the world's water woes more urgent*,* *The Economist*, Special Report: Water, https://www.economist.com/special-report/2019/02/28/climate-change-and-population-growth-are-making-the-worlds-water-woes-more-urgent [accessed 11th April 2019].
- Long, S.P., Ainsworth, E.A., Leakey, A.D., Nösberger, J. and Ort, D.R. (2006). Food for thought: lower-than-expected crop yield stimulation with rising CO_2 concentrations, *Science*, Vol. 312, pp.1918-1921, doi: 10.1126/science.1114722.
- Long, T.B., Blok, V. and Cononix, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy, *Journal of Cleaner Production*, Vol. 112, pp.9e21, http://dx.doi.org/10.1016/j.jclepro.2015.06.044 0959-6526/ [accessed 11th April 2019].
- Longo, S.B., Clark, B., York, R. and Jorgenson, A.K. (2019). Aquaculture and the displacement of fisheries captures, *Conservation Biology*, Vol. 33, pp.832-841, doi: 10.1111/cobi.13295.
- Longrich, N. (2019). Were other humans the first victims of the sixth mass extinction? *The Conversation*, 21st November, https://theconversation.com/were-other-humans-the-first-victims-of-the-sixth-mass-extinction-126638 [accessed 11th April 2019].
- Loopstra, R. and Lalor, D. (2017). *Financial insecurity, food insecurity and disability*, Salisbury, UK: Trussell Trust, https://trusselltrust.org/wp-content/uploads/sites/2/2017/06/OU_Report_final_01_08_online.pdf [accessed 11th April 2019].
- Lopez-Gunn, E. and Llamas, M.R. (2008). Re-thinking water scarcity - can science and technology solve the global water crisis, *Natural Resources Forum*, Vol. 32, pp.228-238, https://doi.org/10.1111/j.1477-8947.2008.00200.x [accessed 11th April 2019].
- Lopez-Medina, I.M., Álvarez-Nieto, C., Grose, J., Elsbernd, A., Huss, N., Huynen, M. and Richardson, J. (2019). Competencies on environmental health and pedagogical approaches in the nursing curriculum: a systematic review of the literature, *Nurse Education in Practice,* Vol. 37, pp.1-8, https://doi.org/10.1016/j.nepr.2019.04.004 [accessed 15th April 2020].

- Lopez-Ridaura, S., Frelat, R., van Wijk, M., Valbuena, D., Krupnik, T. and Jat, M. (2018). Climate smart agriculture, farm household typologies and food security: an ex-ante assessment from Eastern India, *Agricultural Systems*, Vol. 159, pp.57-68, https://doi.org/10.1016/j.agsy.2017.09.007 [accessed 11th April 2019].
- Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L. (2007). Barriers perceived to engaging with climate change among the UK public and their policy implications, *Global Environmental Change*, Vol. 17, No. 3-4, pp.445-459, https://doi.org/10.1016/j.gloenvcha.2007.01.004 [accessed 11th April 2019].
- Lotze-Campen, H., Müller, C., Bondeau, A., Rost, S., Popp, A., and Lucht, W. (2008). Global food demand, productivity growth, and the scarcity of land and water resources, *Agricultural Economics*, Vol. 39, pp.325-338, doi: 10.1111/j.1574-0862.2008.00336.x.
- Louie, J.C.Y. and Rangan, A.M. (2018). No need to change dairy food dietary guidelines yet, *The Lancet*, 11th September, Vol. 392, Iss. 10161, pp.2242-2244, doi: https://doi.org/10.1016/S0140-6736(18)31945-7.
- Louro Caldeira, S., Storcksdieck Genannt Bonsmann, S., Bakogianni, I., Gauci, C., Calleja, A. and Furtado, A. (2017). *Public procurement of food for health: technical report on the school setting*, Brussels, Belgium: Publications Office of the European Commission.
- Love, D.C., Fry, J.P., Li, X., Hill, E.S., Genello, L., Semmens, K. and Thompson, R.E. (2015). Commercial aquaponics production and profitability, *Aquaculture*, Vol. 435, pp.67-74, http://dx.doi.org/10.1016/j.aquaculture.2014.09.023 [accessed 11th April 2019].
- Love, D.C., Fry, J.P., Milli, M.C. and Neff, R.A. (2015). Wasted seafood in the United States: quantifying loss from production to consumption and moving toward solutions, *Global Environmental Change*, Vol. 35, pp.116, https://doi.org/10.1016/j.gloenvcha.2015.08.013 [accessed 11th April 2019].
- Lovera, M. (2015). *Meat from a landscape under threat: testimonies of the impacts of unsustainable livestock and soybean production in Paraguay*, Global Forest Coalition and Brighter Green.
- Lovins, A.B. (2019). Recalibrating climate prospects, *Environmental Research Letters*, Vol. 14, No. 120201, https://doi.org/10.1088/1748-9326/ab55ab.
- Lowe, J.A., Bernie, D., Bett, P.E., Bricheno, L., Brown, S., Calvert, D., Clark, R.T., Eagle, K.E., Edwards, T., Fosser, G., Fung, F., Gohar, L., Good, P., Gregory, J., Harris, G.R., Howard, T., Kaye, N., Kendon, E.J., Krijnen, J., Maisey, P., McDonald, R.E., McInnes, R.N., McSweeney, C.F., Mitchell, J.F.B., Murphy, J.M., Palmer, M., Roberts, C., Rostron, J.W., Sexton, D.M.H., Thornton, H.E., Tinker, J., Tucker, S., Yamazaki, K. and Belcher, S. (2018). *UKCP18 Science Overview report*, Exeter, UK: Met Office.
- Lowy Institute Poll (2018). *Climate change and concern about global warming,* https://lowyinstitutepoll.lowyinstitute.org/climate-change-and-energy/ [accessed on 19 July 2018]
- Lozano-Cabedo, C. and Gomez-Benito, C. (2017). A theoretical model of food citizenship for the analysis of social praxis, *Journal of Agricultural and Environmental Ethics*, doi: 10.1007/s10806-016-9649-0.

- LRO (2007). *The value of food and farming in Lincolnshire*, Lincoln, UK: Lincolnshire Research Observatory / Lincolnshire County Council.
- LRO (2011). *The Horticultural Industry in Lincolnshire*, Lincoln, UK: Lincolnshire Research Observatory / Lincolnshire County Council.
- LRO (2012). *Climate Change and Greater Lincolnshire: a review of policy, baselines, current practice and opportunities*, Lincoln, UK: Lincolnshire Research Observatory / Lincolnshire County Council.
- Lu, G. and Koufteros, X. (2017). Toward a taxonomy of food supply chain security practices, *Journal of Marketing Channels*, Vol 24, No. 3-4, pp.190-203, https://doi.org/10.1080/1046669X.2017.1393237 [accessed 11th April 2019].
- Lucas, C., Jones, A. and Hines, C. (2006). *Fuelling a food crisis: the impact of peak oil on food security*, The Greens/ Eurpoean Green Alliance, https://www.resilience.org/stories/2007-01-03/fuelling-food-crisis-impact-peak-oil-food-security/ [accessed 11th April 2019].
- Lucas, C., Leith, P. and Davison, A. (2014). How climate change research undermines trust in everyday life: a review, *Climate Change*, Vol. 6, No. 1, pp.79-91, https://doi.org/10.1002/wcc.320 [accessed 11th April 2019].
- Lucas, T. and Horton, R. (2019). The 21st-century great food transformation, *The Lancet*, Vol. 393, No. 10170, pp.386-387, http://dx.doi.org/10.1016/S0140-6736(18)33179-9 [accessed 11th April 2019].
- Lucey, J. and Hill, J. (2015). *Co-benefits for biodiversity and carbon in land planning decisions within oil palm landscapes*, Oil palm Research-Policy Partnership Network, http://www.sensorproject.net/wp-content/uploads/2015/09/Biodiversity-and-C-stock-report_FINAL.pdf [accessed 11th April 2019].
- Luck, J., Spackman, M., Freeman, A., Trebicki, P., Griffiths, W., Finlay, K. and Chakraborty, S. (2011). Climate change and diseases of food crops, *Plant Pathology*, Vol. 60, No. 1, pp.113-121, https://doi.org/10.1111/j.1365-3059.2010.02411.x [accessed 11th April 2019].
- Lugsdin, J. and Hook, C. (2016). Climate change and health, *The Lancet*, Vol. 387, Iss. 10017, p.431, doi:https://doi.org/10.1016/S0140-6736(16)00172-0.
- Lui, Y. and Wein, L.M. (2008). Mathematically assessing the consequences of food terrorism scenarios, Journal of Food Science, Vol. 73, No. 7, M346-M353, doi: 10.1111/j.1750-3841.2008.00874.x.
- Lunt, T., Jones, A.W., Mulhern, W., le Zaks, D. and Jahn, M. (2016). Vulnerabilities to agricultural production shocks: an extreme, plausible scenario for assessment of risk for the insurance sector, *Climate Risk Management*, Vol. 13, No. 1, pp.1-9, https://doi.org/10.1016/j.crm.2016.05.001 [accessed 11th April 2019].
- Lupova-Henry, E. and Dotti, N.F. (2019). Governance of sustainable innovation: moving beyond the hierarchy-market-network trichotomy? A systematic literature review using the 'who-how-what' framework, *Journal of Cleaner Production*, Vol. 210, pp.738-748, https://doi.org/10.1016/j.jclepro.2018.11.068 [accessed 11th April 2019].

- Lutz, W. and Samir, K.C. (2010). Dimensions of global population projections: what do we know about future population trends and structures? *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2779-2791, https://doi.org/10.1098/rstb.2010.0133 [accessed 11th April 2019].
- Lynas, M. (2018). *Seeds of science: why we got it so wrong on GMOs*, London, UK: Bloomsbury Publishing.
- Lynch, J. (2019). *Agricultural methane and its role as a greenhouse gas*, Oxford, UK: University of Oxford Food Climate Research Network.
- Lynch, J. (2019). Availability of disaggregated greenhouse gas emissions from beef cattle production: a systematic review, *Environmental Impact Assessment Review*, Vol. 76, pp.69-78, https://doi.org/10.1016/j.eiar.2019.02.003 [accessed 11th April 2019].
- Lynch, J. and Pierrehumbert, R. (2019). Climate impacts of cultured meat and beef cattle, *Frontiers in Sustainable Food Systems*, Vol. 3, No. 5, 19th February 2019, doi: 10.3389/fsufs.2019.00005.
- Lynch, J., Garnett, T., Persson, M., Röös, E. and Reisinger, A. (2020). *Methane and the sustainability of ruminant livestock*, Foodsource building blocks, Food Climate Research Network, University of Oxford.
- Lyster, S. (2015). Macknade - fine and dandy, *The Grocer*, 25th July, pp.25-29.
- Lytle, L.A. and Sokol, R.L. (2017). Measures of the food environment: a systematic review of the field, 2007-2015, *Health & Place*, Vol. 44, pp.18-34, doi: 10.1016/j.healthplace.2016.12.007.
- Maas, J.B. (2018). Towards a European Food and Nutrition Policy. Healthy lifestyles and sustainable diets require changes from consumers as well as the food system at large, including governments, Wageningen University & Research, https://www.wur.nl/en/article/Towards-a-European-Food-and-Nutrition-Policy.htm [accessed 11th April 2019].
- Macalister, T. and Badal, L. (2010). Peak oil alarm revealed by secret official talks: behind government dismissals of 'alarmist' fears there is growing concern over critical future energy supplies, *The Observer*, 22nd August.
- Macaskill, M. and Leake, J. (2020). Outlawed insecticide may be used on Scottish salmon: scientific experts fear ‘catastrophe’ if Norwegian firm’s parasite treatment is deployed on fish farms in Scotland, *The Sunday Times*, 14th June, https://www.thetimes.co.uk/article/outlawed-insecticide-may-be-used-on-scottish-salmon-kgfs5s2rh [accessed 15th June, 2020].
- Macdiarmid, J. (2013). Is a healthy diet an environmentally sustainable diet? *Proceedings of the Nutrition Society*, Vol. 72, pp.13-20, doi: 10.1017/S0029665112002893.
- Macdiarmid, J., Douglas, F. and Campbell, J. (2016). Eating like there's no tomorrow: public awareness of the environmental impact of food and reluctance to eat less meat as part of a sustainable diet, *Appetite*, Vol. 96 pp.487-493, https://doi.org/10.1016/j.appet.2015.10.011 [accessed 11th April 2019].
- Macdiarmid, J., Kyle, J., Horgan, G., Loe, J., Fyfe, C., Johnstone, A. and McNeill, G. (2013). *Is a healthy diet an environmentally sustainable diet*, Godalming, UK: WWF-UK.

- Macdiarmid, J., Kyle, J., Horgan, G., Loe, J., Fyfe, C., Johnstone, A. and McNeill, G. (2011). *Livewell - a balance of healthy and sustainable food choices*, https://livewellforlife.eu/wp-content/uploads/2013/02/A-balance-of-healthy-and-sustainable-food-choices.pdf [accessed 11th April 2019].
- Macdiarmid, J.I. (2014). Seasonality and dietary requirements - will eating seasonal food contribute to health and environmental sustainability, *Proceedings of the Nutrition Society*, Vol. 73, pp.368-375, doi:10.1017/S0029665113003753.
- Macdiarmid, J.I. and Whybrow, S. (2019). Nutrition from a climate change perspective, *Proceedings of the Nutrition Society*, Vol. 78, No. 3, pp.380-387, pp.380-387, doi: 10.1017/S0029665118002896.
- Macdiarmid, J.I., Clark, H., Whybrow, S., de Ruiter, H. and McNeill, G. (2018). Assessing national nutrition security: the UK reliance on imports to meet population energy and nutrient recommendations, *PLoS One*, Vol. 13, No. 2, pp. e0192649, https://doi.org/10.1371/journal.pone.0192649 [accessed 11th April 2019].
- Macdiarmid, J.I., Douglas, F. and Campbell, J. (2016). Eating like there's no tomorrow: public awareness of the environmental impact of food and reluctance to eat less meat as part of a sustainable diet, *Appetite*, Vol. 96, pp.487-493, https://doi.org/10.1016/j.appet.2015.10.011 [accessed 11th April 2019].
- Macdiarmid, J.I., Kyle, J., Horgan, G. W., Loe, J., Fyfe, C., Johnstone, A. and McNeill, G. (2012). Sustainable diets for the future: can we contribute to reducing greenhouse gas emissions by eating a healthy diet? Th*e American Journal of Clinical Nutrition*, Vol. 96, No. 3, pp.632-639, doi: 10.3945/ajcn.112.038729.
- MacDonald, G.K. (2013). Eating on an interconnected planet, *Environmental Research Letters*, Vol. 8, 021002, doi:10.1088/1748-9326/8/2/021002.
- Mace, G. (2019). We need to change our land use practices now to solve the environmental crisis, *Green Alliance Blog*, 22nd May, https://greenallianceblog.org.uk/2019/05/22/we-need-to-change-our-land-use-practices-now-to-solve-the-environmental-crisis/ [accessed 11th April 2019].
- MacFarlane, A. and O'Reilly de Brún, M. (2011). Using a theory-driven conceptual framework in qualitative health research, *Qualitative Health Research*, Vol. 22, No. 5, pp.607-618, doi: 10.1177/1049732311431898.
- Mach, E. (2018). How policymakers can help to address the food insecurity-related causes of migration, *The Economist Intelligence Unit*, 8th June, http://foodsustainability.eiu.com/policymakers-can-help-address-food-insecurity-related-causes-migration [accessed 11th April 2019].
- Machado, E., Mussatto, S., Teixeira, J., Vilanova, M. and Oliveira, J. (2018). Increasing the sustainability of the coffee agro-industry: spent coffee grounds as a source of new beverages, *Beverages*, Vol. 4, No. 4, pp.105, doi: 10.3390/beverages4040105.

- Machado, R.T.M. and Pedini, S. (2008). Fair trade certification as tool for coordination and changing the coffee conventional trade practices, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands.
- Machovina, B., Feeley, K.J. and Ripple, W.J. (2015). Biodiversity conservation: the key is reducing meat consumption, *Science of The Total Environment*, Vol. 536, pp.419-431, https://doi.org/10.1016/j.scitotenv.2015.07.022 [accessed 11th April 2019].
- Macintosh, K.A., Chin, J., Jacobs, B., Cordell, D., McDowell, R.W. and Butler, P. (2019). Transforming phosphorus use on the island of Ireland: a model for a sustainable system, *Science of the Total Environment*, Vol. 656, pp.852-861, https://doi.org/10.1016/j.scitotenv.2018.11.389 [accessed 11th April 2019].
- Maciulevičius, M. (2016). Opinion of the European Economic and Social Committee on 'More sustainable food systems' (exploratory opinion), *Official Journal of the European Union*, 2016/C 303/08, 19th August, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016AE0232&from=EN [accessed 15th April 2019].
- Mackenbach, J.D.; Nelissen, K.G.M., Dijkstra, S.C., Poelman, M.P., Daams, J.G., Leijssen, J.B. and Nicolaou, M. (2019). A systematic review on socioeconomic differences in the association between the food environment and dietary behaviors, *Nutrients*, Vol. 11, Iss. 9, pp.2215, doi: 10.3390/nu11092215.
- MacLeod, M., Eory, V., Gruère, G. and Lankoski, J. (2015). Cost-effectiveness of greenhouse gas mitigation measures for agriculture - a literature review, *OECD Food, Agriculture and Fisheries Papers*, No. 89, Paris: OECD Publishing, http://dx.doi.org/10.1787/5jrvvkq900vj-en [accessed 11th April 2019].
- MacLeod, M., Gerber, P., Mottet, A., Tempio, G., Falcucci, A., Opio, C., Vellinga, T., Henderson, B. and Steinfeld, H. (2013). *Greenhouse gas emissions from pig and chicken supply chains – A global life cycle assessment*, Rome, Italy: Food and Agriculture Organization of the United Nations (FAO), http://www.fao.org/3/i3460e/i3460e.pdf [accessed 11th April 2019].
- Macmillan, A. (2019). Climate Q&A - will we be less healthy because of climate change, https://menafn.com/1098853478/Climate-QA-will-we-be-less-healthy-because-of-climate-change [accessed 11th April 2019].
- MacMillan, T. and Dowler, E. (2012). Just and sustainable? Examining the rhetoric and potential realities of UK food security, *Journal of Agricultural and Environmental Ethics*, Vol. 25, pp.181-204, doi:10.1007/s10806-011-9304-8.
- MacSween, K. and Feliciano, D. (2018). Comparison of online greenhouse gas accounting tools for agriculture - six tools that support the assessment of climate change mitigation in the land use sector, doi: 10.13140/RG.2.2.24591.74400.
- Mäder, P., Fließbach, A., Dubois, D., Gunst, L., Fried, P. and Niggli, U. (2002). Soil fertility and biodiversity in organic farming, *Science*, Vol. 296, No. 5573, pp.1694-1697, http://www.jstor.org/stable/3076892 [accessed 11th April 2019].

- Madin, E.M.P. and Macreadie, P.I. (2015). Incorporating carbon footprints into seafood sustainability certification and eco-labels, *Marine Policy*, Vol. 57, pp.178-181, http://dx.doi.org/10.1016/j.marpol.2015.03.009 [accessed 11th April 2019].
- Maestre-Andrés, S., Drews, S. and van den Bergh, J. (2019). Perceived fairness and public acceptability of carbon pricing - a review of the literature, *Climate Policy*, Vol. 19, No. 9, pp.1186-1204, https://doi.org/10.1080/14693062.2019.1639490 [accessed 11th April 2019].
- Magan, N., Medina, A. and Aldred, D. (2011). Possible climate-change effects on mycotoxin contamination of food crops pre- and postharvest, *Plant Pathology*, Vol. 60, No. 1, pp.150-163, doi: 10.1111/j.1365-3059.2010.02412.x.
- Maggio, A., Criekinge, T.V. and Malingreau, J.P. (2015). *Global Food Security 2030: assessing trends with a view to guiding future EU policies*, Brussels: European Commission Joint Research Centre.
- Magkos, F., Arvaniti, F. and Zampelas, A. (2006). Organic food – buying more safety or just peace of mind – a critical review of the literature, *Critical Reviews in Food Science and Nutrition,* Vol. 46, No. 1, pp.23-56, doi: 10.1080/10408690490911846.
- Magkos, F., Tetens, I., Bügel, S.G., Felby, C., Schacht, S.R., Hill, J.O., Ravussin, E. and Astrup, A. (2020). The environmental foodprint of obesity, *Obesity*, Vol. 28, pp.73-79, doi:10.1002/oby.22657.
- Mah, C.L., Luongo, G., Hasdell, R., Taylor, N.G.A. and Lo, B.K. (2019). A systematic review of the effect of retail food environment interventions on diet and health with a focus on the enabling role of public policies, *Current nutrition reports,* Vol. 8, No. 4, pp.411-428, doi: 10.1007/s13668-019-00295-z.
- Mahon, N., Croute, I., Simmons, E. and Islam, M.M. (2017). Sustainable intensification – ‘‘oxymoron” or ‘‘third-way”? A systematic review, *Ecological Indicators*, Vol. 74, pp.73-97, https://doi.org/10.1016/j.ecolind.2016.11.001 [accessed 11th April 2020].
- Mahony, C.R. and Cannon, A.J. (2018). Wetter summers can intensify departures from natural variability in a warming climate, *Nature Communications*, Vol. 9, No. 1, doi: 10.1038/s41467-018-03132-z.
- Maia, A.G., Miyamoto, B.C.B. and Garcia, J.R. (2018). Climate change and agriculture: do environmental preservation and ecosystem services matter? *Ecological Economics*, Vol. 152, pp.27-39, https://doi.org/10.1016/j.ecolecon.2018.05.013 [accessed 11th April 2019].
- Maini, R., Law, R., Duque, F., Balboa, G., Noda, H., Nakamura, S. and Murray, V. (2017). Monitoring progress towards planetary health, *British Medical Journal*, 7th December, Vol. 359, doi: 10.1136/bmj.j5279.
- Mairie de Paris (2015). Sustainable Food Plan 2015–2020. Direction des espaces verts et de l’environnement, Paris, France, 29 pp, https://api-sitecdn.paris.fr/images/76336 [accessed 11th April 2019].
- Majeed, H. and Lee, J. (2017). The impact of climate change on youth depression and mental health, *Lancet Planet Health*, Vol. 1, pp.e94-e95, https://www.thelancet.com/pdfs/journals/lanplh/PIIS2542-5196(17)30045-1.pdf [accessed 11th April 2019].

- Makarem, N., Bandera, E.V., Nicholson, J.M. and Parekh, N. (2018). Consumption of sugars, sugary foods, and sugary beverages in relation to cancer risk: a systematic review of longitudinal studies, *Annual Review of Nutrition*, Vol. 38, pp.17-39, doi: 10.1146/annurev-nutr-082117-051805 [accessed 15th April 2020].
- Malden, C., Nesheim, M.O. and Tsai Yih, P. (eds)(2015) IOM (Institute of Medicine) and NRC (National Research Council). *A framework for assessing effects of the food system*. Washington, USA: The National Academies Press, ISBN-13: 978-0-309-30780-2, https://www.nap.edu/catalog/18846/a-framework-for-assessing-effects-of-the-food-system [accessed 15th April 2019].
- Malecki, C. (2018). French implementation of the EU CSR Directive: sustainable corporate governance has begun, *Law and Financial Markets Review*, Vol. 12, No. 2, pp.86-92, https://doi.org/10.1080/17521440.2018.1467816 [accessed 11th April 2019].
- Malhotra, A., Melville, N.P. and Watson, R.T. (2013). Spurring impactful research on information systems for environmental sustainability, *MIS Quarterly*, Vol. 37, No. 4, pp.1265-1274, https://doi.org/10.25300/MISQ/2013/37:4.3 [accessed 11th April 2019].
- Malig, M.L. and Hall, R. (2017). *Our food is not your business – alternatives to unsustainable livestock and feedstock farming and the current corporate free trade model*, Asunción, Paraguay: Global Forest Coalition, https://globalforestcoalition.org/our-food-is-not-your-business/ [accessed 11th April 2019].
- Mallinson, L.J., Russell, J.M. and Barker, M.E. (2016). Attitudes and behaviour towards convenience food and food waste in the United Kingdom, *Appetite*, Vol. 103, pp.17-28, http://dx.doi.org/10.1016/j.appet.2016.03.017 [accessed 11th April 2019].
- Malochleb, M. (2018). Sustainability: how food companies are turning over a new leaf, *Food Technology*, Vol 72, No. 8, pp.32-45, https://www.ift.org/news-and-publications/food-technology-magazine/issues/2018/august/features/sustainability-at-food-companies [accessed 11th April 2019].
- Malone, T.C., DiGiacomo, P.M., Gonçalves, E., Knap, A.H., Talaue-McManus, L. and deMora, S. (2014). A global ocean observing system framework for sustainable development, *Marine Policy*, Vol. 43, pp.262-272, http://dx.doi.org/10.1016/j.marpol.2013.06.008 [accessed 11th April 2019].
- Maloni, M.J. and Brown, M.E. (2006). Corporate Social Responsibility in the supply chain - an application in the food industry, *Journal of Business Ethics*, Vol. 68, pp.35-52, doi:10.1007/s10551-006-9038-0.
- Malthus, T.R. (1798). *An essay on the principle of population*, London, UK: J. Johnson.
- Manabe, S. and Wetherald, R. (1967). Thermal equilibrium of the atmosphere with a given degree of relative humidity, *Journal of the Atmospheric Sciences*, Vol. 24, pp.241-259, doi: 10.1175/1520-0469(1967)024<0241:TEOTAW>2.0.CO;2.
- Manchester City Council (2018). Playing our full part on climate change - updating Manchesters Commitment, http://www.manchesterclimate.com/sites/default/files/Appendix%201%20-%20Technical%20Report%20.pdf [accessed 11th April 2019].

- Mandal, S. (2016). Greenhouse gas emission of food groups and diet: healthy choices at odds with the environment: a systematic review, Conference: 81st Annual Scientific Meeting of the American-College-of-Gastroenterology, Las Vegas, 21-26th October, *American Journal of Gastroenterology*, Vol. 111, Supp. 1, pp.S1276-S1277.
- Maniates, M. (2010). *State of the world: transforming cultures - from consumerism to sustainability,* Washington, USA: Worldwatch Institute.
- Mann, A. (2017). Growing food in the post-truth era, *The Conversation*, 30th June, https://theconversation.com/growing-food-in-the-post-truth-era-78256 [accessed 11th April 2019].
- Manners, R. and van Etten, J. (2018). Are agricultural researchers working on the right crops to enable food and nutrition security under future climates? *Global Environmental Change*, Vol. 53, pp.182-194, https://doi.org/10.1016/j.gloenvcha.2018.09.010 [accessed 11th April 2019].
- Manning, A. (1972). Blueprint for Survival, *Nature*, Vol. 235, p.179, https://doi.org/10.1038/235179a0 [accessed 11th April 2019].
- Manning, L. (2013). Corporate and consumer social responsibility in the food supply chain, *British Food Journal*, Vol. 115, Iss. 1, pp.9-29, https://doi.org/10.1108/00070701311289858 [accessed 11th April 2019].
- Manning, L., Baines, R.N. and Chadd, S.A. (2006). Ethical modelling of the food supply chain, *British Food Journal*, Vol. 108, Iss. 5, pp.358-370, http://dx.doi.org/10.1108/00070700610661330 [accessed 11th April 2019].
- Mantyka-Pringle, C.S., Martin, T.G., Moffatt, D.G., Linke, S. and Rhodes, J.R. (2014). Understanding and predicting the combined effects of climate change and land-use change on freshwater macroinvertebrates and fish, *Journal of Applied Ecology*, Vol. 51, pp.572-581, doi: 10.1111/1365-2664.12236.
- Manzini, R., Accorsi, R., Ayyad, Z., Bendini, A., Bortolini, M., Gamberi, M., Valli, E. and Gallina Toschi, T.G. (2014). Sustainability and quality in the food supply chain: a case study of shipment of edible oils, *British Food Journal*, Vol. 116, Iss. 12, pp.2069-2090, https://doi.org/10.1108/BFJ-11-2013-0338 [accessed 11th April 2019].
- Maracchi, G., Sirotenko, O. and Bindi, M. (2005). Impacts of present and future climate variability on agriculture and forestry in the temperate regions: Europe, *Climatic Change*, Vol. 70, No. 1, pp.117-135, doi: 10.1007/s10584-005-5938-8.
- Marcano-Olivier, M.I., Horne, P.J., Viktor, S. and Erjavec, M. (2020). Using nudges to promote healthy food choices in the school dining room: a systematic review of previous investigations, *Journal of School Health,* Vol. 90, No. 2, pp. 143-157, https://doi.org/10.1111/josh.12861 [accessed 15th April 2020].
- Marcantonio, F., Hostak, R., Hertzberg, J.E. and Schmidt, M.W. (2020). Deep Equatorial Pacific Ocean oxygenation and atmospheric CO_2 over the last ice age, *Scientific Reports*, Vol. 10, No. 1, doi: 10.1038/s41598-020-63628-x.

- Marette, S. (2019). The ambiguous impact of information related to fish sustainability, *Journal of Agricultural and Food Industrial Organization*, Vol. 17, No. 2, doi: https://doi.org/10.1515/jafio-2018-0006 [accessed 11th April 2020].
- Margulis, M.E. (2013). The regime complex for food security - implications for the global hunger challenge, *Global Governance*, Vol. 19, No. 1, pp.53-67, doi: 10.1163/19426720-01901005.
- Marine Stewardship Council (2014). *Global impacts delivered in partnership Commercial commitments*, May, London, UK: Marine Stewardship Council.
- Marland, G., Kowalczyk, T. and Cherry, T.L. (2015). Green fluff? The role of corporate sustainability initiatives in effective climate policy: comment on -science-based carbon targets for the corporate world: the ultimate sustainability commitment, or a costly distraction? *Journal of Industrial Ecology*, Vol. 19, Iss. 6, pp. 934-936, https://doi.org/10.1111/jiec.12343 [accessed 11th April 2019].
- Marlon, J.R., Bloodhart, B., Ballew, M.T., Rolfe-Redding, J., Roser-Renouf, C., Leiserowitz, A. and Maibach, E. (2019). How hope and doubt affect climate change mobilization, *Frontiers in Communication*, 21st May, https://doi.org/10.3389/fcomm.2019.00020 [accessed 11th April 2019].
- Marschke, M., Lykhim, O. and Kim, N. (2014). Can local institutions help sustain livelihoods in an era of fish declines and persistent environmental change, *Sustainability*, Vol. 6, pp.2490-2505, doi:10.3390/su6052490.
- Marsden, T. (2013). From post-productionism to reflexive governance - contested transitions in securing more sustainable food futures, *Journal of Rural Studies*, Vol. 29, pp.123-134, doi:10.1016/j.jrurstud.2011.10.001.
- Marsden, T. and Morley, A. (eds)(2014). *Sustainable food systems - building a new paradigm*, London, UK: Routledge, ISBN: 9780415639552
- Marsden, T., Morgan, K. and Morley, A. (2016). *Food policy as public policy: a review of the Welsh Government's Food Strategy and Action Plan*, June, Cardiff, UK: Public Policy Institute for Wales, http://ppiw.org.uk/files/2016/06/PPIW-Report-Food-Policy-as-Public-Policy.pdf [accessed 11th April 2019].
- Marteah, T. (2018). Chapter 8: Changing Behaviour for a Healthier Population. In: Pearson-Stuttard, J. (ed.) *Annual report of the Chief Medical Officer 2018: health 2040- better health within reach*, London: Department of Health and Social Care.
- Marten, R., Kadandale, S., Nordstrom, A. and Smith, R.D. (2018). Shifting global health governance towards the sustainable development goals, *Bulletin of the World Health Organization*, Vol. 96, No. 12, pp.798-798A, http://dx.doi.org/10.2471/BLT.18.209668 [accessed 11th April 2019].
- Martin, A.R., Cadotte, M.W., Isaac, M.E., Milla, R., Vile, D. and Violle, C. (2019). Regional and global shifts in crop diversity through the Anthropocene, *PLoS One*, Vol. 14, No. 2, e0209788 doi: 10.1371/journal.pone.0209788.

- Martin, M. and Brandão, M. (2017). Evaluating the environmental consequences of Swedish food consumption and dietary choices, *Sustainability*, Vol. 9, No. 12, p.2227, https://doi.org/10.3390/su9122227 [accessed 11th April 2019].
- Martindale, W. (2014). *Global food security and supply*, Wiley-Blackwell, ISBN: 978-1-118-69932-4.
- Martindale, W. (2017). Is vegan or vegetarian really any better for the environment? *The Conversation*, 26th January, https://theconversation.com/is-a-vegetarian-diet-really-more-environmentally-friendly-than-eating-meat-71596 [accessed 11th April 2019].
- Martinet, V., Peña-Torres, J., De Lara, M. and Ramírez, H.C. (2016). Risk and sustainability - assessing fishery management strategies, *Environmental and Resource Economics*, Vol. 64, pp.683-707, doi: 10.1007/s10640-015-9894-0.
- Martinez-Harms, M.J., Bryan, B.A., Figueroa, E., Pliscoff, P., Runting, R.K. and Wilson, K.A. (2017). Scenarios for land use and ecosystem services under global change, *Ecosystem Services*, Vol. 25, pp.56-68, https://doi.org/10.1016/j.ecoser.2017.03.021 [accessed 11th April 2019].
- Martín-Martín, A., Orduna-Malea, E., Thelwall, M. and Delgado López-Cózar, E. (2018). Google Scholar, Web of Science, and Scopus: a systematic comparison of citations in 252 subject categories, *Journal of Informetrics*, Vol. 12, No. 4, pp.1160-1177, https://doi.org/10.1016/J.JOI.2018.09.002 [accessed 15th April 2020].
- Maruyama, M. and Hirogaki, M. (2007) The evolution of fresh produce supply chains: from spot markets to contracts, *The International Review of Retail, Distribution and Consumer Research*, Vol. 17, No. 4, pp.359-376, doi: 10.1080/09593960701507575.
- Maslin, M. (2019). Five climate change science misconceptions – debunked, *The Conversation*, 15th September, https://theconversation.com/five-climate-change-science-misconceptions-debunked-122570 [accessed 11th April 2019].
- Maslin, M. and Lewis. S. (2019). Reforesting an area the size of the US needed to help avert climate breakdown, say researchers – are they right? *The Conversation*, 4th July, https://theconversation.com/reforesting-an-area-the-size-of-the-us-needed-to-help-avert-climate-breakdown-say-researchers-are-they-right-119842 [accessed 11th April 2019].
- Mason, P. (2019). My manifesto for a post-carbon future, *New Statesman*, 17th July, https://www.newstatesman.com/politics/environment/2019/07/my-manifesto-post-carbon-future [accessed 11th April 2019].
- Mason, P. (2019). Tackling the climate crisis means the end of capitalism as we know it, centralised state intervention, planning and ownership could be the only way to achieve the rapid reduction in carbon we need, *New Statesman*, 26th June, https://www.newstatesman.com/politics/economy/2019/06/tackling-climate-crisis-means-end-capitalism-we-know-it [accessed 11th April 2019].
- Mason, P. and Lang, L. (2017). *Sustainable diets: how ecological nutrition can transform consumption and the food system*, London, UK: Routledge, ISBN-10: 0415744709.

- Mason, R.A. (2015). The sixth mass extinction and chemicals in the environment - our environmental deficit is now beyond nature's ability to regenerate, *Journal of Biological Physics and Chemistry*, Vol. 15, pp.160-176, doi: 10.4024/10MA15F.jbpc.15.03.
- Mason-D'Croz, D., Bogard, J.R., Sulser, T.B., Cenacchi, N., Dunston, S., Herrero, M. and Wiebe, K. (2019). Gaps between fruit and vegetable production, demand, and recommended consumption at global and national levels: an integrated modelling study, *The Lancet Planetary Health*, Vol. 3, No. 7, pp.e318-e329, doi: 10.1016/S2542-5196(19)30095-6.
- Masset, G., Soler, L-G., Vieux, F. and Darmon, N. (2014). Identifying sustainable foods: the relationship between environmental impact, nutritional quality, and prices of foods representative of the French diet, *Journal of the Academy of Nutrition and Dietetics*, pp.2212-2672, http://dx.doi.org/10.1016/j.jand.2014.02.002 [accessed 11th April 2019].
- Masud, M.M., Azam, M.N., Mohiuddin, M., Banna, H., Akhtar, R., Alam, A.S.A.F. and Halima Begum, H. (2017). Adaptation barriers and strategies towards climate change: challenges in the agricultural sector, *Journal of Cleaner Production*, Vol. 156, pp.698-706, https://doi.org/10.1016/j.jclepro.2017.04.060 [accessed 11th April 2019].
- Mathijs, E. (2015). *Exploring sustainable futures through foresight*, University of Leuven, Milan, 7th August.
- Matson, P.A., Parton, W.J., Power, A.G. and Swift, M.J. (1997). Agricultural intensification and ecosystem properties, *Science*, 25th July, Vol. 277, Iss. 5325, pp.504-509, doi: 10.1126/science.277.5325.504.
- Matsuoka, Y., Kainuma, M. and Morita, T. (1995). Scenario analysis of global warming using the Asian Pacific Integrated Model (AIM), *Energy Policy*, Vol. 23, No. 4-5, pp.357-371.
- Matthews, A. (2014). Trade rules, food security and the multilateral trade negotiations, *European Review of Agricultural Economics*, Vol. 41, No. 3, pp.511-535, https://doi.org/10.1093/erae/jbu017 [accessed 11th April 2019].
- Matthews, H.D., Peters, G., Allen, M. and Forster, P. (2018). The Climate Clock: Counting down to 1.5℃, *The Conversation*, 5th December, https://theconversation.com/the-climate-clock-counting-down-to-1-5-107498 [accessed 11th April 2019].
- Matthews, J.A. and Briffa, K.R. (2005). The 'little ice age: re-evaluation of an evolving concept, *Geografiska Annaler: Series A, Physical Geography*, Vol. 87, pp.17-36, doi:10.1111/j.0435-3676.2005.00242.x.
- Mattick, C.S. (2018). Cellular agriculture: the coming revolution in food production, *Bulletin of the Atomic Scientists*, Vol. 74, No. 1, pp.32-35, doi: 10.1080/00963402.2017.1413059.
- Mattioni, D. and Caraher, M. (2018). Moving towards ecologically sustainable diets: lessons from an Italian box delivery scheme, *International Journal of Consumer Studies*, Vol. 42, No. 4, pp.430-438, https://doi.org/10.1111/ijcs.12437 [accessed 11th April 2019].

- Maxwell, D., Ahiadeke, C., Levin, C., Armar-Klemesud, M., Zakariah, S. and Lamptey, G.M. (1996). Alternative food-security indicators – revisiting the frequency and severity of coping strategies, *Food Policy*, Vol. 24, pp.411-429, https://doi.org/10.1016/S0306-9192(99)00051-2 [accessed 11th April 2019].
- Maxwell, D.G. (1996). Measuring food insecurity – the frequency and severity of coping strategies, *Food Policy*, Vol. 21, No. 3, pp.291-303, https://doi.org/10.1016/0306-9192(96)00005-X [accessed 11th April 2019].
- Maxwell, D.G., Parker, J.W. and Stobaugh, H.C. (2013). What drives program choice in food security crises: examining the response analysis question, *World Development*, Vol. 49, pp.68-79, https://doi.org/10.1016/j.worlddev.2013.01.022 [accessed 11th April 2019].
- Maxwell, S. (1996). Food security - a post-modern perspective, *Food Policy*, Vol. 21. No. 2, pp.155-170, https://doi.org/10.1016/0306-9192(95)00074-7 [accessed 11th April 2019].
- Maxwell, S. and Lovell, R. (2017). *Evidence statement on the links between natural environments and human health*, Defra and University of Exeter Medical School, https://beyondgreenspace.files.wordpress.com/2017/03/evidence-statement-on-the-links-between-natural-environments-and-human-health1.pdf [accessed 11th April 2019].
- May, C. and Fearne, A. (2014). *From 'nudge' to 'shove': a case study of the failure of social marketing (Tesco's carbon labelling initiative),* Lincoln, UK: University of Lincoln.
- May, M.M. and Rehfeld, K. (2019). ESD Ideas: photoelectrochemical carbon removal as negative emission technology, *Earth System Dynamics*, Vol. 10, No. 1, 1, doi: 10.5194/esd-10-1-2019.
- Maye, D. and Kirwan, J. (2013). Food security framings within the UK and the integration of local food systems, *Journal of Rural Studies*, Vol. 29, pp.91-100, doi:10.1016/j.jrurstud.2012.03.002.
- Mayén, A-L., Marques-Vidal, P., Paccaud, F., Bovet, P. and Stringhini, S. (2014). Socioeconomic determinants of dietary patterns in low- and middle-income countries - a systematic review, *American Journal of Clinical Nutrition*, Vol. 100, pp.1520-1531, doi: 10.3945/ajcn.114.089029.
- Mayer, A., Hausfather, Z., Jones, A.D. and Silver, W.L. (2018). The potential of agricultural land management to contribute to lower global surface temperatures, *Science Advances*, Vol. 4, No. 8, eaaq0932, doi: 10.1126/sciadv.aaq0932.
- Maynard, D. da Costa., Vidigal, M.D., Farage, P., Zandonadi, R.P., Nakano, E.Y. and Botelho, R.B.A. (2020). Environmental, social and economic sustainability indicators applied to food services: a systematic review, *Sustainability*, Vol. 12, Iss. 5, 1804, doi: 10.3390/su12051804.
- Maynard, R. (2009). UK food security: peak oil, climate change and unstable commodity prices mean that British agriculture is in need of a radical transformation, *Soundings*, No. 42, pp.90.
- Mayne, S.L., Auchincloss, A.H. and Michael, Y.L. (2015). Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments, *Obesity Reviews*, Vol. 16, No. 5, pp.362-375, doi: 10.1111/obr.12269.

- May-Tobin, C., Boucher, D., Decker, E., Hurowitz, G., Martin, J., Mulik, K., Roquemore, S. and Stark, A. (2012). *Recipes for success: solutions for deforestation-free vegetable oils*, Cambridge, USA: Union of Concerned Scientists, https://www.ucsusa.org/sites/default/files/2019-09/Recipes-for-Success.pdf [accessed 11th April 2019].
- McAuliffe, G.A., Takahashi, T., Orr, R.J., Harris, P. and Lee, M.R.F. (2018). Distributions of emissions intensity for individual beef cattle reared on pasture-based production systems, *Journal of Cleaner Production*, Vol. 171, pp.1672-1680, https://doi.org/10.1016/j.jclepro.2017.10.113 [accessed 11th April 2019].
- McBratney, A. (2018). In 100 years' time, maybe our food won't be grown in soil, *The Conversation*, 5th December, https://theconversation.com/in-100-years-time-maybe-our-food-wont-be-grown-in-soil-108049 [accessed 11th April 2019].
- McCarthy, M. (2004). The economics of obesity, *The Lancet*, World Report, 18th December, Vol. 364, Iss. 9452, pp.2169-2170, doi:https://doi.org/10.1016/S0140-6736(04)17613-7.
- McCarthy, U., Uysal, I., Badia-Melis, R., Mercier, S., O'Donnell, C. and Ktenioudaki, A. (2018). Global food security - issues, challenges and technological solutions, *Trends in Food Science & Technology*, Vol. 77, pp.11-20, https://doi.org/10.1016/j.tifs.2018.05.002 [accessed 11th April 2019].
- McCarthy, W.J. and Li, Z. (2019). Healthy diets and sustainable food systems, *The Lancet*, Vol. 394, No. 10194, pp.214-214, doi: 10.1016/S0140-6736(19)31109-2.
- McCarty, J.P., Wolfenbarger, L.L. and Wilson, J.A. (2017). Biological impacts of climate change, *In eLS*, John Wiley & Sons, Ltd (ed.), doi:10.1002/9780470015902.a0020480.pub2.
- McCauley, D.J., Jablonicky, C., Allison, E.H., Golden, C.D., Joyce, F.H., Mayorga, J. and Kroodsma, D. (2019). Wealthy countries dominate industrial fishing, *Science Advances*, Vol. 4, Iss. 8, pp.eaau2161, doi: 10.1126/sciadv.aau2161.
- McClanaha, T., Allison, E.H. and Cinner, J.E. (2015). Managing fisheries for human and food security, *Fish and Fisheries*, Vol. 16, pp.78-103, https://doi.org/10.1111/faf.12045.
- McClenachan, L., Dissanayake, S.T.M. and Chen, X. (2016). Fair trade fish: consumer support for broader seafood sustainability, *Fish and Fisheries*, Vol. 17, No. 3, pp.825-838, https://doi.org/10.1111/faf.12148 [accessed 11th April 2020].
- McConnell, T. (2013). What a waste, *The Grocer*, 30th March, pp.42-45.
- McCulloch, S.P. (2019). Brexit and animal welfare impact assessment: analysis of the threats Brexit poses to animal protection in the UK, EU and internationally, *Animals*, Vol. 9, No. 3, p.117, https://doi.org/10.3390/ani9030117 [accessed 11th April 2019].
- McCurry, J. (2015). Warning over Pacific bluefin tuna stocks as Japan meeting ends in stalemate, *The Guardian*, 3rd September, https://www.theguardian.com/environment/2015/sep/04/warning-over-pacific-bluefin-tuna-stocks-as-japan-meeting-ends-in-stalemate [accessed 11th April 2019].

- McDermott, J., Johnson, N., Kadiyala, S., Kennedy, G. and Wyatt, A.J. (2015). Agricultural research for nutrition outcomes: rethinking the agenda, *Food Security*, Vol. 7, No. 3, pp.593-607.
- McDermott, M.S., Oliver, M., Svenson, A., Simnadis, T., Beck, E.J., Coltman, T., Iverson, D., Caputi, P. and Sharma, R. (2015). The theory of planned behaviour and discrete food choices: a systematic review and meta-analysis, *International Journal of Behavioral Nutrition and Physical Activity*, Vol. 12, No. 1, 162, doi: 10.1186/s12966-015-0324-z.
- McDonald, B.L. (2010) *Food security*, Cambridge, UK: Polity, ISBN 074564807X.
- McElhinney, J. (2016). Influencing the agricultural sector to embrace adaptation to climate change, for the sake of global food security, *Environmental Science and Pollution Research*, Vol. 23, pp.9245-9246, doi: 10.1007/s11356-016-6169-4.
- McFadden, B.R. and Malone, T. (2018). How will mandatory labeling of genetically modified food nudge consumer decision-making? *Journal of Behavioral and Experimental Economics*, Vol. 77, pp.186-194, doi: 10.1016/j.socec.2018.09.004.
- McFarlane, G., Lewis, T. and Lang, T. (2018). *Food, Brexit and Northern Ireland - critical issues*, City University, London, UK: Food Research Collaboration / Centre for Food Policy.
- McGettigan, P. and Pollock, A. (2017). The Indian government is not doing enough to tackle the sale of unapproved antibiotics, *The Conversation*, 11th October, https://theconversation.com/the-indian-government-is-not-doing-enough-to-tackle-the-sale-of-unapproved-antibiotics-85432 [accessed 11th April 2019].
- McGilvray, A. (2016). Diet key to feeding the world in 2050 without further deforestation, modelling suggests, *ABC Science Online*, 19th April, https://www.piccc.org.au/news/diet-key-feeding-world-2050-without-further-deforestation-modelling-suggests [accessed 11th April 2019].
- McGowan, A. (2013). Teaching global climate change, *Natural Science*, Vol. 05, No. 01, pp.120-123, doi: 10.4236/ns.2013.51A018.
- McGranahan, G., Balk, D. and Anderson, B. (2007). The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones, *Environment & Urbanization*, Vol. 19, No. 1, pp.17-37, https://doi.org/10.1177/0956247807076960 [accessed 11th April 2019].
- McGrath, M. (2018a). Climate change moving faster than we are, says UN Secretary General, *BBC News*, 10th September, https://www.bbc.co.uk/news/science-environment-45471410 [accessed 11th April 2019].
- McGrath, M. (2018b). Final call to save the world from 'climate catastrophe', *BBC News*, 8th October, https://www.bbc.co.uk/news/science-environment-45775309 [accessed 11th April 2019].
- McGrath, M. (2018c). 'Flexitarian' diets key to feeding people in a warming world, *BBC News*, 11th October, https://www.bbc.co.uk/news/science-environment-45814659 [accessed 11th April 2019].
- McGrath, M. (2019). Climate change: global sea-level rise could be bigger than expected, *The Guardian*, 20th May, https://www.bbc.co.uk/news/science-environment-48337629 [accessed 11th April 2019].

- McGrath, R. (2012). Bread that lasts for 60 days could cut food waste, *BBC News*, 30 November, https://www.bbc.co.uk/news/science-environment-20540758 [accessed 11th April 2019].
- McGuffin, L.E., Price, R.K., McCaffrey, T.A., Hall, G., Lobo, A., Wallace, J.MW., Livingstone M.B. (2015). Parent and child perspectives on family out-of-home eating: a qualitative analysis, *Public Health Nutrition*, Vol. 18, No. 1, pp.100-111, doi: 10.1017/S1368980014001384.
- McGuinness, F., Brown, J. and Ward, M. (2016). *Household food insecurity measurement in the UK*, Number CDP 2016/0238, 2nd December, London, UK: House of Commons Library.
- McGuire, A.D., Lawrence, D.M., Koven, C., Clein, J.S., Burke, E., Chen, G., Jafarov, E., MacDougall, A.H., Marchenko, S., Nicolsky, D., Peng, S., Rinke, A., Ciais, P., Gouttevin, I., Hayes, D.J., Ji, D., Krinner, G., Moore, J.C., Romanovsky, V., Schädel, C., Schaefer, K., Schuur, E.A.G. and Zhuang, Q. (2018). Dependence of the evolution of carbon dynamics in the northern permafrost region on the trajectory of climate change, *Proceedings of the National Academy of Sciences*, 201719903, doi: 10.1073/pnas.1719903115.
- McKain, T. (2017). Killer waters – why the UK's polluted sea led to the death of a whale, *Geographical*, 25th May, https://geographical.co.uk/nature/oceans/item/2254-killer-waters [accessed 11th April 2019].
- McKay, D.I.A., Dearing, J.A., Dyke, J.G., Poppy, G. and Firbank, L.G. (2018). To what extent has sustainable intensification in England been achieved? *Science of the Total Environment*, Vol. 648, pp.1560-1569, https://doi.org/10.1016/j.scitotenv.2018.08.207 [accessed 11th April 2019].
- McKay, F.H., Haines, B.C. and Dunn, M. (2019). Measuring and understanding food insecurity in Australia: a systematic review, *International Journal of Environmental Research and Public Health*, Vol. 16, No. 3, p.476, doi: 10.3390/ijerph16030476.
- McKenna, M. (2017). Big *chicken: the incredible story of how antibiotics created modern agriculture and changed the way the world eats*, Washington, USA: National Geographic Partners, ISBN 1426217668.
- McKenzie, F.C. and Williams, J. (2015). Sustainable food production: constraints, challenges and choices by 2050, *Food Security*, Vol. 7, Iss. 2, pp.221-233, doi: 10.1007/s12571-015-0441-1.
- McKeon, N. (2011). *Global governance for world food security: a scorecard four years after the eruption of the "food crisis*", Berlin, Germany: Heinrich-Böll-Stiftung.
- McKeon, N. (2015a). *Food security governance: empowering communities, regulating corporations*, Routledge critical security studies series, London, UK: Routledge, ISBN 1134695616.
- McKeon, N. (2015b). Global food governance in an era of crisis - lessons from the United Nations Committee on World Food Security, *Canadian Food Studies*, Vol. 2, No. 2, pp.328-334, doi: 10.15353/cfs-rcea.v2i2.134.
- McKinnon, M.C., Cheng, S.H., Garside, R., Masuda, Y.J. and Miller, D.C. (2015). Sustainability: map the evidence, *Nature*, Vol. 528, pp.185-187, doi:10.1038/528185a.
- McKinsey (2011). *Resource revolution - meeting the world's energy, materials, food, and water needs*, Global Institute, New York, USA: McKinsey & Company.

- McKinsey (2013). *Resource revolution - tracking global commodity markets*, New York, USA: McKinsey & Company.
- McKinsey (2015). *Saving the ocean from plastic waste: an estimated eight million metric tons of plastic waste leaks into the ocean every year*, New York, USA: McKinsey & Company, https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/saving-the-ocean-from-plastic-waste [accessed 11th April 2019].
- McKinsey (2015). *Stemming the tide – land based strategies for a plastic free ocean*, New York, USA: McKinsey & Company.
- McKinsey (2016). Sustainability and Resource Productivity Issue 4, New York, USA: McKinsey & Company.
- McKinsey (2016). *Toward a circular economy in food*, New York, USA: McKinsey & Company, https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/toward-a-circular-economy-in-food [accessed 11th April 2019].
- McKinsey (2017). *Focused acceleration - a strategic approach to climate action in cities to 2030,* New York, USA: McKinsey & Company.
- McKinsey (2018). *Decarbonisation of industrial sectors - the next frontier*, New York, USA: McKinsey & Company.
- McKinsey (2018). *Solving the United Kingdom's productivity puzzle in a digital age*, New York, USA: McKinsey & Company.
- McLaren, D. (2019). Exaggerating how much CO_2 can be absorbed by tree planting risks deterring crucial climate action, *The Conversation*, 12th July, https://theconversation.com/exaggerating-how-much-co-can-be-absorbed-by-tree-planting-risks-deterring-crucial-climate-action-120170 [accessed 11th April 2019].
- McManus, M.C. and Taylor, C.M. (2015). The changing nature of life cycle assessment, *Biomass and Bioenergy*, Vol. 82, pp.13-26, https://doi.org/10.1016/j.biombioe.2015.04.024 [accessed 11th April 2019].
- McMichael, A.J. (1993). *Planetary overload. Global environmental change and the health of the human species,* Cambridge, UK: Cambridge University Press.
- McMichael, A.J. (2011). Food security politics and the Millennium Development Goals, *Third World Quarterly*, Vol. 32, No.1, pp.119-139, http://dx.doi.org/10.1080/01436597.2011.543818 [accessed 11th April 2019].
- McMichael, A.J. (2017). *Climate change and the health of nations*, Oxford, UK: Oxford University Press, ISBN: 9780190262952.
- McMichael, A.J. and Butler, C.D. (2005). Fish, health, and sustainability, *American Journal of Preventive Medicine*, Vol. 29, No. 4, pp.322-323, doi:10.1016/j.amepre.2005.07.033.

- McMichael, A.J. Butler, C.D. and Dixon, J. (2015). Climate change, food systems and population health risks in their eco-social context, *Public Health*, Vol. 129, Iss. 10, pp.1361-1368, https://doi.org/10.1016/j.puhe.2014.11.013 [accessed 11th April 2019].
- McMichael, A.J., Neira, M., Bertollini, R., Campbell-Lendrum, D. and Hales, S. (2009). Climate change: a time of need and opportunity for the health sector, *The Lancet*, 25th November, Vol. 374, pp.2123-2125, doi:10.1016/S0140-6736(09)62031-6.
- McMichael, A.J., Powles, J.W., Butler, C.D. and Uauy, R. (2007). Energy and Health 5: Food, livestock production, energy, climate change, and health, *The Lancet*, Vol. 370, No. 9594, pp. 1253-1263, doi:https://doi.org/10.1016/S0140-6736(07)61256-2.
- McMichael, C., Barnett, J. and McMichael, A.J. (2012). An ill wind? Climate change, migration, and health, *Environmental Health Perspectives*, Vol. 120, pp.646-654, doi: 10.1289/ehp.1104375.
- McMichael, P. and Schneider, M. (2011). Food security politics and the Millennium Development Goals, *Third World Quarterly*, Vol. 32, No. 1, pp.119-139, doi: 10.1080/01436597.2011.543818.
- McSweeney, R. (2018). In-depth Q&A - The UK Climate Projections 2018, *Carbon Brief*, 29th November, https://www.carbonbrief.org/in-depth-qa-the-uk-climate-projections-2018 [accessed 11th April 2019].
- McVeigh, K. (2019). Climate crisis and antibiotic use could 'sink' fish farming industry – report, *The Guardian*, 5th June, https://www.theguardian.com/environment/2019/jun/05/climate-crisis-and-antibiotic-use-could-sink-fish-farming-industry-report [accessed 11th April 2019].
- McWilliams, C., Lurgi, M., Montoya, J.M., Sauve, A. and Montoya, D. (2019). The stability of multitrophic communities under habitat loss, *Nature Communications*, Vol. 10, No. 1, doi: 10.1038/s41467-019-10370-2.
- Meacham, T. (2013). *The importance of soils for ensuring food security*, Global Food Security (GFS) programme, www.foodsecurity.ac.uk [accessed 11th April 2019].
- Meadows, D.H., Meadow, D.L., Randers, J. and Behrens, W.W. (1972). *Limits to growth*, A report to the Club of Rome’s project on the Predicament of Mankind, Washington, USA: Potomac Associates.
- Mearns, R. and Norton, A. (eds)(2010). *Social dimensions of climate change*, Washington, USA: World Bank.
- Mears, C.A. and Wentz, F.J. (2017). A satellite-derived lower-tropospheric atmospheric temperature dataset using an optimized adjustment for diurnal effects, *Journal of Climate,* Vol. 30, No. 19, pp.7695-7718, https://doi.org/10.1175/JCLI-D-16-0768.1 [accessed 11th April 2019].
- Medek, D.E., Schwartz, J. and Myers, S.S. (2017). Estimated effects of future atmospheric CO_2 concentrations on protein intake and the risk of protein deficiency by country and region, *Environmental Health Perspectives*, Vol. 125, Iss. 82, https://doi.org/10.1289/EHP41 [accessed 11th April 2019].
- Medhaug, I., Stolpe, M.B., Fischer, E.M. and Knutti, R. (2017). Reconciling controversies about the ‘global warming hiatus’, *Nature*, 4th May, Vol. 545, pp.41-56, doi:10.1038/nature22315.

- Meehl, G., Zwiers, F., Evans, J., Knutson, T., Mearns, L. and Whetton, P. (2000). Trends in extreme weather and climate events: issues related to modelling extremes in projections of future climate change, *Bulletin of the American Meteorological Society*, Vol. 81, No.3, pp.427-436, https://doi.org/10.1175/1520-0477(2000)081<0427:TIEWAC>2.3.CO;2 [accessed 11th April 2019].
- Meehl, G.A. (2007). The physical science basis. In: Solomon, S. *et al.* (eds.) *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Ciimate Change*, Cambridge, UK: Cambridge University Press, pp.749-845.
- Meehl, G.A., Stocker, T.F., Collins, W.D., Friedlingstein, P., Gaye, T., Gregory, J.M., Kitoh, A., Knutti, R., Murphy, J.M., Noda, A., Raper, S.C.B., Watterson, I.G., Weaver, A.J. and Zhao, Z.C. (2007). Global climate projections. In: *Climate Change 2007: the physical science basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, UK: Cambridge University Press.
- Meier, T. and Christen, O. (2013). Environmental impacts of dietary recommendations and dietary styles, *Environmental Science & Technology*, Vol. 47, pp.877-888, dx.doi.org/10.1021/es302152v.
- Meijboom, F.L.B. (2007). Trust, food, and health - questions of trust at the interface between food and health, *Journal of Agricultural and Environmental Ethics*, Vol. 20, pp.231-245, doi: 10.1007/s10806-007-9035-z.
- Meiklejohn, S., Ryan, L. and Palermo, C. (2016). A systematic review of the impact of multi-strategy nutrition education programs on health and nutrition of adolescents, *Journal of Nutrition Education and Behavior,* Vol. 48, No. 9, pp.631-646.e1, https://doi.org/10.1016/j.jneb.2016.07.015.
- Meissner-Cox, L. (2018). Global temperature rises could be double those predicted by climate modelling, *The Guardian*, 5th July, https://www.theguardian.com/environment/2018/jul/06/global-temperature-rises-could-be-double-those-predicted-by-climate-modelling [accessed 11th April 2019].
- Mekonnen, M. and Hoekstra, A. (2012). A global assessment of the water footprint of farm animal products, *Ecosystems*, Vol. 15, No. 3, pp.401-415, https://doi.org/10.1007/s10021-011-9517-8 [accessed 11th April 2019].
- Mekonnen, M.M. and Fulton, J. (2018). The effect of diet changes and food loss reduction in reducing the water footprint of an average American, *Water International*, Vol. 43, No. 6, pp.860-870, https://doi.org/10.1080/02508060.2018.1515571 [accessed 11th April 2019].
- Mekonnen, M.M. and Hoekstra, A.Y. (2011). *The green, blue and grey water footprint of farm animals and animal products*, *Hydrology and Earth System Sciences,* Vol. 15, pp.1577-1600, doi:10.5194/hess-15-1577-2011.
- Mekonnen, M.M. and Hoekstra, A.Y. (2012). Global assessment of the waterfootprint of farm animal products, *Ecosystems*, Vol. 15, No. 3, pp.401-415, doi: 10.1007/s10021-011-9517-8A.

- Mekonnen, M.M. and Hoekstra, A.Y. (2014). Water footprint benchmarks for crop production: a first global assessment, *Ecological Indicators*, Vol. 46, pp.214-223, https://doi.org/10.1016/j.ecolind.2014.06.013 [accessed 11th April 2019].
- Mekonnen, T., Havdal, H.H., Lien, N., O'Halloran, S.A., Arah, O.A., Papadopoulou, E. and Gebremariam, M.K. (2020). Mediators of socioeconomic inequalities in dietary behaviours among youth: a systematic review, *Obesity Reviews*, doi: 10.1111/obr.13016.
- Melchett, P. (2014). *Working together to improve global food security – the role of NGOs*, Bristol, UK: The Soil Association.
- Melchett, P. (2016). A-maize-ing victory for UK Soils, *Soil Association*, 19th December, https://www.soilassociation.org/blogs/2016/december/a-maize-ing-victory-for-uk-soils/ [accessed 15th April, 2020].
- Meltzer, H.M., Brantsæter, A.L., Trolle, E., Eneroth, H., Fogelholm, M., Ydersbond, T.A. and Birgisdottir, B.E. (2019). Environmental sustainability perspectives of the Nordic diet, *Nutrients*, Vol. 11, No. 9, pp.2248, doi:10.3390/nu11092248.
- Memmott, J., Craze, P.G., Waser, N.M. and Price, M.V. (2007). Global warming and the disruption of plant-pollinator interactions, *Ecological Letters*, Vol. 10, pp.710-717, doi: 10.1111/j.1461-0248.2007.01061.x.
- Mendenhall, E. and Singer, M. (2019). The global syndemic of obesity, undernutrition, and climate change, *The Lancet*, 11th February, p.741, http://dx.doi.org/10.1016/S0140-6736(19)30310-1 [accessed 11th April 2019].
- Meng, K.C. and Rode, A. (2019). The social cost of lobbying over climate policy, *Nature Climate Change*, Vol. 9, pp.472-476, https://doi.org/10.1038/s41558-019-0489-6 [accessed 11th April 2019].
- Mengel, M., Nauels, A., Rogelj, J. and Schleussner, C-F. (2018). Committed sea-level rise under the Paris Agreement and the legacy of delayed mitigation action, *Nature Communications*, Vol. 9, No. 601, doi: 10.1038/s41467-018-02985-8.
- Menhas, R., Umer, S. and Shabbir, G. (2016). Climate change and its impact on food and nutrition security in Pakistan, *Iranian Journal of Public Health*, Vol. 45, No. 4, pp.549-550, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4888188/pdf/IJPH-45-549.pdf [accessed 11th April 2019].
- Menzel, A., Sparks, T.H., Estrella, N., Koch, E., Aasa, A., Ahas, R., Alm-Kübler, K., Bissolli, P., Braslavská, O., Briede, A., Chmielewski, F.M., Crepinsek, Z., Curnel, Y., Dahl, Å., Defila, C., Donnelly, A., Filella, Y., Jatczak, K., Måge, F., Mestre, A., Nordli, Ø., Peñuelas, J., Pirinen, P., Remišová, V., Scheifinger, H., Striz, M., Susnik, A., Van Vliet, A.J.H., Wielgolaski, F-E., Zach, S. and Zust, A. (2006). European phenological response to climate change matches the warming pattern, *Global Change Biology*, Vol. 12, pp.1969-1976, doi:10.1111/j.1365-2486.2006.01193.x.

- Merino, G., Barange, M., Blanchard, J.L., Harle, J., Holmes, R., Allen, I., Allison, E.H., Badjeck, M.C., Dulvy, N.K., Holt, J., Jennings, S., Mullon, C. and Rodwell, L.D. (2012). Can marine fisheries and aquaculture meet fish demand from a growing human population in a changing climate, *Global Environmental Change*, Vol. 22, pp.795-806, doi:10.1016/j.gloenvcha.2012.03.003.
- Merrigan, K., Griffin, T., Wilde, P., Robien, K., Goldberg, J. and Dietz, W. (2015). Designing a sustainable diet: sustainability as dietary guidance created political debate, *Science*, 9th October, Vol. 350, Iss. 6257, pp.165-166.
- Met Office (2014). *Climate impacts on food security and nutrition: a review of existing knowledge*, Exeter, UK: Met Office and World Food Programme Office for Climate Change, https://www.wfp.org/publications/climate-impacts-food-security-and-nutrition-review-existing-knowledge [accessed 11th April 2019].
- Met Office (2017). *Sea-level rise*, Exeter, UK: Meteorological Office, https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/climate/cop/cop23/sea_level_rise_final_v1.2.pdf [accessed 11th April 2019].
- Met Office (2018a). *Food insecurity and climate change*, Exeter, UK: Meteorological Office, https://www.metoffice.gov.uk/food-insecurity-index/ [accessed 11th April 2019].
- Met Office (2018b). *UKCP18 Factsheet: Precipitation*, Exeter, UK: Meteorological Office.
- Met Office (2018c). *UKCP18 Guidance: Representative Concentration Pathways*, Exeter, UK: Meteorological Office.
- Met Office (2018d). *UKCP18 Guidance: UKCP18 for UKCP09 users*, Exeter, UK: Meteorological Office.
- Met Office (2018e). *UKCP18 Headline Findings*, Exeter, UK: Meteorological Office.
- Met Office (2018f). *UKCP18 Land Projections: Science Report*, November 2018, Exeter, UK: Meteorological Office.
- Met Office (2019a). *Effects of climate change*, Exeter, UK: Meteorological Office, https://www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change [accessed 11th April 2019].
- Met Office (2019b). *UK climate projections: headline findings*, Version 2, September, Exeter, UK: Meteorological Office.
- Methley, A.M., Campbell, S., Chew-Graham, C., McNally, R. and Cheraghi-Sohi, S. (2014). PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews, *BMC Health Services Research*, Vol. 14, pp.579, doi: 10.1186/s12913-014-0579-0.
- Metzger, M. (2015). Thinking forward in global food governance—synthesis paper, *Canadian Food Studies*, Vol. 2, No. 2, pp.345-349, doi: 10.15353/cfs-rcea.v2i2.120.
- Meyer, N. and Reguant-Closa, A. (2017). Eat as if you could save the planet and win - sustainability integration into nutrition for exercise and sport, *Nutrients*, Vol. 9, No. 412, doi:10.3390/nu9040412.

- Meyfroidt, P., Lambin, E.F., Erb, K.H. and Hertel, T.W. (2013). Globalization of land use: distant drivers of land change and geographic displacement of land use, *Current Opinion in Environmental Sustainability*, Vol. 5, No. 5, pp.438-444, http://dx.doi.org/10.1016/j.cosust.2013.04.003 [accessed 11th April 2019].
- Mi, Z. and Coffman, D'M. (2019). The sharing economy promotes sustainable societies, *Nature Communications*, Vol. 10, doi:10.1038/s41467-019-09260-4.
- Mialon, M., Fabbri, A. and Fooks, G. (2019). Reply to the article: "What principles should guide interactions between population health researchers and the food industry? Systematic scoping review of peer-reviewed and grey literature, *Obesity Reviews*, Vol. 20, Iss. 10, pp.1504-1506, doi: 10.1111/obr.12905.
- Micha, R., Karageorgou, D., Bakogianni, I., Trichia, E., Whitsel, L.P., Story, M., Peñalvo, J.L. and Mozaffarian, D. (2018). Effectiveness of school food environment policies on children's dietary behaviors: a systematic review and meta-analysis, *PLoS One*, Vol. 13, No. 3, e0194555, doi: 10.1371/journal.pone.0194555.
- Michaelowa, A. and Dransfeld, B. (2008). Greenhouse gas benefits of fighting obesity, *Ecological Economics*, Vol. 66, Iss. 2–3, pp.298-308, https://doi.org/10.1016/j.ecolecon.2007.09.004 [accessed 11th April 2019].
- Micheels, E. and Gow, H. (2008). Market orientation, social embeddedness and firm profitability - an empirical examination of the illinois beef industry, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, The Netherlands.
- Michel-Villarreal, R., Hingley, M., Canavari, M. and Bregoli, I. (2019). Sustainability in alternative food networks: a systematic literature review, *Sustainability*, Vol. 11, No. 3, pp.859, doi:10.3390/su11030859.
- Michler, J.D., Baylis, K., Arends-Kuenning, M. and Mazvimavi, K. (2019). Conservation agriculture and climate resilience, *Journal of Environmental Economics and Management*, Vol. 93, pp.148-169, https://doi.org/10.1016/j.jeem.2018.11.008 [accessed 11th April 2019].
- Middleton, C. (2008). Myth: healthy food is more expensive than unhealthy food, *The Conversation*, 11th September, https://theconversation.com/myth-healthy-food-is-more-expensive-than-unhealthy-food-101213 [accessed 11th April 2019].
- Mie, A., Andersen, H.R., Gunnarsson, S., Kahl, J., Kesse-Guyot, E., Rembiałkowska, E., Quaglio, G. and Grandjean P. (2017). Human health implications of organic food and organic agriculture: a comprehensive review, *Environmental Health*, Vol. 16, No. 1, pp.111, doi: 10.1186/s12940-017-0315-4.
- Mielke, J., Vermaßen, H., Ellenbeck, S., Fernandez Milan, B. and Jaeger, C. (2016). Stakeholder involvement in sustainability science - a critical view, *Energy Research & Social Science*, Vol. 17, pp.71-81, doi: 10.1016/j.erss.2016.04.001.
- Mikaloff Fletcher, S.E. and Schaefer, H. (2019). Rising methane: a new climate challenge, *Science*, 7th Jun, Vol. 364, Iss. 6444, pp.932-933, doi: 10.1126/science.aax1828.

- Miles-Novelo, A. and Anderson, C.A. (2019). Climate change and psychology: effects of rapid global warming on violence and aggression, *Current Climate Change Reports*, doi: 10.1007/s40641-019-00121-2.
- Mill, J.S. (1848). *Principles of political economy with some of their applications to political philosophy*, London, UK: Longmans, Green and Co.
- Miller, A. (2016). Pesticide combination impacts often greater than the sum of their parts, *Sustainable Food Trust*, 24th February, http://sustainablefoodtrust.org/articles/eat-the-week-pesticide-combination/ [accessed 11th April 2019].
- Miller, K.A., Munro, G.R., Sumaila, U.R. and Cheung, W.W.L. (2013). Governing marine fisheries in a changing climate – a game-theoretic perspective, *Canadian Journal of Agricultural Economics*, Vol. 61, pp.309-334, doi: 10.1111/cjag.12011.
- Miller, K.G., Browning, J.V., Schmelz, W.J., Kopp, R.E., Mountain, G.S. and Wright, J.D. (2020). Cenozoic sea-level and cryospheric evolution from deep-sea geochemical and continental margin records, *Science Advances*, doi: 10.1126/sciadv.aaz1346.
- Miller, M., Anderson, M., Francis, C.A., Kruger, C., Barford, C., Park, J. and McCown, B.H. (2013). Critical research needs for successful food systems adaptation to climate change, *Journal of Agriculture, Food Systems, and Community Development*, Vol. 3, No. 4, pp.161-175, http://dx.doi.org/10.5304/jafscd.2013.034.016 [accessed 11th April 2019].
- Miller, R. (2014). *Funding research and innovation for food Security in the UK*, 27th February, London, UK: Technology Strategy Board.
- Miller, S.M., Michalak, A.M., Detmers, R.G., Hasekamp, O.P., Bruhwiler, L.P.M. and Schwietzke, S. (2019). China's coal mine methane regulations have not curbed growing emissions, *Nature Communications*, Vol. 10, No. 303, doi:10.1038/s41467-018-07891-7.
- Mills, S., White, M., Brown, H., Wrieden, W., Kwasnicka, D., Halligan, J., Robalino, S. and Adams, J. (2017). Health and social determinants and outcomes of home cooking: a systematic review of observational studies, *Appetite*, Vol. 111, pp.116-134, doi: 10.1016/j.appet.2016.12.022
- Mills, S., White, M., Robalino, S., Wrieden, W., Brown, H. and Adams, J. (2015). Systematic review of the health and social determinants and outcomes of home cooking: protocol, *Systematic Reviews*, Vol. 4, No. 1, doi: 10.1186/s13643-015-0033-3.
- Millstone, E. and Lang, T. (2018). *Brexit and food – standards could get even worse*, Food Research Collaboration Food Brexit Policy Briefing, London, UK: City, University of London.
- Millstone, E. and Lang, T. (2018). *Weakening UK food law enforcement: a risky tactic in Brexit*, Food Research Collaboration Food Brexit Policy Briefing, March, London, UK: City, University of London, http://foodresearch.org.uk/publications/weakening-uk-food-law-enforcement/ [accessed 11th April 2019].

- Millstone, E., Lang, T. and Marsden, T. (2017). *Will the British public accept chlorine-washed turkey for Christmas dinner, after Brexit*, Food Research Collaboration Food Brexit Policy Briefing, London, UK: City, University of London.
- Millstone, E., Lang, T. and Marsden, T. (2019). Chlorinated chicken - is the UK being softened up to accept lower food standards, London, UK: City, University of London, https://foodresearch.org.uk/publications/chlorinated-chicken-lower-standards/ [accessed 11th April 2019].
- Millward, J. and Garnett, T. (2010). Plenary Lecture 3 Food and the Planet: nutritional dilemmas of greenhouse gas emission reductions through reduced intakes of meat and dairy foods: Conference on 'Over- and undernutrition: challenges and approaches', *Proceedings of the Nutrition Society*, Vol. 69, No. 1, pp.103-118, doi: https://doi.org/10.1017/S0029665109991868.
- Milman, O. (2018). Planet has just 5% chance of reaching Paris climate goal, study says, *The Guardian*, 31st July, https://www.theguardian.com/environment/2017/jul/31/paris-climate-deal-2c-warming-study [accessed 11th April 2019].
- Milner, A. and Boyd, I. (2017). Toward pesticidovigilance - can lessons from pharmaceutical monitoring help to improve pesticide regulation, *Science*, Vol. 357, Iss. 6357, pp.1232-1234, doi: 10.1126/science.aan2683.
- Milner, A.M. and Boyd, I.L. (2017). Toward pesticidovigilance, *Science*, 22nd September, Vol. 357, Iss. 6357, pp.1232-1234, doi: 10.1126/science.aan2683.
- Milner, J. and Green, R. (2018). Sustainable diets are context specific but are they realistic? *The Lancet Planetary Health*, Vol. 2, Iss. 10, pp.e425-e426, doi:https://doi.org/10.1016/S2542-5196(18)30207-9.
- Milner, J., Green, R., Dangour, A.D., Haines, A., Chalabi, Z., Spadaro, J., Markandya, A. and Wilkinson, P. (2014). Health effects of adopting low greenhouse gas emission diets in the UK, *British Medical Journal*, Vol. 5, No. 4, e007364, doi: 10.1136/bmjopen-2014-007364.
- Milner, J., Harpham, C., Taylor, J., Davies, M., Le Quéré, C., Haines, A. and Wilkinson, P. (2017). The challenge of urban heat exposure under climate change: an analysis of cities in the Sustainable Healthy Urban Environments (SHUE) database, *Climate*, Vol. 5, No. 4, pp. 93, https://doi.org/10.3390/cli5040093 [accessed 11th April 2019].
- Mimura, N. (2013). Sea-level rise caused by climate change and its implications for society, *Proceedings of the Japan Academy. Series B, Physical and biological sciences*, Vol. 89, No. 7, pp.281–301, https://doi.org/10.2183/pjab.89.281.
- Ministry of Agriculture, Fisheries and Food (1975). *Food from our own resources*, London, UK: HMSO.

- Miraglia, M., Marvin, H.J.P., Kleter, G.A., Battilani, P., Brera, C., Coni, E., Cubadda, F., Croci, L., De Santis, B., Dekkers, S., Filippi, L., Hutjes, R.W.A., Noordam, M.Y., Pisante, M., Piva, G., Prandini, A., Toti, L., van den Born, G.J. and Vespermann, A. (2009). Climate change and food safety: an emerging issue with special focus on Europe, *Food and Chemical Toxicology*, Vol. 47, pp.1009-1021, doi: 10.1016/j.fct.2009.02.005.
- Miret-Pastor, I., Peiró-Signes, A., Segarra-Oña, M-d-V. and Herrera-Racionero, P. (2014). Empirical analysis of sustainable fisheries and the relation to economic performance enhancement – the case of the Spanish fishing industry, *Marine Policy*, Vol. 46, pp.105-110, http://dx.doi.org/10.1016/j.marpol.2014.01.009 [accessed 11th April 2019].
- Misra, A.K. (2014). Climate change and challenges of water and food security, *International Journal of Sustainable Built Environment*, Vol. 3, Iss. 1, pp.153-165, doi:10.1016/j.ijsbe.2014.04.006.
- Misselhorn, A., Aggarwal, P., Ericksen, P., Gregory, P., Horn-Phathanothai, L., Ingram, J. and Wiebe, K. (2012). A vision for attaining food security, *Current Opinion in Environmental Sustainability*, Vol. 4, Iss. 1, pp.7-17, https://doi.org/10.1016/j.cosust.2012.01.008 [accessed 11th April 2019].
- MIT (2016). *Food, water, energy and climate outlook: perspectives from 2016*, MIT Joint Program on the Science and Policy of Global Change, Cambridge, USA: Massachusetts Institute of Technology.
- Mitchell, A. (2007). There's something deeply suspicious about sustainability, *Marketing Week*, 20th September, pp.26-27.
- Mitchell, M. (2011). Increasing fish consumption for better health – are we being advised to eat more of an inherently unsustainable protein, *Nutrition Bulletin*, Vol. 36, pp.438-442, doi: 10.1111/j.1467-3010.2011.01926.x.
- Mithöfer, D., Roshetko, J.M., Donovan, J.A., Nathalie, E., Robiglio, V., Wau, D., Sonwa, D.J. and Blare, T. (2017). Unpacking 'sustainable' cocoa: do sustainability standards, development projects and policies address producer concerns in Indonesia, Cameroon and Peru? *International Journal of Biodiversity Science, Ecosystem Services and Management*, Vol. 13, No. 1, pp.444-469, https://doi.org/10.1080/21513732.2018.1432691 [accessed 11th April 2020].
- MMO (2015). *UK sea fisheries statistics 2015*, Marine Management Organisation, Newport, South Wales, UK: Office for National Statistics, https://www.gov.uk/government/organisations/marine-management-organisation [accessed 11th April 2019].
- MMO (2019). *Monthly UK sea fisheries statistics - reported landings*, January 2019
- MoD (2014). *Global strategic trends out to 2045*, Fifth Edition, London, UK: Ministry of Defence.
- MoD (2018). *Global strategic trends – the future starts today*, London, UK: Ministry of Defence.
- Mohamed Shaffril, H.A., Ahmad, N., Samsuddin, S.F., Samah, A.A. and Hamdan, M.E. (2020). Systematic literature review on adaptation towards climate change impacts among indigenous people in the Asia Pacific regions, *Journal of Cleaner Production*, Vol. 258, No. 120595, doi: 10.1016/j.jclepro.2020.120595.

- Mohammed, K., Saiful, I., Tarekul, I., Lorenzo, A., Kumar, B.S. and Uddin, K.J. (2017). Extreme flows and water availability of the Brahmaputra River under 1.5 and 2°C global warming scenarios, *Climatic Change*, Vol. 145, No. 1-2, pp.159-175, doi: 10.1007/s10584-017-2073-2.
- Mohan, S. (2016). Institutional change in value chains – evidence from tea in Nepal, *World Development*, Vol. 78, pp.52-65, http://dx.doi.org/10.1016/j.worlddev.2015.10.004 [accessed 11th April 2019].
- Moher, D., Liberati, A., Tetzlaff, J. and Altman, D. (2009a). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, *BMJ*, Vol. 339, No. 1, 21st July, pp.b2535-b2535.
- Moher, D., Liberati, A., Tetzlaff, J. and Altman, D.G. (2009b). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement, *Journal of Clinical Epidemiology*, Vol. 62, No. 10, pp.1006-1012.
- Moioli, E., Salvati, F., Chiesa, M., Siecha, R.T., Manenti, F. and Laio, F. (2018). Analysis of the current world biofuel production under a water–food–energy nexus perspective, *Advances in Water Resources*, Vol. 121, pp.22-31, https://doi.org/10.1016/j.advwatres.2018.07.007 [accessed 11th April 2019].
- Molho, N. (2016). Post referendum, the UK must continue to lead on environmental issues, *The Economist*, 29th June, https://www.eiuperspectives.economist.com/sustainability/post-referendum-uk-must-continue-lead-environmental-issues [accessed 11th April 2019].
- Molinos, J.G., Halpern, B.S., Shoeman, D.S., Brown, C.J., Kiessling, W., Moore, P.J., Pandolfi, J.M., Poloczanska, E.S., Richardson, A.J. and Burrows, M.T. (2015). Climate velocity and the future global redistribution of marine biodiversity, *Nature Climate Change*, Vol. 6, pp.83-88, https://doi.org/10.1038/nclimate2769 [accessed 11th April 2019].
- Monahan, W.B. and Theobald, D.M. (2018). Climate change adaptation benefits of potential conservation partnerships, *PLoS One*, Vol. 13, No. 2, e0191468, doi: 10.1371/journal.pone.0191468.
- Monasterolo, I., Pasqualino, R., Janetos, A. and Jones, A.W. (2016). Sustainable and inclusive food systems through the lenses of a complex system thinking approach: a literature review and research agenda, *Agriculture*, Vol. 6, No. 3, 44, doi:10.3390/agriculture6030044.
- Monbiot (2019). How the media let malicious idiots take over, *The Guardian*, 22nd March, https://www.theguardian.com/commentisfree/2019/mar/22/political-monsters-media-jacob-rees-mogg-platforms [accessed 11th April 2019].
- Monbiot, G. (2015). *Feral: rewilding the land, sea and human life*, Chicago, USA: University of Chicago Press.
- Monbiot, G. (2018a). We're in a new age of obesity. How did it happen - you'd be surprised, *The Guardian*, 15th August, https://www.theguardian.com/commentisfree/2018/aug/15/age-of-obesity-shaming-overweight-people [accessed 15th April 2019].
- Monbiot, G. (2018b). Pathological consumption has become so normalised that we scarcely notice it, 14th November, https://www.filmsforaction.org/articles/pathological-consumption-has-become-so-normalised-that-we-scarcely-notice-it/ [accessed 11th April 2019].

- Monbiot, G. (2018c). Mass starvation is humanity's fate if we keep flogging the land to death, *The Guardian*, 11th December, https://www.theguardian.com/commentisfree/2017/dec/11/mass-starvation-humanity-flogging-land-death-earth-food [accessed 11th April 2019].
- Monbiot, G. (2019a). Dare to declare capitalism dead – before it takes us all down with it: the economic system is incompatible with the survival of life on Earth - it is time to design a new one, *The Guardian*, 25th April, https://www.theguardian.com/commentisfree/2019/apr/25/capitalism-economic-system-survival-earth [accessed 25th April 2019].
- Monbiot, G. (2019b). Only rebellion will prevent an ecological apocalypse, *The Guardian*, 15th April, https://www.theguardian.com/commentisfree/2019/apr/15/rebellion-prevent-ecological-apocalypse-civil-disobedience [accessed 15th April 2019].
- Monbiot, G. (2019c). Only rebellion will prevent an ecological apocalypse, *The Guardian*, 15th April, https://www.theguardian.com/commentisfree/2019/apr/15/rebellion-prevent-ecological-apocalypse-civil-disobedience [accessed 15th April 2019].
- Monbiot, G., Grey, R., Kenny, T., Macfarlane, L., Powell-Smith, A., Shrubsole, G. and Stratford, B. (2019). *Land for the many: changing the way our fundamental asset is used, owned and governed*, London, UK: The Labour Party, https://labour.org.uk/wp-content/uploads/2019/06/12081_19-Land-for-the-Many.pdf [accessed 11th April 2019].
- Monforti-Ferrario, F. and Pascua, I.P. (2015). *Energy use in the EU food sector: State of play and opportunities for improvement*, European Commission: Institute for Energy and Transport and Institute for Environment and Sustainability, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC96121/ldna27247enn.pdf [accessed 15th April 2019].
- Montague-Jones, G. (2013) Fairtrade foundation losing the plot claim tea growers, *The Grocer,* 26th April, p.5.
- Montague-Jones, G. (2014). Passion, people and palm oil, *The Grocer,* 3rd May, pp.36-40.
- Montague-Jones, G. (2014). The new weapons against dodgy meat, *The Grocer,* 26th April, pp.46-47.
- Monteiro, C., Moubarac, J., Levy, R., Canella, D., Louzada, M. and Cannon, G. (2018). Household availability of ultra-processed foods and obesity in nineteen European countries, *Public Health Nutrition*, Vol. 21, No. 1, pp.18-26, doi:10.1017/S1368980017001379.
- Monteiro, C.A., Cannon, G., Moubarac, J-C., Levy, R.B., Louzada, M.L. and Jaime, P.C. (2018). The UN Decade of Nutrition, the NOVA food classification and the trouble with ultra-processing, *Public Health Nutrition*, Vol. 21, No. 1, pp.5-17, doi: 10.1017/S1368980017000234.
- Monteiro, C.A., Cannon, G., Moubarac, J-C., Martins, A.P., Martins, C.A., Garzillo, J., Canella, D.S., Baraldi, L.G., Barciotte, M., Louzada, M.L., Levy, R.B., Claro, R.M. and Jaime, P.C. (2015). Dietary guidelines to nourish humanity and the planet in the twenty-first century: a blueprint from Brazil, *Public Health Nutrition*, Vol. 18, pp.2311–2322, doi: 10.1017/S1368980015002165.

- Monteiro, C.A., Moubarac, J.C., Cannon, G., Ng, S.W. and Popkin, B. (2013). Ultra-processed products are becoming dominant in the global food system, *Obesity Reviews*, Vol. 14, pp.21-28, doi: 10.1111/obr.12107.
- Monteiro, C.A., Moubarac, J-C., Levy, R.B. and Canella, D.S. (2017). Household availability of ultra-processed foods and obesity in nineteen European countries, *Ultra Processed Foods*, Vol. 21, Iss. 1, pp. 18-26, doi.org/10.1017/S1368980017001379.
- Montgomery, D.R. (2007). Soil erosion and agricultural sustainability, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 104, pp.13268–13272, https://doi.org/10.1073/pnas.0611508104 [accessed 15th April 2019].
- Moodie, R., Stuckler, D., Monteiro, C., Sheron, N., Neal, B., Thamarangsi, T., Lincoln, P. and Casswell, S. (2013). Profits and pandemics: prevention of harmful effects of tobacco, alcohol and ultra-processed food and drink industries, *The Lancet*, Vol. 381, pp.670-679, DOI:https://doi.org/10.1016/S0140-6736(12)62089-3.
- Moola, S., Munn, Z., Sears, K., Sfetcu, R., Currie, M., Lisy, K., Tufanaru, C., Qureshi, R., Mattis, P. and Mu, P. (2015). Conducting systematic reviews of association (etiology): the Joanna Briggs Institute's approach, *International Journal of Evidence-Based Healthcare*, Vol. 13, No. 3, pp.163-169, doi: 10.1097/XEB.0000000000000064.
- Moolna, A. (2019). Coffee: 60% of wild species are at risk of extinction due to climate change, *The Conversation*, 17th January, https://theconversation.com/coffee-60-of-wild-species-are-at-risk-of-extinction-due-to-climate-change-109982 [accessed 15th April 2019].
- Moomaw, W. and Tzachor, A. (2017). Micro solutions for a macro problem: How marine algae could help feed the world, *The Conversation*, 8th October, http://theconversation.com/micro-solutions-for-a-macro-problem-how-marine-algae-could-help-feed-the-world-85702 [accessed 15th April 2019].
- Moomaw, W., Berzin, I. and Tzachor, A. (2017). Cutting out the middle fish: marine microalgae as the next sustainable omega-3 fatty acids and protein source, *Industrial Biotechnology*, Vol. 13, No. 5, pp.234-243, https://doi.org/10.1089/ind.2017.29102.wmo [accessed 15th April 2019].
- Moon, M. and Stanton, C. (2014). The first course: a case for locating public history within “the food movement”, *The Public Historian*, Vol. 36, No. 3, pp.109-129,
- Moon, W., Agarwal, S. and Wettlaufer, J.S. (2018). Intrinsic pink-noise multidecadal global climate dynamics mode, *Physical Review Letters*, Vol. 121, No. 10, doi: 10.1103/PhysRevLett.121.108701.
- Moore, F.C. and Lobell, D.B. (2014). Adaptation potential of European agriculture in response to climate change, *Nature Climate Change*, Vol. 4, pp.610-614, https://doi.org/10.1038/nclimate2228 [accessed 15th April 2019].
- Moore, F.C., Baldos, U., Hertel, T. and Diaz, D. (2017). New science of climate change impacts on agriculture implies higher social cost of carbon, *Nature Communications*, Vol. 8, No. 1607, https://doi.org/10.1038/s41467-017-01792-x [accessed 15th April 2019].

- Moore, K., Fu, W., Primeau, F., Britten, G.L., Lindsay, K., Long, M., Doney, S.C., Mahowald, N., Hoffman, F. and Randerson, J.T. (2018). Sustained climate warming drives declining marine biological productivity, *Science*, Vol. 359, No. 6380, pp.1139, doi: 10.1126/science.aao6379.
- Moragues-Faus, A., Sonnino, R. and Marsden, T. (2017). Exploring European food system vulnerabilities: towards integrated food security governance, *Environmental Science & Policy*, Vol. 75, pp.184-215, https://doi.org/10.1016/j.envsci.2017.05.015 [accessed 15th April 2019].
- Moreira, P.V.L., Baraldi, L.G., Moubarac, J-C., Monteiro, C.A., Newton, A., Capewell, S. and O'Flah, M. (2015). Comparing different policy scenarios to reduce the consumption of ultra-processed foods in UK: impact on cardiovascular disease mortality using a modelling approach, *PLoS One*, Vol. 10, No. 2, e0118353, doi:10.1371/journal.pone.0118353.
- Moresi, M. (2014). Assessment of the life cycle greenhouse gas emissions in the food industry, *Agro Food Industry Hi Tech*, May, https://www.researchgate.net/publication/285136461 [accessed 15th April 2019].
- Moretti, C.L., Mattos, L.M., Calbo, A.G. and Sargent, S.A. (2010). Climate changes and potential impacts on postharvest quality of fruit and vegetable crops: a review, *Food Research International*, Vol. 43, Iss. 7, pp.1824-1832, https://doi.org/10.1016/j.foodres.2009.10.013 [accessed 15th April 2019].
- Morgan, C.J., Widmar, N.J.O., Wilcox, M.D. and Croney, C.C. (2018). Perceptions of agriculture and food corporate social responsibility, *Journal of Food Products Marketing*, Vol. 24, No. 2, pp.146-162, https://doi.org/10.1080/10454446.2017.1266550 [accessed 15th April 2019].
- Morgan, K. (2015). Nourishing the city: the rise of the urban food question in the Global North, *Urban Studies*, Vol. 52, No. 8, pp.1379-1394, https://doi.org/10.1177/0042098014534902 [accessed 15th April 2019].
- Morgan, P.B., Mies, T.A., Bollero, G.A., Nelson, R.L. and Long, S.P. (2006). Season-long elevation of ozone concentration to projected 2050 levels under fully open-air conditions substantially decreases the growth and production of soybean, *New Phytologist*, Vol. 170, pp.333-343, https://doi.org/10.1111/j.1469-8137.2006.01679.x [accessed 15th April 2019].
- Morgans, C.L., Meijaard, E., Santika, T., Law, E., Budiharta, S., Ancrenaz, M. and Wilson, K.A. (2018). Evaluating the effectiveness of palm oil certification in delivering multiple sustainability objectives, *Environmental Research Letters*, Vol. 13, pp.064032, https://orcid.org/0000-0002-2562-1482 [accessed 15th April 2019].
- Morisetti, N. and Blackstock, J.J. (2017). Impact of a changing climate on global stability, wellbeing, and planetary health, *The Lancet*, Vol. 1, April, pp.e10-e11.
- Morison, J.I.L. and Matthews, R.B. (eds.) (2016). *Agriculture and forestry climate change impacts summary report*: *living with environmental change*, Living With Environmental Change (LWEC) Network, ISBN 978-0-9934074-0-6, https://nerc.ukri.org/research/partnerships/ride/lwec/report-cards/agriculture/ [accessed 15th April 2019].

- Morone, P., Falcone, P.M. and Lopolito, A. (2019). How to promote a new and sustainable food consumption model: a fuzzy cognitive map study, *Journal of Cleaner Production*, Vol. 208, pp.563-574, https://doi.org/10.1016/j.jclepro.2018.10.075 [accessed 15th April 2019].
- Morris, T. (2019). *Scotland's nature on red alert: climate change impacts on Scottish biodiversity*, Edinburgh, UK: Scottish Environment LINK and WWF Scotland partnership.
- Morrison-Bell, C. (2018). A Green Future: Our 25 Year Plan to Improve the Environment; the good, the bad, and the non-committal, *British Ecological Society*, 22nd January, https://www.britishecologicalsociety.org/green-future-25-year-plan-improve-environment-good-bad-non-committal/ [accessed 15th April 2019].
- Morse, G.D., Lombardo, J.C., Forrester, T., Fletcher, H., McDonald, A., Talal, A.H., Sethi, S., Tsuji, B., Govindaraju, V., DeHovitz, J. and Lindo, J.F. (2018). Development of a dual university system health research partnership as a foundation for the Sustainable Development Goals, *Lancet: Global Health*, Vol. 6, No. 2, pp.S11-S11, doi:https://doi.org/10.1016/S2214-109X(18)30140-2.
- Mortada, S., Abou Najm, M., Yassine, A., El Fadel, M. and Alamiddine, I. (2018). Towards sustainable water-food nexus: an optimization approach, *Journal of Cleaner Production*, Vol. 178, pp.408-418, https://doi.org/10.1016/j.jclepro.2018.01.020 [accessed 15th April 2019].
- Morton, D.C., DeFries, R.S., Shimabukuro, Y.E., Anderson, L.O., Arai, E., del Bon Espirito-Santo, F., Freitas, R. and Morisette, J. (2006). Cropland expansion changes deforestation dynamics in the southern Brazilian Amazon, *Proceedings of the National Academy of Sciences*, Vol. 103, pp.14637-14641, https://doi.org/10.1073/pnas.0606377103 [accessed 11th April 2019].
- Morton, J.F. (2007). The impact of climate change on smallholder and subsistence agriculture, *Proceedings of the National Academy of Science*, Vol. 104, pp.19680-19685, https://doi.org/10.1073/pnas.0701855104 [accessed 15th April 2019].
- Moscatelli, S., El Bilali, H., Gamboni, M. and Capone, R. (2016). Towards sustainable food systems - a holistic, interdisciplinary and systemic approach, *International Journal Agroforestry Systems*, Vol. 1, pp.103-112, doi: 10.7251/AGRENG1601103M.
- Moser, S.C. (2019). The work after "It's too late" (to prevent dangerous climate change), *WIREs Climate Change*, e606, https://doi.org/10.1002/wcc.606 [accessed 15th April 2019].
- Moss, R., Edmonds, J., Hibbard, K., Manning, M.R., Rose, S.K., van Vuuren, D.P., Carter, T.R., Emori, S., Kainuma, M., Kram, T., Meehl, G.A., Mitchell, J.F.B., Nakicenovic, N., Riahi, K., Smith, S.J., Stouffer, R.J., Thomson, A.M., WeyanT, J.P. and Wilbanks, T.J. (2010). The next generation of scenarios for climate change research and assessment. *Nature*, Vol. 463**,** pp.747-756, https://doi.org/10.1038/nature08823.
- Motesharrei, S., Rivas, J. and Kalnay, E. (2014). Human and nature dynamics (HANDY): modeling inequality and use of resources in the collapse or sustainability of societies, *Ecological Economics*, Vol. 101, pp.90-102, https://doi.org/10.1016/j.ecolecon.2014.02.014 [accessed 15th April 2019].

- Mötteli, S., Keller, C., Siegrist, M., Barbey, J. and Bucher, T. (2016). Consumers' practical understanding of healthy food choices, *Appetite*, Vol. 107, pp.677-694, doi: https://doi.org/10.1017/S0007114516002130 [accessed 15th April 2019].
- Mottet, A., de Haan, C., Falcucci, A., Tempio, G., Opioa, C. and Gerbera, P. (2017). Livestock – on our plates or eating at our table – a new analysis of the feed, *Global Food Security*, Vol. 14, pp.1-8, http://dx.doi.org/10.1016/j.gfs.2017.01.001 [accessed 15th April 2019].
- Moult, J.A., Allan, S.R., Hewitt, C.N. and Berners-Lee, M. (2018). Greenhouse gas emissions of food waste disposal options for UK retailers, *Food Policy*, Vol. 77, pp.50-58, https://doi.org/10.1016/j.foodpol.2018.04.003 [accessed 15th April 2019].
- Mouysset, L., Doyen, L., Léger, F., Jiguet, F. and Benton, T.G. (2018). Operationalizing sustainability as a safe policy space, *Sustainability*, Vol. 10, No. 10, pp.3682, https://doi.org/10.3390/su10103682 [accessed 15th April 2019].
- Moyer, J.D. and Bohl, D.K. (2019). Alternative pathways to human development: assessing trade-offs and synergies in achieving the Sustainable Development Goals, *Futures*, Vol. 105, pp.199-210, https://doi.org/10.1016/j.futures.2018.10.007 [accessed 15th April 2019].
- Moysés, S.J. and Soares, R.C. (2019). Planetary health in the Anthropocene, *Health Promotion Internationa*l, Vol. 34, Suppl. 1, doi: 10.1093/heapro/daz012.
- Mozaffarian, D. (2016). Dietary and policy priorities for cardiovascular disease, diabetes, and obesity a comprehensive review, *Circulation*, Vol. 133, pp.187-225, doi: 10.1161/CIRCULATIONAHA.115.018585.
- Mozaffarian, D. (2019). Should you avoid meat for good health? How to slice off the facts from the fiction, *The Conversation*, 19th December, https://theconversation.com/should-you-avoid-meat-for-good-health-how-to-slice-off-the-facts-from-the-fiction-127958.
- Mozaffarian, D., Angell, S.Y., Lang, T. and Rivera, J.A. (2018). Role of government policy in nutrition - barriers to and opportunities for healthier eating, *British Medical Journal*, Vol. 361, No. k2426, pp.1-11, doi: 10.1136/bmj.k2426.
- Mozaffarian, D., Rosenberg, I. and Uauy, R. (2018). History of modern nutrition science—implications for current research, dietary guidelines, and food policy, *The British Medical Journal*, Vol. 361, k2392, doi: 10.1136/bmj.k2392.
- Mpandeli, S., Naidoo, D., Mabhaudhi, T., Nhemachena, C., Nhamo, L., Liphadzi, S., Hlahla, S. and Modi, A.T. (2018). Climate change adaptation through the water-energy-food nexus in Southern Africa, *International Journal of Environmental Research and Public Health*, Vol. 15, No. 2306, doi:10.3390/ijerph15102306.
- MRC (2014). *Global impacts delivered in partnership: commercial commitments*, May, London, UK: Marine Stewardship Council.

- Msangi, S. and Batka, M. (2015). Major trends in diets and nutrition: a global perspective to 2050. In: Schmitz, A., Kennedy, P.L. and Schmitz, T.G. (ed.) *Food security in an uncertain world*, (Frontiers of Economics and Globalization, Volume 15), Emerald Group Publishing Limited, pp.227-241.
- MSC (2015). *Global Impacts Report 2015*, London, UK: Marine Stewardship Council.
- MSC (2019). *Sustainable tuna handbook*, London, UK: Marine Stewardship Council.
- MSF (2014). *Famine and feast - life on the margins - the inequality of food and nutrition security*, Médecins Sans Frontières / Doctors Without Borders (MSF) UK.
- Muchenje, V. and Mukumbo, F.E. (2015). Introduction to the special issue Food and Nutrition Security: can science and good governance deliver dinner? *Food Research International*, Vol. 76, Part 4, October, pp.879-881, https://doi.org/10.1016/j.foodres.2015.05.060 [accessed 15th April 2019].
- Muchow, R.C. and Sinclair, T.R. (1991). Water deficit effects on maize yields modeled under current and “greenhouse” climates, *Agronomy Journal*, Vol. 83, pp.1052-1059, doi:10.2134/agronj1991.00021962008300060023x.
- Mueller Loose, S. and Remaud, H. (2013). Impact of corporate social responsibility claims on consumer food choice - a cross-cultural comparison, *British Food Journal*, Vol. 115, Iss. 1, pp.142-166, https://doi.org/10.1108/00070701311289920 [accessed 15th April 2019].
- Mueller, N.D. and Binder, S. (2015). Closing yield gaps: consequences for the global food supply, environmental quality and food security, *Dædalus*, Vol. 144, pp.45-56, https://doi.org/10.1162/DAED_a_00353 [accessed 15th April 2019].
- Mueller, N.D., Butler, E.E., McKinnon, K.A., Rhines, A., Tingley, M., Holbrook, N.M. and Huybers, P. (2015). Cooling of US Midwest summer temperature extremes from cropland intensification, *Nature Climate Change*, Vol. 6, pp.317-322, https://doi.org/10.1038/nclimate2825 [accessed 15th April 2019].
- Mueller, N.D., Butler, E.E., McKinnon, K.A., Rhines, A., Tingley, M., Holbrook, N.M. and Huybers, P. (2017). Global relationships between cropland intensification and summer temperature extremes over the last 50 Years, American *Meteorological Society*, Vol. 144, No. 4, pp.45-56, https://doi.org/10.1175/JCLI-D-17-0096.1 [accessed 15th April 2019].
- Mueller, N.D., Gerber, J.S., Johnston, M., Ray, D.K., Ramankutty, N. and Foley, J.A. (2012). Closing yield gaps through nutrient and water management, *Nature*, Vol. 490, pp.254-257, https://doi.org/10.1038/nature11420 [accessed 15th April 2019].
- Mueller, S.A., Anderson, J.A. and Wallington, T.J. (2011). Impact of biofuel production and other supply and demand factors on food price increases in 2008, *Biomass and Bioenergy*, Vol. 35, No. 162, pp.1623-1632, doi:10.1016/j.biombioe.2011.01.030.

- Muhammed, S.E., Coleman, K., Wu, L., Bell, V.A., Davies, J.A.C., Quinton, J.N., Carnell, J.E.J., Tomlinson, S.J., Dore, A.J., Dragosits, U., Naden, P.S., Glendining, M.J., Tipping, E. and Whitmore, A.P. (2018). Impact of two centuries of intensive agriculture on soil carbon, nitrogen and phosphorus cycling in the UK, *Science of the Total Environment*, Vol. 634, pp.1486-1504, https://doi.org/10.1016/j.scitotenv.2018.03.378 [accessed 15th April 2019].
- Muldowney, J., Mounsey, J. and Kinsella, L. (2013). Agriculture in the climate change negotiations; ensuring that food production is not threatened, *Animal*, Vol. 7, No. s2, pp.206-211, doi: https://doi.org/10.1017/S175173111300089X [accessed 15th April 2019].
- Muller, A., Schader, C., Scialabba, N.E-H., Brüggemann, J., Isensee, A., Erb, K-H., Smith, P., Klocke, P., Leiber, P., Stolze, M. and Niggli, U. (2017). Strategies for feeding the world more sustainably with organic agriculture, *Nature Communications*, Vol. 8, No. 1290, doi: 10.1038/s41467-017-01410-w.
- Müller, B., Johnson, L. and Kreuer, D. (2017). Maladaptive outcomes of climate insurance in agriculture, *Global Environmental Change*, Vol. 46, pp.23-33, doi:10.1016/J.GLOENVCHA.2017.06.010.
- Munasinghe, M. (1993). *Environmental economics and sustainable development*, World Bank Environment Papers no. 3, Washington, USA: World Bank.
- Munasinghe, M., Deraniyagala, Y., Dassanayake, N. and Karunarathna, H. (2017). Economic, social and environmental impacts and overall sustainability of the tea sector in Sri Lanka, *Sustainable Production and Consumption*, Vol. 12, pp.155-169, https://doi.org/10.1016/j.spc.2017.07.003 [accessed 11th April 2020].
- Mundaca-Shah, V., Ogawa, A. and Nicholson, A. (2017). *Combating antimicrobial resistance - a one health approach to a global threat*, Washington, USA: The National Academies Press.
- Mungkung, R., Aubin, J., Prihadi, T.H., Slembrouck, J., van der Werf, H.M.G. and Legendre, M. (2013). Life Cycle Assessment for environmentally sustainable aquaculture management, *Journal of Cleaner Production*, Vol. 57, pp.249-256, http://dx.doi.org/10.1016/j.jclepro.2013.05.029 [accessed 15th April 2019].
- Munro, A., Kovats, R.S., Rubin, G.J., Waite, T.D., Bone, A. and Armstrong, B. (2017). Effect of evacuation and displacement on the association between flooding and mental health outcomes: a cross-sectional analysis of UK survey data, *The Lancet Planetary Health*, Vol. 1, No. 4, pp.e134-141, doi: 10.1016/S2542-5196(17)30047-5.
- Murakami, K. and Livingstone, M.B.E. (2018). Greenhouse gas emissions of self-selected diets in the UK and their association with diet quality: is energy under-reporting a problem? *Nutrition Journal*, Vol. 17, No. 27, https://doi.org/10.1186/s12937-018-0338-x [accessed 15th April 2019].
- Murphy, A. (2018). Brexit Britain has taken its eye off the Paris Agreement on climate change, *The Conversation*, 24th September, https://theconversation.com/uk/topics/brexit-9976?page=3.

- Murphy, A. (2019). Will politicians take action and try to save the planet from climate change, *The Conversation*, 16th September, https://theconversation.com/will-politicians-take-action-and-try-to-save-the-planet-from-climate-change-122754 [accessed 15th April 2019].
- Murphy, C., Gardoni, P. and McKim, R. (Eds.) (2018). *Climate change and its impacts: risks and inequalities*, Berlin, Germany: Springer International Publishing, doi:10.1007/978-3-319-77544-9.
- Murphy, J.M., Harris, G.R., Sexton, D.M.H., Kendon, E.J., Bett, P.E., Clark, R.T., Eagle, K.E., Fosser, G., Fung, F., Lowe, J., McDonald, R.E., McInnes, R.N., McSweeney, C.F., Mitchell, J.F.B., Rostron, J.W., Thornton, H.E., Tucker, S. and Yamazaki, K. (2018). *UKCP18 Land Projections: Science Report*, Exeter, UK Met Office.
- Murphy, S. (2015). Food security and international trade: risk, trust and rules, *Canadian Food Studies*, pp.88-96, doi: 10.15353/cfs-rcea.v2i2.133.
- Murphy-Bokern, D. (2010). Understanding the carbon footprint of our food, *Complete Nutrition*, Vol. 10, No. 5, October, pp.61-61, http://www.murphy-bokern.com/images/Food_carbon_footprint_explained.pdf [accessed 15th April 2019].
- Murray, C. (2014). *Metrics for healthy and sustainable food systems*. Presentation at the EAT Forum, Stockholm, May.
- Murray, N. (2020). Who is likely to go without food in the looming supply crisis, *IHS Markit Report*, 23rd April, https://ihsmarkit.com/research-analysis/article-who-is-likely-to-go-without-food-in-the-looming-supply.html [accessed 23rd April, 2020].
- Murray, S. (2010). How to feed people and save the planet, *Financial Times Special Report*, Business & Food Sustainability, 27th January.
- Murray-Tortarolo, G. and Jaramillo, V.I. (2018). Hoping for rain: the link between rainfed maize, climate change, and human wellbeing in Mexico, *Earth*, 30th April, https://sciencetrends.com/hoping-for-rain-the-link-between-rainfed-maize-climate-change-and-human-wellbeing-in-mexico/ [accessed 15th April 2019].
- Murray-Tortarolo, G.N., Jaramillo, V.J. and Larsen, J. (2018). Food security and climate change: the case of rainfed maize production in Mexico, *Agricultural and Forest Meteorology*, Vol 253, pp.124-131, https://doi.org/10.1016/j.agrformet.2018.02.011 [accessed 15th April 2019].
- Mushtaq, S., White, N., Cockfield, G., Power, B. and Jakeman, G. (2015). Reconfiguring agriculture through the relocation of production systems for water, environment and food security under climate change, *Journal of Agricultural Science*, Vol. 153, No. 5, pp.779-797, doi: https://doi.org/10.1017/S0021859614001117 [accessed 15th April 2019].
- Muttarak, R. and Lutz, W. (2014). Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? *Ecology and Society*, Vol. 19, No. 1. p. 42, http://dx.doi.org/10.5751/ES-06476-190142 [accessed 15th April 2019].

- Mwatsama, M. (2018). *Fresh start: A framework for health and sustainable diets in the UK – Policy options review*, London, UK: UK Health Forum.
- Myers, S.S. (2017). Planetary health: protecting human health on a rapidly changing planet, *The Lancet*, Vol. 390, Iss. 10114, https://doi.org/10.1016/S0140-6736(17)32846-5 [accessed 15th April 2019].
- Myers, S.S., Wessells, K.R., Kloog, I., Zanobetti, A. and Schwartz, J. (2015). Effect of increased concentrations of atmospheric carbon dioxide on the global threat of zinc deficiency: a modelling study, *The Lancet Global Health*, Vol. 3, pp.e639-645, doi: 10.1016/S2214-109X(15)00093-5.
- Myers, S.S., Zanobetti, A., Kloog, I., Huybers, P., Leakey, A.D.B., Bloom, A.J., Carlisle, E., Dietterich, L.H., Fitzgerald, G., Hasegawa, G., Holbrook, N.M., Nelson, R.L., Ottman, M.J., Raboy, V., Sakai, H., Sartor, K.A., Schwartz, J., Seneweera, S., Tausz, M. and Usui, Y. (2014). Increasing CO_2 threatens human nutrition, *Nature*, Vol. 510, pp.139-142, doi:10.1038/nature13179.
- Mytton, O.T., Clarke, D. and Rayner, M. (2012). Taxing unhealthy food and drinks to improve health, *British Medical Journal*, Vol. 344, pp.e2931, doi: https://doi.org/10.1136/bmj.e2931.
- Mytton, O.T., Nnoaham, K., Eyles, H., Scarborough, P. and Ni Mhurchu, C. (2014). Systematic review and meta-analysis of the effect of increased vegetable and fruit consumption on body weight and energy intake, *BMC Public Health,* Vol. 14, No. 1, pp.886-886, http://www.biomedcentral.com/1471-2458/14/886.
- NABIM (2014). *UK Flour Milling Industry 2014*, London, UK: The National Association of British and Irish Millers.
- Nabudere, P.D.W. (2013). *From agriculture to agricology: towards a glocal circular economy*, Real African Publishers, Houghton.
- Nagothu, U.S. (Ed) (2016). *Climate change and agricultural development: improving resilience through climate smart agriculture*, London, UK: Earthscan Food and Agriculture / Taylor and Francis.
- Nagyová, L., Holienčinová, M., Košičiarová, I. and Holota, T. (2016). Corporate social responsibility in food manufacturing companies – environmental dimensions, *Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis*, Vol. 64, No. 3, pp.1037-1043, http://dx.doi.org/10.11118/actaun201664031037 [accessed 15th April 2019].
- NAO (2013). *Food safety and authenticity in the processed meat supply chain*, Report by the Comptroller and Auditor General, 10th October, London, UK: The Food Standards Agency, Department for Environment, Food & Rural Affairs, Department of Health, National Audit Office.
- NAO (2019a). *Early review of the new farming programme*, HC 2221 SESSION 2017–2019, 5th June, London, UK: Department for Environment, Food & Rural Affairs.
- NAO (2019b). Time and space needed to fully test and evaluate policy to avoid the unintended consequences on both environmental and food security,
- NAP (2011). *America's climate choices*, Washington, USA: National Academies Press, doi: 10.17226/12781.

- NAP (2012a). *A sustainability challenge food security for all - report of two workshops*, Washington, USA: National Academies Press.
- NAP (2012b). *Exploring health and environmental costs of food*, Washington, USA: National Academies Press.
- NAP (2012c). *Climate change evidence and causes*, Washington, USA: National Academies Press.
- NAP (2013). *Abrupt impacts of climate change - anticipating surprises*, Washington, USA: National Academies Press.
- NAP (2015a). *Climate intervention carbon dioxide removal and reliable sequestration,* Washington, USA: National Academies Press, ISBN 978-0-309-30529-7.
- NAP (2015b). *Critical role of animal science research in food security and sustainability*, Washington, USA: National Academies Press.
- NAP (2016a). *Attribution of extreme weather events in the context of climate change*, Washington, USA: National Academies Press, doi: 10.17226/21852.
- NAP (2016b). *Genetically engineered crops: experiences and prospects*, Washington, USA: National Academies Press.
- NAP (2017a). *Genetically engineered crops - experiences and prospects*, Washington, USA: National Academies Press.
- NAP (2017b). *Impact of genetically engineered crops on farm sustainability in the United States*, Washington, USA: National Academies Press.
- NAP (2017c). *Preparing for future products of biotechnology*, Washington: National Academies Press.
- NAP (2017d). *Review of the draft climate science special report*, Washington: National Academies Press.
- NAP (2018a). *Abrupt impacts of climate change: anticipating surprises*, Washington, USA: National Academies Press, doi: 10.17226/18373.
- NAP (2018b). *Climate change: evidence and causes*, Washington, USA: National Academies Press, doi:10.17226/18730.
- NAP (2019a). *Climate change and ecosystems*, Washington, USA: The National Academies Press, https://www.nap.edu/catalog/25504/climate-change-and-ecosystems [accessed 11th April 2019].
- NAP (2019b). *Climate communications initiative strategic plan*, Washington, USA: The National Academies Press, https://doi.org/10.17226/25368.
- NAP (2019c). *Making climate assessments work: learning from California and other subnational climate assessments: proceedings of a workshop*, Washington, USA: The National Academies Press, https://doi.org/10.17226/25324 [accessed 15th April 2019].
- NAP (2019d). *Science breakthroughs to advance food and agricultural research by 2030*, Washington, USA: The National Academies Press, https://doi.org/10.17226/25059 [accessed 15th April 2019].

- Nardone, A., Ronchi, B., Lacetera, N. and Ranieri, M.S. (2010). Effects of climate changes on animal production and sustainability of livestock systems, *Livestock Science*, Vol. 130, pp.57-69, https://doi.org/10.1016/j.livsci.2010.02.011 [accessed 15th April 2019].
- NAS (2019). Global warming is contributing to extreme weather events, https://sites.nationalacademies.org/BasedOnScience/climate-change-global-warming-is-contributing-to-extreme-weather-events/index.htm [accessed 15th April 2019].
- NASA (2018a). *Climate change: how do we know?* National Aeronautics and Space Administration (NASA), https://climate.nasa.gov/evidence/ [accessed 3rd October 2019].
- NASA (2018b). *Climate change: vital signs of the planet*, National Aeronautics and Space Administration (NASA), https://climate.nasa.gov/scientific-consensus/#*, [accessed 3rd October 2019].
- NASA (2019). *Global temperature anomalies from 1880 to 2019*, NASA's Scientific Visualization Studio video, Washington, USA: National Aeronautics and Space Administration, https://climate.nasa.gov/climate_resources/139/video-global-warming-from-1880-to-2019/ [accessed 3rd October 2019].
- NASA (2020). *NASA, NOAA analyses reveal 2019 second warmest year on record*, National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA), Press release number 20-003, 15th January, https://www.nasa.gov/press-release/nasa-noaa-analyses-reveal-2019-second-warmest-year-on-record [accessed 16th January, 2020].
- NASA/Goddard Space Flight Center (2018). NASA soil moisture data advances global crop forecasts, *Science Daily*, 1st June, www.sciencedaily.com/releases/2018/06/180601134729.htm [accessed 15th April 2019].
- Nastari, P.M. (2015). Investments money that brings money, *Conference on Global Food Security Challenges*, Università degli Studi di Milano - Aula Magna, 7-8th August, Milan, Italy.
- Natale, F., Hofherr, J., Fiore, G. and Virtanen, J. (2013). Interactions between aquaculture and fisheries, *Marine Policy*, Vol. 38, pp.205-213, http://dx.doi.org/10.1016/j.marpol.2012.05.037 [accessed 15th April 2019].
- Natalini, D., Bravo, G. and Jones, A.W. (2019). Global food security and food riots – an agent-based modelling approach, *Food Security*, Vol. 11, No. 5, pp.1153-1173, https://doi.org/10.1007/s12571-017-0693-z [accessed 11th April 2020].
- *National Geographic* (2018). Seven things to know about climate change, *National Geographic*, https://www.nationalgeographic.com/magazine/2017/04/seven-things-to-know-about-climate-change/ [accessed 15th April 2019].
- National Intelligence Council (2017). Global trends - paradox of progress, Washington, USA: National Intelligence Council.
- National Intelligence Council (2017). *Global trends: a publication of the National Intelligence Council*, NIC 2017-001, Washington, USA: National Intelligence Council, ISBN 978-0-16-093614-2.

- National Policy Forum (2019). *A sustainable food policy*, Environment, Energy and Culture Policy Commission, London, UK: Labour Party's 2019 National Policy Forum Consultation, www.policyforum.labour.org.uk [accessed 15th April 2019].
- National Research Council (2012). *A sustainability challenge food security for all*, Washington, USA: National Academies Press.
- National Research Council (2012). *Exploring health and environmental costs of food*, Washington, USA: National Academies Press.
- National Research Council (2015). *Critical role of animal science research in food security and sustainability*, Washington, USA: National Academies Press.
- Nätt, D., Kugelberg, U., Casas, E., Nedstrand, E., Zalavary, S., Henriksson, P., Nijm, C., Jäderquist, C., Sandborg, J., Flinke, E., Ramesh, R., Örkenby, L., Appelkvist, F., Lingg, T., Guzzi, N., Bellodi, C., Löf, M., Vavouri, T. and Öst, A. (2019). Human sperm displays rapid responses to diet, *PLOS Biology*, Vol. 17, No. 12, e3000559, doi: 10.1371/journal.pbio.3000559.
- Natural England (2020). *Regional Agricultural Land Classification Maps: Likelihood of Best and Most Versatile Agricultural Land - East Midlands Region*, ALC005, York, UK: Natural England, http://publications.naturalengland.org.uk/category/5954148537204736 [accessed 15th April, 2020].
- *Nature* (1897). A history of the Fens of South Lincolnshire, *Nature*, Vol. 55, No. 1897, pp.436-437 (1897). https://doi.org/10.1038/055436a0.
- Nature (2010). Closing the climategate, *Nature*, Vol. 468, No. 345, doi:10.1038/468345a.
- *Nature* (2016). *Climate change: knowledge alters public perception*, http://link.galegroup.com/apps/doc/A488470640/ITOF?u=mmucal5&sid=ITOF&xid=56c901a6 [accessed 15th April 2019].
- *Nature* (2016). UK food imports use scarce water, *Nature*, 5th May, Vol. 533, p.11.
- Nature Conservancy Council (2018). *The science of sustainability: exploring a unified path for development and conservation,* London, UK: Nature Conservancy Council.
- *Nature Materials* (2017). A sustainable material world, *Nature Materials*, Vol. 16, No. 7, p.691.
- Nauen, C.E. (2008). Ten years of international scientific cooperation in fisheries, aquaculture and coastal zones, *Environment, Development and Sustainability*, Vol. 10, pp.605-622, doi: 10.1007/s10668-008-9153-4.
- Navarrete, M., Dupré, L. and Lamine, C. (2014). Crop management, labour organization, and marketing: three key issues for improving sustainability in organic vegetable farming, *International Journal of Agricultural Sustainability*, Vol. 13, No. 3, pp.257-274, doi: 10.1080/14735903.2014.959341
- Naylor, R.L. (2008). Managing food production systems for resilience (chapter 12). In: Chapin, F.S., Kofinas, G.P. and Folke, C. (eds), *Principles of natural resource stewardship: resilience-based management in a changing world*, New York, USA: Springer.

- Naylor, R.L. (2018). The elusive goal of global food security, *Current History*, Vol. 117, No. 795, pp.3-9.
- Naylor, R.L. and Higgins, M.M. (2018). The rise in global biodiesel production: implications for food security, *Global Food Security*, Vol. 16, pp.75-84, doi: 10.1016/j.gfs.2017.10.004.
- NCEI (2018). *Global climate report- 2018, State of the Climate*, https://www.ncdc.noaa.gov/sotc/global/201806 [accessed 15th April 2019].
- NEF (2019). *Landing the blame: overfishing in the North East Atlantic 2019*, London, UK: The New Economics Foundation, https://neweconomics.org/ [accessed 15th April 2019].
- Nelleman C., MacDevette, M., Manders, T., Eickhout, B., Svihus, B., Prins, A.G. and Kaltenborn, B.P. (2009). *The environmental food crisis: the environment's role in averting future food crises*, A UNEP rapid response assessment, United Nations Environment Programme, Norway: GRID-Arendal, ISBN: 978-82-7701-054-0.
- Nellemann, C., Hain, S., and Alder, J. (eds) (2008). *In dead water – merging of climate change with pollution, over-harvest, and infestations in the world's fishing grounds*, United Nations Environment Programme, Norway: GRID-Arendal, ISBN: 978-82-7701-048-9.
- Nelson, G.C. Rosegrant, M.W., Koo, J., Robertson, R., Sulser, T., Zhu, T., Ringler, C., Msangi, S., Palazzo, A., Batka, M., Magalhaes, M., Valmonte-Santos, R., Ewing, M. and Le, D. (2009). *Climate change - impact on agriculture and costs of adaptation*, Washington, USA: International Food Policy Research Institute, http://www.fao.org/fileadmin/user_upload/rome2007/docs/Impact_on_Agriculture_and_Costs_of_Adaptation.pdf [accessed 15th April 2019].
- Nelson, G.C., Rosegrant, M.W., Palazzo, A., Gray, I., Ingersoll, C. (2010). *Food security, farming, and climate change to 2050 - scenarios, results, policy options*, Washington, USA: International Food Policy Research Institute,
Institute,http://www.fao.org/fileadmin/user_upload/rome2007/docs/Impact_on_Agriculture_and_Costs_of_Adaptation.pdf [accessed 15th April 2019].
- Nelson, G.C., Rosegrant, M.W., Palazzo, A., Gray, I., Ingersoll, C., Robertson, R., Tokgoz, S., Zhu, T., Sulser, T.B., Ringler, C., Msangi, S. and You, L. (2010). *Food security, farming, and climate change to 2050: challenges to 2050 and beyond*, IFPRI Issue Brief No. 66. Washington DC, USA: International Food Policy Research Institute (IFPRI), www.ifpri.org/publication/food-security-farming-and-climate-change-2050 [accessed 15th April 2019].
- Nelson, G.C., Valin, H., Sands, R.D., Havlík, P., Ahammad, H., Deryng, D. and Willenbockel, D. (2014). Climate change effects on agriculture: economic responses to biophysical shocks, *Proceedings of the National Academy of Sciences*, Vol. 111, No. 9, pp.3274-3279, https://doi.org/10.1073/pnas.1222465110 [accessed 15th April 2019].

- Nelson, M.C., Ingram, S.E., Dugmore, A.J., Streeter, R., Peeples, M.A., McGovern, T.H., Hegmon, M., Arneborg, J., Kintigh, K.W., Brewington, S., Spielmann, K.A., Simpson, I.A., Strawhacker, C., Comeau, L.E.L., Torvinen, A., Madsen, C.K., Hambrecht, G. and Smiarowski, K. (2016). Climate challenges, vulnerabilities, and food security, *Proceedings of the National Academy of Sciences*, Vol. 113, No. 2, pp.298-303, www.pnas.org/cgi/doi/10.1073/pnas.1506494113 [accessed 15th April 2019].
- Nelson, M.D. (2015). Climate change science & propaganda, *International Journal of Geosciences,* Vol. 6, No.12, pp.1323-1338, doi: 10.4236/ijg.2015.612105.
- Nelson, M.E., Hamm, M.W., Hu, F.B., Abrams, S.A. and Griffin, T.S. (2016). Alignment of healthy dietary patterns and environmental sustainability: a systematic review, *Advances in Nutrition: An International Review Journal*, Vol. 7, Iss. 6, doi.org/10.3945/an.116.012567.
- Nemecek, T., Bengoa, X., Lansche, J., Mouron, P., Rossi, V. and Humbert, S. (2015). *World food LCA database: methodological guidelines for the life cycle inventory of agricultural products*, Version 3.0, Lausanne and Zurich, Switzerland.
- Nemecek, T., Bengoa, X., Lansche, J., Mouron, P., Rossi, V. and Humbert, S. (2014). *Methodological guidelines for the life cycle inventory of agricultural products*, Version 2.0, July 2014, World Food LCA Database (WFLDB), Quantis and Agroscope, Lausanne and Zurich, Switzerland.
- Nemecek, T., Hayer, F., Bonninc, E., Carrouée, B., Schneider, A. and Vivier, C. (2015). Designing eco-efficient crop rotations using life cycle assessment of crop combinations, *European Journal of Agronomy*, Vol. 65, pp.40-51, http://dx.doi.org/10.1016/j.eja.2015.01.005 [accessed 15th April 2019].
- Nemecek, T., Jungbluth, N., i Canals, L.M. and Schenck, R. (2016). Environmental impacts of food consumption and nutrition, *International Journal of Life Cycle Assessment*, Vol. 21, pp.607-620, doi: 10.1007/s11367-016-1071-3.
- NERC (2018). *Water Climate Change Impacts Report Card 2016*, https://nerc.ukri.org/research/partnerships/ride/lwec/report-cards/water/ [accessed 15th April 2019].
- Nerem, R.S., Beckley, B.D., Fasullo, J.T., Hamlington, B.D., Masters, D. and Mitchum, G.T. (2018). Climate-change–driven accelerated sea-level rise detected in the altimeter era, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 9, pp.2022-2025, https://doi.org/10.1073/pnas.1717312115 [accessed 15th April 2019].
- Neset, T-S., Wirehn, L., Opach, T., Glaas, E. and Linner, B-O (2019). Evaluation of indicators for agricultural vulnerability to climate change: the case of Swedish agriculture, *Ecological Indicators*, Vol. 105, pp.571-580, https://doi.org/10.1016/j.ecolind.2018.05.042 [accessed 15th April 2019].
- Neslen, A. (2018). UK defies EU over Indonesian palm oil trade, leaked papers show, *The Guardian*, 9th March, https://www.theguardian.com/environment/2018/mar/09/uk-defies-eu-over-indonesian-palm-oil-trade-leaked-papers-show?CMP=share_btn_tw [accessed 15th April 2019].
- Nestlé (2018). *Action on sustainable diets - a best practice guideline for implementing diets that are good for people, planet and business in foodservice*, Footprint Intelligence.

- Nestle, M. (2018). *Unsavory truth: how food companies skew the science of what we eat,* New York, USA: Basic Books, ISBN 9781541617315.
- Neumann, R.B., Moorberg, C.J., Lundquist, J.D., Turner, J.C., Waldrop, M.P., McFarland, J.W., Euskirchen, E.S., Edgar, C.W. and Turetsky, M.R. (2019). Warming effects of spring rainfall increase methane emissions from thawing permafrost, *Geophysical Research Letters*, Vol. 46, pp.1393-1401, doi: 10.1029/2018GL081274.
- New Citizenshift (2017). *This is the citizenshift - a guide to understanding & embracing the emerging era of the citizen*, https://newcitizenshipproject.wordpress.com/2015/10/28/this-is-the-citizen-shift/ [accessed 15th April 2019].
- New Citizenship (2017). *Toolkit handout: five ways to be a food citizen*,
- *New Food* (2017). Nearly two billion people depend on imported food, *New Food*, 13th April, https://www.newfoodmagazine.com/news/36941/two-billion-people-food-imports/ [accessed 15th April 2019].
- *New Food* (2018a). Current food systems may not be ready for the future, *New Food*, 26th November, https://www.newfoodmagazine.com/news/76245/current-food-systems-future/ [accessed 15th April 2019].
- *New Food* (2018b). Lactalis site salmonella strain linked to outbreak 10 years ago. The CEO of Lactalis has said that he “cannot rule out” the possibility that babies have consumed salmonella-contaminated milk from his company’s Craon site between 2005 and last year, *New Food Magazine*, 16th November, https://www.newfoodmagazine.com/news/64430/lactilis-decade/ [accessed 15th April 2019].
- *New Food* (2018c). Inquiry to scrutinise impact of energy drinks on young people’s health*, New Food Magazine*, 12th March, https://www.newfoodmagazine.com/news/65297/inquiry-energy-drinks-young-people/ [accessed 15th April 2019].
- *New Food* (2019a). Are misplaced economic incentives major drivers of obesity and climate change? Experts have argued that obesity, undernutrition and climate change are all part of the ‘The Global Syndemic’, and should be focused on by leaders, *New Food*, 28th January, https://www.newfoodmagazine.com/news/78418/are-misplaced-economic-incentives-major-drivers-of-obesity-and-climate-change [accessed 15th April 2019].
- *New Food* (2019b). Rising temperatures could safeguard crop nutrition, at the expense of yield. Conflicting research does not always show what will happen – only what might. Here, researchers predict changes to crops as temperatures continue to rise, *New Food*, 28th January, https://www.newfoodmagazine.com/news/78180/climate-change-nutrition/ [accessed 15th April 2019].
- *New Scientist* (2017a). Food for thought - finding a diet that's good for you and the planet, *New Scientist*, Vol. 3144, pp.35, https://archive.org/stream/NewScientistMagazineSeptember232017/ [accessed 15th April 2019].

- *New Scientist* (2019a). Everything you know about nutrition is wrong: why almost all food advice is fatally flawed, *New Scientist,* Vol. 3238, pp.32-35, https://www.newscientist.com/article/mg24332380-000-why-everything-you-know-about-nutrition-is-wrong/ [accessed 15th April 2019].
- *New York Times* (2018). Trump imperils the planet: endangered species, climate change — the administration is taking the country, and the world, backward, *New York Times*, 26th December, https://www.nytimes.com/2018/12/26/opinion/editorials/climate-change-environment-trump.html [accessed 15th April 2019].
- Newbold, T. (2018). Future effects of climate and land-use change on terrestrial vertebrate community diversity under different scenarios, *Proceedings of the Royal Society B: Biological Sciences*, Vol. 285, No. 188, https://doi.org/10.1098/rspb.2018.0792 [accessed 15th April 2019].
- Newell, P., Taylor, O. and Touni, C. (2018). Governing food and agriculture in a warming world, *Global Environmental Politics*, Vol. 18, No. 2, pp.53-71, https://doi.org/10.1162/glep_a_00456 [accessed 15th April 2019].
- Newton, A.C., Flavell, A.J., George, T.S., Leat, P., Mullholland, B., Ramsay, L., Revoredo-Giha, C., Russell, J., Steffenson, B.S., Swanston, J.S., Thomas, W.T.B., Waugh, R., WhiteIan, P.J. and Bingham, J. (2011). Crops that feed the world 4 - barley a resilient crop? Strengths and weaknesses in the context of food security, *Food Security*, Vol. 3, pp.141, https://doi.org/10.1007/s12571-011-0126-3 [accessed 15th April 2019].
- NFU (2012). *Catalyst for change: better ways of doing business in the horticulture & potatoes sector*, Stoneleigh, UK: NFU Horticulture & Potatoes Board, July, https://www.nfuonline.com/assets/6106 [accessed 15th April, 2019].
- NFU (2016). *Fit for the future: helping consumers eat more fruit and vegetables*, Stoneleigh Park, UK: National Farmers Union.
- NFU (2017). Feeding the future review: four years on, Stoneleigh Park, UK: National Farmers Union, https://www.nfuonline.com/nfu-online/science-and-environment/science/science-team-reports/feeding-the-future-2013/ [accessed 15th April 2019].
- NFU (2018). *UK – a nation united by food*, Stoneleigh Park, UK: National Farmers Union.
- NFU (2018). *Why farming matters in the Fens*, Newmarket, UK: National Farmer's Union East Anglia, https://www.nfuonline.com/assets/23991 [accessed 15th April 2019].
- NFU (2019). *Achieving net zero - farming's 2040 goal*, Stoneleigh Park, UK: National Farmers Union.
- NFU (2019). *The future of food 2040*, Stoneleigh Park, UK: National Farmers Union.
- NFU (2019a). *Delivering for Britain: food and farming in the Fens*, Newmarket, UK: National Farmer's Union East Anglia, https://www.nfuonline.com/pcs-pdfs/food-farming-in-the-fens_web/ [accessed 15th April 2019].
- NFU (2019b). NFU responds to the EAT Lancet Commission report, London, UK: National Farmer's Union, https://www.nfuonline.com/news/press-centre/press-releases/nfu-responds-to-the-eat-lancet-commission-report/ [accessed 15th April 2019].

- NFU (2019c). *The Future of Food 2040*, London, UK: National Farmers Union, https://www.nfuonline.com/news/latest-news/nfu-publishes-future-of-food-report/ [accessed 15th April 2019].
- Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., Mullany, E.C., Biryukov, S., Abbafati, C., Abera, S.F., Abraham, J.P., Abu-Rmeileh, N.M., Achoki, T., AlBuhairan, F.S., Alemu, Z.A., Alfonso, R., Ali, M.K., Ali, R., Guzman, N.A., Ammar, W., Anwari P., Banerjee. A., Barquera, S., Basu, S., Bennett, D.A., Bhutta, Z., Blore, J., Cabral, N., Nonato I.C., Chang, J.C., Chowdhury, R., Courville, K.J,, Criqui, M.H., Cundiff, D.K., Dabhadkar, K.C., Dandona, L., Davis, A., Dayama, A., Dharmaratne, S.D., Ding, E.L., Durrani, A.M., Esteghamati, A., Farzadfar, F., Fay, D.F., Feigin, V.L., Flaxman, A., Forouzanfar, M.H., Goto, A., Green, M.A., Gupta, R., Hafezi-Nejad, N., Hankey, G.J., Harewood, H.C., Havmoeller, R., Hay, S., Hernandez, L., Husseini, A., Idrisov, B.T., Ikeda, N., Islami, F., Jahangir, E., Jassal, S.K., Jee, S.H., Jeffreys, M., Jonas, J.B., Kabagambe, E.K., Khalifa, S.E., Kengne, A.P., Khader, Y.S., Khang, Y.H., Kim, D., Kimokoti, R.W., Kinge, J.M., Kokubo, Y., Kosen, S., Kwan, G., Lai, T., Leinsalu, M., Li, Y., Liang, X., Liu, S., Logroscino, G., Lotufo, P.A., Lu, Y., Ma, J., Mainoo, N.K., Mensah, G.A., Merriman, T.R., Mokdad, A.H., Moschandreas, J., Naghavi, M., Naheed, A., Nand, D., Narayan, K.M., Nelson, E.L., Neuhouser, M.L., Nisar, M.I.., Ohkubo, T., Oti, S.O., Pedroza, A., Prabhakaran, D., Roy, N., Sampson, U., Seo, H., Sepanlou, S.G., Shibuya, K., Shiri, R., Shiue, I., Singh, G.M., Singh, J.A., Skirbekk, V., Stapelberg, N.J., Sturua, L.., Sykes, B.L., Tobias, M., Tran, B.X., Trasande, L., Toyoshima, H., van de Vijver, S., Vasankari, T.J., Veerman, J.L., Velasquez-Melendez, G., Vlassov, V.V., Vollset, S.E., Vos, T., Wang, C., Wang, X., Weiderpass, E., Werdecker, A., Wright, J.L., Yang, Y.C., Yatsuya, H., Yoon, J., Yoon, S.J., Zhao, Y., Zhou, M., Zhu, S., Lopez, A.D., Murray, C.J., Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the global burden of disease study 2013, *The Lancet*, Vol. 384, pp.766-781, doi: 10.1016/S0140-6736(14)60460-8.
- Nguyen, T.L.T., Hermansen, J.E. and Mogensen, L. (2010). Environmental consequences of different beef production systems in the EU, *Journal of Cleaner Production*, Vol. 18, Iss. 8, pp.756-766, https://doi.org/10.1016/j.jclepro.2009.12.023 [accessed 15th April 2019].
- NHS (2016). *A healthier Manchester - our vision, your health*, Manchester, UK: Manchester City Council.
- Nicholls, R.J., Marinova, N., Lowe, J.A., Brown, S., Vellinga, P., de Gusmão, D., Hinkel, J. and Tol, R.S.J. (2011). Sea-level rise and its possible impacts given a ‘beyond 4°C world’ in the twenty-first century, *Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences*, Vol. 369, pp.161-181, https://doi.org/10.1098/rsta.2010.0291 [accessed 15th April 2019].
- Nichols, A., Maynard, V., Goodman, B. and Richardson, J. (2009). Health, climate change and sustainability: a systematic review and thematic analysis of the literature, *Environmental Health Insights*, Vol. 3, doi: 10.4137/EHI.S3003.

- Nie, Y., Avraamidou, S., Xiao, X., Pistikopoulos, E.N., Li, J., Zeng, Y., Song, F., Yu, J. and Zhu, M. (2019). A Food-Energy-Water Nexus approach for land use optimization, *Science of the Total Environment*, Vol. 659, pp.7-19, https://doi.org/10.1016/j.scitotenv.2018.12.242 [accessed 15th April 2019].
- Niebylski, M.L., Redburn, K.A., Duhaney, T. and Campbell, N.R. (2015). Healthy food subsidies and unhealthy food taxation: a systematic review of the evidence, *Nutrition*, Vol. 31, No. 6, pp.787-795, doi: 10.1016/j.nut.2014.12.010.
- Nielsen (2015). *Global health and wellness report*, January, Diemen, The Netherlands: Nielsen Holdings N.V.
- Niggli, U. (2014). Sustainability of organic food production: challenges and innovations, *Proceedings of the Nutrition Society*, Vol. 760, doi: 10.1017/S0029665114001438.
- Nijdam, D., Rood, G.A. and Westhoek, H. (2012). The price of protein: review of land use and carbon footprints from life cycle assessments of animal food products and their substitutes, *Food Policy*, Vol. 37, No. 6, pp.760-770, doi: 10.1016/j.foodpol.2012.08.002.
- Niles, M.T. and Salerno, J.D. (2018). A cross-country analysis of climate shocks and smallholder food insecurity, *PLoS One*, Vol. 13, No. 2, e0192928, doi.org/10.1371/journal.pone.0192928.
- Niles, M.T., Ahuja, R., Barker, T., Esquivel, J., Gutterman, S., Heller, M.C., Mango, N., Portner, D., Raimond, R., Tirado, C. and Vermeulen, S. (2018). Climate change mitigation beyond agriculture: a review of food system opportunities and implications, *Renewable Agriculture and Food System*, Vol. 33, Special Issue 3, pp.297-308, doi.org/10.1017/S1742170518000029.
- Niles, M.T., Ahuja, R., Esquivel, M.J., Mango, N., Duncan, M., Heller, M. and Tirado, C. (2017). *Climate change and food systems: assessing impacts and opportunities*, Washington, USA: Meridian Institute and the Global Alliance for the Future of Food, http://www.merid.org/~/media/CCFS/CC-FS%20Final%20Report%20November%202017 [accessed 15th April 2019].
- Nilsson, L.M., Destouni, G., Berner, J., Dudarev, A.A., Mulvad, G., Odland, J.O., Parkinson, A., Tikhonov, C., Rautio, A. and Evengård, B. (2013). A call for urgent monitoring of food and water security based on relevant indicators for the Arctic, *Ambio*, Vol. 42, pp.816-822, doi: 10.1007/s13280-013-0427-1.
- Niman, N.H. (2014). *Defending beef: the case for sustainable meat production*, White River Junction, USA: Chelsea Green Publishing Co., ISBN-10: 1603585362.
- NOAA (2016). *Time series*, Washington, USA: NOAA (National Centre for Environmental Information), https://governmentshutdown.noaa.gov/ [accessed 15th April 2019].
- NOAA (2019a). Carbon dioxide levels in atmosphere hit record high in May: Monthly average surpassed 414 ppm at NOAA's Mauna Loa Observatory in Hawaii, *Science Daily*, 4th June, www.sciencedaily.com/releases/2019/06/190604140109.htm [accessed 15th April 2019].
- NOAA (2019b). *Research data from Mauna Loa in Hawaii*, Washington, USA: U.S. Department of Commerce National Oceanic & Atmospheric Administration (NOAA), https://www.esrl.noaa.gov/gmd/ccgg/trends/monthly.html [accessed 15th April 2019].

- NOAA (2020). *National centers for environmental information, state of the climate: global climate report for June 2018*, published online July 2018, https://www.ncdc.noaa.gov/sotc/global/201806 [accessed 25th March, 2020].
- Nobajas, A. (2018). How Brexit could drain Britain's bottled mineral water industry dry, *The Conversation*, 21st February, https://theconversation.com/how-brexit-could-drain-britains-bottled-mineral-water-industry-dry-91859 [accessed 15th April 2019].
- Nolan, C., Overpeck, J.T., Allen, J.R.M., Anderson, P.M., Betancourt, J.L., Binney, H.A., Brewer, S., Bush, M.B., Chase, B.M., Cheddadi, R., Djamali, M., Dodson, J., Edwards, M.E., Gosling, W.D., Haberle, S., Hotchkiss, S.C., Huntley, B., Ivory, S.J., Kershaw, A.P., Kim, S-H., Latorre, C., Leydet, M., Lézine, A-M., Liu, K-B., Liu, Y., Lozhkin, A.V., Mcglone, M.S., Marchant, R.A., Momohara, A., Moreno, P.I., Müller, S., Otto-Bliesner, B.L., Shen, C., Stevenson, J., Takahara, H., Tarasov, P.E., Tipton, J., Vincens, A., Weng, C., Xu, Q., Zheng, Z. and Jackson, S.T. (2018). Past and future global transformation of terrestrial ecosystems under climate change, *Science*, 31st August, pp.920-923, doi: 10.1126/science.aan5360.
- Nordhaus, W.D. (1991). To slow or not to slow: the economics of the greenhouse effect, *The Economic Journal*, Vol. 101, No. 407, pp.920-937, doi: 10.2307/2233864.
- Norgaard, R.B. (2017). Sustainability: growing pains, *Nature*, Vol. 542, No. 7640, pp.162-162, https://doi.org/10.1038/542162a [accessed 15th April 2019].
- North and North East Lincolnshire (2011). Strategic Flood Risk Assessment, November, https://www.nelincs.gov.uk/planning-and-building-control/planning-policy/the-local-plan/local-plan-background-information/strategic-flood-risk-assessment-2011-sfra/ [accessed 15th April 2019].
- Northrop, E. (2018). 7 signs of progress: a year of national climate action, *World Resources Institute*, 29th May, http://www.wri.org/blog/2018/05/7-signs-progress-year-national-climate-action [accessed 15th April 2019].
- Notarnicola, B., Hayashi, K., Curran, M.A. and Huisingh, D. (2012). Progress in working towards a more sustainable agri-food industry, *Journal of Cleaner Production*, Vol. 28, pp.1-8, https://doi.org/10.1016/j.jclepro.2012.02.007 [accessed 15th April 2019].
- Notarnicola, B., Sala, S., Anton, A., McLaren, S.J., Saouter, E. and Sonesson, U. (2017). The role of life cycle assessment in supporting sustainable agri-food systems: a review of the challenges, *Journal of Cleaner Production*, Vol. 140, pp.399-409, http://dx.doi.org/10.1016/j.jclepro.2016.06.071 0959 [accessed 15th April 2019].
- Notarnicola, B., Tassiellia, G., Alexander, P., Valentina, R., and Castellani, V.R. and Salab, C. (2017). Environmental impacts of food consumption in Europe, *Journal of Cleaner Production*, Vol. 140, pp.753-765, https://doi.org/10.1016/j.jclepro.2016.06.080 [accessed 15th April 2019].
- Nour, M., Lutze, S.A., Grech, A. and Allman-Farinelli, M. (2018). The relationship between vegetable intake and weight outcomes - a systematic review of cohort studies, *Nutrients*, Vol. 10, 1626, doi:10.3390/nu10111626.

- Nour, M., Lutze, S.A., Grech, A. and Allman-Farinelli, M. (2018). The relationship between vegetable intake and weight outcomes: a systematic review of cohort studies, *Nutrients*, Vol. 10, No11, 1626, doi: 10.3390/nu10111626.
- Nowosad, J., Stepinski, T.F. and Netzel, P. (2018). Global assessment and mapping of changes in mesoscale landscapes: 1992–2015, *International Journal of Applied Earth Observation and Geoinformation*, Vol. 78, pp.332-340, doi: 10.1016/j.jag.2018.09.013.
- NRC (2016). *Impact of genetically engineered crops on farm - sustainability in the United States*, Washington, USA: National Academies Press, doi: 10.17226/12804.
- NuFEAST project: Optimising Nutritional Health and Well-being through local, sustainable food systems, https://research.bournemouth.ac.uk/project/nufeast-nutritional-well-being-and-growing-food/ [accessed 15th April 2019].
- Nugent, R., Levin, C., Hale, J. and Hutchinson, B. (2019). Economic effects of the double burden of malnutrition, *The Lancet*, Vol. 395, No. 10217, doi:https://doi.org/10.1016/S0140-6736(19)32473-0.
- Nunan, C. (2017). Antibiotic use in farm animals: the global threat. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.228-239, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Nuttall, C. (2013). Why horsegate isn't all bad, *The Grocer*, 23rd February, p.25.
- Nuttall, C. (2014). Food poverty is a disgrace, *The Grocer*, 8th March, p.25.
- Nuttall, C. (2015). Healthy must be easy too, *The Grocer*, 13th June, p.26.
- Nyamwanza, A.M., New, M.G., Fujisawa, M., Johnston, P. and Hajat, A. (2017). Contributions of decadal climate information in agriculture and food systems in east and southern Africa, *Climatic Change*, Vol. 143, No. 1-2, pp.115-128, doi: 10.1007/s10584-017-1990-4.
- NYSAG (2018). *Fishy business: seafood fraud and mislabelling in New York state supermarkets*, New York, USA: Office of the New York State Attorney General.
- O'Bannon, C., Carr, J.A., Seekell, D.A. and D'Odorico, P. (2014). Globalization of agricultural pollution due to international trade, *Hydrology and Earth System Sciences*, Vol. 18, pp.503-510, doi:10.5194/hess-18-503-2014.
- O'Brien, D., Shalloo, L., Patton, J., Buckley, F., Grainger, C. and Wallace, M. (2013). A life cycle assessment of seasonal grass-based and confinement dairy farms, *Agricultural Systems*, Vol. 107, pp.33-46, https://doi.org/10.1016/j.agsy.2011.11.004 [accessed 15th April 2019].
- O'Brien, L.V., Berry, H.L., Coleman, C. and Hanigan, I. (2014). Drought as a mental health exposure, *Environmental Health*, Vol. 131, pp.181-187, doi: 10.1016/j.envres.2014.03.014.
- O'Connor, A. (2015). Coca-Cola funds scientists who shift blame for obesity away from bad diets, *New York Times*, 9th August, https://well.blogs.nytimes.com/2015/08/09/coca-cola-funds-scientists-who-shift-blame-for-obesity-away-from-bad-diets/ [accessed 15th April 2019].

- O'Connor, A. (2016). How the sugar industry shifted blame to fat, *New York Times*, 13th September, https://www.nytimes.com/2016/09/13/well/eat/how-the-sugar-industry-shifted-blame-to-fat.html [accessed 11th April 2019].
- O'Connor, A. (2019). Why eating processed foods might make you fat, *The New York Times*, 16th May, https://www.nytimes.com/2019/05/16/well/eat/why-eating-processed-foods-might-make-you-fat.html [accessed 15th April 2019].
- O'Donnell, A., Anderson, P., Jané-Llopis, E., Manthey, J., Kaner, E. and Rehm, J. (2019). Immediate impact of minimum unit pricing on alcohol purchases in Scotland: controlled interrupted time series analysis for 2015-18, *BMJ*, Vol. 366, l5274, http://dx.doi.org/10.1136/bmj.l5274 [accessed 15th April 2019].
- O'Donnell, T., Deutsch, J., Pepino, R., Millron, B.J., Yungmann, C. and Katz, S.H. (2015). New solutions for food loss and waste prevention, *BioCycle*, Vol. 56, No. 11, pp.34-34, https://www.biocycle.net/2015/12/15/new-solutions-for-food-loss-and-waste-prevention/ [accessed 15th April 2019].
- O'Donovan, J. (2019). *Transition to an Irish Vegan Agricultural System*, https://www.vegansociety.com/about-us/research/research-news/research-briefing-transition-irish-vegan-agricultural-system [accessed 15th April 2019].
- O'Halloran, S., Eksteen, G., Gebremariam, M. and Alston, L. (2020). Measurement methods used to assess the school food environment: a systematic review, *International Journal of Environmental Research and Public Health*, Vol. 17, No. 1623, doi: 10.3390/ijerph17051623.
- O'Kane, G. (2012). What is the real cost of our food - implications for the environment, society and public health nutrition, *Public Health Nutrition*, Vol. 15, No. 2, pp.268-276, doi:10.1017/S136898001100142X.
- O'Kane, G. (2016). A movable feast: exploring barriers and enablers to food citizenship, *Appetite*, Vol. 105, pp.674-687, https://doi.org/10.1016/j.appet.2016.07.002 [accessed 15th April 2019].
- O'Mara, F.P. (2012). The role of grasslands in food security and climate change, *Annals of Botany*, Vol. 110, No. 6, pp.1263-1270, doi: 10.1093/aob/mcs209.
- O'Neil, D.W. (2007). *The total external environmental costs and benefits of agriculture in the UK*, Bristol, UK: Environment Agency.
- O'Neil, D.W., Dietz, R. and Jones, N. (eds)(2014). *Enough is enough: building a sustainable economy in a world of finite resources*, The Report of the Steady State Economy Conference, Leeds, UK: Center for the Advancement of the Steady State Economy and Economic Justice for All.
- O'Neill, B., Kriegler, E., Ebi, K., Kemp-Benedict, E., Riahi, K., Rothman, D.S., van Ruijven, B.J., van Vuuren, D.P., Birkmann, J., Kok, K., Levy, M. and Solecki. W. (2015). The roads ahead: narratives for shared socioeconomic pathways describing world futures in the 21st century, *Global Environmental Change*, Vol. 42, pp.169-180, https://doi.org/10.1016/j.gloenvcha.2015.01.004 [accessed 15th April 2019].

- O'Neill, D.W., Dietz, R. and Jones, N. (eds)(2010). *Enough is enough: ideas for a sustainable economy in a world of finite resources*, The report of the Steady State Economy Conference, Leeds, UK: Center for the Advancement of the Steady State Economy and Economic Justice for All.
- O'Neill, D.W., Fanning, A.L., Lamb, W.F. and Steinberger, J.K. (2018). A good life for all within planetary boundaries, *Nature Sustainability*, Vol. 1, pp.88-95, https://www.nature.com/articles/s41893-018-0021-4.pdf [accessed 15th April 2019].
- O'Riordan, T. and Stoll-Kleemann, S. (2015). The challenges of changing dietary behaviour toward more sustainable consumption, *Environment: Science and Policy for Sustainable Development*, Vol. 57, Iss. 5, pp. 4-13, https://www.tandfonline.com/doi/full/10.1080/00139157.2015.1069093 [accessed 15th April 2019].
- Öborn, I., Bengtsson, J., Hedenus, F., Rydhmer, L., Stenström, M., Vrede, K., Westin, C. and Magnusson, U. (2013). Scenario development as a basis for formulating a research program on future agriculture: a methodological approach, *Ambio,* Vol. 42, No. 7, pp.823-839, doi:10.1007/s13280-013-0417-3.
- Obradovich, N., Migliorini, R., Mednick, S.C. and Fowler, J.H. (2017). Night-time temperature and human sleep loss in a changing climate, *Science Advances*, Vol. 3, e1601555, doi: 10.1126/sciadv.1601555.
- Obradovich, O., Migliorini, R., Paulus, M.P. and Rahwan, I. (2018). Empirical evidence of mental health risks posed by climate change, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 115, No. 43, pp.10953-10958, https://doi.org/10.1073/pnas.1801528115 [accessed 15th April 2019].
- Odegard, I.Y.R. and van der Voet, e. (2014). The future of food - scenarios and the effect on natural resource use in agriculture in 2050, *Ecological Economics*, Vol. 97, pp.51-59, http://dx.doi.org/10.1016/j.ecolecon.2013.10.005 [accessed 15th April 2019].
- OECD (2006). *Water and agriculture - sustainability, markets and policies: conclusions and recommendations*, Paris, France: Organisation for Economic Co-operation and Development.
- OECD (2011). *Evaluation of Agricultural Policy Reforms in the European Union*, Paris, France: Organisation for Economic Co-operation and Development.
- OECD (2013). *The European Union's Common Agricultural Policy (CAP) post-2013*, Paris, France: Organisation for Economic Co-operation and Development.
- OECD (2015). *Climate Fund Inventory*, OECD report to the G20 Climate Finance Study Group, Paris, France: Organisation for Economic Co-operation and Development, https://www.oecd.org/env/cc/Climate-Fund-Inventory-Background-report-OECD.pdf [accessed 15th April 2019].
- OECD (2016). Towards Sustainable, Productive and Climate Friendly Agricultural Systems, Agriculture Policy Note, Paris, France: Organisation for Economic Co-operation and Development, https://www.oecd.org/tad/policynotes/sustainable-productive-climate-friendly-agricultural-systems.pdf [accessed 15th April 2019].
- OECD (2017a). *Agriculture Policy Monitoring and Evaluation 2017*, Paris: Organisation for Economic Co-operation and Development.

- OECD (2017b). *Health at a glance*, Organisation for Economic Co-operation and Development.
- OECD-FAO (2019). Agricultural outlook 2019-2028, Paris: Food and Agriculture Organization of the United Nations and Organisation for Economic Co-operation and Development, https://www.oecd.org/agriculture/oecd-fao-agricultural-outlook-2019/ [accessed 11th April 2020].
- Ogallo, L.A., Omondi, P., Ouma, G. and Wayumba, G. (2018). Climate change projections and the associated potential impacts for Somalia, *American Journal of Climate Change*, Vol. 7, pp.153-170, doi: 10.4236/ajcc.2018.72011.
- Ogleby, G. (2018). Top investors call on global food brands to make plant-based shift, *Edie News*, 13th February, https://www.edie.net/news/9/Top-investors-call-on-global-food-brands-to-make-plant-based-shift/ [accessed 15th April 2019].
- Okafor-Yarwood, I. (2018). Nigeria's depleting fish stocks may pose a threat to regional security, *The Conversation*, 7th December, https://theconversation.com/nigerias-depleting-fish-stocks-may-pose-a-threat-to-regional-security-105168 [accessed 15th April 2019].
- Olawumi, T.O. and Chan, D.W.M. (2018). A scientometric review of global research on sustainability and sustainable development, *Journal of Cleaner Production*, Vol. 183, pp.231-250, https://doi.org/10.1016/j.jclepro.2018.02.162 [accessed 15th April 2019].
- Olesen, I., Myhr, A.I. and Rosendal, G.K. (2011). Sustainable aquaculture - are we getting there - ethical perspectives on salmon farming, *Journal of Agricultural and Environmental Ethics*, Vol. 24, pp.381-408, doi: 10.1007/s10806-010-9269-z.
- Oliver, T.H., Boyd, E., Balcombe, K., Benton, T.G., Bullock, J.M., Donovan, D., Feola, G., Heard, M., Mace, G.M., Mortimer, S.R., Nunes, R.J., Pywell, R.F. and Zaum, D. (2018). Overcoming undesirable resilience in the global food system, *Global Sustainability,* Vol. 1, No. 9, pp.1-9, https://doi.org/10.1017/sus.2018.9 [accessed 15th April 2019].
- Olivero, J., Fa, J.E., Real, R., Márquez, A.L., Farfán, M.A., Vargas, J.M., Gaveau, D., Salim, M.A., Park, D., Suter, J., King, S., Leendertz, S.A., Sheil, D. and Nasi, R. (2017). Recent loss of closed forests is associated with Ebola virus disease outbreaks, *Scientific Reports*, Vol. 7, No. 14291, pp.1-9, doi:10.1038/s41598-017-14727-9.
- Olsen, P. and Borit, M. (2018). The components of a food traceability system, *Trends in Food Science & Technology*, Vol. 77, pp.143-149, doi: https://doi.org/10.1016/j.tifs.2018.05.004.
- Olsen, R.L. and Hasan, M.R. (2012). A limited supply of fishmeal: impact on future increases in global aquaculture production, *Trends in Food Science & Technology*, Vol. 27, No. 2, pp.120-128, http://dx.doi.org/10.1016/j.tifs.2012.06.003 [accessed 15th April 2019].
- Olson, J., Clay, P.M. and daSilva, P.P. (2014). Putting the seafood in sustainable food systems, *Marine Policy*, Vol. 43, pp.104-111, http://dx.doi.org/10.1016/j.marpol.2013.05.001 [accessed 15th April 2019].

- Olstad, D.L., Ancilotto, R., Teychenne, M., Minaker, L.M., Taber, D.R., Raine, K.D., Nykiforuk, C.I.J. and Ball, K. (2017). Can targeted policies reduce obesity and improve obesity-related behaviours in socioeconomically disadvantaged populations? A systematic review, *Obesity Reviews*, Vol. 18, No. 7, pp.791-807, doi: 10.1111/obr.12546.
- Omar, H. and El-Haggar, S.M. (2017). Sustainable industrial community, *Journal of Environmental Protection*, Vol. 8, pp.301-318, http://www.scirp.org/journal/jep [accessed 15th April 2019].
- ONS (2015). *UK natural capital land cover in the UK*, London, UK: Office for National Statistics, https://www.ons.gov.uk/economy/environmentalaccounts/articles/uknaturalcapitallandcoverintheuk/2015-03-17 [accessed 15th April 2019].
- ONS (2019). *The decoupling of economic growth from carbon emissions: UK evidence*, London, UK: Office for National Statistics, https://www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/compendium/economicreview/october2019/thedecouplingofeconomicgrowthfromcarbonemissionsukevidence [accessed 24th December, 2019].
- Oostenbach, L.H., Slits, E., Robinson, E. and Sacks, G. (2019). Systematic review of the impact of nutrition claims related to fat, sugar and energy content on food choices and energy intake, *BMC Public Health*, Vol. 19, No. 1, 1296, doi: 10.1186/s12889-019-7622-3.
- Oosterveer, P. (2015) Promoting sustainable palm oil - viewed from a global networks and flows perspective, *Journal of Cleaner Production*, Vol. 107, pp.146-153, http://dx.doi.org/10.1016/j.jclepro.2014.01.019 [accessed 15th April 2019].
- Opio, C., Gerber, P., Mottet, A., Falcucci, A., Tempio, G., MacLeod, M., Vellinga, T., Henderson, B. and Steinfeld, H. (2013). *Greenhouse gas emissions from ruminant supply chains – A global life cycle assessment*, Rome, Italy: Food and Agriculture Organization of the United Nations.
- Oppenheimer, M., Glavovic, B.C., Hinkel, J., van de Wal, R., Magnan, A.K., Abd-Elgawad, A., Cai, R., Cifuentes-Jara, M., DeConto, R.M., Ghosh, T., Hay, J., Isla, F., Marzeion, B., Meyssignac, B. and Sebesvari, Z. (2019). Sea-level rise and implications for low-lying islands, coasts and communities. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, N.M. Weyer (eds.)]. In press.
- Oreskes, N. (2004). The scientific consensus on climate change, *Science*, Vol. 306, Issue 5702, pp. 1686, doi: 10.1126/science.1103618.
- Oreskes, N. and Conway, E. (2010). *The merchants of doubt: how a handful of scientists obscured the truth on issues from tobacco smoke to global warming*, New York, USA: Bloomsbury Press, ISBN 978-1-59691-610-4.
- Orr, D.W. (2011). National security and sustainability, *Journal of Environmental Studies and Sciences*, Vol. 1, pp.36-43, doi: 10.1007/s13412-011-0011-6.

- Orsini, S. (2016). Securing the promise, reducing the risks: aquaculture at a crossroads? *Sustainable Food Trust*, 22nd July, https://sustainablefoodtrust.org/articles/aquaculture-risks/ [accessed 15th April 2019].
- Ortiz, R. (2015). Plant genetic engineering as a means to improve food security: potential and issues surrounding it, *ICAE Preconference: Global Food Security Challenges*, Milan, Italy, 8th August.
- Ortiz-Bobea, A. and Tack, J. (2018). Is another genetic revolution needed to offset climate change impacts for US maize yields? *Environmental Research Letters*, Vol. 13, 124009, https://doi.org/10.1088/1748-9326/aae9b8 [accessed 15th April 2019].
- Ortiz-Bobea, A., Knippenberg, E. and Chambers, R.G. (2018). Growing climatic sensitivity of U.S. agriculture linked to technological change and regional specialization, *Science Advances*, Vol. 4, No. 12, doi: 10.1126/sciadv.aat4343.
- Orwell, G. (1937). *The road to Wigan Pier*, London, UK: Victor Gollancz Ltd.
- Osborn, D. (2019). The breadth of climate change impacts on biological systems, *Emerging Topics in Life Sciences*, 10th May, Vol. 3, No. 2, pp.107-113, doi: https://doi.org/10.1042/ETLS20180114 [accessed 15th April 2019].
- Osei-Owusu, A.K., Kastner, T., de Ruiter, H., Thomsen, M. and Caro, D. (2019). The global cropland footprint of Denmark's food supply 2000–2013, *Global Environmental Change*, Vol. 58, 101978, https://doi.org/10.1016/j.gloenvcha.2019.101978 [accessed 15th April 2019].
- Osman, M. and Nelson, W. (2019). How can food futures insight promote change in consumers' choices, are behavioural interventions (e.g. nudges) the answer, *Futures*, Vol. 111, pp.116-122, https://doi.org/10.1016/j.futures.2019.04.008 [accessed 15th April 2019].
- Osman, M. and Thornton, K. (2019). Traffic light labelling of meals to promote sustainable consumption and healthy eating, *Appetite*, Vol. 138, pp.60-71, https://doi.org/10.1016/j.appet.2019.03.015 [accessed 15th April 2019].
- Osofsky, S.A., Pattanayak, S.K., Pongsiri, M.J., Romanelli, C., Soucat, A., Vega, J. and Yach, D. (2015). Safeguarding human health in the Anthropocene epoch - report of the Rockefeller Foundation-Lancet Commission on planetary health, *The Lancet*, Vol. 386, 14th November, pp.1973-2028.
- Osofskya, S.A. and Pongsiria, M.J. (2018). Operationalising planetary health as a game-changing paradigm: health impact assessments are key, *The Lancet Planetary Health*, Vol. 2, Iss. 2, pp.e54–e55, doi.org/10.1016/S2542-5196(17)30183-3.
- Österblom, H., Jouffray, J-B., Folke, C., Crona, B., Troell, M., Merrie, A. and Rockström, J. (2015). Transnational corporations as ‘keystone actors’ in marine ecosystems, *PLoS One,* Vol. 10, No. 5, pp.e0127533, https://doi.org/10.1371/journal.pone.0127533 [accessed 15th April 2019].
- Ostle, N.J., Levy, P.E., Evans, C.D. and Smith, P. (2009). UK land use and soil carbon sequestration, *Land Use Policy*, Vol. 26, pp.s274-s283, https://doi.org/10.1016/j.landusepol.2009.08.006 [accessed 15th April 2019].

- Oszvald, M., Primavesi, L.F., Griffiths, C.A., Cohn, J., Basu, S., Nuccio, M.L. and Paul, M.J. (2018). Trehalose 6-Phosphate regulates resource allocation in maize, *Plant Physiology*, Vol. 176, No. 4, pp.2623-2638, doi: 10.1104/pp.17.01673.
- Ottrey, E., Jong, J. and Porter, J. (2018). Ethnography in nutrition and dietetics research: a systematic review, *Journal of the Academy of Nutrition and Dietetics*, Vol. 118, No. 10, pp.1903-1942, doi: 10.1016/j.jand.2018.06.002.
- Our World in Data (2017). http://ourworldindata.org/food-per-person [accessed 15th April 2019].
- Owen, G. (2020). What makes climate change adaptation effective? A systematic review of the literature, *Global Environmental Change*, Vol. 62, art. no. 102071, doi: 10.1016/j.gloenvcha.2020.102071.
- Owen, L., Seaman, H. and Prince, S. (2007). *Public understanding of sustainable consumption of food: a report to the Department for Environment, Food and Rural Affairs.* Opinion Leader, London, UK: Department for Environment, Food and Rural Affairs.
- Oxfam (2016). *The journey to sustainable food – a three-year update on the Behind the Brands campaign*, Oxford, UK: Oxfam, https://www.oxfam.org/sites/www.oxfam.org/files/file_attachments/bp-journey-to-sustainable-food-btb-190416-en.pdf [accessed 15th April 2019].
- Oxfam (2018). *Reward work, not wealth*, Oxford, UK: Oxfam, https://www.oxfam.org/sites/www.oxfam.org/files/file_attachments/bp-reward-work-not-wealth-220118-summ-en.pdf [accessed 15th April 2019].
- Oxfam (2019). Extreme carbon inequality-why the Paris climate deal must put the poorest, lowest emitting and most vulnerable people first, Oxford, UK: Oxfam.
- Ozkan, B., Akpinar, M.G. and Ceylan, F. (2008). *A research on consumer purchasing preferences for organic fresh fruits and vegetables in Turkey*, Antalya/Turkey: University of Akdeniz Department of Agricultural Economics.
- Pacheco, A.F., Balam, G.C., Archibald, D., Grant, E. and Skafida, V. (2018). Exploring the relationship between local food environments and obesity in UK, Ireland, Australia and New Zealand: a systematic review protocol, *BMJ Open*, Vol. 8, Iss. 2, e018701, doi: 10.1136/bmjopen-2017-018701.
- Paddison, L. (2017). From algae to yeast: the quest to find an alternative to palm oil. The race is on to develop an eco-friendly substitute for palm oil but, as Ecover discovered, the path can be bumpy, *The Guardian*, 29th September, https://www.theguardian.com/sustainable-business/2017/sep/29/algae-yeast-quest-to-find-alternative-to-palm-oil [accessed 15th April 2019].
- Padhy, S.K., Sarkar, S., Panigrahi, M. and Paul, S. (2015). Mental health effects of climate change, *Indian Journal of Occupational and Environmental Medicine*, Vol. 19, pp.3-7, doi: 10.4103/0019-5278.156997.
- Padilla, M., Prosperi, P., Cogill, B., Allen, T. and Peri, I. (2015). *Metrics of sustainable diets and food systems - insights from a multi-institutional research partnership*, Watch Letter - Lettre de veille du CIHEAM, CIHEAM, 2015, Feeding Expo Milano 2015 with Mediterranean perspectives, pp.35-39.

- Padley, M. and Hirsch, D. (2013). Households below a minimum income standard: 2008/9 to 2010/11, York, UK: Joseph Rowntree Foundation.
- Pahl-Wostl, C. (2019). Governance of the water-energy-food security nexus: a multi-level coordination challenge, *Environmental Science & Policy*, Vol. 92, pp.356-367, https://doi.org/10.1016/j.envsci.2017.07.017 [accessed 15th April 2019].
- Paillard, S., Treyer, S. and Dorin, B. (eds)(2014). *Agrimonde - Scenarios and challenges for feeding the world in 2050*, The Netherlands, Springer, doi: 10.1007/978-94-017-8745-1.
- Pairotti, M.B., Cerutti, A.K., Martini, F., Vesce, E., Padovan, D. and Beltramo, R. (2014). Energy consumption and GHG emission of the Mediterranean diet, *Journal of Cleaner Production*, Vol. 103, pp.507-516, https://doi.org/10.1016/j.jclepro.2013.12.082 [accessed 15th April 2019].
- Palazzo, A., Vervoort, J.M., Mason-D'Croz, D., Rutting, L., Havlik, P. and Islam, S. (2017). Linking regional stakeholder scenarios and shared socioeconomic pathways: quantified West African food and climate futures in a global context, *Global Environmental Change*, Vol. 45, pp.227-242, https://doi.org/10.1016/j.gloenvcha.2016.12.002 [accessed 15th April 2019].
- Pall, P., Aina, T., Stone, D.A., Stott, P.A., Nozawa, T., Hilberts, A.G.J., Lohmann, D. and Allen, M.R. (2011). Anthropogenic greenhouse has contribution to flood risk in England and Wales in autumn 2000, *Nature*, Vol. 470, pp.382-385, https://doi.org/10.1038/nature09762 [accessed 15th April 2019].
- Palomo-Vélez, G., Tybur, J.M. and van Vugt, M. (2018). Unsustainable, unhealthy, or disgusting? Comparing different persuasive messages against meat consumption, *Journal of Environmental Psychology*, Vol. 58, pp.63-71, doi: 10.1016/j.jenvp.2018.08.002.
- Panitchpakdi, S. (2010). *The global food crisis causes and policy response*, Switzerland: UNCTAD, http://www.mfa.gov.tr/data/Kutuphane/yayinlar/EkonomikSorunlarDergisi/sayi30/journal.pdf [accessed 15th April 2019].
- Panko, B. (2017). Humans overwhelmingly rely on only a few crops like wheat, making our food supplies vulnerable to climate change, *Smithsonian Magazine*, 2nd October, https://www.smithsonianmag.com/smart-news/extinction-threatens-foods-we-eat-180965081/ [accessed 15th April 2019].
- Panorama Perspectives (2017a). *Conversations on Planetary Health - Planetary Health 101*, Seattle, USA: Panorama Global, www. http://panoramaglobal.org/ [accessed 15th April 2019].
- Panorama Perspectives (2017b). *Conversations on Planetary Health - The Planetary Health landscape: from concept to action,* Seattle, USA: Panorama Global, www. http://panoramaglobal.org/ [accessed 15th April 2019].
- Panorama Perspectives (2017c). *Conversations on Planetary Health - global policy opportunities for planetary health: a review of existing policy frameworks*, Seattle, USA: Panorama Global, www. http://panoramaglobal.org/ [accessed 15th April 2019].

- Parajuli, R., Thoma, G. and Matlock, M.D. (2019). Environmental sustainability of fruit and vegetable production supply chains in the face of climate change: a review, *Science of the total environment*, Vol. 650, No. 2, pp.2863-2879, https://doi.org/10.1016/j.scitotenv.2018.10.019 [accessed 15th April 2019].
- Parfitt, J., Barthel, M. and Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.3065-3081, https://doi.org/10.1098/rstb.2010.0126 [accessed 15th April 2019].
- Park, C-E., Jeong, S-J., Joshi, M., Osborn, T.J., Ho, C-H., Piao, S., Chen, D., Liu, J., Yang, H., Park, H., Kim, B-M. and Feng, S. (2018). Keeping global warming within 1.5 °C constrains emergence of aridification, *Nature Climate Change*, Vol. 8, pp.70–74, doi:10.1038/s41558-017-0034-4 [accessed 15th April 2019].
- Park, Y.S., Gokhan Egilmezb, G. and Kucukvarca, M. (2016). Emergy and end-point impact assessment of agricultural and food production in the United States - a supply chain-linked Ecologically-based Life Cycle Assessment, *Ecological Indicators*, Vol. 62, pp.117-137, http://dx.doi.org/10.1016/j.ecolind.2015.11.045 [accessed 15th April 2019].
- Parker, R.W.R., Blanchard, J.L., Gardner, C., Green, B.S., Hartmann, K., Tyedmers, P.H. and Watson, R.A. (2018). Fuel use and greenhouse gas emissions of world fisheries, *Nature Climate Change*, Vol. 8, pp.333-337, doi:10.1038/s41558-018-0117-x [accessed 15th April 2019].
- Parkes, G., Young, J.A., Walmsley, S.F., Abel, R., Harman, J., Horvat, P., Lem, A., MacFarlane, A., Mens, M. and Nolan, C. (2010). Behind the signs—a global review of fish sustainability information schemes, *Reviews in Fisheries Science*, Vol. 18, No. 4, pp.344-356, doi: 10.1080/10641262.2010.516374 (2010).
- Parmesan, C. and Yohe, G. (2003). A globally coherent fingerprint of climate change impacts across natural systems, *Nature*, Vol. 421, pp.37-42, https://doi.org/10.1038/nature01286 [accessed 15th April 2019].
- Parris, T.M, and Kates, R.W. (2003). Characterizing a sustainability transition: goals, targets, trends, and driving forces, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 100, No. 14, pp.9068-9073, https://doi.org/10.1073/pnas.1231336100 [accessed 15th April 2019].
- Parry, M. (2009). Adapting future agricultural production to climate change: a survey of the challenge to increase food security and reduce risk of hunger, *IOP Conference Series: Earth and Environmental Science*, Vol. 6, No. 37, pp.372001, doi: 10.1088/1755-1307/6/7/372001.
- Parry, M., Evans, A. Rosegrant, M.W. and Wheeler, T. (2009). *Climate change and hunger: responding to the challenge*, Rome, Italy: United Nations World Food Programme.
- Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (eds) (2007). *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK and New York, USA.
- Parry, M.L., Rosenzweig, C. and Livermore, M. (2005). Climate change, global food supply and risk of hunger, *Philosophical Transactions of the Royal Society B*, Vol. 360, Iss. 1463, doi: 10.1098/rstb.2005.1751.

- Parry, M.L., Rosenzweig, C., Iglesias, A., Livermore, M. and Fischer, G. (2004). Effects of climate change on global food production under SRES emissions and socio-economic scenarios, *Global Environmental Change*, Vol. 14, No. 1, pp.53-67, https://doi.org/10.1016/j.gloenvcha.2003.10.008 [accessed 15th April 2019].
- Parsons, K. (2019a). *Brief 3: Integrated food policy: what it is, and how can it help transform food systems?* Centre for Food Policy, City University of London.
- Parsons, K. (2019b). What transforming food systems means for policy: from ideas to action, *Global Food Security*, 29th October, https://www.foodsecurity.ac.uk/blog/what-transforming-food-systems-means-for-policy-from-ideas-to-action/ [accessed 15th April 2019].
- Parsons, K. and Hawkes, C. (2018). *Connecting food systems for co-benefits: how can food systems combine diet-related health with environmental and economic policy goals?* Denmark: World Health Organisation, https://www.ncbi.nlm.nih.gov/pubmed/31465160 [accessed 15th April 2019].
- Parsons, K. and Hawkes, C. (2019a). *Brief 1: Tackling food systems challenges: the role of food policy*, London, UK: Centre for Food Policy, City University of London.
- Parsons, K. and Hawkes, C. (2019b). *Brief 4: Embedding food in all policies*, London, UK: Centre for Food Policy, City University of London.
- Parsons, K. and Hawkes, C. (2019c). *Brief 5: Policy coherence in food systems*, London, UK: Centre for Food Policy, City University of London.
- Parsons, K., Barling, D. and Lang, T. (2018). UK policymaking institutions and their implications for integrated food policy, *Advances in Food Security and Sustainability*, Vol. 3, pp.211-251, https://doi.org/10.1016/bs.af2s.2018.09.005.
- Parsons, K., Hawkes, C. and Wells, R. (2019). *Brief 2: Understanding the food system: why it matters for food policy*, London, UK: Centre for Food Policy, City University of London, https://www.city.ac.uk/__data/assets/pdf_file/0008/471599/7643_Brief-2_What-is-the-food-system-A-food-policy-perspective_WEB_SP.pdf [accessed 15th April 2020].
- Pasqualino, R., Jones, A.W., Monasterolo, I. and Phillips, A. (2015). Understanding global systems today – a calibration of the World3-03 model up to 2012, *Sustainability*, Vol. 7, No. 8, pp.9864, https://doi.org/10.3390/su7089864 [accessed 15th April 2019].
- Patel, P. (2018). Missing Paris climate goals could cost trillions, *The Anthropocene*, 31st May, http://www.anthropocenemagazine.org/2018/05/missing-paris-climate-goals-could-cost-trillions/ [accessed 15th April 2019].
- Patel, R. (2017). Against cheap food: an aide memoir, 21st February, *Global Alliance for the Future of Food*, https://futureoffood.org/cheap-food-aide-memoir/ [accessed 15th April 2019].
- Paterson, K. (2017). Environmental groups urge Scottish fish farms to scale back, as mortality rates in Scottish farms may be as high as 25 per cent, *The National*, 5th February, http://www.thenational.scot/news/15919237.Fish_farms_put_under_pressure_to_scale_back_production/ [accessed 15th April 2019].

- Patil, S. and Phansalkar, S. (2019). A systematic review on the studies of climate change and its effect on public health, *International Journal of Advanced Science and Technology*, Vol. 28, No. 16, pp.106-118, ISSN: 2005-4238.
- Patthanaissaranukool, W. and Polprasert, C. (2016). Reducing carbon emissions from soybean cultivation to oil production in Thailand, *Journal of Cleaner Production*, Vol. 131, pp.170-178, http://dx.doi.org/10.1016/j.jclepro.2016.05.053 0959 [accessed 11th April 2020].
- Patz, J.A., Campbell-Lendrum, D., Holloway, T. and Foley, J.A. (2005). Impact of regional climate change on human health, *Nature*, Vol. 438, pp.310-317, https://doi.org/10.1038/nature04188 [accessed 15th April 2019].
- Patz, J.A., McGeehin, M.A., Bernard, S.M., Ebi, K.L., Epstein, P.R., Grambsch, A., Gubler, D.J., Reither, P., Romieu, I., Rose, J.B., Samet, J.M. and Trtanj, J. (2000). The potential health impacts of climate variability and change for the United States: executive summary of the report of the health sector of the US National Assessment, *Environmental Health Perspectives*, Vol. 108, pp.367-376, doi: 10.1289/ehp.00108367.
- Paulson, H.M. (2015). Short-termism and the threat from climate change, https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/short-termism-and-the-threat-from-climate-change [accessed 15th April 2019].
- Pauly, D. (2009). Aquacalypse now: the end of fish, *New Republic*, 7th October, pp.24-27.
- Pauly, D. and Froese, R. (2012). Comments on FAO's State of Fisheries and Aquaculture, *Marine Policy*, Vol. 36, pp.746-752, http://www.fao.org/3/i9540en/i9540en.pdf [accessed 15th April 2019].
- Pauly, D. and Zeller, D. (2016). Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining, *Nature Communications*, Vol. 7, pp.10244, https://doi.org/10.1038/ncomms10244 [accessed 15th April 2019].
- Pauly, D., Christensen, V., Guénette, S., Pitcher, T.J., Sumaila, U.R., Walters, C.J., Watson, R. and Zeller, D. (2002). Towards sustainability in world fisheries, *Nature*, Vol. 418, pp.689-695, https://doi.org/10.1038/nature01017 [accessed 15th April 2019].
- Payen, S., Falconer, S., Carlson, B., Yang, W. and Ledgard, S. (2020). Eutrophication and climate change impacts of a case study of New Zealand beef to the European market, *Science of the Total Environment*, Vol. 710, 136120, doi: 10.1016/j.scitotenv.2019.136120.
- Payne, C.L.R., Scarborough, P. and Cobiac, L. (2016). Do low-carbon-emission diets lead to higher nutritional quality and positive health outcomes? A systematic review of the literature, *Public Health Nutrition*, Vol. 19, No. 14, pp.2654-2661, doi: 10.1017/S1368980016000495.
- Payne, J., Bush, A., Heim, N., Knope, M. and McCauley, D. (2016). Ecological selectivity of the emerging mass extinction in the oceans, *Science*, Vol. 353, No. 6305, pp.1284-1286, doi: 10.1126/science.aaf2416.
- Peak Food (2010). Peak oil will lead to peak food - food shortages, *Peak Food: Famine in the West by 2025?* 29th January, http://www.peakfood.co.uk/2010/01/peak-oil-will-cause-peak-food/ [accessed 15th April 2019].

- Pearce, F. (2014). It's not overpopulation that causes climate change, it's consumption, *The Guardian*, 19th September, https://www.theguardian.com/commentisfree/2014/sep/19/not-overpopulation-that-causes-climate-change-but-overconsumption [accessed 11th April 2019].
- Pearce, F. (2018). Are we approaching peak stuff? Almost imperceptibly, we are stepping off the consumption treadmill, *The Anthropocene*, September, http://www.anthropocenemagazine.org/2018/09/are-we-approaching-peak-stuff/ [accessed 15th April 2019].
- Pearce, T.D., Rodríguez, E.H., Fawcett, D. and Ford, J.D. (2018). How is Australia adapting to climate change based on a systematic review? *Sustainability*, Vol. 10, No. 9, 3280, doi: 10.3390/su10093280.
- Pearson, N. and Biddle, S.J.H. (2011). Sedentary behavior and dietary intake in children, adolescents, and adults. a systematic review, *American Journal of Preventive Medicine,* Vol. 41, No. 2, pp.178, https://doi.org/10.1016/j.amepre.2011.05.002.
- Peeters, A. (2018). Obesity and the future of food policies that promote healthy diets, *Nature Reviews - Endocrinology*, Vol. 14, Iss. 7, pp.430-437, doi:10.1038/s41574-018-0026-0.
- Pellegrini, P. and Fernández, R.J. (2018). Crop intensification, land use, and on-farm energy-use efficiency during the worldwide spread of the green revolution, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 10, pp.2335-2340, https://doi.org/10.1073/pnas.1717072115 [accessed 15th April 2019].
- Pelletier, D., Mahevas, S., Drouineau, H., Vermard, Y., Thebaud, O., Guyader, O. and Poussin, B. (2009). Evaluation of the bioeconomic sustainability of multi-species multi-fleet fisheries under a wide range of policy options using ISIS-Fish, *Ecological Modelling*, Vol. 220, pp.1013-1033, doi:10.1016/j.ecolmodel.2009.01.007 [accessed 15th April 2019].
- Pelletier, N. (2008). Environmental performance in the US broiler poultry sector, *Agricultural Systems*, Vol. 98, pp.67-73, doi:10.1016/j.agsy.2008.03.007.
- Pelletier, N. and Tyedmers, P. (2007). Feeding farmed salmon - is organic better, *Aquaculture*, Vol. 272, pp.399-416, https://doi.org/10.1016/j.aquaculture.2007.06.024 [accessed 15th April 2019].
- Pelletier, N. and Tyedmers, P. (2010). Forecasting potential global environmental costs of livestock production 2000–2050, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 107, No. 43, pp.18371-18374, https://doi.org/10.1073/pnas.1004659107 [accessed 15th April 2019].
- Pelletier, N., Tyedmers, P., Sonesson, U., Scholz, A., Ziegler, F., Flysjo, A., Kruse, S., Cancino, B. and Silverman, H. (2009). Not all salmon are created equal - life cycle assessment (LCA) of global salmon farming systems, *Environ. Sci. Technology*, Vol. 43, pp.8730-8736, https://doi.org/10.1021/es9010114 [accessed 15th April 2019].
- Pember, S.E. and Knowlden, A.P. (2017). Dietary change interventions for undergraduate populations: systematic review and recommendations, *American Journal of Health Education*, Vol. 48, No. 1, pp.48-57, https://doi.org/10.1080/19325037.2016.1250018.

- Pendrous, R. (2007). Green revolution drives the food supply chain forward, *Food Manufacture*, February, p.19.
- Pendrous, R. (2017). Failure to publish clear direction for the future of UK farming and food, *Food Manufacture*, 27th April, https://www.foodmanufacture.co.uk/Article/2017/04/27/UK-food-policy-is-urgently-needed [accessed 15th April 2019].
- Pennekamp, F., Pontarp, M., Tabi, A., Altermatt, F., Alther, R., Choffat, Y., Fronhofer, E.A., Ganesanandamoorthy, P., Garnier, A., Griffiths, J.I., Greene, S., Horgan, K., Massie, T.M., Mächler, E., Palamara, G.M., Seymour, M. and Petchey, O.L. (2018). Biodiversity increases and decreases ecosystem stability, *Nature*, Vol. 563, pp.109-112, doi: 10.1038/s41586-018-0627-8.
- Penney, T.L., Brown, H.E., Maguire, E.R., Kuhn, I. and Monsivais, P. (2015). Local food environment interventions to improve healthy food choice in adults: a systematic review and realist synthesis protocol, *BMJ Open*, Vol. 5, Iss. 4, e007161, doi: 10.1136/bmjopen-2014-007161.
- People & Planet (2019). *People & planet*, https://peopleandplanet.org/, [accessed on 17 June 2019].
- Pereira, L.S. (2017). Water, agriculture and food: challenges and issues, *Water Resources Management*, Vol. 31, No. 10, pp.2985-2999, https://link.springer.com/content/pdf/10.1007%2Fs11269-017-1664-z.pdf [accessed 15th April 2019].
- Perez-Cueto, F.J.A. (2019). An umbrella review of systematic reviews on food choice and nutrition published between 2017 and-2019, *Nutrients,* Vol. 11, No. 10, pp.2398, doi:10.3390/nu11102398.
- Pérez-Cueto, F.J.A., Aschemann-Witzel, J., Shankar, B., Brambila-Macias, J., Bech-Larsen, T., Mazzocchi, M., Capacci, S., Saba, A., Turrini, A., Niedzwiedzka, B., Piorecka, B., Kozioł-Kozakowska, A., Wills, J., Traill, W.B. and Verbeke, W. (2012). Assessment of evaluations made to healthy eating policies in Europe: a review within the EATWELL Project, *Public Health Nutrition*, Vol. 15, pp.1489-1496, doi: 10.1017/S1368980011003107.
- Pérez-Escamilla, R. (2017). Food security and the 2015–2030 sustainable development goals: from human to planetary health: perspectives and opinions, *Current Developments in Nutrition*, Vol. 1, Iss. 7, July, pp.e000513, https://doi.org/10.3945/cdn.117.000513 [accessed 15th April 2019].
- Perfecto, I., Vandermeer, J. and Wright, A. (2009). *Nature's matrix: linking agriculture, biodiversity conservation and food sovereignty,* https://www.routledge.com/Natures-Matrix-Linking-Agriculture-Biodiversity-Conservation-and-Food/Perfecto-Vandermeer-Wright/p/book/9780367137816 [accessed 15th April 2019].
- Perignon, M., Vieux, F., Soler, L-G., Masset, G. and Darmon, N. (2017). Improving diet sustainability through evolution of food choices: review of epidemiological studies on the environmental impact of diets, *Nutrition Reviews*, Vol. 75, No. 1, pp.2-17, doi:10.1093/nutrit/nuw043.
- Pernollet, F., Coelho, C.R.V. and van der Werf, H.M.G. (2016) Methods to simplify diet and food life cycle inventories, *Journal of Cleaner Production*, pp.1-11, http://dx.doi.org/10.1016/j.jclepro.2016.06.111 [accessed 15th April 2019].

- Peters, C.J., Picardy, J.A., Darrouzet-Nardi, A.F. and Griffin, T.S. (2014). Feed conversions, ration compositions, and land use efficiencies of major livestock products in U.S. agricultural systems, *Agricultural Systems*, Vol. 130, pp.35-43, https://doi.org/10.1016/j.agsy.2014.06.005 [accessed 15th April 2019].
- Peters, C.J., Picardy, J.A., Darrouzet-Nardi, A.F., Wilkins, J.L., Griffin, T.S. and Fick, G.W. (2016). Carrying capacity of US agricultural land - ten diet scenarios, *Elementa: Science of the Anthropocene*, Vol. 4, pp.000116, doi: 10.12952/journal.elementa.000116.
- Peters, G.M., Wiedemann, S.G., Rowley, H.V. and Tucker, R.W. (2010). Accounting for water use in Australian red meat production, *International Journal of Life Cycle Assessment*, Vol. 15, pp.311-320, https://doi.org/10.1007/s11367-010-0161-x [accessed 15th April 2019].
- Peters, H.P. (2013). Gap between science and media revisited: Scientists as public communicators, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 20, No. 110 (Suppl 3), pp.14102-14109, https://doi.org/10.1073/pnas.1212745110 [accessed 15th April 2019].
- Peters, J.L., Sutton, A.J., Jones, D.R., Rushton, L. and Abrams, K.R. (2006). A systematic review of systematic reviews and meta-analyses of animal experiments with guidelines for reporting, *Journal of Environmental Science and Health. Part. B, Pesticides, Food Contaminants, and Agricultural Wastes*, Vol. 41, No. 7, pp.1245-1258. https://doi.org/10.1080/03601230600857130 [accessed 11th June, 2020].
- Peters, K. and Mayhew, L. (2015). *The securitisation of climate change: a developmental perspective*, London, UK: Overseas Development Institute.
- Peters, M.D., Godfrey, C., McInerney, P., Baldini Soares, C., Khalil, H. and Parker, D. (2017). Chapter 11: Scoping Reviews. In: Aromataris, E. and Munn, Z. (eds.) *JBI Reviewer's Manual*, Adelaide, Australia: Joanna Briggs Institute.
- Petersen, A. (2018). Climate change - 1.5°C is worth striving for – but is it feasible, *The Conversation*, 11th October, https://theconversation.com/climate-change-1-5-c-is-worth-striving-for-but-is-it-feasible-104668 [accessed 15th April 2019].
- Peterson, R. and Wood, P. (2017). Global warming and climategate: an excerpt from sustainability: higher education's new fundamentalism, *Academic Questions*, Vol. 30, No. 4, pp.442-455, https://doi.org/10.1007/s12129-017-9668-y [accessed 15th April 2019].
- Petetin, L., Gravey, V. and Moore, B. (2019). *Setting the Bar for a Green Brexit in Food and Farming*, Bristol, UK: Soil Association.
- Petrikova, I. (2019). Food-security governance in India and Ethiopia: a comparative analysis, *Third World Quarterly*, Vol. 40, No. 4, pp.743-762, doi: https://doi.org/10.1080/01436597.2018.1538734.
- Pettinger, C. (2018). Sustainable eating: opportunities for nutrition professionals, *British Nutrition Foundation Nutrition Bulletin*, Vol. 43, pp.226-237, https://doi.org/10.1111/nbu.12335 [accessed 15th April 2019].

- Pettorelli, N, Smith, J., Pecl, G.T., Hill, J.K. and Norris, K. (2019). Tackling the national challenges associated with the redistribution of biodiversity driven by climate change, *Journal of Applied Ecology*, Vol. 56, pp.2298-2304, https://doi.org/10.1111/1365-2664.13465 [accessed 15th April 2019].
- Pfister, S., Bayer, P., Koehler, A. and Hellweg, S. (2011). Environmental impacts of water use in global crop production: hotspots and trade-offs with land use, *Environmental Science and Technology*, Vol. 45, pp.5761-5768, https://doi.org/10.1021/es1041755 [accessed 15th April 2019].
- Pham, Y., Reardon-Smith, K., Mushtaq, S. and Cockfield, G. (2019). The impact of climate change and variability on coffee production: a systematic review, *Climatic Change*, Vol. 156, No. 4, pp.609-630, doi: 10.1007/s10584-019-02538-y.
- PHE (2016). *From plate to guide - what, why and how for the eatwell model*, London, UK: Public Health England.
- Philips (2016). *Taste the new green - produce that is fresh, healthy and safe*, Koninklijke Philips N.V.
- Phillips, D., Camargos, D., Campos, A., Wasley, A. and Heal, A. (2019). Revealed - rampant deforestation of Amazon driven by global greed for meat, *The Guardian*, 2nd July, https://www.theguardian.com/environment/2019/jul/02/revealed-amazon-deforestation-driven-global-greed-meat-brazil [accessed 15th April 2019].
- Phillips, L. (2006). Food and globalization, *Annual Review of Anthropology*, Vol. 35, No. 1, pp.37-57, doi: 10.1146/annurev.anthro.35.081705.123214.
- Piacentini, M., MacFadyen, L. and Eadie, D. (2000). Corporate social responsibility in food retailing, *International Journal of Retail & Distribution Management*, Vol. 28, No. 11, pp.459-469, https://doi.org/10.1108/09590550010356822 [accessed 15th April 2019].
- Piazza, J., Ruby, M.B., Loughnan, S., Luong, M., Kulik, J., Watkins, H.M., and Seigerman, M. (2015). Rationalizing meat consumption: the 4Ns, *Appetite*, Vol. 91, pp.114-128, https://doi.org/10.1016/j.appet.2015.04.011 [accessed 15th April 2019].
- Pickard, J. (2019). Warning of threat to UK-EU trade deal from US food demands, *Financial Times*, 7th August, https://www.ft.com/content/778b2d6c-e830-11e9-a240-3b065ef5fc55 [accessed 15th April 2019].
- Pickering, T.D., Ponia, B., Hair, C.A., Southgate, P.C., Poloczanska, E.S., Patrona, L.D., Teitelbaum, A., Mohan, C.V., Phillips, M.J., Bell, J.D. and De Silva, S. (2011). Vulnerability of aquaculture in the tropical Pacific to climate change. In: *Aquaculture in the Third Millennium*, Technical Proceedings of the Conference on Aquaculture in the Third Millennium, Bangkok, Thailand, 20th-25th February 2000 (eds) R.P. Subasinghe, P. Bueno, M.J. Phillips, C. Hough, S.E. McGladdery, and J.R. Arthur, pp.295–305, Bangkok/Rome: Netw. Aquacult. Cent. Asia-Pac./Food Agric. Organ. U. N.
- Pidcock, R. (2017). Explainer: how much did climate change ‘cost’ in the 20th century? *Carbon Brief*, 1st March, https://www.carbonbrief.org/explainer-how-much-climate-change-cost-twentieth-century [accessed 15th April 2019].

- Piecuch, G.C., Huybers, P., Hay, C.C., Kemp, A.C., Little, C.M., Mitrovica, J.X., Ponte, R.M. and Tingley, M.P. (2018). Origin of spatial variation in US East Coast sea-level trends during 1900–2017, *Nature*, Vol. 564, No. 7736, pp.400, doi: 10.1038/s41586-018-0787-6.
- Pierce, D.W., Barnett, T.P., Santer, B.D. and Gleckle, P.J. (2009). Selecting global climate models for regional climate change studies, *Proceedings of the National Academy of Sciences*, Vol. 106, No. 21, pp.8441–8446, doi.10.1073.pnas.0900094106.
- Piguet, E., Pécoud, A. and Guchteneire, D. (2011). Migration and climate change: an overview, *Refugee Survey Quarterly*, Vol. 30, pp.1-23, https://doi.org/10.1093/rsq/hdr006 [accessed 15th April 2019].
- Pikaar, I., Matassa, S., Bodirsky, B.L., Weindl, I., Humpenöder, F., Rabaey, K., Boon, N., Bruschi, M., Yuan, Z., van Zanten, H., Herrero, M., Verstraete, W. and Popp, A. (2018). Decoupling livestock from land use through industrial feed production pathways, *Environmental Science & Technology*, Vol. 52, No. 13, pp.7351-7359, https://doi.org/10.1021/acs.est.8b00216 [accessed 15th April 2019].
- Pimentel, D. (2006). Soil erosion a food and environmental threat, *Environment, Development and Sustainability*, Vol. 8, pp.119-137, doi: 10.1007/s10668-005-1262-8.
- Pimentel, D. and Pimentel, M. (1993). World population, food, natural resources and survival, *World Futures*, Vol. 59, pp.145-167, https://doi.org/10.1080/02604020310124 [accessed 15th April 2019].
- Pineda, E., Swinburn, B. and Sassi, F. (2019). Effective school food environment interventions for the prevention of childhood obesity: systematic review and meta-analysis, *The Lancet,* Vol. 394, pp.S77-S77, https://doi.org/10.1016/S0140-6736(19)32874-0.
- Pingali, P.L. (2012). Green revolution: impacts, limits, and the path ahead, *Proceedings of the National Academy of Sciences*, Vol. 109, No. 31, pp.12302–12308, www.pnas.org/cgi/doi/10.1073/pnas.0912953109 [accessed 15th April 2019].
- Pinsky, M., Reygondeau, G., Caddell, R., Palacios-Abrantes, J., Spijkers, J. and Cheung, W.W.L. (2018). Preparing ocean governance for species on the move, *Science*, Vol. 360, Iss. 6394, 15th June, pp.1189-1191, doi: 10.1126/science.aat2360.
- Pinstrup-Andersen, P. (2009). Food security: definition and measurement, *Food Security*, Vol. 1, No. 1, pp.5-7, https://doi.org/10.1007/s12571-008-0002-y [accessed 15th April 2019].
- Pinstrup-Andersen, P. (2013). *The political economy of food price policy: an overview*, Research Brief No. 1, March, http://www.wider.unu.edu/research/current-programme/en_GB/Political-Economy-of-Food/ [accessed 15th April 2019].
- Pinstrup-Andersen, P., Pandya-Lorch, R. and Rosegrant, M.W. (2001). Global food security - a review of the challenges, chapter 2. In: Pinstrup-Andersen, P. and Rosegrant, M.W. (eds). *The Unfinished Agenda: Perspectives on Overcoming Hunger, Poverty, and Environmental Degradation*, Washington, USA: International Food Policy Research Institute ISBN: 0896297063.

- Pinto de Moura, A., Cunha, L.M., Castro-Cunha, M. and Lima, R.C. (2012). A comparative evaluation of women's perceptions and importance of sustainability in fish consumption, *Management of Environmental Quality: An International Journal*, Vol. 23, Iss. 4, pp.451-461, http://dx.doi.org/10.1108/14777831211232263 [accessed 15th April 2019].
- Pirker, J., Mosnier, A., Kraxner, F., Havlík, P. and Obersteiner, M. (2016) What are the limits to oil palm expansion, *Global Environmental Change*, Vol. 40, pp.73-81, http://dx.doi.org/10.1016/j.gloenvcha.2016.06.007 [accessed 15th April 2019].
- Piscopo, S. (2017). Beyond health: extending teaching about sustainability of the Mediterranean diet in Malta, *Journal of Nutrition Education and Behavior*, Vol. 49, Iss. 7, Suppl. 1, pp.S8, https://doi.org/10.1016/j.jneb.2017.05.028 [accessed 15th April 2019].
- Pitcher, T.J. and Lam, M.E. (2015). Fish commoditization and the historical origins of catching fish for profit, *Maritime Studies*, Vol. 14, No. 1, pp.1-19, https://doi.org/10.1186/s40152-014-0014-5 [accessed 15th April 2019].
- Pitesky, M., Gunasekara, A., Cook, C. and Mitloehner, F. (2014). Adaptation of agricultural and food systems to a changing climate and increasing urbanization, *Current Sustainable/Renewable Energy Reports*, Vol. 1, No. 2, pp.43-50, https://doi.org/10.1007/s40518-014-0006-5 [accessed 15th April 2019].
- Pivato, S., Misaniand, N. and Tencatin, A. (2008). The impact of corporate social responsibility on consumer trust - the case of organic food, *Business Ethics: A European Review*, Vol. 17, No. 1, pp.3-12, doi:10.1111/j.1467-8608.2008.00515.x.
- Plagányi, E. (2019). Climate change impacts on fisheries, *Science*, Vol. 363, No. 6430, pp.930-931, doi: 10.1126/science.aaw5824.
- Pluhar, E.B. (2010). Meat and morality - alternatives to factory farming, *Journal of Agricultural and Environmental Ethics*, Vol. 23, pp.455-468, doi: 10.1007/s10806-009-9226-x.
- Plunkett Foundation (2015). *A guide to low carbon community food*, Woodstock, Oxfordshire, UK: The Plunkett Foundation.
- Pollan, M. (2006). *The omnivore's dilemma: a natural history of four meals*, London, UK: Bloomsbury, ISBN-10: 1408812185.
- Ponsioen, T.C. and van der Werf, H.M.G. (2017). Five propositions to harmonize environmental footprints of food and beverages, *Journal of Cleaner Production*, Vol. 153, pp.457-464, https://doi.org/10.1016/j.jclepro.2017.01.131 [accessed 15th April 2019].
- Ponte, S. (2012) The Marine Stewardship Council (MSC) and the making of a market for 'sustainable fish', *Journal of Agrarian Change*, April, Vol. 12, Iss. 2-3, pp.300-315, http://onlinelibrary.wiley.com/doi/10.1111/j.1471-0366.2011.00345.x [accessed 15th April 2019].
- Poore, J. and Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers, *Science*, Vol. 360, No. 6392, pp.987-992, doi: 10.1126/science.aaq0216.

- Poortinga, W., Spence, A., Whitmarsh, L., Capstick, S. and Pidgeon, N. (2011). Uncertain climate: an investigation into public scepticism about anthropogenic climate change, *Global Environmental Change*, Vol. 21, No. 3, pp.1015-1024, https://doi.org/10.1016/j.gloenvcha.2011.03.001 [accessed 15th April 2019].
- Popkin, B.M., Corvalan, C. and Grummer-Strawn, L.M. (2019). Dynamics of the double burden of malnutrition and the changing nutrition reality, *The Lancet*, Vol. 395, No. 10217, doi:https://doi.org/10.1016/S0140-6736(19)32497-3.
- Popp, A., Lotze-Campen, H. and Bodirsky, B. (2010). Food consumption, diet shifts and associated non-CO_2 greenhouse gases from agricultural production, *Global Environmental Change*, Vol. 20, pp.451-462, doi: 10.1016/j.gloenvcha.2010.02.001.
- Popper, K.R. (1952). The nature of philosophical problems and their roots in science, *Royal Society Open Science*, Vol. 3, pp.124-156, doi:10.1093/bjps/III.10.124.
- Poppy, G., Chiotha, S., Eigenbrod, F. and Al, E. (2014). Food security in a perfect storm: using the ecosystem services framework to increase understanding, *Philosophical Transactions of the Royal Society B-Biological Sciences*, 369, https://doi.org/10.1098/rstb.2012.0288.
- Poppy, G.M. (2014). *Addressing global food security and the other millennium development goals through research and development*, Ecosystem Services for Poverty Alleviation Programme (ESPA) and Department for International Development (DFID).
- Poppy, G.M. and Baverstock, J. (2019). Rethinking the food system for human health in the Anthropocene, *Current Biology*, Vol. 29, 7th October, pp.R972-R977, https://doi.org/10.1016/j.cub.2019.07.050 [accessed 15th April 2019].
- Poppy, G.M., Baverstock, J., Baverstock-Poppy, J. (2019). Meeting the demand for meat – Analysing meat flows to and from the UK pre and post Brexit, *Trends in Food Science & Technology*, Vol. 86, pp.569-578, https://doi.org/10.1016/j.tifs.2019.01.010 [accessed 15th April 2020].
- Poppy, G.M., Chiotha, G.M., Eigenbrod, F., Harvey, C.A., Honzák, M., Hudson, M.D., A. Jarvis, A., Madise, N.J., Schreckenberg, K., Shackleton, C.M., Villa, F. and Dawson, T.P. (2014). Food security in a perfect storm - using the ecosystem services framework to increase understanding, *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 369, pp.20120288, http://dx.doi.org/10.1098/rstb.2012.0288 [accessed 15th April 2019].
- Poppy, G.M., Jepson, P.C., Pickett, J.A., and Birkett, M.A. (2014). Achieving food and environmental security new approaches to close the gap, *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 369, pp.20120272, http://dx.doi.org/10.1098/rstb.2012.0272 [accessed 15th April 2019].
- Population Institute (2010). *The perfect storm scenario for 2030*, Washington, USA: Population Institute, https://www.populationinstitute.org/external/files/reports/The_Perfect_Storm_Scenario_for_2030.pdf [accessed 15th April 2019].

- Porfirio, L.P., Newth, D., Finnigan, J.J. and Cai, Y. (2018). Economic shifts in agricultural production and trade due to climate change, *Palgrave Communications*, Vol. 4, No. 111, pp.1-9, doi: 10.1057/s41599-018-0164-y.
- Porkka, M., Kummu, M., Siebert, S. and Varis, O. (2013). From food insufficiency towards trade dependency: a historical analysis of global food availability, *PLoS One*, Vol. 8, No. 12, e82714, doi:10.1371/journal.pone.0082714.
- Porritt, J. (2010). Confronting policy dilemmas. In: Webster, J., D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 1st edition, pp.275-286, London, UK: Routledge.
- Porritt, J. (2015). The hypocrisy at the heart of today's food security debate, *Sustainable Food Trust*, 24th July, https://sustainablefoodtrust.org/articles/overpopulation-food-security-debate/ [accessed 15th April 2019].
- Porritt, J. (2017). Confronting policy dilemmas. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.355-368, London, UK: Routledge, https://doi.org/10.4324/9781315562032 [accessed 11th April 2020].
- Porritt, J. (2019). Saying no to BP and Shell today: hard choices have to be made, *Resiliance*, 5th July, https://www.resilience.org/stories/2019-07-05/saying-no-to-bp-and-shell-today-hard-choices-have-to-be-made/ [accessed 15th April 2019].
- Porritt, J. (2020). *Hope in hell: a decade to confront the climate emergency*, London, UK: Simon & Schuster, ISBN-10: 1471193276.
- Porter, J.J., Dessai, S. and Tompkins, E.L. (2014). What do we know about UK household adaptation to climate change? A systematic review, *Climatic Change*, Vol. 127, No. 2, pp.371-379, doi: 10.1007/s10584-014-1252-7.
- Porter, J.R. and Gawith, M. (1999). Temperatures and the growth and development of wheat: a review, *European Journal of Agronomy*, Vol. 10, 23-36, https://doi.org/10.1016/S1161-0301(98)00047-1 [accessed 15th April 2019].
- Porter, J.R., Challinor, A.J., Henriksen, C.B., Howden, S.M. and Martre, P. (2019). Invited review: Intergovernmental Panel on Climate Change, agriculture, and food—a case of shifting cultivation and history, *Global Change Biology*, Vol. 25, No. 8, pp.2518-2529, https://doi.org/10.1111/gcb.14700 [accessed 15th April 2019].

- Porter, J.R., Xie, L., Challinor, A.J., Cochrane, K., Howden, S.M., Iqbal, M.M., Lobell, D.B. and Travasso, M.I. (2014). (2014). Food security and food production systems. In: Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., Girma, B., Kissel, E.S., Levy, A.N., MacCracken, S., Mastrandrea, P.R. and White, LL. (Eds.). *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 485-533, http://www.ipcc.ch/report/ar5/wg2/ [accessed 15th April 2019].
- Portmann, F.T., Siebert, S. and Döll, P. (2010). MIRCA2000 - Global monthly irrigated and rainfed crop areas around the year 2000: a new high-resolution data set for agricultural and hydrological modelling, *Global Biogeochemistry Cycles*, Vol. 24, doi:10.1029/2008GB003435.
- Pörtner, H.-O., Karl, D.M., Boyd, P.W., Cheung, W.W.L., Lluch-Cota, S.E., Nojiri, Y., Schmidt, D.N. and Zavialov, P.O. (2014). Ocean systems – supplementary material. In: *Climate change 2014: impacts, adaptation, and vulnerability*, part a: global and sectoral aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. www.ipcc-wg2.gov/AR5 and www.ipcc.ch [accessed 15th April 2019].
- POST (2019). *Climate change and agriculture*, POSTNOTE 600, May, London, UK: The Parliamentary Office of Science and Technology, www.parliament.uk/post [accessed 11th April 2019].
- Poti, J.M., Braga, B. and Qin, B. (2017). Ultra-processed food intake and obesity: what really matters for health—processing or nutrient content? *Current Obesity Reports*, Vol. 6, No. 4, pp.420-431, doi: 10.1007/s13679-017-0285-4.
- Poudel, B.N., Paudel, K.P., Timilsina, G. and Zilberman, D. (2012). Providing numbers for a food versus fuel debate - an analysis of a future biofuel production scenario, *Applied Economic Perspectives and Policy*, Vol. 34, No. 4, pp.637-668, doi:10.1093/aepp/pps039.
- Poulton, P., Johnston, J., Macdonald, A., White, R. and Powlson, D. (2018). Major limitations to achieving "4 per 1000" increases in soil organic carbon stock in temperate regions: evidence from long-term experiments at Rothamsted Research, United Kingdom, *Global Change Biology*, doi: 10.1111/gcb.14066.
- *Poultry World* (2007). Poultry's the most sustainable meat, *Poultry World*, June, Vol. 161, Iss. 6, 00325813.
- Poutiainen, C., Berrang-Ford, L., Ford, J. and Heymann, J. (2013). Civil society organizations and adaptation to the health effects of climate change in Canada, *Public Health*, Vol. 127, No. 5, pp.403-409, doi: 10.1016/j.puhe.2013.02.004.
- Poux, X. and Aubert, P-M. (2018). *An agroecological Europe in 2050: multifunctional agriculture for healthy eating*, N°09, 18th September, Paris, France: Institut du développement durable et des relations internationals (IDDRI), www.iddri.org [accessed 15th April 2019].

- Powell, J. (2017). Scientists reach 100% consensus on anthropogenic global warming, *Bulletin of Science, Technology and Society*, *Bulletin of Science, Technology & Society*, Vol. 37, No. 4, pp.183-184, doi: 10.1177/0270467619886266.
- Powell, J. and Castle, C. (2019). *Brexit and Wales: a fresh approach to food and farming?* FRC Food Briefing Paper, March, https://foodresearch.org.uk/publications/wales/ [accessed 15th April 2019].
- Powell, J.L. (2016). The consensus on anthropogenic global warming matters, *Bulletin of Science, Technology & Society*, Vol. 36, pp.157-163, https://doi.org/10.1177/0270467617707079 [accessed 15th April 2019].
- Power, A.G. (2010). Ecosystem services and agriculture: tradeoffs and synergies, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2959-2971, https://doi.org/10.1098/rstb.2010.0143 [accessed 15th April 2019].
- Pradyumna, A., Egal, F. and Utzinger, J. (2019). Sustainable food systems, health and infectious diseases: concerns and opportunities, *Acta Tropica*, Vol. 191, pp.172-177, doi: 10.1016/j.actatropica.2018.12.042.
- Prášková, D.M. (2012). *Land grabs in Africa - a threat to food security*, Praha: Prague Global Policy Institute – Glopolis, www.glopolis.org [accessed 15th April 2019].
- Prather, M., Flato, G., Friedlingstein, P., Jones, C. and Lamarque, J.F. (2013). Annex II: climate system scenario tables, IPCC, 2013: Annex II: Climate System Scenario tables [Prather, M., G. Flato, P. Friedlingstein, C. Jones, J.-F. Lamarque, H. Liao and P. Rasch (eds.)]. In: *Climate Change 2013: The Physical Science Basis*, Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp.1395–445.
- Pratley, E.M. (2012). *A case study comparison of direct selling alternative food networks in Belo Horizonte, Brazil and Toronto*, Ontario, Canada: The University of Western Ontario London.
- Premalatha, M., Abbasi, T., Abbasi, T. and Abbasi, S.A. (2011). Energy-efficient food production to reduce global warming and ecodegradation - the use of edible insects, *Renewable and Sustainable Energy Reviews*, Vol. 15, pp.4357-4360, doi:10.1016/j.rser.2011.07.115.
- Prescott, S.L. and Logan, A.C. (2019). Planetary health: from the wellspring of holistic medicine to personal and public health imperative, *Explore*, Vol. 15, Iss. 2, pp.98-106, doi: 10.1016/j.explore.2018.09.002.
- Preston, I., Banks, N., Hargreaves, K. Kazmierczak, A., Lucas, K., Mayne, R., Downing, C. and Street, R. (2014). *Climate change and social justice: an evidence review*, February, Centre for Sustainable Energy, York, UK: Joseph Rowntree Foundation, ISBN: 978 1 909 586079.
- Pretty, J. (2018). Intensification for redesigned and sustainable agricultural systems, *Science*, Vol. 362, Iss. 6417, pp.eaav0294, doi: 10.1126/science.aav0294.

- Pretty, J., Sutherland, W.J., Ashby, J., Auburn, J., Baulcombe, D., Bell, M., Bentley, J., Bickersteth, S., Brown, K., Burke, J., Campbell, H., Chen, K., Crowley, E., Crute, I., Dobbelaere, D., Edwards-Jones, G., Funes-Monzote, F., Godfray, H.C.J., Griffon, M., Gypmantisiri, P., Haddad, L., Halavatau, S., Herren, H., Holderness, M., Izac, A.-M., Jones, M., Koohafkan, P., Lal, R., Lang, T., McNeely, J., Mueller, A., Nisbett, N., Noble, A., Pingali, P., Pinto, Y., Rabbinge, R., Ravindranath, N.H., Rola, A., Roling, N., Sage, C., Settle, W., Sha, J.M., Shiming, L., Simons, T., Smith, P., Strzepeck, K., Swaine, H., Terry, E., Tomich, T.P., Toulmin, C., Trigo, E., Twomlow, S., Vis, J.K., Wilson, J. and Pilgrim, S. (2010). The top 100 questions of importance to the future of global agriculture, *International Journal of Agricultural Sustainability*, Vol. 8, No. 4, pp.219-236, doi: 10.3763/ijas.2010.0534.
- Price, M. (2013). Help bees by banning neonicotinoids, *The Grocer*, 27th April, p.24.
- PricewaterhouseCoopers (2013). *International threats and opportunities of climate change for the UK*, http://www.pwc.co.uk/services/sustainability-climate-change/insights/international-threats-and-opportunities-of-climate-change-to-the-uk.html [accessed 15th April 2019].
- Pritchard, C. (2018). Agroforestry can help the UK meet climate change commitments without cutting livestock numbers, *The Conversation*, 7th December, https://theconversation.com/agroforestry-can-help-the-uk-meet-climate-change-commitments-without-cutting-livestock-numbers-108395 [accessed 15th April 2019].
- Pritchard, S. (2018). Food, farming and countryside, *RSA Journal*, 28TH February, https://medium.com/rsa-journal/food-farming-and-countryside-f6c60d705389 [accessed 15th April 2019].
- Pritcher, T.W. and Cheung, W.W.L. (2013). Fisheries - hope or despair, *Marine Pollution Bulletin*, Vol. 74, pp.506-516, http://dx.doi.org/10.1016/j.marpolbul.2013.05.045 [accessed 15th April 2019].
- *Produce Business* (2017). Five-a-day fruit & veg recommendation will be “unaffordable” after Brexit, *Produce Business*, 20th November, http://www.producebusinessuk.com/insight/insight-stories/2017/11/20/five-a-day-fruit-veg-recommendation-will-be-unaffordable-after-brexit [accessed 15th April 2019].
- Prosekova, A.Y. and Ivanova, S.A. (2018). Food security: the challenge of the present, *Geoforum*, Vol. 91, pp.73-77, https://doi.org/10.1016/j.geoforum.2018.02.030 [accessed 15th April 2019].
- Prosperi, P., Allen, T., Padilla, M., Peri, I. and Cogill, B. (2014). Sustainability and food & nutrition security: a vulnerability assessment framework for the Mediterranean region, *SAGE Open*, April-June, pp.1-15, doi: 10.1177/2158244014539169.
- Proteinsect (2016). *Insect Protein – feed for the future: addressing the need for feeds of the future today*, www.proteinsect.eu [accessed 11th April 2019].
- Provost, C., Ford, L. and Tran, M. (2014). G8 New Alliance condemned as new wave of colonialism in Africa, *The Guardian*, 18th February, https://www.theguardian.com/global-development/2014/feb/18/g8-new-alliance-condemned-new-colonialism [accessed 15th April 2019].

- Psarikidou, K. and Szerszynski, B. (2012). Growing the social - alternative agrofood networks and social sustainability in the urban ethical foodscape, *Sustainability: Science, Practice, & Policy*, Winter, Vol. 8, Iss. 1, pp.30-39, https://doi.org/10.1080/15487733.2012.11908082 [accessed 15th April 2019].
- Public Health England (2015). *Sugar reduction: the evidence for action*, London, UK: Public Health England, https://www.gov.uk/government/publications/sugar-reduction-from-evidence-into-action [accessed 15th April 2019].
- Public Health England (2016). *Eatwell guide*, 4th edition, London: Public Health England, https://www.gov.uk/government/publications/the-eatwell-guide [accessed 15th April 2019].
- Public Policy Exchange (2012). *Beyond the horsemeat scandal: restoring public confidence in food standards*, public policy exchange symposium, 15th October, London.
- Pulker, C.E., Trapp, G.S.A. and Scott, J.A. (2018). What are the position and power of supermarkets in the Australian food system, and the implications for public health? A systematic scoping review, *Obesity Reviews*, Vol. 19, Iss. 2 pp.198-218, doi: 10.1111/obr.12635.
- Pulker, C.E., Trapp, G.S.A., Scott, J.A. and Pollard, C.M. (2018). Global supermarkets corporate social responsibility commitments to public health: a content analysis, *Globalization and Health*, Vol. 14, No.1, p.121, https://doi.org/10.1186/s12992-018-0440-z [accessed 15th April 2019].
- Puma, M.J., Bose, S., Chon, S.Y. and Cook, B.I. (2015). Assessing the evolving fragility of the global food system, *Environmental Research Letters*, Vol. 10, 024007, doi:10.1088/1748-9326/10/2/024007.
- Purvis, A. (2009). No tuna, no salmon, no oysters, no skate, no cod and chips: imagine a world without seafood supper – it’s nearer than you think, *Observer Food Monthly*, April pp.22-26.
- Purvis, B., Mao, Y. and Robinson, D. (2019). Three pillars of sustainability: in search of conceptual origins, *Sustainability Science*, Vol. 14, pp.681-695, doi:10.1007/s11625-018-0627-5.
- PWA (2019). *The impacts of climate change on meeting government outcomes in England,* Final Report for the Adaptation Committee of the Committee on Climate Change, June, Southampton, UK: Paul Watkiss Associates.
- PwC (2013a). *Are UK companies prepared for the international impacts of climate change?* FTSE 350 Climate Change Report, 9th October, London, UK: PricewaterhouseCoopers / CDP.
- PwC (2013b). *International threats and opportunities of climate change for the UK*, 17th June, London, UK: PricewaterhouseCoopers, www.pwc.co.uk/sustainability-climate-change [accessed 15th April 2019].
- Qaim, M., Sibhatu, K.T., Siregar, H. and Grass, I. (2020). Environmental, economic, and social consequences of the oil palm boom, *Annual Review of Resource Economics*, Vol. 12 No. 1, doi: 10.1146/annurev-resource-110119-024922.
- Qi, A., Holland, R.A., Taylor, G. and Richter, G.M. (2018). Grassland futures in Great Britain – Productivity assessment and scenarios for land-use change opportunities, *Science of The Total Environment*, Vol. 634, pp.1108-1118, https://doi.org/10.1016/j.scitotenv.2018.03.395 [accessed 15th April 2019].

- Quam, V.G.M., Rocklöv, J., Quam, M.B.M. and Lucas, R.A.I. (2017). Assessing greenhouse gas emissions and health co-benefits: a structured review of lifestyle-related climate change mitigation strategies, *International Journal of Environmental Research and Public Health*, Vol. 14, No. 5, 468, doi: 10.3390/ijerph14050468.
- Quaye, W. (2012). *Climate change and food security - the role of biotechnology*, Food Research Institute (CSIR) Box M20, Accra, Ghana.
- Quenneville, G. (2019). Scheer says he'd 'absolutely' review Canada's new Food Guide: Conservative leader also vows to abolish Liberals' planned front-of-package nutrition labelling, *CBC News*, 17th July, https://www.cbc.ca/news/canada/saskatoon/canada-food-guide-andrew-scheer-1.5215689 [accessed 11th April 2020].
- Quinn, T.J. and Collie, J.S. (2005). Sustainability in single - species population models, *Philosophical Transactions: Biological Sciences*, Vol. 360, No. 1453, pp.147-162, http://www.jstor.org/stable/30040883 [accessed 15th April 2019].
- Rabobank (2015). *Building a smarter food system: more productive, connected and sustainable*, Food & Agribusiness Research and Advisory, Utrecht, Netherlands: Rabobank.
- Radford, T. (2013). Ocean of life - how our seas are changing, by Callum Roberts, 18th November.
- Rae, A. and Pardey, P. (2014). Global food security, *Australian Journal of Agricultural and Resource Economics*, Vol. 58, pp.499–503, doi: 10.1111/1467-8489.12091.
- Raftery, A.E., Zimmer, A., Frierson, D.M.W., Startz, R. and Liu, P. (2017). Less than 2°C warming by 2100 unlikely, *Nature Climate Change*, Vol. 7, pp.637-641, https://doi.org/10.1038/nclimate3352.
- Rahmstorf, S. (2004). *The climate sceptics*, http://www.pik-potsdam.de/~stefan/Publications/Other/rahmstorf_climate_sceptics_2004.pdf [accessed 15th April 2019].
- Rai, R.K., Bhatta, L.D., Acharya, U. and Bhatta, A.P. (2018). Assessing climate-resilient agriculture for smallholders, *Environmental Development*, Vol. 27, pp.26-33, https://doi.org/10.1016/j.envdev.2018.06.002 [accessed 15th April 2019].
- Rainforest Alliance (2014). *New sustainability narrative: tapping into meaning and purpose*, Innovation Workshop Report 6th April, New York, USA: Rainforest Alliance.
- Rainforest Alliance (2015). *An evaluation of Asia pulp & paper's progress to meet its forest conservation policy (2013) and additional public statements: 18 month progress evaluation report*, 1st February 2013 to 15th August 2014, New York, USA: Rainforest Alliance.
- Rajmil, L., de Sanmamed, M.-J.F., Choonara, I., Faresjö, T., Hjern, A., Kozyrskyj, A., Lucas, P.J., Raat, H., Séguin, L., Spencer, N. and Taylor-Robinson, D. (2014). Impact of the 2008 economic and financial crisis on child health: a systematic review, *International Journal of Environmental Research and Public Health*, Vol. 11, No. 6, pp.6528-6546, doi: 10.3390/ijerph110606528.

- Raleigh, C. (2011). The search for safety: the effects of conflict, poverty and ecological influences on migration in the developing world, *Global Environmental Change*, Vol. 21, No. 1, pp.S82–S93, https://doi.org/10.1016/j.gloenvcha.2011.08.008 [accessed 15th April 2019].
- Ramankutty, N., Evan, A.T., Monfreda, C. and Foley, J. (2008). Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000, *Global Biogeochemistry Cycles*, Vol. 22, doi:10.1029/2007GB002952.
- Ramankutty, N., Mehrabi, Z., Waha, K., Jarvis, L., Kremen, C., Herrero, M. and Rieseberg, L.H. (2018). Trends in global agricultural land use: implications for environmental health and food security, *Annual Review of Plant Biology*, Vol. 69, No. 1, pp.789-815, https://doi.org/10.1146/annurev-arplant-042817-040256 [accessed 15th April 2019].
- Ramírez, R. and Wilkinson, A. (2016). *Strategic reframing - the Oxford scenario planning approach*, Oxford, UK: OUP Oxford, ISBN-10: 0198745699.
- Ramsey, J.L. (2015). On not defining sustainability, *Journal of Agricultural and Environmental Ethics*, Vol. 28, pp.1075-1087, doi: 10.1007/s10806-015-9578-3.
- Randall, D.A. and Wood, R.A. (2007). Climate models and their evaluation. In: *Climate Change 2007: The Physical Science Basis*, Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge.
- Ranganathan, J., Vennard, D. and Waite, R. (2016). *Shifting diets for a sustainable food future: creating a sustainable food future*, Installment Eleven. Washington, USA: World Resources Institute, https://www.wri.org/sites/default/files/Shifting_Diets_for_a_Sustainable_Food_Future_0.pdf [accessed 15th April 2019].
- Ranum, P., Pena-Rosas, J.P. and Garcia-Casal, M.N. (2014). Global maize production, utilization and consumption, *Annals of the New York Academy of Sciences*, Vol. 1312, pp.105-112, doi: 10.1111/nyas.12396.
- Rao, M., Afshin, A., Singh, G. and Mozaffarian, D. (2013). Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis, *British Medical Journal Open*, Vol. 3, No. 12, p.e004277, doi:10.1136/bmjopen-2013-004277.
- Rao, N.R., Min, J., DeFries, R., Ghosh-Jerath, S., Valin, H. and Fanzo, J. (2018). Healthy, affordable and climate-friendly diets in India, *Global Environmental Change*, Vol. 49, pp.154-165, doi.org/10.1016/j.gloenvcha.2018.02.013.
- Rappaport, E. (2018). The taste of Empire: how Britain's quest for food shaped the modern world, by Lizzie Collingham. (New York, NY: Basic Books) *Historian*, Vol. 80, No. 3, pp.589-590, ISBN-10: 0465056660.

- Raskin, P., Gallopin, G., Gutman, P., Hammond, A. and Swart, R. (1998). *Bending the curve: toward global sustainability*, Polestar Series Report no. 8, https://www.sei.org/publications/bending-curve-toward-global-sustainability/ [accessed 15th April 2019].
- Raskin, P.D., Electris, C. and Rosen, R.A. (2010). The century ahead: searching for sustainability, *Sustainability*, Vol. 2, pp.2626-2651, https://doi.org/10.3390/su2082626 [accessed 15th April 2019].
- Rasmussen, D.J., Bittermann, K., Buchanan, M.K., Kulp, S., Strauss, B.H., Kopp, R.E. and Oppenheimer, M. (2018). Extreme sea level implications of 1.5°C, 2.0°C, and 2.5°C temperature stabilization targets in the 21st and 22nd centuries, *Environmental Research Letters*, Vol. 13, No. 3, pp.034040, doi: 10.1088/1748-9326/aaac87.
- Rasmussen, E. and Storm, L. (2015). issions*The business case for saving the planet*, Copenhagen, Denmark: Monday Morning, www.sustainia.me [accessed 11th April 2019].
- Rasmussen, L.V., Coolsaet, B., Martin, A., Mertz, O., Pascual, U., Corbera, E., Dawson, N., Fisher, J.A., Franks, P. and Ryan, C.M. (2018). Social-ecological outcomes of agricultural intensification, *Nature Sustainability*, Vol 1, pp.275-282, doi: 10.1038/s41893-018-0070-8.
- Rasul, G. and Sharma, B. (2016). A nexus approach to food, water, and energy - sustainably meeting asia's future food and nutrition requirements, *Climate Policy*, Vol. 16, No. 6, pp.682-702, doi: 10.1080/14693062.2015.1029865.
- Ravetz, J. (2015). *Future climate forum - climate proof cities: from smart to wise*, Manchester, UK: University of Manchester Centre for Urban Resilience & Energy.
- Rawles, K. (2017). Developing ethical, sustainable and compassionate food policies. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.259-275, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Raworth K. (2012). *A safe and just space for humanity: can we live within the doughnut?* Oxfam Discussion Paper, Oxford, UK: Oxfam International, https://www.oxfam.org/sites/www.oxfam.org/files/dp-asafe-and-just-space-for-humanity-130212-en.pdf [accessed 15th April 2019].
- Raworth, K. (2017). A doughnut for the Anthropocene - humanity's compass in the 21st century, *The Lancet Planetary Health*, Vol. 1, May, pp.e48-e49, doi:https://doi.org/10.1016/S2542-5196(17)30028-1.
- Ray, D.K., Gerber, J.S., MacDonald, G.K. and West, P.C. (2015). Climate variation explains a third of global crop yield variability, *Nature Communication*, Vol. 6**,** 5989, https://doi.org/10.1038/ncomms6989.
- Ray, D.K., Mueller, N.D., West, P.C. and Foley, J.A. (2013). Yield trends are insufficient to double global crop production by 2050, *PLoS One*, Vol. 8, No. 6, pp.e66428, doi: 10.1371/journal.pone.0066428.

- Ray, D.K., Ramankutty, N., Mueller, N.D., West, P.C. and Foley, J.A. (2012). Recent patterns of crop yield growth and stagnation, *Nature Communications*, Vol. 3, 1293, https://doi.org/10.1038/ncomms2296 [accessed 15th April 2019].
- Ray, D.K., West, P.C., Clark, M., Gerber, J.S., Prishchepov, A.V. and Chatterjee, S. (2019). Climate change has likely already affected global food production, *PLoS One*, Vol. 14, No. 5, https://doi.org/10.1371/journal.pone.0217148 [accessed 15th April 2019].
- Rayner, J. (2017). Written submission for Michael Gove MP, Secretary of State at the Department of Environment, Food and Rural Affairs, http://www.jayrayner.co.uk/news/michael-gove-asked-me-to-a-meeting-to-share-my-expertise-i-declined-instead-ive-given-him-a-piece-of-my-mind/ [accessed 15th April 2019].
- Rayner, J. (2020). From panic buying to food banks: how Britain fed itself in the first phase of coronavirus, *The Observer*, 21st June, https://www.theguardian.com/food/2020/jun/21/from-panic-buying-to-food-banks-how-britain-fed-itself-in-the-first-phase-of-coronavirus [accessed 21st January, 2020].
- Rayner, M. (2016). How reliable is the Eatwell Guide, the official chart of what foods you should be eating? *The Conversation*, 22nd April, https://theconversation.com/how-reliable-is-the-eatwell-guide-the-official-chart-of-what-foods-you-should-be-eating-69947 [accessed 15th April 2019].
- Rayner, M. and Scarborough, P. (2017). How much meat and milk is optimal for health? In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.240-256, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Raynor, G., Barling, D. and Lang, T. (2008). Sustainable food systems in Europe - policies, realities and futures, *Journal of Hunger & Environmental Nutrition*, Vol. 3, No. 2-3, pp.145-168, doi: 10.1080/19320240802243209.
- RCP and RCPCH (2016). *Every breath we take: the lifelong impact of air pollution*, Royal College of Physicians and Royal College of Paediatrics and Child Health, February, https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution [accessed 11th April 2019].
- Reacher, M., McKenzie, K., Lane, C., Nichols, T., Kedge, I., Iversen, A., Hepple, P., Walter, T., Laxton, C. and Simpson, J. (2004). Health impacts of flooding in Lewes: a comparison of reported gastrointestinal and other illness and mental health in flooded and non-flooded households, *Communicable Disease and Public Health*, Vol. 7, pp.39-46.
- Readfearn, G. (2018). WHO launches health review after microplastics found in 90% of bottled water, *The Guardian*, 15th March, https://www.theguardian.com/environment/2018/mar/15/microplastics-found-in-more-than-90-of-bottled-water-study-says [accessed 15th April 2019].

- Reardon, T., Chen, K., Minten, B. and Adriano, l. (2012). *The quiet revolution in staple food value chains: enter the dragon, the elephant, and the tiger*, Metro Manila, Philippines: Asian Development Bank and International Food Policy Research Institute, http://www.adb.org/publications/quiet-revolution-staple-food-value-chains [accessed 15th April 2019].
- Reay, D. (2019). *Climate-smart food*, Basingstoke, UK: Palgrave Macmillan, https://www.palgrave.com/gp/book/9783030182052 [accessed 15th April 2019].
- Rebolledo-Leiva, R., Angulo-Meza, L., Iriarte, A. and Gonzalez-Araya, M.C. (2017). Joint carbon footprint assessment and data envelopment analysis for the reduction of greenhouse gas emissions in agriculture production, *Science of the Total Environment*, Vol. 593, pp.36-46, http://dx.doi.org/10.1016/j.scitotenv.2017.03.147 [accessed 15th April 2019].
- Recanati, F., Marveggio, D. and Dotelli, G. (2018). From beans to bar: a life cycle assessment towards sustainable chocolate supply chain, *Science of the Total Environment*, Vol. 613-614, pp.1013-1023, doi: 10.1016/j.scitotenv.2017.09.187.
- Recanati, F., Maughan, C., Pedrotti, M., Dembska, K. and Antonelli, M. (2019). Assessing the role of CAP for more sustainable and healthier food systems in Europe: a literature review, *Science of the Total Environment*, Vol. 653, pp.908-919, https://doi.org/10.1016/j.scitotenv.2018.10.377 [accessed 15th April 2019].
- Reed, K. and Ryan, P. (2019). Lessons from the past and the future of food, *World Archaeology*, Vol. 51, No. 1, pp.1-16, doi: 10.1080/00438243.2019.1610492.
- Rees, M. (2003). *Our final hour: a scientist's warning: how terror, error, and environmental disaster threaten humankind's future in this century - on earth and beyond*, New York, USA: Basic Books, ISBN 0-465-0682-6.
- Rees, R.M., Barnes, A.P. and Moran, D. (2016). Sustainable intensification: the pathway to low carbon farming? *Regional Environmental Change*, Vol. 16, pp.2253-2255, https://doi.org/10.1007/s10113-016-1065-5 [accessed 15th April 2019].
- Reganold, J.P., Andrews, P.K., Reeve, J.R., Carpenter-Boggs, L., Schadt, C.W., Alldredge, J.R., Ross, C.F., Davies, N.M. and Zhou, J. (2010). Fruit and soil quality of organic and conventional strawberry agroecosystems, *PLoS One*, Vol. 5, No. 9, pp.e12346, doi:10.1371/journal.pone.0012346.
- Regmi, A. and Meade, B. (2013). Demand side drivers of global food security, *Global Food Security*, Vol. 2, pp.166-171, http://dx.doi.org/10.1016/j.gfs.2013.08.001 [accessed 15th April 2019].
- Regnier, E. and Schubert, K. (2013). *Consumer preferences, aquaculture technology and the sustainability of fisheries*, Documents de Travail du Centre d'Economie de la Sorbonne, Paris, France: Maison des Sciences Économiques.
- Reifels, L., Bassilios, B., Spittal, M.J., King, K., Fletcher, J. and Pirkis, J. (2014). Patterns and predictors of primary mental health service use following bushfire and flood disasters, *European Journal of Psychotraumatology*, Vol. 5, 26527, doi: 10.1017/dmp.2015.23.

- Reilly, J. and Schimmelpfennig, D. (2000). Irreversibility, uncertainty, and learning: portraits of adaptation to long-term climate change, *Climatic Change*, Vol. 45, Iss. 1, pp.253-278, https://doi.org/10.1023/A:1005669807945 [accessed 15th April 2019].
- Reilly, M. and Willenbockel, D. (2010). Managing uncertainty: a review of food system scenario analysis and modelling, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.3049-3063, https://doi.org/10.1098/rstb.2010.0141 [accessed 15th April 2019].
- Reinert, K. (2015). Food security as basic goods provision, *World Medical & Health Policy*, Vol. 7, No. 3, pp.171-186, doi:10.1002/wmh3.151.
- Reinhardt, S.L., Boehm, R., Tichenor Blackstone, N., El-Abbadi, N.H., McNally Brandow, J.S., Taylor, S.F. and DeLonge, M.S. (2020). Systematic review of dietary patterns and sustainability in the United States, *Advances in Nutrition*, nmaa026, https://doi.org/10.1093/advances/nmaa026 [accessed 15th April 2020].
- Reis, S., Morris, G., Fleming, L.E., Beck, S., Taylor, T., White, M., Depledge, M.H., Steinle, S., Sabel, C.E., Cowie, H., Hurley, F., Dick, J., Smith, R.I. and Austen, M. (2015). Integrating health and environmental impact analysis, *Public Health*, Vol. 129, pp.1383-1389, https://doi.org/10.1016/j.puhe.2013.07.006 [accessed 15th April 2019].
- Reisch, L., Eberle, U. and Lorek, S. (2013). Sustainable food consumption: an overview of contemporary issues and policies, *Sustainability: Science, Practice and Policy*, Vol. 9, Iss. 2, pp.7-25, https://doi.org/10.1080/15487733.2013.11908111 [accessed 15th April 2019].
- Reisfield, M. (2018). *Increasing emphasis on sustainable supply chains: implications for retailers and manufacturers*, Michigan, USA: NSF International, www.nsf.org [accessed 15th April 2019].
- Reisinger, A. (2018). Agricultural GHGs - from a Global Research Alliance to shared policies and practices, *International Conference on Agricultural GHG Emissions and Food Security*, Berlin, 10th-13th September.
- Reisinger, A. and Clark, H. (2018). How much do direct livestock emissions actually contribute to global warming, *Global Change Biology*, Vol. 24, pp.1749-1761, https://doi.org/10.1111/gcb.13975 [accessed 15th April 2019].
- Rembold, F., Meroni, M., Urbano, F., Csak, G., Kerdiles, H. and Perez-Hoyos, A. (2019). ASAP: a new global early warning system to detect anomaly hot spots of agricultural production for food security analysis, *Agricultural Systems*, Vol. 168, pp.247-257, https://doi.org/10.1016/j.agsy.2018.07.002 [accessed 15th April 2019].
- Renard, C.M.G.C. and Le Bourvellec, C. (2017). 2nd Euro-Mediterranean symposium on fruit and vegetable processing: an integrated view on sustainability and how it can interact with quality, safety and consumers, *LWT - Food Science and Technology*, Vol. 85, pp.283-283, doi: 10.1016/j.lwt.2017.05.080.

- Research for AGRI Committee (2017). *EU – UK agricultural trade - state of play and possible impacts of Brexit*, https://www.europarl.europa.eu/RegData/etudes/STUD/2017/602008/IPOL_STU(2017)602008_EN.pdf [accessed 15th April 2019].
- Resplandy, L., Keeling, R.F., Eddebbar, Y.L., Resplandy, R.F., Keeling, Y., Eddebbar, M., Brooks, K., Wang, R., Bopp, L., Long, M.C., Dunne, J.P., Koeve, W. and Oschlies, A. (2019). Retraction Note: Quantification of ocean heat uptake from changes in atmospheric O_2 and CO_2 composition, *Nature*, Vol. 573, No. 614, doi:10.1038/s41586-019-1585-5.
- Revell, B.J. (2015). One man's meat … 2050? Ruminations on future meat demand in the context of global warming, *Journal of Agricultural Economics*, Vol. 66, pp.573-614, doi:10.1111/1477-9552.12121.
- Reverter, M., Sarter, S., Caruso, D., Avarre, J.-C., Combe, M., Pepey, E., Pouyaud, L., Vega-Heredía, S., de Verdal, H. and Gozlan, R.E. (2020). Aquaculture at the crossroads of global warming and antimicrobial resistance, *Nature Communications*, Vol. 11, No. 1, 1870, doi: 10.1038/s41467-020-15735-6.
- Revesz, R.L., Howard, P.H., Arrow, K., Goulder, L.H., Kopp, R.E., Livermore, M.A., Oppenheimer, M. and Sterner, T. (2014). Global warming: improve economic models of climate change, *Nature*, 10th April 2014, Vol. 508, pp.173-174, doi:10.1038/508173a.
- Reynolds, C. (2017). How to cook a more sustainable Sunday roast, *The Conversation*, 20th October, https://theconversation.com/how-to-cook-a-more-sustainable-sunday-roast-85337 [accessed 15th April 2019].
- Reynolds, C.J., Horgan, G.W., Whybrow, S. and Macdiarmid, J.I. (2019). Healthy and sustainable diets that meet greenhouse gas emission reduction targets and are affordable for different income groups in the UK, *Public Health Nutrition*, Vol. 22, No. 8, pp.1503-1517, doi:10.1017/S1368980018003774.
- Reynolds, C.J., Horgan, G.W., Whybrow, S. and Macdiarmid, J.I. (2019). Healthy and sustainable diets that meet greenhouse gas emission reduction targets and are affordable for different income groups in the UK, *Public Health Nutrition*, pp.1-15, https://doi.org/10.1017/S1368980018003774 [accessed 15th April 2019].
- Reynolds, M.P., Hellin, J., Govaerts, B., Kosina, P., Sonder, K., Hobbs, P. and Braun, H. (2012). Global crop improvement networks to bridge technology gaps, *Journal of Experimental Botany*, Vol. 63, No. 1, pp.1-12, doi:10.1093/jxb/err241.
- Rhodes, C.J. (2013). Peak phosphorus - peak food? The need to close the phosphorus cycle, *Science Progress*, Vol. 96, No. 2, pp.109-152, doi: 10.3184/003685013X13677472447741.
- Ricci, C., Marinelli, N. and Puliti, L. (2016). The consumer as citizen: the role of ethics for a sustainable consumption, *Agriculture and Agricultural Science Procedia*, Vol. 8, pp.395-401, https://doi.org/10.1016/j.aaspro.2016.02.035 [accessed 15th April 2019].

- Ricciardi, V., Ramankutty, N., Mehrabi, Z., Jarvis, L. and Chookolingo, B. (2018). How much of the world's food do smallholders produce? *Global Food Security*, Vol. 17, pp.64-72, https://doi.org/10.1016/j.gfs.2018.05.002 [accessed 15th April 2019].
- Ricciardi, V., Ramankutty, N., Mehrabi, Z., Jarvis, L. and Chookolingo, B. (2018). An open-access dataset of crop production by farm size from agricultural censuses and surveys, *Data in Brief*, Vol. 19, pp.1970-1988, https://doi.org/10.1016/j.dib.2018.06.057 [accessed 15th April 2019].
- Ricciardi, V., Ramankutty, N., Mehrabi, Z., Jarvis, L. and Chookolingo, B. (2018). How much of the world's food do smallholders produce? *Global Food Security*, Vol. 17, pp.64-72, https://doi.org/10.1016/j.gfs.2018.05.002 [accessed 15th April 2019].
- Rice, J. (2014). Evolution of international commitments for fisheries sustainability, *ICES Journal of Marine Science*, Vol. 71, No. 2, pp.157-165, doi:10.1093/icesjms/fst078.
- Richards, C.E., Lupton, R.C. and Allwood, J.M. (2021). Re-framing the threat of global warming: an empirical causal loop diagram of climate change, food insecurity and societal collapse, *Climatic Change*, 164, 49, https://doi.org/10.1007/s10584-021-02957-w.
- Richards, M.B., Wollenberg, E. and van Vuuren, D. (2018). National contributions to climate change mitigation from agriculture: allocating a global target, *Climate Policy*, Vol 18, No. 10, pp.1271-1285, https://doi.org/10.1080/14693062.2018.1430018 [accessed 15th April 2019].
- Richards, P., Reardon, T., Tschirley, D., Jayne, T., Oehmke, J. and Atwood, D. (2016). Cities and the future of agriculture and food security: a policy and programmatic roundtable, *Food Security*, Vol. 8, No. 4, pp.871-877, https://link.springer.com/article/10.1007/s12571-016-0597-3/fulltext.html [accessed 15th April 2019].
- Richards, T.J and Pofahl, G.M. (2009). Commodity prices and food inflation: high and volatile commodity prices: what do they mean for food prices and consumers? *Agricultural and Applied Economics Association*, Vol. 91, No. 5, pp.1450-1455, doi: 10.1111/j.1467-8276.2009.01363.x.
- Richards, T.J. and Padilla, L. (2007). *Promotion and fast food demand where's the beef*, Consumer and Market Demand, Agricultural Policy Research Network, Research Project Number CMD-07-03, University of Alberta Department of Rural Economy.
- Richards, Z., Thomas, S.L., Randle, M. and Pettigrew, S. (2015). Corporate social responsibility programs of big food in Australia - a content analysis of industry documents, *Australian and New Zealand Journal of Public Health*, Vol. 39, No. 6, pp.550-556, doi: 10.1111/1753-6405.12429.
- Richardson, B. (2016). Sugar shift - six ideas for a healthier and fairer food system, http://foodresearch.org.uk/sugar-shift-six-ideas-for-a-healthier-and-fairer-food-system [accessed 15th April 2019].
- Richardson, K.J., Lewis, K.H., Krishnamurthy, P.K., Kent, C., Wiltshire, A.J. and Hanlon, H.M. (2018). Food security outcomes under a changing climate: impacts of mitigation and adaptation on vulnerability to food insecurity, *Climatic Change*, Vol. 147, Iss. 1-2, pp.327-341, doi.org/10.1007/s10584-018-2137-y.

- Richter, D., Steffen, W., Syvitski, J., Vidas, D., Wagreich, M., Williams, M., Zhisheng, A., Grinevald, J., Odada, E., Oreskes, N. and Wolfe, A.P. (2016). The Anthropocene is functionally and stratigraphically distinct from the Holocene, *Science*, Vol. 351, Iss. 6269, 10.1126/science.aad2622.
- Rickard, G. (2019). How is the Science Based Targets Initiative (SBTi) changing? *Carbon Trust*, 15th May, https://www.carbontrust.com/news/2019/05/science-based-targets-new-changes-from-sbti-initiative/ [accessed 15th April 2019].
- Ridgway, E., Baker, P., Woods, J. and Lawrence, M. (2019). Historical developments and paradigm shifts in public health nutrition science, guidance and policy actions: a narrative review, *Nutrients, Vol. 11,* No. 3, p.531, doi: 10.3390/nu11030531.
- Ridley, M. and Hill, D. (2018). *The effect of innovation in agriculture in the environment*, London, UK: Institute of Economic Affairs, https://iea.org.uk/wp-content/uploads/2018/11/Effect-of-Innovation-in-agriculture_web.pdf [accessed 11th April 2019].
- Ries, C.P., Hafner, M., Smith, T.D., Burwell, F.G., Egel, D., Han, E., Stepanek, M. and Shatz, H.J. (2017). *Alternate forms of Brexit and their implications for the United Kingdom, the European Union and the United States – summary*, Santa Monica, California and Cambridge, UK: RAND Corporation.
- Riggs, P.K., Fields, M.J. and Cross, H.R. (2018). Food and nutrient security for a growing population, *Animal Frontiers*, Vol. 8, No. 3, pp.3-4, https://doi.org/10.1093/af/vfy014 [accessed 15th April 2019].
- Rigod, B. and Tovar, P. (2019). Indonesia-Chicken: tensions between international trade and domestic food policies? *World Trade Review*, Vol. 18, No. 2, pp.219-243, doi:10.1017/S1474745619000028.
- Riley, H. and Buttriss, J.L. (2011). A UK public health perspective - what is a healthy sustainable diet, *British Nutrition Foundation Nutrition Bulletin*, Vol. 36, pp.426-431, doi: 10.1111/j.1467-3010.2011.01931.x.
- Riley, J. (2015). British produce vital for food security, say MPs, *Farmers Weekly*, 22nd January.
- Riley, T. (2017). Companies' 'zero deforestation' pledges. Corporations globally have made hundreds of commitments on deforestation. But what do these pledges really mean and why do scandals keep happening? *The Guardian,* 29th September, https://www.theguardian.com/sustainable-business/2017/sep/29/companies-zero-deforestation-pledges-agriculture-palm-oil-environment [accessed 15th April 2019].
- Rimmington, M., Smith, J.C. and Hawkins, R. (2006). CSR and sustble food procurement, *British Food Journal*, Vol. 108, No. 10, pp.824-837, doi: 10.1108/00070700610702082.
- Ringø, E., Olsen, R.E., Gifstad, T.Ø., Dalmo, R.A., Amlund, H., Hemre, G-I. and Bakke, A.M. (2010). Prebiotics in aquaculture: a review, *Aquaculture Nutrition*, Vol. 16, pp.117-136, doi: 10.1111/j.1365-2095.2009.00731.x.

- Rippke, U., Ramirez-Villegas, J., Jarvis, A., Vermeulen, J.J., Parker, L., Mer, F., Diekkrüger, B., Challinor, A.J. and Howden, M. (2016). Timescales of transformational climate change adaptation in sub-Saharan African agriculture, *Nature Climate Change*, Vol. 6, pp.605-609, https://doi.org/10.1038/nclimate2947 [accessed 15th April 2019].
- Ripple, W.J., Wolf, C., Newsome, T.M., Barnard, P. and Moomaw, W.R. (2019). World scientists' warning of a climate emergency, *BioScience*, biz088, https://doi.org/10.1093/biosci/biz088 [accessed 15th April 2019].
- Ripple, W.J., Wolf, C., Newsome, T.M., Galetti, M., Alamgir, M., Crist, E., Mahmoud, M.I. and Laurance, W.F. (2017). World scientists' warning to humanity: a second notice, *BioScience*, Vol. 67, Iss. 12, pp.1026-1028, https://doi.org/10.1093/biosci/bix125 [accessed 15th April 2019].
- Risku-Norja, H., Kurppa, S. and Helenius, J. (2009). Dietary choices and greenhouse gas emissions – assessment of impact of vegetarian and organic options at national scale, *Progress in Industrial Ecology – An International Journal*, Vol. 6, No. 4, pp.340–354, doi: 10.1504/PIE.2009.032323.
- Ritchie, H., Reay, D.S. and Higgins, P. (2018). The impact of global dietary guidelines on climate change, *Global Environmental Change*, Vol. 49, pp.46-55, doi.org/10.1016/j.gloenvcha.2018.02.005.
- Ritchie, P.D.L., Smith, G.S., Davis, K.J., Fezzi, C., Halleck-Vega, S., Harper, A.D., Boulton, C.A., Binner, A.R., Day, B.H., Gallego-Sala, A.V., Mecking, J.V., Sitch, S.A., Lenton, T.M. and Bateman, I.J. (2020). Shifts in national land use and food production in Great Britain after a climate tipping point, *Nature Food*, Vol. 1, pp.76-83. https://doi.org/10.1038/s43016-019-0011-3.
- Ritson, C. (2016). *The concept of food security and the future of world food prices*, Centre for Rural Economy Discussion Paper Series No. 37, Newcastle, UK: Newcastle University, https://www.ncl.ac.uk/media/wwwnclacuk/centreforruraleconomy/files/discussion-paper-37.pdf [accessed 15th April 2019].
- Rizvi, S., Pagnutti, C., Fraser, E., Bauch, C.T. and Anand, M. (2018). Global land use implications of dietary trends, *PLoS One*, Vol. 13, No. 8, pp.e0200781, https://doi.org/10.1371/journal.pone.0200781 [accessed 15th April 2019].
- Robbins, A. (2015). Health consequences of climate change interventions, *The Lancet*, Vol. 386, Iss. 10006, 7th November, p.1819, http://dx.doi.org/10.1016/S0140-6736(15)00549-8 [accessed 15th April 2019].
- Robbins, A. (2017). What's missing in climate change discussions, *The Lancet*, Vol. 390, 7th October, p.1641, doi: http://dx.doi.org/10.1016/S0140-6736(17)32151-7.
- Roberts, C. (2014). Our seas are being degraded, fish are dying – but humanity is threatened too, *The Observer*, 20th September, https://www.theguardian.com/environment/2015/sep/20/fish-are-dying-but-human-life-is-threatened-too [accessed 15th April 2019].
- Roberts, C.M. (2002). Deep impact - the rising toll of fishing in the deep sea, *Trends in Ecology & Evolution*, Vol. 17, No. 5, May, pp.242-245.

- Roberts, D.P. and Mattoo, A.K. (2018). Sustainable agriculture - enhancing environmental benefits, food nutritional quality and building crop resilience to abiotic and biotic stresses, *Agriculture*, Vol. 8, No. 8, doi:10.3390/agriculture8010008.
- Roberts, M.J. and Schlenker, W. (2009). World supply and demand of food commodity calories: the causes and consequences of rising food prices, *Agricultural and Applied Economics Association*, Vol. 91, No. 5, pp.1235-1242, doi: 10.1111/j.1467-8276.2009.01290.x
- Robinson, E., Thomas, J., Aveyard, P. and Higgs, S. (2014). What everyone else is eating: a systematic review and meta-analysis of the effect of informational eating norms on eating behavior, *Journal of the Academy of Nutrition and Dietetics,* Vol. 114, No. 3, pp.414-429, doi:10.1016/j.jand.2013.11.009.
- Robinson, O.J., Tewkesbury, A., Kemp, S. and Williams, I.D. (2018). Towards a universal carbon footprint standard: a case study of carbon management at universities, *Journal of Cleaner Production*, Vol. 172, pp.4435-4455, doi: 10.1016/j.jclepro.2017.02.147.
- Robinson, P. and Lowe, J. (2015). Literature reviews vs systematic reviews, *Australian and New Zealand Journal of Public Health*, Vol. 39, pp.103-103, doi:10.1111/1753-6405.12393.
- Robinson, S. (2020). *Climate change adaptation in SIDS: a systematic review of the literature pre and post the IPCC Fifth Assessment Report*, WIREs Clim Change, e653. https://doi.org/10.1002/wcc.653 [accessed 15th April, 2020].
- Rocchi, L., Paolotti, L., Rosati, A., Boggia, A. and Castellini, C. (2019). Assessing the sustainability of different poultry production systems: a multicriteria approach, *Journal of Cleaner Production*, Vol. 211, pp.103-114, https://doi.org/10.1016/j.jclepro.2018.11.013 [accessed 15th April 2019].
- Rocha, J.C., Peterson, G., Bodin, Ö. and Levin, S. (2018). Cascading regime shifts within and across scales, *Science*, Vol. 362, No. 6421, pp.1379-1383, doi: 10.1126/science.aat7850.
- Rocha, J.C., Peterson, G.D. and Biggs, R. (2015). Regime shifts in the anthropocene: drivers, risks, and resilience, *PLoS One*, Vol. 10, Iss. 8, pp.e0134639, doi: 10.1371/journal.pone.0134639.
- Rochford, C., Sridhar, D., Woods, N., Saleh, Z., Hartenstein, L., Ahlawat, H., Whiting, E., Dybul, M., Cars, O., Goosby, E., Cassels, A., Velasquez, G., Hoffman, S., Baris, E., Wadsworth, J., Gyansa-Lutterodt, M. and Davies, S. (2018). Global governance of antimicrobial resistance, *The Lancet*, 19th May, Vol. 391, Iss. 10134, pp.1976-1978, doi:https://doi.org/10.1016/S0140-6736(18)31117-6.
- Röcklinsberg, H. (2014). Fish consumption - choices in the intersection of public concern, fish welfare, food security, human health and climate change, *Journal of Agricultural and Environmental Ethics,* Vol. 28, pp.533-551, doi: 10.1007/s10806-014-9506-y.
- Rockström, J. (2014). Food, health and sustainability - we become what we eat, and so does Earth, *The Guardian*, 27th May, https://www.theguardian.com/sustainable-business/food-health-sustainability-earth-johan-rockstrom [accessed 15th April 2019].
- Rockström, J. and Falkenmark, M. (2015). Agriculture: increase water harvesting in Africa, *Nature*, 19th March, Vol. 519, pp.283-285, doi:10.1038/519283a.

- Rockström, J. and Sukhdev, P. (2016). *How food connects all the SDGs*, Stockholm Resilience Centre, http://www.stockholmresilience.org/research/research-news/2016-06-14-how-food-connects-all-the-sdgs.html [accessed 15th April 2019].
- Rockström, J., Falkenmark, M., Karlberg, L., Hoff, H., Rost, S. and Gerten, D. (2009c). Future water availability for global food production: the potential of green water for increasing resilience to global change, *Water Resources Research*, Vol. 45, Iss. 7, https://doi-org.ezproxy.mmu.ac.uk/10.1029/2007WR006767 [accessed 15th April 2019].
- Rockström, J., Gaffney, O., Rogelj, J., Meinshausen, M., Nakicenovic, N. and Schellnhuber, H.J. (2017a). A roadmap for rapid decarbonisation, *Science*, Vol. 355, Issue 6331, pp.1269-1271, doi: 10.1126/science.aah3443.
- Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sorlin, S., Snyder, P.K., Costanza, R., USvedin, U., M. Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and Foley, J. (2009a). Planetary boundaries: exploring the safe operating space for humanity, *Ecology and Society*, Vol. 14, No. 2, p.32, http://www.ecologyandsociety.org/vol14/iss2/art32/ [accessed 15th April 2019].
- Rockström, J., Steffen, W., Noone, K., Persson, A., Chapin, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sorlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and J. Foley, J. (2009b). A safe operating space for humanity, *Nature*, Vol. 461, No. 7263, pp.472-475, doi:10.1038/461472a.
- Rockström, J., Stordalen, G.A. and Horton, R. (2016). Acting in the Anthropocene: the EAT-Lancet Commission, *The Lancet*, Vol. 387, pp.2364-2365, doi: 10.1016/S0140-6736(16)30681-X.
- Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., Wetterstrand, H., DeClerck, F., Shah, M., Steduto, P., de Fraiture, C., Hatibu, N., Unver, O., Bird, J., Sibanda, L. and Smith, J. (2017b). Sustainable intensification of agriculture for human prosperity and global sustainability, *Ambio*, Vol. 46, No. 1, pp.4-17, doi:10.1007/s13280-016-0793-6.
- Röder, M., Thornley, P., Campbell, G. and Bows-Larkin, A. (2014). Emissions associated with meeting the future global wheat demand - a case study of UK production under climate change constraints, *Environmental Science & Policy*, Vol. 3, No. 9, pp.13-24, http://dx.doi.org/10.1016/j.envsci.2014.02.002 [accessed 15th April 2019].
- Rödl, M.B. (2018). Why France banned meat names for vegetarian alternatives, *The Conversation*, 30th April, https://theconversation.com/why-france-banned-meat-names-for-vegetarian-alternatives-95549 [accessed 15th April 2019].

- Roe, S., Streck, C., Obersteiner, M. Frank, S., Griscom, B., Drouet, L., Fricko, O., Gusti, M., Harris, N., Hasegawa, T., Hausfather, Z., Havlík, P., House, J., Nabuurs, G-J., Popp, A., Sanz Sánchez, M.J., Sanderman, J., Smith, P., Stehfest, E. and Lawrence, D. (2019). Contribution of the land sector to a 1.5°C world, *Nature Climate Change*, Vol. 9, pp.817-828, https://doi.org/10.1038/s41558-019-0591-9.
- Roe, S., Streck, C., Obersteiner, M., Frank, S., Griscom, B., Drouet, L., Fricko, O., Gusti, M., Harris, N., Hasegawa, T., Hausfather, Z., Havlík, P., House, J., Nabuurs, G-J., Popp, A., Sánchez, M.J., Sanderman, J., Smith, P., Stehfest, E. and Lawrence, D. (2019). Contribution of the land sector to a 1.5°C world, *Nature Climate Change*, Vol. 9, pp.817-828, https://doi.org/10.1038/s41558-019-0591-9.
- Roeder, M., Thornley, P., Campbell, G. and Gilbert, P. (2011). *Adaptation strategies for sustainable global wheat production*, Paper presented at the Reframing sustainability? Climate Change and North–south Dynamics Helsinki, Finland.
- Roep, D. and Wiskerke, J.S.C. (2010). On governance, embedding and marketing - reflections on the construction of alternative sustainable food networks, *Journal of Agricultural and Environmental Ethics*, Vol. 25, pp.205-221, doi: 10.1007/s10806-010-9286-y.
- Rogelj, J., Popp, A., Calvin, K.V., Luderer, G., Emmerling, J., Gernaat, D., Fujimori, S., Strefler, J., Hasegawa, T., Marangoni, G., Krey, V., Kriegler, E., Riahi, K., van Vuuren, D.P., Doelman, J., Drouet, L., Edmonds, J., Fricko, O., Harmsen, M., Havlík, P., Humpenöder, F., Stehfest, E. and Tavoni, M. (2018). Scenarios towards limiting global mean temperature increase below 1.5°C, *Nature Climate Change*, Vol. 8, pp.325-332, doi:10.1038/s41558-018-0091-3.
- Rogers, A.D., Brierley, A., Croot, P., Cunha, M.R., Danovaro, R., Devey, C., Hoel, A.H., Ruhl, H.A., Sarradin, P-M., Trevisanut, S., van den Hove, S., Vieira, H. and Visbeck, M. (2015). Delving deeper: critical challenges for 21st century deep-sea research. In: Larkin, K.E., Donaldson, K. and McDonough, N. (eds.) *Position Paper 22 of the European Marine Board*, Ostend, Belgium, ISBN 978-94-920431-1-5.
- Rohling, E.J., Hibbert, F.D., Grant, K.M., Galaasen, E.V., Irvalı, N., Kleiven, H.F., Marino, G., Ninnemann, U., Roberts, A.P., Rosenthal, Y., Schulz, H., Williams, F.H. and Yu, J. (2019). Asynchronous Antarctic and Greenland ice-volume contributions to the last interglacial sea-level highstand, *Nature Communications*, Vol. 10, 5040, doi:10.1038/s41467-019-12874-3.
- Rohmer, S.U.K., Gerdessen, J.C. and Claassen, G.D.H. (2019). Sustainable supply chain design in the food system with dietary considerations: a multi-objective analysis, *European Journal of Operational Research*, Vol. 273, No. 3, pp.1149-1164, https://doi.org/10.1016/j.ejor.2018.09.006 [accessed 15th April 2019].
- Rojas, R.V., Achouri, M., Maroulis, J. and Caon, L. (2016). Healthy soils: a prerequisite for sustainable food security, *Environmental Earth Sciences*, Vol. 75, No. 3, pp.1-10, https://doi.org/10.1007/s12665-015-5099-7 [accessed 15th April 2019].

- Rojas-Downing, M.M., Nejadhashemi, A.P., Harrigan, T. and Woznicki, S.A. (2017). Climate change and livestock: impacts, adaptation, and mitigation, *Climate Risk Management*, Vol. 16, pp.145-163, https://doi.org/10.1016/j.crm.2017.02.001 [accessed 15th April 2019].
- Rolland, M., Le Moal, J., Wagner, V., Royère, D. and De Mouzon, J. (2012). Decline in semen concentration and morphology in a sample of 26,609 men close to general population between 1989 and 2005 in France, *Human Reproduction*, Vol. 28, Iss. 2, pp.462-470, doi: 10.1093/humrep/des415.
- Romund, G. (2017). *Understanding review types: umbrella reviews*, University of Manitoba Libraries, https://libguides.lib.umanitoba.ca/reviewtypes/umbrella [accessed 15th April 2020].
- Ronto, R., Rathi, N., Worsley, A., Sanders, T., Lonsdale, C. and Wolfenden, L. (2020). Enablers and barriers to implementation of and compliance with school-based healthy food and beverage policies: a systematic literature review and meta-synthesis, *Public Health Nutrition*, doi: 10.1017/S1368980019004865.
- Röös, E. (2013). *Analysing the carbon footprint of food: insights for consumer communication*, Doctoral Thesis, Uppsala: Swedish University of Agricultural Sciences.
- Röös, E. (2017). *The Swedish Meat Guide – multidisciplinary research that reached society*, Food Climate Research Netwok Blog, 18th August, https://www.fcrn.org.uk/fcrn-blogs/swedish-meat-guide-%E2%80%93-multidisciplinary-research-reached-society [accessed 15th April 2019].
- Röös, E., Bajzeli, B., Smith, P., Patel, M., Little, D.C. and Garnett, T. (2017a). Greedy or needy? Land use and climate impacts of food in 2050 under different livestock futures, *Global Environmental Change*, Vol. 47, pp.1-12, doi: 10.1016/j.gloenvcha.2017.09.001.
- Röös, E., Bajzeli, B., Smith, P., Patel, M., Little, D.C. and Garnett, T. (2017b). Protein futures for Western Europe: potential land use and climate impacts in 2050, *Regional Environmental Change*, Vol. 17, pp.367-377, doi: 10.1007/s10113-016-1013-4.
- Röös, E., Ekelund, L. and Tjärnemo, H. (2014). Communicating the environmental impact of meat production: challenges in the development of a Swedish meat guide, *Journal of Cleaner Production*, Vol. 73, pp.154-164, https://doi.org/10.1016/j.jclepro.2013.10.037 [accessed 15th April 2019].
- Röös, E., Karlsson, H., Witthöft, C. and Sundberg, C. (2015). Evaluating the sustainability of diets–combining environmental and nutritional aspects, *Environmental Science & Policy*, Vol. 47, pp.157-166, https://doi.org/10.1016/j.envsci.2014.12.001 [accessed 15th April 2019].
- Röös, E., Patel, M., Spångberg, J., Carlsson, G. and Rydhmer, L. (2016). Limiting livestock production to pasture and by-products in a search for sustainable diets, *Food Policy*, Vol. 58, pp.1-13, https://doi.org/10.1016/j.foodpol.2015.10.008 [accessed 15th April 2019].
- Röös, E., Sundberg, C., Tidåker, P., Strid, I. and Hansson, P.-A. (2013). Can carbon footprint serve as an indicator of the environmental impact of meat production? *Ecological Indicators*, Vol. 24, pp.573-581, https://doi.org/10.1016/j.ecolind.2012.08.004 [accessed 15th April 2019].

- Rosa, L., Rulli, M.C., Davis, K.F., Chiarelli, D.D., Passera, C. and D'Odorico, P. (2018). Closing the yield gap while ensuring water sustainability, *Environmental Research Letters*, Vol. 13, Iss. 10, pp.104002, doi: 10.1088/1748-9326/aadeef.
- Rose, D., Heller, M., Willits-Smith, A. and Meyer, R. (2017). Relation between healthiness of the diet and greenhouse gas emissions from food in the USA: a population-based cross-sectional study, *The Lancet*, Vol. 389, No. 2, pp.S18.
- Rose, D., Heller, M.C., Willits-Smith, A.M., and Meyer, R.J. (2019). Carbon footprint of self-selected US diets: nutritional, demographic, and behavioural correlates, *The American Journal of Clinical Nutrition*, Vol. 109, Iss. 3, pp.526–534, https://doi.org/10.1093/ajcn/nqy327 [accessed 15th April 2019].
- Rose, D., Willits-Smith, A. and Heller, M. (2019). Diet and planetary health: single-item substitutions significantly reduce the carbon footprint of self-selected diets reported in NHANES, Annual meeting of American Society for Nutrition, *Current Developments in Nutrition*, Vol. 3, Suppl. 1, https://doi.org/10.1093/cdn/nzz047.OR20-08-19 [accessed 15th April 2019].
- Rose, J.B. and Wu, F. (2015). Waterborne and foodborne diseases. In: *Climate Change and Public Health* (eds) B.S. Levy and J.A. Patz, pp.157–72, Oxford, UK: Oxford University Press.
- Rosegrant, M.W. and Cline, S.A. (2003). Global food security - challenges and policies, *Science*, Vol. 302, No. 5652, 12th Dec, pp.1917-1919, http://www.jstor.org/stable/3835716 [accessed 15th April 2019].
- Rosegrant, M.W., Koo, J., Cenacchi, N., Ringler, C., Robertson, R., Fisher, M., Cox, C., Garrett, K., Perez, N.D. and Sabbagh, P. (2014). *Food security in a world of natural resource scarcity - the role of agricultural technologies*, Washington, USA: International Food Policy Research Institute.
- Rosegrant, M.W., Tokgoz, S. and Bhandary, P. (2013). The new normal - a tighter global agricultural supply and demand relation and its implications for food security, *Agricultural and Applied Economics Association*, Vol. 95, No. 2, pp.303-309, doi: 10.1093/ajae/aas041.
- Roseland, M. and Spiliotopoulou, M. (2016). Converging urban agendas: toward healthy and sustainable communities, *Social Sciences*, Vol. 5, No.3, p.28, https://doi.org/10.3390/socsci5030028 [accessed 15th April 2019].
- Rösemann, C., Haenel, H-D., Dämmgen, U., Freibauer, A., Döring, U., Wulf, S., Eurich-Menden, B., Döhler, H., Schreiner, C. and Osterburg, B. (2017). *Calculations of gaseous and particulate emissions from German agriculture 1990 – 2015: report on methods and data (RMD) Submission 2017*, Braunschweig: Johann Heinrich von Thünen-Institut, Thünen Rep 46, doi:10.3220/REP1490877117000.
- Rosen, S. (2015). International Food Security Assessment, 2015-25: past progress and projections, *Global Food Security Challenges ICAE pre-conference event*, Milan, Italy, 7th August.
- Rosenfeld, D.L. (2018). The psychology of vegetarianism: recent advances and future directions, *Appetite*, Vol. 131, pp.125-138, https://doi.org/10.1016/j.appet.2018.09.011 [accessed 15th April 2019].
- Rosenzweg, C. and Parry, M.L. (1994). Potential impact of climate change on world food supply, *Nature*, Vol. 367, 13th January, pp.133-138.

- Rosenzweig, C., Elliott, J., Deryng, D., Ruane, A.C., Müller, C., Arneth, A., Boote, K.J., Folberth, C., Glotter, M., Khabarov, N., Neumann, K., Piontek, F., Pugh, T.A.M., Schmid, E., Stehfest, E., Yang, H. and Jones, J.W. (2013). Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison, *Proceedings of the National Academy of Science*, Vol. 111, pp.3268-3273, doi: 10.1073/pnas.1222463110.
- Rosenzweig, C., Iglesias, A., Yang, X., Epstein, P.R., Chivian, E. (2001). Climate change and extreme weather events: implications for food production, plant diseases, and pests, *Global Change Human Health*, Vol. 2, pp.90-104, https://doi.org/10.1023/A:1015086831467 [accessed 15th April 2019].
- Rosi, A., Mena, P., Pellegrini, N., Turroni, S., Neviani, E., Ferrocino, I., Di Cagno, R., Ruini, L., Ciati, R., Angelino, D., Maddock, J., Gobbetti, M., Brighenti, F., Del Rio, D. and Scazzina, F. (2017). Environmental impact of omnivorous, ovo-lacto-vegetarian, and vegan diet, *Scientific Reports*, Vol. 7, 6105, doi:10.1038/s41598-017-06466-8.
- Ross, C. (2018). Earth overshoot day: we've almost used up our annual environmental resources already, *Europe Breaking News*, 23rd July, https://www.europebreakingnews.net/2018/07/earth-overshoot-day-weve-almost-used-up-our-annual-environmental-resources-already/ [accessed 15th April 2019].
- Ross, C.L., Orenstein, M. and Botchwey, N. (2014). Public health and community planning 101. In: Health Impact Assessment in the United States [Ross, C.L., Orenstein, M. and Botchwey, N. (eds.)]. Springer New York, New York, NY, pp.15-32.
- Rossi, A., Bui, S. and Marsden, T. (2019). Redefining power relations in agrifood systems, *Journal of Rural Studies*, Vol. 68, pp.147-158, https://doi.org/10.1016/j.jrurstud.2019.01.002 [accessed 15th April 2019].
- Rossoll, D., Bermudez, R., Hauss, H., Schulz, K.G., Riebesell, U., Sommer, U. and Winder, M. (2012). Ocean acidification-induced food quality deterioration constrains trophic transfer, *PLoS One*, Vol. 7, pp.e34737, https://doi.org/10.1371/journal.pone.0034737 [accessed 15th April 2019].
- Roth, E., Rosenthal, H. and Burbridge, P. (2000). A discussion of the use of the sustainability index: ‘ecological footprint’ for aquaculture, *Aquatic Living Resources*, Vol. 13, No. 6, https://doi.org/10.1016/S0990-7440(00)01071-8 [accessed 15th April 2019].
- Rothstein, H.R., Sutton, A.J. and Borenstein, M. (2006). *Publication bias in meta-analysis: prevention, assessment and adjustments*, Hoboken, USA: Wiley.
- Rötter, R. and Höhn, J. (2015). An overview of climate change impact on crop production and its variability in Europe, related uncertainties and research challenges. In: Elbehri, A. (ed) (2015). *Climate change and food systems: global assessments and implications for food security and trade*, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), ISBN 978-92-5-108699-5.
- Rotz, C.A., Asem-Hiablie, S., Place, S. and Thoma, G. (2019). Environmental footprints of beef cattle production in the United States, *Agricultural Systems*, Vol. 169, pp.1-13, https://doi.org/10.1016/j.agsy.2018.11.005 [accessed 15th April 2019].

- Roudier, P., Sultan, B., Quirion, P. and Berg, A. (2011). The impact of future climate change on West African crop yields: what does the recent literature say? *Global Environmental Change*, Vol. 21, pp.1073-1083, https://doi.org/10.1016/j.gloenvcha.2011.04.007 [accessed 15th April 2019].
- Round, K., Borromeo, L., MacDougall, C., Riley, T., Paddison, L., Weigel, L. and von Harrach, A. (2016). Palm oil in Liberia: hope and anger in one of Africa's poorest countries – video, *The Guardian*, 20th October, https://www.theguardian.com/sustainable-business/video/2016/oct/20/palm-oil-liberia-hope-anger-one-of-africa-poorest-countries-video?CMP=ema-1706&CMP= [accessed 15th April 2019].
- Rousseau, Y., Watson, R.A., Blanchard, J.L. and Fulton, E.A. (2019). Evolution of global marine fishing fleets and the response of fished resources, *Proceedings of the National Academy of Sciences*, 201820344, doi: 10.1073/pnas.1820344116.
- Rowe, A. and Bansal, T. (2013). *Ten steps to sustainable business in 2013*, The Ivey Business Journal, January – February, https://iveybusinessjournal.com/publication/ten-ways-to-help-companies-become-sustainable-in-2013/ [accessed 15th April 2019].
- Rowe, S., Alexander, N., Almeida, N., Black, R., Burns, R., Bush, L., Crawford, P., Keim, N., Kris-Etherton, P. and Weaver, C. (2011). Food science challenge: translating the dietary guidelines for Americans to bring about real behavior change, *Journal of Food Science*, Vol. 76, R29-37, doi: 10.1111/j.1750-3841.2010.01973.x.
- Rowe, S.B. (2018). Today's food landscape: not a pretty picture, *Nutrition*, Vol. 55, No. 56, S1, https://doi.org/10.1016/j.nut.2018.07.009 [accessed 15th April 2019].
- Roy, J., Tschakert, P., Waisman, H., Abdul Halim, S., Antwi-Agyei, P. Dasgupta, P., B. Hayward, B., M. Kanninen, M., D. Liverman, M., Okereke, C., Pinho, P.F., Riahi, K. and Suarez Rodriguez, A.G. (2018). Sustainable development, poverty eradication and reducing inequalities. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press
- Roy, P., Nei, D., Orikasa, T., Xu, Q., Okadome, H., Nakamura, N. and Shiina, T. (2009). A review of life cycle assessment (LCA) on some food products, *Journal of Food Engineering*, Vol. 90, pp.1-10, doi:10.1016/j.jfoodeng.2008.06.016.
- Roy, P., Orikasa, T., Thammawong, M., Nakamura, N., Xu, Q. and Shiina, T. (2012). Life cycle of meats: an opportunity to abate the greenhouse gas emission from meat industry in Japan, *Journal of Environmental Management*, Vol. 93, Iss. 1, pp.218-224, https://doi.org/10.1016/j.jenvman.2011.09.017 [accessed 15th April 2019].

- Royal Society (2009). *Reaping the benefits - science and the sustainable intensification of global agriculture*, London, UK: The Royal Society, https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2009/4294967719.pdf [accessed 15th April 2019].
- Royal Society (2009). *Reaping the benefits - science and the sustainable intensification of global agriculture*, London, UK: The Royal Society.
- Royal Society (2014). *Resilience to extreme weather*, London, UK: The Royal Society Science Policy Centre report 02/14.
- Royal Society (2020). How fast is sea level rising? March 2020, https://royalsociety.org/topics-policy/projects/climate-change-evidence-causes/question-14/ [accessed 15th April, 2020].
- RSA FFCC (2017). *A growing mandate for change*, London, UK: Royal Society for the encouragement of Arts, Manufactures and Commerce Food, Farming and Countryside Commission.
- RSA FFCC (2018a). *Food, Farming and Countryside Commission: our common ground*, London, UK: Royal Society of Arts, Manufactures and Commerce, https://www.thersa.org/globalassets/pdfs/reports/rsa-our-common-ground.pdf [accessed 15th April 2019].
- RSA FFCC (2018b). *Where next for the RSA Food, Farming and Countryside Commission*, London, UK: Royal Society for the encouragement of Arts, Manufactures and Commerce Food, Farming and Countryside Commission, https://www.thersa.org/discover/publications-and-articles/rsa-blogs/2018/06/where-next-for-the-rsa-food-farming-and-countryside-commission [accessed 15th April 2019].
- RSA FFCC (2019a). *Food, Farming and Countryside Commission: field guide for the future*, London, UK: Royal Society of Arts, Manufactures and Commerce.
- RSA FFCC (2019b). Back to the land — the case for a more strategic approach to land use and management, London, UK: Royal Society for the encouragement of Arts, Manufactures and Commerce Food, Farming and Countryside Commission, https://medium.com/the-rsa-food-farming-countryside-commission/back-to-the-land-the-case-for-a-more-strategic-approach-to-land-use-and-management-c7d22bde4c00 [accessed 15th April 2019].
- RSA FFCC (2019c). *Food, Farming and Countryside Commission: our future in the land*, London, UK: Royal Society of Arts, Manufactures and Commerce.
- RSA FFCC (2019d). *The Eat-Lancet Commission report: my favourite eight take-aways,* https://www.thersa.org/discover/publications-and-articles/rsa-blogs/2019/01/the-eat-lancet-commission-report-my-favourite-eight-take-aways [accessed 15th April 2019].
- RSA-FFCC (2019e). An open letter to secretaries of state, 27th September, London, UK: Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA) established a Food, Farming and Countryside Commission, https://www.thersa.org/action-and-research/rsa-projects/public-services-and-communities-folder/food-farming-and-countryside-commission [accessed 15th April 2019].

- RSPB (2016). *State of nature 2016*, Horsham, UK: Royal Society for the Protection of Birds.
- RSPB (2018). *Eat less, eat better - two weeks of family-friendly recipes*, Horsham, UK: Royal Society for the Protection of Birds.
- RSPB WT, Friends of the Earth, Sustain, National Trust, Eating Better, Compassion in World Farming, Food Research Collaboration, Food Ethics Council, Soil Association (2014). Square Meal: Why We Need a Better Recipe for the Future, London, UK: Food Research Collaboration.
- Ruben, R. and Verhagen, J. (2019). *Towards sustainable global food systems. Conceptual and policy analysis of agriculture, food and environment linkages*, MDPI - Multidisciplinary Digital Publishing Institute, doi: 10.3390/books978-3-03897-815-2.
- Rudel, T.K. (2013). Food versus fuel - extractive industries, insecure land tenure, and gaps in world food production, *World Development*, Vol. 51, pp.62-70, http://dx.doi.org/10.1016/j.worlddev.2013.05.015 [accessed 15th April 2019].
- Rudolph, R., Hörtenhuber, S., Bochicchio, D., Butler, G., Brandhofer, R., Dippel, S., Dourmad, J.Y., Edwards, S., Früh, B., Meier, M., Prunier, A., Winckler, C., Zollitsch, W. and Leeb, C. (2018). Effect of three husbandry systems on environmental impact of organic pigs, *Sustainability*, 2018, Vol. 10, No. 3796, doi:10.3390/su10103796.
- Ruel, M., Quisumbing, A.R. and Balagamwala, M. (2018). Nutrition-sensitive agriculture: what have we learned so far, *Global food Security*, Vol. 17, pp.128-153, https://doi.org/10.1016/j.gfs.2018.01.002 [accessed 15th April 2019].
- Rugg, D. (2016). The role of evaluation at the UN and in the new sustainable development goals - towards the future we want, *Global Policy*, Vol. 7, Iss. 3, September, pp.426-430, doi: 10.1111/1758-5899.12346.
- Rumpel, C., Lehmann, J. and Chabbi, A. (2018). '4 per 1,000' initiative will boost soil carbon for climate and food security, *Nature*, Vol. 553, No. 7686, p.27, doi: 10.1038/d41586-017-09010-w.
- Rundlof, M., Andersson, G.K.S., Bommarco, R., Fries, I., Hederström, V., Herbertsson, L., Jonsson, O., Klatt, B.K., Pedersen, T.R., Yourstone, J. and Smith, H.G. (2015). Seed coating with a neonicotinoid insecticide negatively affects wild bees, *Nature*, Vol. 521, 7th May, pp.77-93, doi:10.1038/nature14420.
- Running, S.W. (2012). A measurable planetary boundary for the biosphere, *Science*, Vol. 337, pp.1458-1459, doi: 10.1126/science.1227620.
- *Rural 21* (2018a). Food, nutrition and energy security in an urbanising world, *Rural 21*, Vol. 52, No. 4, pp. 20-21.
- *Rural 21* (2018b). From small farms to big cities - leveraging food systems for ending hunger and malnutrition, *Rural 21*, Vol. 52, No. 4, pp.10-13.
- Rush, E. (2019). Wicked problems: the challenge of food safety versus food security-working towards the SDG goals? *European Journal of Clinical Nutrition*, Vol. 73, No. 8, pp.1091-1094, https://doi.org/10.1038/s41430-018-0352-2 [accessed 11th April 2020].

- RuSource (2013). Food security and the UK, Briefing 445, briefing is taken from '*Food Security and the UK: An Evidence and Analysis Paper'* published by Defra in December 2006, http://statistics.defra.gov.uk/esg/reports/foodsecurity/foodsecurity.doc [accessed 15th April 2019].
- Russell, M. (2019). Food security for everyone: an academy priority, *Journal of the Academy of Nutrition and Dietetics*, Vol. 119, No. 2, p.191, doi: 10.1016/j.jand.2018.11.018.
- Rust, N., Ridding, L., Ward, C., Clark, B., Kehoe, L., Dora, M., Whittingham, M.J., McGowan, P., Chaudhary, A., Reynolds, C.J., Trivedy, C. and West, N. (2020). How to transition to reduced-meat diets that benefit people and the planet, Science of the Total Environment, Vol. 718, 137208, https://doi.org/10.1016/j.scitotenv.2020.137208.
- Ruthrof, K.X., Breshears, D.B., Fontaine, J.B., Froend, R.H., Matusick, G., Kala, J., Miller, B.P., Mitchell, P.J., Wilson, S.K., van Keulen, M., Enright, N.J., Law, D.J., Wernberg, T. and Hardy, G.E.St.J. (2018). Subcontinental heat wave triggers terrestrial and marine, multi-taxa responses, *Scientific Reports*, Vol. 8, No. 1, pp.1-9, doi: 10.1038/s41598-018-31236-5.
- Rutten, M., Achterbosch, T.J., de Boer, I.J.M., Cuaresma, J.C. and Geleijnse, J. (2018). Metrics, models and foresight for European sustainable food and nutrition security: the vision of the SUSFANS project, *Agricultural Systems*, Vol. 163, pp.45-57, https://doi.org/10.1016/j.agsy.2016.10.014 [accessed 15th April 2019].
- Rutter, H., Savona, N., Glonti, K., Bibby, J., Cummins, S., Finegood, D.T., Greaves, F., Harper, L., Hawe, P., Moore, L., Petticrew, M., Rehfuess, E., Shiell, A., Thomas, J. and White, M. (2017). The need for a complex systems model of evidence for public health, *The Lancet*, 9–15th December, Vol. 390, Iss. 10112, pp.2602-2604, doi:https://doi.org/10.1016/S0140-6736(17)31267-9 [accessed 15th April 2019].
- Rutter, S.S., Smith, M.R., Guth, S., Golden, C.D., Vaitla, B., Mueller, N.D., Dangour, A.D. and Huybers, P. (2018). Climate change and global food systems: potential impacts on food security and undernutrition, *Annual Review of Public Health*, Vol. 38, pp.259-277, https://doi.org/10.1146/annurev-publhealth-031816-044356 [accessed 15th April 2019].
- Rüttinger, L., Smith, D., Stang, G., Tänzler, D. and Vivekananda, J. (2015). *A new climate for peace*, An independent report commissioned by the G7 members, https://www.newclimateforpeace.org/ [accessed 15th April 2019].
- Ruysschaert, D., Carter, C. and Cheyns, E. (2019). Territorializing effects of global standards: what is at stake in the case of 'sustainable' palm oil? *Geoforum*, Vol. 104, pp.1-12, https://doi.org/10.1016/j.geoforum.2019.05.009 [accessed 11th April 2020].
- Rytwinski, T., Taylor, J.J., Bennett, J.R., Smokorowski, K.E. and Cooke, S.J. (2017). What are the impacts of flow regime changes on fish productivity in temperate regions? A systematic map protocol, *Environmental Evidence,* Vol. 6, No. 1, pp.1-7, doi: 10.1186/s13750-017-0093-z.

- Sa, J., Lal, R., Cerri, C., Lorenz, K., Hungria, M. and Carvalho, P. (2017). Low-carbon agriculture in South America to mitigate global climate change and advance food security, *Environment International*, Vol. 98, pp.102-112, https://doi.org/10.1016/j.envint.2016.10.020 [accessed 15th April 2019].
- Saadun, N., Lim, E.A.L., Esa, S.M., Ngu, F., Awang, F., Gimin, A., Johari, I.H., Firdaus, M.A., Wagimin, N.I. and Azhar, B. (2018). Socio-ecological perspectives of engaging smallholders in environmental-friendly palm oil certification schemes, *Land Use Policy*, Vol. 72, pp.333-340, https://doi.org/10.1016/j.landusepol.2017.12.057 [accessed 11th April 2020].
- Sabiha, N-E., Salim, R., Rahman, S. and Rola-Rubzen, M.F. (2016) Measuring environmental sustainability in agriculture: a composite environmental impact index approach, *Journal of Environmental Management*, Vol. 166, pp.84-93, https://doi.org/10.1016/j.jenvman.2015.10.003 [accessed 15th April 2019].
- Sabini, L., Muzio, D. and Alderman, N. (2019). 25 years of 'sustainable projects'. What we know and what the literature says, *International Journal of Project Management*, Vol. 37, No. 6, pp.820-838,
- SAC (2012). *Environment, sustainability and the food supply challenge*, Edinburgh, UK: SAC.
- Sachs, J. (2010). Monitoring the world's agriculture to feed the world without further damaging the planet, Nature, Vol. 29, No. 466, 7306, pp.558-560, doi: 10.1038/466558a.
- Sachs, J., Schmidt-Traub, G., Kroll, C., Durand-Delacre, D. and Teksoz, K. (2017). *SDG index and dashboards report 2017: Global Responsibilities; International spillovers in achieving the goals*, New York, USA: Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN), https://popdesenvolvimento.org/images/noticias/2017-SDG-Index-and-Dashboards-Report.pdf [accessed 15th April 2019].
- Sackler Institute for Nutrition Science (2017). *Key points from an expert consultation: operationalizing sustainable nutrition*, technical brief, The New York Academy of Sciences, Sackler Institute for Nutrition Science.
- Sage, C. (2014). The transition movement and food sovereignty - from local resilience to global engagement in food, *Journal of Consumer Culture*, Vol. 14, No. 2, pp.254-275, doi: 10.1177/1469540514526281.
- Sakr, D. (2017). Sustainability and innovation: the next global industrial revolution, *Journal of Cleaner Production*, Vol. 142, pp.3355-3356, doi: 10.1016/j.jclepro.2016.10.135.
- Sala, E., Mayorga, J., Costello, C., Kroodsma, D., Palomares, M.L.D., Pauly, D., Sumaila, U.R. and Zeller, D. (2018). The economics of fishing the high seas, *Science Advances*, 6th June, Vol. 4, No. 6, pp.eaat2504, doi: 10.1126/sciadv.aat2504.
- Sala, S., Anton, A., McLaren, S.J., Notarnicola, B., Saouter, E. and Sonesson, U. (2017). In quest of reducing the environmental impacts of food production and consumption, *Journal of Cleaner Production*, Vol. 140, pp.387-398, https://doi.org/10.1016/j.jclepro.2016.09.054 [accessed 15th April 2019].

- Sala, S., Ciuffo, B. and Nijkamp, P. (2015). A systemic framework for sustainability assessment, *Ecological Economics*, Vol. 119, pp.314-325, http://dx.doi.org/10.1016/j.ecolecon.2015.09.015 [accessed 15th April 2019].
- Sala, S., Vasta, A., Mancini, L., Dewulf, J. and Rosenbaum, E. (eds.) (2015). *Social Life Cycle Assessment - State of the art and challenges for supporting product policies*, European Commission, Joint Research Centre, Institute for Environment and Sustainability, Publications Office of the European Union, Luxemburg, doi:10.2788/253715.
- Salami, S.A., Luciano, G., O'Grady, M.N., Biondi, L., Newbold, C.J., Kerry, J.P. and Priolo, A. (2019). Sustainability of feeding plant by-products: a review of the implications for ruminant meat production, *Animal Feed Science and Technology*, Vol. 251, pp.37-55, https://doi.org/10.1016/j.anifeedsci.2019.02.006 [accessed 11th April 2020].
- Salazar, E., Billing, S. and Breen, M. (2020). *We need to talk about chicken*, London, UK: Eating Better, https://www.eating-better.org/ (accessed 12th March 2020).
- Salem, M.A., Shawtari, F.A., Shamsudin, M.F. and Hussain, H.I. (2016). The relation between stakeholders' integration and environmental competitiveness, *Social Responsibility Journal*, Vol. 12, Iss. 4, pp.755-769, https://doi.org/10.1108/SRJ-12-2015-0189 [accessed 15th April 2019].
- Salmoral, G., Khatun, K., Llive, F. and Lopez, C.M. (2018). Agricultural development in Ecuador: a compromise between water and food security? *Journal of Cleaner Production*, Vol. 202, pp.779-791, https://doi.org/10.1016/j.jclepro.2018.07.308 [accessed 15th April 2019].
- Salter, A.M. (2017). Improving the sustainability of global meat and milk production, *Proceedings of the Nutrition Society*, Vol. 76, pp.22-27, doi:10.1017/S0029665116000276.
- Saltré, F. and Bradshaw, C.J.A. (2019). What is a 'mass extinction' and are we in one now? *The Conversation*, 12th November, https://theconversation.com/what-is-a-mass-extinction-and-are-we-in-one-now-122535 [accessed 15th April 2019].
- Samberg, L.H., Gerber, J.S., Ramankutty, N., Herrero, M. and West, P.C. (2016). Subnational distribution of average farm size and smallholder contributions to global food production, *Environmental Research Letters*, Vol. 11, No. 12, 031002, doi:10.1088/1748-9326/11/12/124010.
- Samir, K.C. and Lutz, W. (2015). The human core of the shared socioeconomic pathways: population scenarios by age, sex and level of education for all countries to 2100, *Global Environmental Change*, Vol. 42, pp.181-192, https://doi.org/10.1016/j.gloenvcha.2014.06.004 [accessed 15th April 2019].
- Samper, L. and Quiñones-Ruiz, X. (2017). Towards a balanced sustainability vision for the coffee industry, *Resources*, Vol. 6, No. 2, pp.17, https://doi.org/10.3390/resources6020017 [accessed 11th April 2020].
- Sampson, H. (2004). Navigating the waves: the usefulness of a pilot in qualitative research, *Qualitative Research*, Vol. 4, No. 3, pp.383-402, doi: 10.1177/1468794104047236.

- Samuel-Fitwi, B., Wuertz, S., Schroeder, J.P. and Schulz, C. (2012). Sustainability assessment tools to support aquaculture development, *Journal of Cleaner Production*, Vol. 32, pp.183-192, doi:10.1016/j.jclepro.2012.03.037.
- Sánchez, B., Rasmussen, A. and Porter, J.R. (2014). Temperatures and the growth and development of maize and rice: a review, *Global Change Biology*, Vol. 20, pp.408-417, https://doi.org/10.1111/gcb.12389 [accessed 15th April 2019].
- Sánchez-Bayo, F. and Goka, K. (2014). Pesticide residues and bees – a risk assessment, *PLoS One*, Vol. 9, Iss. 4, pp.e94482, doi: 10.1371/journal.pone.0094482.
- Sánchez-Bayo, F. and Wyckhuys, K.A.G. (2019). Worldwide decline of the entomofauna: a review of its drivers, *Biological Conservation*, Vol. 232, pp.8-27, https://doi.org/10.1016/j.biocon.2019.01.020 [accessed 15th April 2019].
- Sanchez-Sabate, R. and Sabaté, J. (2019). Consumer attitudes towards environmental concerns of meat consumption: a systematic review, *International Journal of Environmental Research and Public Health*, Vol. 16, No. 7, pp.1220, doi: 10.3390/ijerph16071220.
- Sanchez-Sabate, R., Badilla-Briones, Y. and Sabaté, J. (2019). Understanding attitudes towards reducing meat consumption for environmental reasons: a qualitative synthesis review, *Sustainability*, Vol. 11, No. 22, 6295, doi: 10.3390/su11226295.
- Sanders, J.K.M. (2018). Onwards and upwards: towards a sustainable future, *Royal Society Open Science*, Vol. 5, No. 1, pp.1-2, https://doi.org/10.1098/rsos.172294 [accessed 15th April 2019].
- Sandhu, A. (2014). National Food Security Act, 2013 and food security outcomes in India, *Vision*, Vol. 18, No. 4, pp.365-370, doi: 10.1177/0972262914552174.
- Sandhu, H. (2016). *The future of food and agriculture: quantifying the social and environmental benefits and costs of different production systems*, Farm Sustainability Assessment Report, Bristol, UK: Sustainable Food Trust.
- Sandström, V., Valin, H., Krisztin, T., Havlík, P., Herrero, M. and Kastner. T. (2018). The role of trade in the greenhouse gas footprints of EU diets, *Global Food Security*, Vol. 19, No. 48, doi: 10.1016/j.gfs.2018.08.007.
- Sandy, M. (2019). The Amazon is completely lawless': the rainforest after Bolsonaro's first year, *The New York Times*, 5th December, https://www.nytimes.com/2019/12/05/world/americas/amazon-fires-bolsonaro-photos.html [accessed 15th April 2020].
- San-Epifanio, L.E. (2015). Challenging food governance models – 586nalysing the food citizen and the emerging food constitutionalism from an EU perspective, *Journal of Agricultural and Environmental Ethics*, Vol. 28, pp.435-454, doi: 10.1007/s10806-015-9543-1.

- Santer, B.D., Po-Chedley, S., Zelinka, M.D., Cvijanovic, I., Bonfils, C., Durack, P.J., Fu, Q., Kiehl, J., Mears, C., Painter, J., Pallotta, G., Solomon, S., Wentz, F.J. and Zou, C-Z. (2018). Human influence on the seasonal cycle of tropospheric temperature, *Science*, 20th July, Vol. 361, Iss. 6399, eaas8806, doi: 10.1126/science.aas8806.
- Santeramo, F.G., Carlucci, D., De Devitiis, B., Seccia, A., Stasi, A., Viscecchia, R. and Nardone, G. (2018). Emerging trends in European food, diets and food industry, *Food Research International*, Vol. 104, pp.39-47, https://doi.org/10.1016/j.foodres.2017.10.039 [accessed 15th April 2019].
- Sanz-Cobena, A., Lassaletta, L., del Prado, E.A.A., Garnier, J., Billen, G., Iglesias, A., Sánchez, B., Guardia, G., Abalos, D., Plaza-Bonilla, D., Puigdueta-Bartolomé, I., Moral, R., Galán, E., Arriaga, H., Merino, P., Infante-Amate, J., Meijide, A. and Smith, P. (2017). Strategies for greenhouse gas emissions mitigation in Mediterranean agriculture: a review, *Agriculture, Ecosystems & Environment*, Vol. 238, pp.5-24, https://doi.org/10.1016/j.agee.2016.09.038 [accessed 15th April 2019].
- Sargant, J.M., Rajic, A., Read, S. and Ohlsson, A. (2006). The process of systematic review and its application in agri-food public-health, *Preventive Veterinary Medicine*, Vol. 75, pp.141-151, doi:10.1016/j.prevetmed.2006.03.002.
- Sarkar, D., Baishya, L.K., Meitei, C.B., Naorem, G.C., Thokchom, R.C., Singh, J., Bhuvaneswari, S., Batabyal, K., Das, R., Padhan, D., Prakash, N. and Rahman, F.H. (2018). Can sustainability of maize-mustard cropping system be achieved through balanced nutrient management? *Field Crops Research*, Vol. 225, pp.9-21, https://doi.org/10.1016/j.fcr.2018.05.018 [accessed 11th April 2020].
- Saswattecha, K., Kroeze, C., Jawjit, W. and Hein, L. (2015). Assessing the environmental impact of palm oil produced in Thailand, *Journal of Cleaner Production*, Vol. 100, pp.150-169, https://doi.org/10.1016/j.jclepro.2015.03.037 [accessed 11th April 2020].
- Saswattecha, K., Kroeze, C., Jawjit, W. and Hein, L. (2017). Improving environmental sustainability of Thai palm oil production in 2050, *Journal of Cleaner Production*, Vol. 147, pp.572-588, https://doi.org/10.1016/j.jclepro.2017.01.137 [accessed 11th April 2020].
- Satterthwaite, D., McGranahan, G. and Tacoli, C. (2010). Urbanization and its implications for food and farming, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp. 2809-2820, https://doi.org/10.1098/rstb.2010.0136 [accessed 15th April 2019].
- Sauer, S. (2018). Soy expansion into the agricultural frontiers of the Brazilian Amazon: The agribusiness economy and its social and environmental conflicts, *Land Use Policy*, Vol. 79, pp.326-338, doi:10.1016/j.landusepol.2018.08.030.
- Saunder, D. (2015). *Populations and sustainability: fisheries*, Cranfield, UK: Cranfield University.
- Saunders, C., Grasso, M.T. and Hedges, C. (2018). Attention to climate change in British newspapers in three attention cycles (1997–2017), *Geoforum*, Vol. 94, pp.94-102, https://doi.org/10.1016/j.geoforum.2018.05.024 [accessed 15th April 2019].

- Säwe, F. and Hultman, J. (2014). From moral to markets - the rhetoric of responsibility and resource management in European Union fisheries policy, *Society & Natural Resources: An International Journal*, Vol. 27, No. 5, pp.507-520, doi: 10.1080/08941920.2013.861566.
- Saxe, H. (2014). The New Nordic Diet is an effective tool in environmental protection – it reduces the associated socioeconomic cost of diet, *American Journal of Clinical Nutrition*, Vol. 99, No. 5, pp.1117-1125, doi: 10.3945/ajcn.113.066746.
- Sayers, P.B., Horritt, M., Penning-Rowsell, E. and McKenzie, A. (2015). Climate change risk assessment 2017: projections of future flood risk in the UK, London, UK: Sayers and Partners LLP report for the Committee on Climate Change.
- Sayers, P.B., Horritt, M., Penning-Rowsell, E., McKenzie, A. and Thompson, D. (2016). The analysis of future flood risk in the UK using the Future Flood Explorer, *Proceedings of FLOOD risk 2016 E3S Web of Conferences*, 7 (21005), doi:10.1051/e3sconf/20160721005.
- Sayre, L., Rhazi, N., Carpenter, H. and Hughes, N.L. (2010). Climate change and human health: the role of nurses in confronting the issue, *Nursing Administration Quarterly*, Vol. 34, pp.334-342, doi: 10.1097/NAQ.0b013e3181f60df9.
- SCAR (2011). *Sustainable food consumption and production in a resource-constrained world*, The 3rd SCAR Foresight Exercise, Brussels: European Commission Standing Committee on Agricultural Research (SCAR).
- Scarborough, P., Appleby, P.N., Mizdrak, A., Briggs, A.D.M., Travis, R.C., Bradbury, K.E. and Key, T.J. (2014). Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK, *Climatic Change*, Vol. 125, pp.179-192, doi: 10.1007/s10584-014-1169-1.
- Scarborough, P., Kaur, A., Cobiac, L., Owens, P., Parlesak, A., Sweeney, K. and Rayner, M. (2016). Eatwell Guide - modelling the dietary and cost implications of incorporating new sugar and fibre guidelines, *BMJ*, Vol. 6, pp.e013182, doi:10.1136/bmjopen-2016-013182.
- Scarlett, L. (2019). Climate, courage and the ambition we need now, 16th July, Arlington, USA: The Nature Conservancy, https://www.nature.org/en-us/what-we-do/our-insights/perspectives/climate-courage-and-the-ambition-we-need-now/ [accessed 15th April 2019].
- Scearce, C. (2009). European fisheries history: pre-industrial origins of overfishing, *ProQuest*, August, http://www.csa.com/discoveryguides/discoveryguides-main.php [accessed 15th April 2019].
- Schanes, K., Giljum, S. and Hertwich, E. (2016). Low carbon lifestyles: a framework to structure consumption strategies and options to reduce carbon footprints, *Journal of Cleaner Production*, Vol. 139, pp.1033-1043, doi: 10.1016/j.jclepro.2016.08.154.
- Scharber, H. and Dancs, A. (2016). Do locavores have a dilemma? Economic discourse and the local food critique, *Agriculture and Human Values*, Vol. 33, No. 1, pp.121-133, https://doi.org/10.1007/s10460-015-9598-7 [accessed 15th April 2019].

- Scheelbeek, P.F.D., Bird, F.A., Tuomisto, H.L., Green, R., Harris, F.B., Joy, E.M.J., Chalabi, Z., Allen, E., Haines, A. and Dangour, A.D. (2018). Effect of environmental changes on vegetable and legume yields and nutritional quality, *Proceedings of the National Academy of Sciences*, 201800442, doi: 10.1073/pnas.1800442115.
- Scheelbeek, P.F.D., Tuomisto, H.L., Bird, F.A., Haines, A. and Dangour, A.D. (2017). Effect of environmental change on yield and quality of fruits and vegetables: two systematic reviews and projections of possible health effects, *Lancet Global Health,* Vol. 5, No. S1, pp.S21-S21, https://doi.org/10.1016/S2214-109X(17)30128-6.
- Scheidel, W. (2017). *The great leveller*, Princeton, USA: Princeton University Press.
- Schellnhuber, H.J., Hare, B., Serdeczny, O., Schaeffer, M., Adams, S., Baarsch, F., Schwan, S., Coumou, D., Robinson, A., Vieweg, M., Piontek, F., Donner, R., Runge, J., Rehfeld, K., Rogelj, J., Perette, M., Menon, A., Schleussner, C-F., Bondeau, A., Svirejeva-Hopkins, A., Schewe, J., Frieler, K., Warszawski, L. and Rocha, M. (2013). Turn down the heat: climate extremes, regional impacts, and the case for resilience - full report. Washington, USA: The World Bank.
- Schepers, J. and Annemans, L. (2018). The potential health and economic effects of plant-based food patterns in Belgium and the United Kingdom, *Nutrition*, Vol. 48, pp.24-32, https://doi.org/10.1016/j.nut.2017.11.028 [accessed 15th April 2019].
- Scher, A. (2018). Climate grief: the growing emotional toll of climate change, *NBC News*, 24th December, https://www.nbcnews.com/health/mental-health/climate-grief-growing-emotional-toll-climate-change-n946751 [accessed 15th April 2019].
- Scherer, L. and Pfister, S. (2015). Modelling spatially explicit impacts from phosphorus emissions in agriculture, *International Journal of Life Cycle Assessment*, Vol. 20, pp.785-795, https://doi.org/10.1007/s11367-015-0880-0 [accessed 15th April 2019].
- Scherer, L. and Verburg, P.H. (2017). Mapping and linking supply- and demand-side measures in climate-smart agriculture: a review, *Agronomy for Sustainable Development*, Vol. 37, No. 6, pp.1-17, https://doi.org/10.1007/s13593-017-0475-1 [accessed 15th April 2019].
- Scherer, L., Behrens, P. and Tukker, A. (2019). Opportunity for a dietary win-win-win in nutrition, environment, and animal welfare, *One Earth*, Vol. 1, No. 3, pp.349-360, https://doi.org/10.1016/j.oneear.2019.10.020.
- Scherer, L.A., Verburg, P.H. and Schulp, C.J.E. (2018). Opportunities for sustainable intensification in European agriculture, *Global Environmental Change*, Vol. 48, pp.43-55, https://doi.org/10.1016/j.gloenvcha.2017.11.009 [accessed 15th April 2019].

- Schewe, J., Heinke, J., Gerten, D., Haddeland, I., Arnell, N.W., Clark, D.B. Dankers, R., Eisner, S., Fekete, B.M., Colón-González, F.J., Gosling, S.N., Kim, H., Liu, X., Masaki, Y., Portmann, F.T., Satoh, Y., Stacke, T., Tang, Q., Wada, Y., Wisser, D., Albrecht, T., Frieler, K., Piontek, F., Warszawski, L. and Kabat, P.S. (2014). Multimodel assessment of water scarcity under climate change, *Proceedings of the National Academy of Sciences*, Vol. 111, No. 9, pp.3245-3250, https://doi.org/10.1073/pnas.1222460110 [accessed 15th April 2019].
- Schiermeier, Q. (2010). IPCC flooded by criticism, *Nature*, Vol. 463, No. 596, doi:10.1038/463596a.
- Schill, C., Wijermans, N., Schlüter, M. and Lindahl, T. (2016). Cooperation is not enough - exploring social-ecological micro-foundations for sustainable common-pool resource use, *PLoS One*, Vol. 11, No. 8, pp.e0157796, https://doi.org/10.1371/journal.pone.0157796 [accessed 15th April 2019].
- Schiller, L., Bailey, M., Jacquet, M. and Sala, E. (2018). High seas fisheries play a negligible role in addressing global food security, *Science Advances*, Vol. 4, pp.eaat8351, doi: 10.1126/sciadv.aat8351.
- Schlenker, W. and Lobell, D.B. (2010). Robust negative impacts of climate change on African agriculture, *Environmental Research Letters*, Vol. 5, pp.014010, doi:10.1088/1748-9326/5/1/014010.
- Schlenker, W. and Roberts, M.J. (2009). Nonlinear temperature effects indicate severe damages to U.S. crop yields under climate change, *Proceedings of the National Academy of Science*, Vol. 106, No. 37, pp.15594-15598, www.pnas.org.cgi.doi:10.1073.pnas.0906865106 [accessed 15th April 2019].
- Schleussner, C., Lissner, T., Fischer, E., Wohland, J., Perrette, M., Golly, A., Rogelj, J., Childers, K., Schewe, J., Frieler, K., Mengel, M., Hare, W. and Schaeffer, M. (2016). Differential climate impacts for policy-relevant limits to global warming: the case of 1.5°C and 2°C, *Earth System Dynamics*, Vol. 7, No. 2, pp.327-351, doi: 10.5194/esd-7-327-2016.
- Schmidhuber, J. and Tubiello, F.N. (2007). Global food security under climate change, *Proceedings of the National Academy of Science*, Vol. 104, pp.19703-19708, https://doi.org/10.1073/pnas.0701976104 [accessed 15th April 2019].
- Schmidt, G.A. and Frank, A. (2018). The Silurian hypothesis - would it be possible to detect an industrial civilization in the geological record? *International Journal of Astrobiology*, Vol. 1-9, https://doi.org/10.1017/S1473550418000095 [accessed 15th April 2019].
- Schmidt, J.J. and Matthews, N. (2018). From state to system: financialization and the water-energy-food-climate nexus, *Geoforum*, Vol. 91, pp.151-159, https://doi.org/10.1016/j.geoforum.2018.03.001 [accessed 15th April 2019].
- Schmitt, E., Galli, F., Menozzi, D., Maye, D., Touzard, J-M., Marescotti, A., Six, J. and Brunori, G. (2017). Comparing the sustainability of local and global food products in Europe, *Journal of Cleaner Production*, Vol. 165, pp.346-359, https://doi.org/10.1016/j.jclepro.2017.07.039 [accessed 15th April 2019].

- Schmitz, C., Biewald, A., Lotze-Campen, H., Popp, A., Dietrich, J.P., Bodirsky, B., Krause, M. and Weindl, I. (2012). Trading more food: Implications for land use, greenhouse gas emissions, and the food system, *Global Environmental Change*, Vol. 22, pp.189-209, https://doi.org/10.1016/j.gloenvcha.2011.09.013 [accessed 15th April 2019].
- Schmitz, P.M. (2013). Do biofuels contribute to price volatility and food insecurity? *Presentation to Biofuels: A Challenge or an Opportunity for Food Production?* Brussels, 20th March.
- Schmitz, S. (2018). Healthy food for healthy people on a healthy planet Germany's food policy in development co-operation, *Rural 21*, Vol. 52, No. 2, pp.20-21, https://www.rural21.com/english/current-issue/detail/article/healthy-food-for-healthy-people-on-a-healthy-planet-00002855/ [accessed 15th April 2019].
- Schneider, T., Kaul, C.M. and Pressel, K.G. (2019). Possible climate transitions from breakup of stratocumulus decks under greenhouse warming, *Nature Geoscience*, Vol. 12, No. 3, pp.164 doi: 10.1038/s41561-019-0310-1.
- Schnitter, R. and Berry, P. (2019). The climate change, food security and human health nexus in Canada: a framework to protect population health, *International Journal of Environmental Research and Public Health*, Vol. 16, No. 16, 14, pii: E2531, doi: 10.3390/ijerph16142531.
- Schnitter, R., Verret, M., Berry, P., Chung Tiam Fook, T., Hales, S., Lal, A. and Edwards, S. (2018). An assessment of climate change and health vulnerability and adaptation in Dominica, *International Journal of Environmental Research and Public Health*, Vol. 28, No. 16, p.E70, doi: 10.3390/ijerph16010070.
- Schnurr, M.A. (2015). GMO 2.0 Genetically modified crops and the push for Africa’s green revolution, *Canadian Food Studies*, Vol. 2, No. 2, pp.201-208, doi: 10.15353/cfs-rcea.v2i2.97.
- Schoen, V. and Lang, T. (2016). *Brexit, food and farming – a submission to the House of Lords EU Energy and Environment Sub-Committee inquiry into the implications of Brexit for agriculture*, 24th March, Food Research Collaboration Policy Brief, www.foodresearch.org.uk [accessed 15th April 2019].
- Schoen, V. and Lang, T. (2016). *Horticulture in the UK potential for meeting dietary guideline demands,* 24th March, Food Research Collaboration Policy Brief, www.foodresearch.org.uk [accessed 15th April 2019].
- Schonwald, J. (2012). Tomorrows GM food, *The Futurist*, May-June, pp.24-28.
- Schoolman, E.D., Guest, J.S., Bush, K.F. and Bell, A.R. (2012). How interdisciplinary is sustainability research? Analyzing the structure of an emerging scientific field, *Sustainable Science*, Vol. 7, No. 1, pp.67-80, https://doi.org/10.1007/s11625-011-0139-z [accessed 15th April 2019].
- Schoormans, J. (2018). Routledge Handbook of Sustainable Product Design, *Design Journal*, Vol. 21, No. 4, pp.553-557, https://doi.org/10.1080/14606925.2018.1467661 [accessed 15th April 2019].
- Schöpfel, J. (2011). Towards a Prague definition of grey literature, *Grey Journal*, Vol. 7, No. 1, pp.5-18.

- Schösler, H. and Boer, J. (2018). Towards more sustainable diets: insights from the food philosophies of "gourmets" and their relevance for policy strategies, *Appetite*, Vol. 127, pp.59-68, https://doi.org/10.1016/j.appet.2018.04.022 [accessed 15th April 2019].
- Schösler, H. and de Boer, J. (2018). What if plants could make their own fertilizer—from the air? *The Anthropocene*, 20th July, https://www.anthropocenemagazine.org/2018/07/what-if-plants-could-make-their-own-fertilizer-from-the-air/ [accessed 15th April 2019].
- Schösler, H., Boer, J. and Boersema, J. (2012). A theoretical framework to analyse sustainability relevant food choices from a cultural perspective: caring for food and sustainability in a pluralistic society. In: *Climate Change and Sustainable Development: Ethical Perspectives on Land Use and Food Production*, pp.335-341, doi:10.3920/978-90-8686-753-0_50.
- Schösler, H., de Boer, J., and Boersema, J.J. (2012). Can we cut out the meat of the dish? Constructing consumer-oriented pathways towards meat substitution, *Appetite*, Vol. 58, No. 1, pp.39-47, https://doi.org/10.1016/j.appet.2011.09.009 [accessed 15th April 2019].
- Schouten, G., Leroy, P. and Glasbergen, P. (2012). On the deliberative capacity of private multi-stakeholder governance - the Roundtables on Responsible Soy and Sustainable Palm Oil, *Ecological Economics*, Vol. 83, pp.42-50, http://dx.doi.org/10.1016/j.ecolecon.2012.08.007 [accessed 15th April 2019].
- Schramski, J.R., Woodson, C.B., Steck, G., Munn, D. and Brown, J.H. (2019). Declining country-level food self-sufficiency suggests future food insecurities, *BioPhysical Economics and Resource Quality*, Vol. 4, 12 https://doi.org/10.1007/s41247-019-0060-0 [accessed 11th April 2019].
- Schroter, M., Stumpf, K.H., Loos, J., van Oudenhoven, A.P.E., Böhnke-Henrich, A. and Abson, D.J. (2017). Refocusing ecosystem services towards sustainability, *Ecosystem Services*, Vol. 25, pp.35-43, https://doi.org/10.1016/j.ecoser.2017.03.019 [accessed 15th April 2019].
- Schultink, G. (2000). Critical environmental indicators - performance indices and assessment models for sustainable rural development planning, *Ecological Modelling*, Vol. 130, pp.47-58, https://doi.org/10.1016/j.ecoser.2017.03.019 [accessed 15th April 2019].
- Schultz, A., Goertzen, L., Rothney, J., Wener, P., Enns, J., Halas, G. and Katz, A. (2018). A scoping approach to systematically review published reviews: adaptations and recommendations, *Research Synthesis Methods*, Vol. 9, pp.116-123, doi: 10.1002/jrsm.1272.
- Schweisfurth, L. (2017). The tragic demise of Scotland's salmon, *Sustainable Food Trust*, 22nd March, http://sustainablefoodtrust.org/articles/the-tragic-demise-of-scotlands-salmon/ [accessed 15th April 2019].
- Schweitzer, J-P., Petsinaris, F. and Gionfra, C. (2018). *Justifying plastic pollution: how Life Cycle Assessments are misused in food packaging policy*, Institute for European Environmental Policy (IEEP), Brussels, A study by Zero Waste Europe and Friends of the Earth Europe for the Rethink Plastic Alliance.

- Schwenkenbecher, A. (2018). We need to rethink our moral obligations to create a better world (antibiotics), *The Conversation*, 20th March, https://theconversation.com/we-need-to-rethink-our-moral-obligations-to-create-a-better-world-93286 [accessed 15th April 2019].
- Schyns, J.F., Hoekstra, A.Y., Booij, M.J., Hogeboom, R.J. and Mekonnen, M.M. (2019). Limits to the world's green water resources for food, feed, fiber, timber, and bioenergy, *Proceedings of the National Academy of Sciences*, Vol. 116, No. 11, pp.4893-4898, https://doi.org/10.1073/pnas.1817380116 [accessed 15th April 2019].
- Science for Environment Policy (2017). Taking stock: progress in natural capital accounting. In-depth Report 16 produced for the European Commission, DG Environment by the Science Communication Unit, Bristol, UK: University of the West of England, http://ec.europa.eu/science-environment-policy [accessed 15th April 2019].
- Science for Environment Policy (2018). *What are the health costs of environmental pollution?* Future Brief 21 produced for the European Commission DG Environment, Bristol, UK: University of the West of England, Science Communication Unit, http://ec.europa.eu/science-environment-policy [accessed 15th April 2019].
- ScienceDaily (2018). Feeding 10 billion people by 2050 within planetary limits may be achievable, *ScienceDaily* https://www.sciencedaily.com/releases/2018/10/181010132300.htm, [accessed 10th October 2018].
- Scotland Food and Drink (2018). *Ambition 2030: industry strategy for growth*, Edinburgh, UK: Scotland Food and Drink, https://www.foodanddrink.scot/media/1465/ambition-2030.pdf [accessed 15th April 2019].
- Scott, C. (2018). Sustainably sourced junk food? Big food and the challenge of sustainable diets, *Global Environmental Politics*, Vol. 18, No. 2, pp.93-113, doi:10.1162/glep_a_00458.
- Scott, C.M. (2015). The role of transnational food and agriculture corporations in creating and responding to food crises - synthesis paper, *Canadian Food Studies, Special Issue - Mapping the Global Food Landscape*, Vol. 2, No. 2, pp.146-151, doi: http://dx.doi.org/10.15353/cfs-rcea.v2i2.91.
- Scott, H.M., Acuff, G., Bergeron, G., Bourassa, M.W., Gill, J. and Graham, D.W. (2019). Critically important antibiotics: criteria and approaches for measuring and reducing their use in food animal agriculture, *Annals of the New York Academy of Sciences*, Vol. 1441, No. 1, pp.8-16, doi: 10.1111/nyas.14058.
- Scott, K., Jessani, N., Qiu, M. and Bennett, S. (2018). Developing more participatory and accountable institutions for health: identifying health system research priorities for the Sustainable Development Goal-era, *Health Policy and Planning*, Vol. 33, No. 9, pp.975-987, doi: 10.1093/heapol/czy079.
- Scott, S., Craig, G. and Geddes, A. (2012). *Experiences of forced labour in the UK food industry*, Joseph Rowntree Foundation, www.jrf.org.uk/publications [accessed 15th April 2019].

- Scott, S., McCormick, A. and Zaloznik, M. (2008). *Staff Shortages and Immigration in Agriculture*, Evidence paper for the Migration Advisory Committee.
- Scottish Food Coalition (2016). *Plenty: food, farming and health in a new Scotland*, http://www.foodcoalition.scot/uploads/6/2/6/8/62689573/plenty_complete.pdf [accessed 15th April 2019].
- Scovronick, N. (2015). *Reducing global health risks through mitigation of short-lived climate pollutants: scoping report for policy makers*, Geneva, Switzerland: World Health Organization.
- Scown, M.W., Winkler, K.J. and Nicholas, K.A. (2019). Aligning research with policy and practice for sustainable agricultural land systems in Europe, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 116, No. 11, pp.4911-4916, https://doi.org/10.1073/pnas.1812100116 [accessed 15th April 2019].
- Scrinis, G. (2015). Big Food corporations and the nutritional marketing and regulation of processed foods, *Canadian Food Studies*, Vol. 2, No. 2, pp.136-145, doi: 10.15353/cfs-rcea.v2i2.113.
- Scrinis, G. (2018). Concentration and power in the food system: who controls what we eat? *The Journal of Peasant Studies*, Vol. 45, No. 2, pp.483-485, doi: 10.1080/03066150.2017.1420592.
- SCWG (2019). *Final report from the Science Council Working Group on food systems risks and horizon scanning*, May, London: Science Council Working Group on Food System Risks and Horizon Scanning (Working Group 3).
- SDC (2007). *Vision for a sustainable food chain*, Workshop Report 20th June, London, UK: Sustainable Development Commission.
- SDSN (2013). *Solutions for sustainable agriculture and food systems*, New York, USA: Sustainable Development Solutions Network.
- SDSN (2013). *Sustainable agriculture and food systems released their report solutions for sustainable agriculture and food systems*, New York, USA: Sustainable Development Solutions Network.
- Seaquist, J.W., Johansson, E.L. and Nicholas, K.A. (2014). Architecture of the global land acquisition system - applying the tools of network science to identify key vulnerabilities, *Environmental Research Letters*, Vol. 9, pp.114006, doi:10.1088/1748-9326/9/11/114006.
- Searchinger, T. (2013). *Understanding the biofuel trade-offs between indirect land-use change*, Brussels: Friends of the Earth Europe.
- Searchinger, T., Hanson, C., Ranganathan, J., Lipinski, B., Waite, R., Winterbottom, R., Dinshaw A. and Heimlic, R. (2013). *The great balancing act*, Working Paper, Installment 1 of Creating a Sustainable Food Future. Washington, USA: World Resources Institute, http://www.worldresourcesreport.org [accessed 15th April 2019].

- Searchinger, T., Hanson, C., Ranganathan, J., Lipinski, B., Waite, R., Winterbottom, R., Dinshaw, A. and Heimlich, R. (2013). *Creating a sustainable food future: interim findings: a menu of solutions to sustainably feed more than 9 billion people by 2050*, World Resources Institute, https://www.climatelearningplatform.org/creating-sustainable-food-future-interim-findings-menu-solutions-sustainably-feed-more-9-billion [accessed 15th April 2019].
- Searchinger, T., Heimlich, R., Houghton, R.A., Dong, F. and Elobeid, A., Fabiosa, J., Tokgoz, S., Hayes, D. and Yu, T-H. (2008). Use of U.S. croplands for biofuels increase greenhouse gases through emissions from land-use change, *Science*, Vol. 319, pp.1238-1240, doi: 10.1126/science.1151861.
- Searchinger, T., Waite, R., Hanson, C., Ranganathan, J., Dumas, P. and Matthews, E. (2018). *Creating a sustainable food future: a menu of solutions to feed nearly 10 billion people by 2050*, Synthesis report, Washington, USA: World Resources Institute in partnership with the World Bank, UN Environment, UN Development Programme, CIRAD and INRA.
- Searchinger, T.D., Wirsenius, S., Beringer, T. and Dumas, P. (2018). Assessing the efficiency of changes in land use for mitigating climate change, *Nature*, Vol. 564, No. 7735, pp.249, doi: 10.1038/s41586-018-0757-z.
- Sebastiani, R., Corsaro, D., Montagnini, F. and Caruana, A. (2014). Corporate sustainability in action, *The Service Industries Journal*, Vol. 34, No. 7, pp.584-603, doi: 10.1080/02642069.2014.886191.
- Seck, P.A., Diagne, A., Mohanty, S. and Wopereis, M.C.S. (2012). Crops that feed the world 7 – Rice, *Food Security*, Vol. 4, pp.7-24, doi: 10.1007/s12571-012-0168-1.
- Seconda, L., Baudry, J., Allès, B., Soler, L-J., Hercberg, S., Langevin, B., Pointereau, P., Lairon, D. and Kesse-Guyot, E. (2018). Identification of sustainable dietary patterns by a multicriteria approach in the NutriNet-Santé cohort, *Journal of Cleaner Production*, Vol. 196, pp.1256-1265, https://doi.org/10.1016/j.jclepro.2018.06.143 [accessed 15th April 2019].
- Sedghi, A. (2014). How obese is the UK? And how does it compare to other countries, *The Guardian*, 29th May, https://www.theguardian.com/news/datablog/2014/may/29/how-obese-is-the-uk-obesity-rates-compare-other-countries [accessed 15th April 2019].
- Seed, B. (2015). Sustainability in the Qatar national dietary guidelines, among the first to incorporate sustainability principles, *Public Health Nutrition*, Vol. 18, pp.2303-2310, doi:10.1017/S1368980014002110.
- Seed, B. and Rocha, C. (2018). Can we eat our way to a healthy, ecologically sustainable and resilient food system? *Canadian Food Studies*, Vol. 5, Iss. 3, pp.182-207, doi: 10.15353/cfs-rcea.v5i3.258,
- Seekell, D., Carr, J., Dell'Angelo, J., D'Odorico, P., Fader, F., Gephart, J., Kummu, M., Magliocca, N., Porkka, M., Puma, M., Ratajczak, Z., Rulli, M.C., Suweis, S. and Tavoni, A. (2017). Resilience in the global food system, *Environmental Research Letters*, Vol. 12, No. 2, pp.025010, doi.org/10.1088/1748-9326/aa5730.

- Seekell, D., D'Odorico, P. and MacDonald, G.K. (2018). Focus on food, trade and the environment, *Environmental Research Letters*, Vol. 13, pp.100201, https://doi.org/10.1088/1748-9326/aae065 [accessed 15th April 2019].
- Selin, H. (2019). Can the Paris Agreement on climate change succeed without the US? 4 questions answered, *The Conversation*, 12th November, https://theconversation.com/can-the-paris-agreement-on-climate-change-succeed-without-the-us-4-questions-answered-126477 [accessed 15th April 2019].
- SEL-JPU (2019). *South East Lincolnshire Local Plan 2011-2036*, March, Boston, UK: South East Lincolnshire Joint Policy Unit, http://www.southeastlincslocalplan.org/wp-content/uploads/2019/02/Local-Plan-text-March-2019.pdf [accessed 11th April 2019].
- Sellers, P.J., Schimel, D.S., Moore, B., Liu, J. and Eldering, A. (2018). Observing carbon cycle–climate feedbacks from space, *Proceedings of the National Academy of Sciences*, 201716613, doi: 10.1073/pnas.1716613115.
- Selvaraj, S., Ganeshamoorthi, P. and Pandiaraj, T. (2013). Potential impacts of recent climate change on biological control agents in agro-ecosystem: a review, *International Journal of Biodiversity and Conservation*, Vol. 5, pp.845-852, doi: 10.5897/IJBC2013.0551.
- Selvaraju, R., Gommes, R. and Bernardi, M. (2011). Climate science in support of sustainable agriculture and food security, *Climate Research*, Vol. 47, No. 1/2, pp. 95-110, doi: https://doi.org/10.3354/cr00954.
- Selwyn, B. (2019). The agro-food complex and climate change: veganism or a green new deal? *Socialist Project*, 5th April, https://socialistproject.ca/2019/04/agrofood-complex-climate-change-veganism-or-green-new-deal/ [accessed 15th April 2019].
- Senge, P. (2010). The sustainable supply chain, *Harvard Business Review*, October, pp.70-72.
- Serrano, R. and Pinilla, V. (2010). Causes of world trade growth in agricultural and food products, 1951-2000, *Applied Economics*, Vol. 42, pp.3503-3518, doi: 10.1080/00036840802167368.
- Settele, J., Díaz, S., Brondizio, E. and Daszak, P. (2020). COVID-19 stimulus measures must save lives, protect livelihoods, and safeguard nature to reduce the risk of future pandemics, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Guest Article, 27th April, https://ipbes.net/covid19stimulus [accessed 15th April 2020].
- Seufert, V. and Ramankutty, N. (2017). Many shades of gray - the context-dependent performance of organic agriculture, *Science Advances*, Vol. 3, No. 3, e1602638, doi: 10.1126/sciadv.1602638.
- Seufert, V., Ramankutty, N. and Foley, J.A. (2012). Comparing the yields of organic and conventional agriculture, *Nature*, Vol. 485, 10th May, pp.229-233, https://doi.org/10.1038/nature11069 [accessed 15th April 2019].
- Sévellec, F. (2018). Climate models predict the world will be 'anomalously warm' until 2022, *The Conversation*, 14th August, https://theconversation.com/climate-models-predict-the-world-will-be-anomalously-warm-until-2022-101542 [accessed 15th April 2019].

- Severson, K. (2019). Can meat actually save the planet, *Huffington Post*, 18th July, https://www.huffingtonpost.co.uk/entry/meat-save-planet-regenerative-farming [accessed 15th April 2019].
- Seves, S.M., Seves, S.M., Temme, E.H.M., Temme, E.H.M., Brosens, M.C.C., Brosens, M.C.C., Zijp, M.C., Zijp, M.C., Hoekstra, J., Hoekstra, J., Hollander, A. and Hollander, A. (2016). Sustainability aspects and nutritional composition of fish: evaluation of wild and cultivated fish species consumed in the Netherlands, *Climatic Change*, Vol. 135, No. 3, pp.597-610, doi: 10.1007/s10584-015-1581-1 [accessed 11th April 2020].
- Sexton, A.E., Garnett, T. and Lorimer, J. (2019). Framing the future of food: the contested promises of alternative proteins, *Environment and Planning E: Nature and Space*, Vol. 2, Iss. 1, https://doi.org/10.1177/2514848619827009.
- Seyfang, G. (2006). Ecological citizenship and sustainable consumption Examining local organic food networks, *Journal of Rural Studies*, Vol. 22, pp.383-395, doi:10.1016/j.jrurstud.2006.01.003.
- Seyfang, G. (2006). Sustainable consumption, the new economics and community currencies – developing new institutions for environmental governance, *Regional Studies*, Vol. 40, No. 7, pp.781-791, doi: 10.1080/00343400600959173.
- Seyfang, G. (2007). Growing sustainable consumption communities - the case of local organic food networks, *International Journal of Sociology and Social Policy*, Vol. 27, No. 3/4, pp.120-134, doi: 10.1108/01443330710741066.
- Seyfang, G. (2008). *Local organic food - the social implications of sustainable consumption*, CSERGE Working Paper EDM 04-09, Norwich: University of East Anglia, Centre for Social and Economic Research on the Global Environment (CSERGE).
- SFC (2016). *Enhancing the impact of sustainable urban food strategies*, Bristol, UK: Sustainable Food Cities Network.
- ShabbirHusain, R.V. and Varshney, S. (2019). Is current way of promoting sustainability, sustainable? *Journal of Nonprofit & Public Sector Marketing*, Vol. 31, No. 1, pp.84-113, https://doi.org/10.1080/10495142.2018.1526735 [accessed 15th April 2019].
- Shah, H., Huxley, P., Elmes, J. and Murray, K. (2018). Agricultural land use and infectious disease risks in southeast Asia: a systematic review and meta analyses, *The Lancet Planetary Health*, Vol. 2, S20, doi: https://doi.org/10.1016/S2542-5196(18)30105-0.
- Shah, R., Hagell, A. and Cheung, R. (2019). *International comparisons of health and wellbeing in adolescence and early adulthood*, Nuffield Trust, https://www.nuffieldtrust.org.uk/research/international-comparisons-of-health-and-wellbeing-in-adolescence-and-early-adulthood [accessed 15th April 2019].
- Sharif, A. and Irani, Z. (2017). Food security in the UK: a post-brexit view, *European Financial Review*, 5th March, http://www.europeanfinancialreview.com/?p=14084 [accessed 15th April 2019].

- Sharma, H.C. (2010). Global warming and climate change: impact on arthropod biodiversity, pest management, and food security. In: *National Symposium on Perspectives and Challenges of Integrated Pest Management for Sustainable Agriculture*, 19th-21st November, Solan, http://oar.icrisat.org/2030/ [accessed 15th April 2019].
- Sharma, H.C. (2012). Biological consequences of climate change: Implications for arthropod diversity, pest management and food security, *Journal of Ecosystem and Ecography*, Vol. 2, No. 4, http://dx.doi.org/10.4172/2157-7625.S1.002 [accessed 15th April 2019].
- Sharma, R. and Ghoshal, G. (2018). Emerging trends in food packaging, *Nutrition & Food Science,* Vol. 48, Iss. 5, pp.764-779, https://doi.org/10.1108/NFS-02-2018-0051 [accessed 15th April 2019].
- Sharma, R., Kamble, S.S., Gunasekaran, A., Kumar, V. and Kumar, A. (2020). A systematic literature review on machine learning applications for sustainable agriculture supply chain performance, *Computers and Operations Research*, Vol. 119, No. 104926, doi: 10.1016/j.cor.2020.104926.
- Sharpe, L. (2016). *Time to count the hungry the case for a standard measure of household food insecurity in the UK*, UK Food Poverty Alliance.
- Shatrugna, V. (2012). The right to food security, *BMJ*, Vol. 345, pp.e8273, doi: 10.1136/bmj.e8273.
- Shea, B.J., Grimshaw, J.M., Wells, G.A., Boers, M., Andersson, N., Hamel, C., Porter, A.C., Tugwell, P., Moher, D. and Bouter, L.M. (2007). Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews, *BMC Medical Research Methodology*, Vol. 7, pp.10-16, https://doi.org/10.1186/1471-2288-7-10 [accessed 15th April 2020].
- Shea, B.J., Reeves, B.C., Wells, G., Thuku, M., Hamel, C., Moran, J., Moher, D., Tugwell, P., Welch, V., Kristjansson, E. and Henry, D.A. (2017). AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both, *British Medical Journal*, Vol. 358, j4008, http://dx.doi.org/10.1136/bmj.j4008 [accessed 15th April 2020].
- Sheane, R., McCosker, C. and Lillywhite, R. (2017). *Food waste in primary production - a preliminary study on strawberries and lettuces*, Waste & Resources Action Programme: 3Keel LLP and University of Warwick.
- Shellenberger, M. (2019). Why apocalyptic claims about climate change are wrong, *Forbes*, 25th November, https://www.forbes.com/sites/michaelshellenberger/2019/11/25/why-everything-they-say-about-climate-change-is-wrong/ [accessed 11th April 2019].
- Shepherd, A., Ivins, E. and Rignot, E. (2019). Mass balance of the Greenland Ice Sheet from 1992 to 2018, *Nature*, https://doi.org/10.1038/s41586-019-1855-2 [accessed 15th April 2019].
- Shepherd, R. (2005). Influences on food choice and dietary behaviour, *Forum Nutrition*, Vol. 57, pp.36-43.
- Shepon, A., Eshel, G., Noor, E. and Milo, R. (2016). Energy and protein feed-to-food conversion efficiencies in the US and potential food security gains from dietary changes, *Environmental Research Letters*, Vol. 11, doi: 10.1088/1748-9326/11/10/105002.

- Shepon, A., Eshel, G., Noor, E. and Milo, R. (2018). The opportunity costs of animal based diets exceeds all food losses, *Proceedings of the National Academy of Sciences*, Vol. 115, pp.3804-3809, doi: 10.1073/pnas.1713820115.
- Shepon, A., Henriksson, P., Gustav, J. and Wu, T. (2018). Conceptualizing a sustainable food system in an automated world: toward a “eudaimonian” future, *Frontiers in Nutrition*, Vol. 5, https://doi.org/10.3389/fnut.2018.00104 [accessed 15th April 2019].
- Sherriff, G. (2009). Towards healthy local food - issues in achieving Just Sustainability, *Local Environment: The International Journal of Justice and Sustainability*, Vol. 14, No. 1, pp.73-92, doi: 10.1080/13549830802522566.
- Sheth, J., Sethia, N. and Srinivas, S. (2011). Mindful consumption - a customer-centric approach to sustainability, *Journal of the Academy of Marketing Science*, Vol. 39, No. 1, pp.21-39, doi:10.1007/s11747-010-0216-3.
- Shi, J., Visschers, V.H.M., Bumann, N. and Siegrist, M. (2018). Consumers' climate-impact estimations of different food products, *Journal of Cleaner Production*, Vol. 172, pp.1646-1653, https://doi.org/10.1016/j.jclepro.2016.11.140 [accessed 15th April 2019].
- Shiferaw, B., Prasanna, B.M., Hellin, J. and Bänziger, M. (2012). Crops that feed the world 6 – past successes and future challenges to the role played by maize in global food security, *Food Security*, Vol. 3, pp.307-327, doi: 10.1007/s12571-011-0140-5.
- Shiferaw, B., Smale, M., Braun, H-J., Duveiller, E., Reynolds, M. and Muricho, G. (2013). Crops that feed the world 10 - past successes and future challenges to the role played by wheat in global food security, *Food Security*, Vol. 5, pp.291-317, doi: 10.1007/s12571-013-0263-y.
- Shilomboleni, H. (2015). Sustainable food systems and global environmental change—Synthesis paper, *Canadian Food Studies, Special Issue - Mapping the Global Food Landscape*, Vol. 2, No. 2, pp.321-325, doi: 10.15353/cfs-rcea.v2i2.110.
- Shindell, D., Kuylenstierna, J.C.I., Vignati, E., van Dingenen, R., Amann, M., Klimont, Z., Anenberg, S.C., Muller, N., Janssens-Maenhout, G., Raes, F., Schwartz, J., Faluvegi, G., Pozzoli, L., Kupiainen, K., Höglund-Isaksson, L., Emberson, L., Streets, D., Ramanathan, V., Hicks, K., Oanh, N.T.K., Milly, G., Williams, M., Demkine, V. and Fowler, D. (2012). Simultaneously mitigating near-term climate change and improving human health and food security, *Science*, Vol. 335, No. 6065, pp.183-189, doi: 10.1126/science.1210026.
- Shindell, D.T. (2015). The social cost of atmospheric release, *Climatic Change*, Vol. 130, pp.313-326, doi: 10.1007/s10584-015-1343-0.
- Shine, K. (2018). IPCC 1.5°C report – here’s what the climate science says, *The Conversation*, 8th October, https://theconversation.com/ipcc-1-5-report-heres-what-the-climate-science-says-104592 [accessed 15th April 2019].
- Shiva, V. (2019a). A new report sustains unsustainable food systems, *Seed Freedom*, 20th January, https://seedfreedom.info/poison-cartel-toxic-food-eat-report/ [accessed 15th April 2019].

- Shiva, V. (2019b). Fake food, fake meat - big food's desperate attempt to further the industrialisation of food, *Independent Science News*, 18th June, https://www.independentsciencenews.org/health/fake-food-fake-meat-big-foods-desperate-attempt-to-further-industrialisation-food/ [accessed 15th April 2019].
- Shiva, V. (2019c). The industrialisation of fake food, *The Ecologist*, 18th June, https://theecologist.org/2019/jun/18/industrialisation-fake-food [accessed 15th July 2019].
- Shokri, A., Oglethorpe, D. and Nabhani, F. (2014). Evaluating sustainability in the UK fast food supply chain, *Journal of Manufacturing Technology Management*, Vol. 25, Iss. 8, pp.1224-1244, http://dx.doi.org/10.1108/JMTM-04-2013-0031 [accessed 15th April 2019].
- Shrimpton, R. (2017). Fixing our food system - an imperative for achieving sustainable development, *World Nutrition*, Vol. 8, No. 2, pp.207-231, doi: https://doi.org/10.26596/wn.201782207-231 [accessed 15th April 2019].
- Shultz, J.M., Kossin, J.P., Ettman, C., Kinney, P.L. and Galea, S. (2018). The 2017 perfect storm season, climate change, and environmental injustice, *The Lancet*, Vol. 2, September, pp.e270-e271, doi:https://doi.org/10.1016/S2542-5196(18)30168-2.
- SIANI (2014). *Food security in the Sustainable Development Goals - where is the process heading?* Discussion brief 28/06, Stockholm: Swedish International Agricultural Network Initiative, http://www.siani.se/resources/report/food-security-SDG [accessed 15th April 2019].
- Siegel, K.R., Ali, M.A., Srinivasiah, A., Nugent, R.A. and Venkat Narayan, K.M. (2014). Do we produce enough fruits and vegetables to meet global health need? *PLoS One*, Vol. 9, https://doi.org/10.1371/journal.pone.0104059 [accessed 15th April 2019].Siegner, A., Sowerwine, J. and Acey, C. (2018). Does urban agriculture improve food security? Examining the nexus of food access and distribution of urban produced foods in the United States: a systematic review, *Sustainability*, Vol. 10, No. 9, 2988, doi: 10.3390/su10092988.
- Siegrist, M., Vivianne, H.M. and Visschers, C.H. (2015). Factors influencing changes in sustainability perception of various food behaviours - results of a longitudinal study, *Food Quality and Preference*, Vol. 46, pp.33-39, https://doi.org/10.1016/j.foodqual.2015.07.006 [accessed 15th April 2019].
- Sifferlin, A. (2017). Climate change is already making people sicker, *Time*, 20th September, http://time.com/4949720/climate-change-united-nations/ [accessed 15th April 2019].
- Sigma (2016). *Putting sustainable development into practice - a guide for organisations*, www.projectsigma.com [accessed 15th April 2019].
- Silalertruksa, T., Gheewala, S.H., Pongpat, P., Kaenchan, P., Permpool, N., Lecksiwilai, N. and Mungkung, R. (2017). Environmental sustainability of oil palm cultivation in different regions of Thailand: Greenhouse gases and water use impact, *Journal of Cleaner Production*, Vol. 167, pp.1009-1019, https://doi.org/10.1016/j.jclepro.2016.11.069 [accessed 11th April 2020].

- Silchenko, K., Askegaard, S. and Cedrola, E. (2019). Three decades of research in health and food marketing: a systematic review, *Journal of Consumer Affairs*, doi:10.1111/joca.12289.
- Sildén, K.E. (2018). Impact of competitive foods in public schools on child nutrition: effects on adolescent obesity in the United States an integrative systematic literature review, *Global Health Action*, Vol. 11, No. 1, 1477492, doi: 10.1080/16549716.2018.1477492.
- Sills, J. (2019). Make EU trade with Brazil sustainable, *Science*, 26th April, Vol. 364, Iss. 6438, pp.341-342, doi: 10.1126/science.aaw8276 [accessed 15th April 2019].
- Silva, J.G. (2019). Transforming food systems for better health, *The Lancet*, 27th January, https://doi.org/10.1016/S0140-6736(18)33249-5 [accessed 15th April 2019].
- Silvestre, B.S. and Tirca, D.M. (2019). Innovations for sustainable development: moving toward a sustainable future, *Journal of Cleaner Production*, Vol. 208, pp.325-332, https://doi.org/10.1016/j.jclepro.2018.09.244 [accessed 15th April 2019].
- Simelton, E., Fraser, E.D.G., Termansen, M., Benton, T.G., Gosling, S.N., South, A., Arnell, N.W., Challinor, A.J., Dougill, A.J. and Forster, P.M. (2012). The socioeconomics of food crop production and climate change vulnerability: a global scale quantitative analysis of how grain crops are sensitive to drought, *Food Security*, Vol. 4, pp.163-179, https://doi.org/10.1007/s12571-012-0173-4 [accessed 15th April 2019].
- Simić, V.M., Simić, S.B., Piperac, M.S., Petrović, A. and Milošević, D. (2014). Commercial fish species of inland waters - a model for sustainability assessment and management, *Science of The Total Environment*, Vol. 497-498, pp.642-650, doi: 10.1016/j.scitotenv.2014.07.092.
- Simkin, A.J., Lopez-Calcagno, P.E. and Raines, C.A. (2019). Feeding the world: improving photosynthetic efficiency for sustainable crop production, *Journal of Experimental Botany*, Vol. 70; No. 4, pp.1119-1140, https://doi.org/10.1093/jxb/ery445 [accessed 15th April 2019].
- Sims, R. (2009). Food, place and authenticity - local food and the sustainable tourism experience, *Journal of Sustainable Tourism*, Vol. 17, No. 3, pp.321-336, doi:10.1080/09669580802359293.
- Sinclair Taylor, J. (2019). *Fishy business: the Scottish salmon industry's hidden appetite for wild fish and land*, London, UK: Feedback.
- Sinclair, T.R. and Rufty, T.W. (2012). Nitrogen and water resources commonly limit crop yield increases, not necessarily plant genetics, *Global Food Security*, Vol. 1, pp.94-98, https://doi.org/10.1016/j.gfs.2012.07.001 [accessed 15th April 2019].
- Singh, A. and Abhilash, P.C. (2018). Agricultural biodiversity for sustainable food production, *Journal of Cleaner Production*, Vol. 172, pp.1368-1369, https://doi.org/10.1016/j.jclepro.2017.10.279 [accessed 15th April 2019].
- Sinha, E., Michalak, A.M. and Balaji, V. (2017). Eutrophication will increase during the 21st century as a result of precipitation changes, *Science*, Vol. 357, No. 6349, p.405, doi: 10.1126/science.aan2409.

- Sinha, E., Michalak, A.M., Calvin, K.V. and Lawrence, P.J. (2019). Societal decisions about climate mitigation will have dramatic impacts on eutrophication in the 21st century, *Nature Communications*, Vol. 10, No. 1, pp.1-11, doi: 10.1038/s41467-019-08884-w.
- Sirieix, L., Delanchy, M., Remaud, H., Zepeda, L. and Gurviez, P. (2013). Consumers' perceptions of individual and combined sustainable food labels - a UK pilot investigation, *International Journal of Consumer Studies*, Vol. 37, pp.143-151, https://doi.org/10.1111/j.1470-6431.2012.01109.x [accessed 15th April 2019].
- Sisnowski, J., Street, J.M. and Merlin, T. (2017). Improving food environments and tackling obesity: a realist systematic review of the policy success of regulatory interventions targeting population nutrition, *PLoS One*, Vol. 12, No. 8, e0182581, doi: 10.1371/journal.pone.0182581.
- Siviter, H., Brown, M.J.F. and Leadbeater, E. (2018). Sulfoxaflor exposure reduces bumblebee reproductive success, *Nature*, Vol. 561, p.109-112, https://doi.org/10.1038/s41586-018-0430-6.
- SIWI (2005). *Let it reign: the new water paradigm in global food security*, Stockholm International Water Institute, Swedish International Development Cooperation Agency.
- SMC (2018). *Briefing notes on climate science and climate change*, London, UK: Science Media Centre.
- Smed, S. and Robertson, A. (2012). Are taxes on fatty foods having their desired effects on health? *British Medical Journal*, Vol. 345, pp.e6885, doi: https://doi.org/10.1136/bmj.e6885.
- Smedley, T. (2015). If the palm oil industry waited for consumers to care, *The Guardian*, 26th October, http://www.theguardian.com/sustainable-business/2015/oct/26/palm-oil-industry-consumer-understanding-sustainability-cspo-packaging-marks-spencer-boots-ecover [accessed 15th April 2019].
- Smetana, S.M., Bornkessel, S. and Heinz, V. (2019). A path from sustainable nutrition to nutritional sustainability of complex food systems, *Frontiers in Nutrition*, Vol. 6, No. 39, doi: 10.3389/fnut.2019.00039.
- Smil, V. (2000). *Feeding the world: a challenge for the twenty-first century*, Cambridge, USA: MIT Press.
- Smith P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsiddig, E.A., Haberl, H., Harper, R., House, J., Jafari, M., Masera, O., Mbow, C., Ravindranath, N.H., Rice, C.W., Robledo Abad, C., Romanovskaya, A., Sperling, F. and Tubiello, F. (2014). Agriculture, forestry and other land use (AFOLU). In: *Climate change 2014: mitigation of climate change*, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Smith, A. (1776). *An inquiry into the nature and causes of the wealth of nations*, London, UK: W. Strahan and T. Cadell.
- Smith, E.R. (2018). Global nutrient availability - a call for accountability and action, *The Lancet Planetary Health*, Vol. 2, September, pp.e380-e381, doi:https://doi.org/10.1016/S2542-5196(18)30201-8.

- Smith, G. (2017). Nearly half of Canada's fish mislabelled, report suggests, *New Food*, 6th December, https://www.newfoodmagazine.com/news/46752/nearly-half-canadas-fish-mislabelled-report-finds/ [accessed 15th April 2019].
- Smith, G. (2018). Processed meats the source of world's deadliest listeria outbreak, *New Food*, 12th March, https://www.newfoodmagazine.com/news/65300/processed-meats-listeria-outbreak/ [accessed 15th April 2019].
- Smith, J., Lang, T., Vorley, B. and Barling, D. (2015). *GLAMUR WP6 - Policy Recommendations and Policy Implementation Road Map* (Deliverable 6.2), City University London, IIED and University of Hertfordshire UK.
- Smith, J., Lang, T., Vorley, B. and Barling, D. (2016). Addressing policy challenges for more sustainable local–global food chains: policy frameworks and possible food "futures", *Sustainability*, Vol. 8, No. 4, p.299-316, doi: 10.3390/su8040299.
- Smith, J., Tarawali, S., Grace, D. and Sones, K. (2013). Feeding the World in 2050: trade-offs, synergies and tough choices for the livestock sector, *Tropical Grasslands-Forrajes Tropicales*, Vol. 1, No. 2, pp.125-130.
- Smith, L. (2015). Cod stocks may be sustainable again in as little as five years, report finds, *The Guardian*, 9th April [accessed 15th April 2019].
- Smith, L.G., Kirk, G.J.D., Jones, P.J. and Williams, A.G. (2019). The greenhouse gas impacts of converting food production in England and Wales to organic methods, *Nature Communications*, Vol. 10, No. 4641, https://doi.org/10.1038/s41467-019-12622-7 [accessed 15th April 2019].
- Smith, M.D., Rabbitt, M.P. and Coleman- Jensen, A. (2017). Who are the World's food insecure? New evidence from the food and agriculture organization's food insecurity experience scale, *World Development*, Vol. 93, pp.402-412, https://doi.org/10.1016/j.worlddev.2017.01.006 [accessed 15th April 2019].
- Smith, M.R. and Myers, S.S. (2018). Impact of anthropogenic CO^2 emissions on global human nutrition, *Nature Climate Change*, Vol. 8, pp.834-839, doi: 10.1038/s41558-018-0253-3.
- Smith, M.R., Singh, G.M., Mozaffarian, D. and Myers, S.S. (2015). Effects of decreases of animal pollinators on human nutrition and global health: a modelling analysis, *The Lancet*, Vol. 386, pp.1964-1972, doi:https://doi.org/10.1016/S0140-6736(15)61085-6.
- Smith, M.S., Cook, C., Sokona, Y., Elmqvist, T. Fukushi, K., Broadgate, W. and Jarzebski, M.P. (2018). Advancing sustainability science for the SDGs, *Sustainability Science*, Vol. 13, No. 6, pp.1483-1487, https://doi.org/10.1007/s11625-018-0645-3 [accessed 15th April 2019].
- Smith, P. (2011). The geopolitics of climate change: power transitions, conflict and the future of military activities, *Conflict, Security & Development*, Vol. 11, pp.309-334, https://doi.org/10.1080/14678802.2011.593810 [accessed 15th April 2019].

- Smith, P. (2013). Delivering food security without increasing pressure on land, *Global Food Security*, Vol. 2, Iss. 1, pp.18-23, https://doi.org/10.1016/j.gfs.2012.11.008 [accessed 15th April 2019].
- Smith, P. and Gregory, P.J. (2013). Climate change and sustainable food production, Conference on 'Future food and health' Symposium I: Sustainability and food security, *Proceedings of the Nutrition Society*, Vol. 72, pp.21-28, doi:10.1017/S0029665112002832.
- Smith, P., Gregory, P.J., van Vuuren, D., Obersteiner, M., Havlík, P., Rounsevell, M., Woods, J., Stehfest, E. and Bellarby, J. (2010). Competition for land, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2941–2957, doi: 10.1098/rstb.2010.0127.
- Smith, P., Haberl, H., Popp, A., Erb, K.H., Lauk, C., Harper, R., Tubiello, F.N., De Siqueira Pinto, A., Jafari, M., Sohi, S., Masera, O., Böttcher, S.H., Berndes, G., Bustamante, M., Ahammad, M., Clark, H., Dong, H., Elsiddig, E.A., Mbow, C., Ravindranath, N.H., Rice, C.W., Abad, C.R., Romanovskaya, A., Sperling, F., Herrero, M., House, J.I. and Rose, S. (2013). How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals, *Global Change Biology*, Vol. 19, pp.2285-2302, doi: 10.1111/gcb.12160.
- Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, B., Sirotenko, O., Howden, M., McAllister, T., Pan, G., Romanenkov, V., Uwe Schneider, U., Towprayoon, S., Wattenbach, M. and Smith, J. (2007a). Greenhouse gas mitigation in agriculture, *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 363, No. 1492, pp.789-813, https://doi.org/10.1098/rstb.2007.2184 [accessed 15th April 2019].
- Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, B. and Sirotenko, O. (2007b). Agriculture. In Climate Change 2007: Mitigation. Contribution of Working Group III to the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, B., Sirotenko, O., Howden, M., McAllister, T., Pan, G., Romanenkov, V., UweSchneider, U. and Towprayoon, S. (2007c). Policy and technological constraints to implementation of greenhouse gas mitigation options in agriculture, *Agriculture, Ecosystems & Environment*, Vol. 118, pp.6-28, doi:10.1016/j.agee.2006.06.006.
- Smith, P., Price, J., Molotoks, A., Warren, R. and Malhi, Y. (2018). Impacts on terrestrial biodiversity of moving from a 2C to a 1.5C target, *Philosophical Transactions Royal Society*, Vol. 376, No. 2119, doi:10.1098/rsta.2016.0456.
- Smith, R., Kelly, B., Yeatman, H. and Boyland, E. (2019). Food marketing influences children's attitudes, preferences and consumption: a systematic critical review, *Nutrients*, Vol. 11, No. 4, 875, doi: 10.3390/nu11040875.

- Smith, T. (2011). Two sides of the coin – shareholders engaging companies on sustainability: issues / companies promoting CSR leadership as good business, *The Journal of Investing*, Fall, pp.103-107, doi: https://doi.org/10.3905/joi.2011.20.3.103.
- Smith, T.D. (2013). A review of all the fish in the sea - maximum sustainable yield and the failure of fisheries management, *Transactions of the American Fisheries Society*, Vol. 142, No. 3, pp.885-886, doi: 10.1080/00028487.2013.791520.
- Smith, V., Devane, D., Begley, C. and Clarke, M. (2011). Methodology in conducting a systematic review of systematic reviews of healthcare interventions, *BMC Medical Research Methodology*, Vol. 11, pp.15-20, doi: https://doi.org/10.1186/1471-2288-11-15 [accessed 15th April 2020].
- Smithers, R. (2015). Customer demand for sustainable fish has soared, identified by the MSC certified blue label, *The Guardian*, 30th January. http://www.theguardian.com/environment/2015/jan/30/uk-supermarkets-failing-stock-enough-sustainable-fish-report [accessed 15th April 2019].
- Smithers, R. (2017). Tesco faces legal threat over marketing its food with 'fake farm' names. Charity accuses UK supermarkets of misleading customers with fake farm branding and claims Tesco is damaging the reputation of a real farm with the same name, *The Guardian*, 13th December, https://www.theguardian.com/environment/2017/dec/13/tesco-faces-legal-threat-over-marketing-its-food-with-fake-farm-names [accessed 15th April 2019].
- Smith-Taillie, L., Ng, S.W., Xue, Y., Busey, E. and Harding, M. (2017). No fat, no sugar, no salt . . . no problem? Prevalence of “low-content” nutrient claims and their associations with the nutritional profile of food and beverage purchases in the United States, *Journal of the Academy of Nutrition and Dietetics*, doi: 10.1016/j.jand.2017.01.011.
- Smyth, C. (2018). Ready meals and cereals linked with rise in cancer. Warning over too much factory-made food, *The Times*, 1st February, https://www.thetimes.co.uk/edition/news/ready-meals-and-cereals-linked-with-rise-in-cancer-bmsrmx6fc [accessed 15th April 2019].
- Smythe, D. (2018). We feed the world: as small-farm holdings produce most of the world's food, a collaborative project of 47 photographers highlights their contribution to the global ecosystem, from the Scottish isles to the Colombian Amazon and beyond, *British Journal of Photography*, Vol. 7879, pp.40-45, https://www.bjp-online.com/2018/10/we-feed-the-world/ [accessed 15th April 2019].
- Snapp, S.S., Grabowski, P., Chikowo, R., Smith, A., Anders, E. and Sirrine, D. (2018). Maize yield and profitability tradeoffs with social, human and environmental performance: is sustainable intensification feasible? *Agricultural Systems*, Vol. 162, pp.77-88, https://doi.org/10.1016/j.agsy.2018.01.012 [accessed 15th April 2019].
- Snowden, C. (2017). *Cheap as chips - is a healthy diet affordable?* The Institute of Economic Affairs, Discussion Paper No.82, https://iea.org.uk/wp-content/uploads/2017/03/Cheap-as-Chips-PDF.pdf [accessed 15th April 2019].

- Snowdon, C. (2019). Tax, ban, regulate - the radical ‘planetary health diet’ explained, *Spectator Health*, 17th January, https://health.spectator.co.uk/tax-ban-regulate-the-radical-planetary-health-diet-explained/ [accessed 15th April 2019].
- Snuggs, S., Houston-Price, C. and Harvey, K. (2019). Healthy eating interventions delivered in the family home: a systematic review, *Appetite*, Vol. 140, pp.114-133,
- Sodano, V. (2019). Innovation trajectories and sustainability in the food system, *Sustainability*, Vol. 11, 1271, doi:10.3390/su11051271.
- Sodano, V. and Hingley, M. (2013). The food system, climate change and CSR, *British Food Journal*, Vol. 115, Iss. 1, pp.75-91, http://dx.doi.org/10.1108/00070701311289885 [accessed 15th April 2019].
- Soder, K. and Muller, L. (2016). *Average nutrient composition of typical high quality pastures (dry matter basis)*, Pennsylvania State University, 9th May, https://extension.psu.edu/average-nutrient-composition-of-typical-high-quality-pastures-dry-matter-basis [accessed 15th April 2019].
- Sodhi, K. (2011). Has marketing come full circle - demarketing for sustainability, *Business Strategy Series*, Vol. 12, No. 4, pp.177-185, http://dx.doi.org/10.1108/17515631111155133 [accessed 15th April 2019].
- Soil Association (2015). *Runaway maize subsidised soil destruction*, June, Bristol, UK: Soil Association, https://www.soilassociation.org/media/4671/runaway-maize-june-2015.pdf [accessed 15th April 2019].
- Soil Association (2018). *State of the nation children’s food in England*, Bristol, UK: Soil Association, https://www.soilassociation.org/media/17422/state-of-the-nation-soil-association-report.pdf [accessed 15th April 2019].
- Soil Association (2019a). *EAT-Lancet Commission shows that diverse, agro-ecological farming and ‘livestock on leftovers’ CAN feed the world*, Bristol, UK: Soil Association, https://www.soilassociation.org/press-centre/press-releases/diverse-agro-ecological-farming-and-livestock-on-leftovers-can-feed-the-world/ [accessed 15th April 2019].
- Soil Association (2019b). *Green Brexit*, Bristol, UK: Soil Association, https://www.soilassociation.org/green-brexit/ [accessed 15th April 2019].
- Solazzo, A., Jones, A.W. and Cooper, N. (2015). Revising payment for ecosystem services in the light of stewardship: the need for a legal framework, *Sustainability*, Vol. 7, No. 11, 15449, https://doi.org/10.3390/su71115449 [accessed 15th April 2019].
- Solomon, S., Plattner, G., Knutti, R. and Friedlingstein, P. (2009). Irreversible climate change due to carbon dioxide emissions, *Proceedings of the National Academy of Sciences*, Vol. 106, No. 6, pp.1704-1709, https://doi.org/10.1073/pnas.0812721106 [accessed 15th April 2019].

- Sonesson, U.G., Lorentzon, K., Andersson, A., BarrJan, U-K., Bertilsson, J., Borch, E., Brunius, C., Emanuelsson, M., Göransson, L., Gunnarsson, S., Hamberg, L., Hessle, A., Kumm, K-I., Lundh, A., Nielsen, T., Östergren, K., Salomon, E., Sindhöj, E., Stenberg, B., Stenberg, M. Sundberg, M. and Wall, H. (2016). Paths to a sustainable food sector: integrated design and LCA of future food supply chains: the case of pork production in Sweden, *International Journal of Life Cycle Assessment*, Vol. 21, No. 5, pp.664-676, doi: 10.1007/s11367-015-0969-5.
- Song, H. (2017). *The water, land, and carbon footprints of different human diets in China*, Enschede, The Netherlands: University of Twente.
- Sonnino, R., Faus, A.M. and Maggio, A. (2014). Sustainable food security - an emerging research and policy agenda, *International Journal of Sociology of Agriculture and Food*, Vol. 21, No. 1, pp.173-188.
- Sonnino, R., Tegoni, C.L.S. and De Cunto, A. (2019). The challenge of systemic food change: insights from cities, *Cities*, Vol. 85, pp.110-116, https://doi.org/10.1016/j.cities.2018.08.008 [accessed 15th April 2019].
- Sonntag, D., Schneider, S., Mdege, N., Ali, S. and Schmidt, B. (2015). Beyond food promotion: a systematic review on the influence of the food industry on obesity-related dietary behaviour among children, *Nutrient*s, Vol. 7, No. 10, pp.8565-8576, doi: 10.3390/nu7105414.
- Soroye, P., Newbold, T. and Kerr, J. (2020). Climate change contributes to widespread declines among bumble bees across continents, *Science*, 7th February, Vol. 367, Iss. 6478, pp.685-688, doi: 10.1126/science.aax8591.
- Sotiris, V. and Patrick, P. (2019). Grand challenges in sustainable cities and health, *Frontiers in Sustainable Cities*, Vol. 1, No. 7, doi: 10.3389/frsc.2019.00007.
- Soussana, J-F. (2014). Research priorities for sustainable agri-food systems and life cycle assessment, *Journal of Cleaner Production*, Vol. 73, pp.19-23, http://dx.doi.org/10.1016/j.jclepro.2014.02.061 [accessed 15th April 2019].
- Soussana, J-F. (2015). Food and nutritional security in the context of climate change eco-efficiency or agroecology, *Global Food Security Challenges: the International Conference of the Agricultural Economists*, 7-8th August, Milan, Italy.
- South, P. (2018). Helping plants remove natural toxins could boost crop yields by 47 percent, *The Conversation*, 25th June, https://theconversation.com/helping-plants-remove-natural-toxins-could-boost-crop-yields-by-47-percent-97505 [accessed 15th April 2019].
- South, P.F., Cavanagh, A.P., Liu, H.W. and Ort, D.R. (2019). Synthetic glycolate metabolism pathways stimulate crop growth and productivity in the field, *Science*, 4th January, Vol. 363, Iss. 6422, eaat9077, doi: 10.1126/science.aat9077.
- Souza-Monteiro, D. and Hooker, N. (2017). Comparing UK food retailers corporate social responsibility strategies, *British Food Journal*, Vol. 119, Iss. 3, pp.658-675, https://doi.org/10.1108/BFJ-04-2016-0152 [accessed 15th April 2019].

- Sovacool, B.K. (2009). A game of cat and fish: how to restore the balance in sustainable fisheries management, *Ocean Development & International Law*, Jan-Mar, Vol. 40, No. 1, pp.97-125, https://doi.org/10.1080/00908320802631486 [accessed 15th April 2019].
- Spaargaren (2003). Sustainable consumption - a theoretical and environmental policy perspective, *Society & Natural Resources: An International Journal*, Vol. 16, No. 8, pp.687-701, doi: 10.1080/08941920309192.
- Spedding, A. (2007). *Food security and the UK*, RuSource Briefing 445, http://www.arthurrankcentre.org.uk/ [accessed 15th April 2019].
- Speers, A.E., Besedin, E.Y., Palardy, J.E. and Moore, C. (2016). Impacts of climate change and ocean acidification on coral reef fisheries: an integrated ecological-economic model, *Ecological Economics*, Vol. 128, pp.33-43, https://doi.org/10.1016/j.ecolecon.2016.04.012 [accessed 15th April 2019].
- Springer, N. and Duchin, F. (2014). Feeding nine billion people sustainably - conserving land and water through shifting diets and changes in technologies, *Environmental Science & Technology*, Vol. 48, No. 8, pp.4444-4451, https://doi.org/10.1021/es4051988 [accessed 15th April 2019].
- Springmann, M. (2018). Brexit diet could lead to 5,600 deaths a year as fresh fruit and veg prices shoot up, *The Conversation*, 24th October, https://theconversation.com/brexit-diet-could-lead-to-5-600-deaths-a-year-as-fresh-fruit-and-veg-prices-shoot-up-105450 [accessed 15th April 2019].
- Springmann, M. (2019). Can diets be both healthy and sustainable? Solving the dilemma between healthy diets versus sustainable diets. In: Sabaté, J. (ed) *Environmental nutrition: connecting health and nutrition with environmentally sustainable diets*, pp.197-227, doi: 10.1016/B978-0-12-811660-9.00013-8.
- Springmann, M. and Freund, F. (2018). *The impacts of Brexit on agricultural trade, food consumption, and diet-related mortality in the UK*, 22nd October, Oxford, UK: Oxford Martin School Working Paper.
- Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Leon Bodirsky, B., Lassaletta, L., Vries, W., deVermeulen, S.J., Herrero, M.T., Carlson, K.M., Jonell, M., Troell, M., DeClerck, F., Gordon, L.J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., Godfray, H.C.J., Tilman, D., Rockström, J. and Willett, W. (2018b). Options for keeping the food system within environmental limits, *Nature*, 10th October, Vol. 562, No. 7728, pp.519-529, doi: 10.1038/s41586-018-0594-0.
- Springmann, M., Godfray, H.C J., Rayner, M. and Scarborough, P. (2016a). Analysis and valuation of the health and climate change cobenefits of dietary change, *Proceedings of the National Academy of Science*, Vol. 113, pp.4146-4151, https://doi.org/10.1073/pnas.1523119113 [accessed 15th April 2019].
- Springmann, M., Mason-D'Croz, D., Robinson, S., Wiebe, K., Godfray, H.C.J., Rayner, M. and Scarborough, P. (2018a). Health-motivated taxes on red and processed meat: a modelling study on optimal tax levels and associated health impacts, *PLoS One*, Vol. 13, No. 11, pp. e0204139, https://doi.org/10.1371/journal.pone.0204139 [accessed 15th April 2019].

- Springmann, M., Mason-D'Croz, D., Robinson, S., Garnett, T., Godfray, H.C.J., Gollin, D., Rayner, M., Ballon, P. and Scarborough, P. (2016b). Global and regional health effects of future food production under climate change: a modelling study, *The Lancet*, Vol. 387, Iss. 10031, pp.1937-1946, doi: http://dx.doi.org/10.1016/S0140-6736(15)01156-3 [accessed 15th April 2019].
- Springmann, M., Sacks, G., Ananthapavan, J. and Scarborough, P. (2018d). Carbon pricing of food in Australia: an analysis of the health, environmental and public finance impacts, *Australian and New Zealand Journal of Public Health*, Vol. 42, No. 6, pp.523-529, doi: 10.1111/1753-6405.12830.
- Springmann, M., Wiebe, K., Mason-D'Croz, D., Sulser, T.B., Rayner, M. and Scarborough, P. (2018c). Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail, *The Lancet Planet Health*, Vol. 2, No. 10, pp.e451-e461, doi: 10.1016/S2542-5196(18)30206-7.
- Springmann, M., Mason-D’Croz, D., Robinson, S., Wiebe, K., Godfray, H.C.J., Rayner, M. and Scarborough, P. (2017). Mitigation potential and global health impacts from emissions pricing of food commodities, *Nature Climate* Change, Vol. 7, pp.69-74, doi:10.1038/nclimate3155.
- Stafford, N. (2012). Denmark cancels “fat tax” and shelves “sugar tax” because of threat of job losses, *British Medical Journal*, Vol. 345, pp.e7889, doi: https://doi.org/10.1136/bmj.e7889.
- Standal, D. and Utne, I.B. (2007). Can cod farming affect cod fishing - a system evaluation of sustainability, *Marine Policy*, Vol. 31, pp.527-534, doi:10.1016/j.marpol.2006.12.003.
- Stanisljevic, J. (2018). Is ‘chocapocalypse’ looming? Why we need to understand what’s at stake, *The Conversation*, 21st August, https://theconversation.com/is-chocapocalypse-looming-why-we-need-to-understand-whats-at-stake-101548 [accessed 15th April 2019].
- Stanley, D.A., Garratt, M.P.D., Wickens, J.B., Wickens, V.J., Potts, S.G. and Raine, N.E. (2015). Neonicotinoid pesticide exposure impairs crop pollination services provided by bumblebees, *Nature*, Vol. 528, No. 7583, pp.548-50, doi:10.1038/nature16167.
- Statista (2018). *Concern about climate change 2018 - UK Survey*, https://www.statista.com/statistics/426733/united-kingdom-uk-concern-about-climate-change/ [accessed 15th April 2019].
- Stauss, D.M. (2008). Feast or famine - the impact of the WTO decision favoring the US biotechnology industry in the EU ban of genetically modified foods, *American Business Law Journal*, Vol. 45, Iss. 4, Winter, pp.775-826, https://ssrn.com/abstract=1307859 [accessed 15th April 2019].
- Steadman, D., Appleby, T. and Hawkins, J. (2014). Minimising unsustainable yield: ten failing European fisheries, *Marine Policy*, Vol. 48, pp.192-201, https://doi.org/10.1016/j.marpol.2014.03.030 [accessed 15th April 2019].
- Steeden, K. (2017). Generation waste: why are millennials throwing away so much food? *Sustainable Food Trust*, 23rd November, http://sustainablefoodtrust.org/articles/generation-waste-why-are-millennials-throwing-away-so-much-food/ [accessed 15th April 2019].

- Steedman, P. and Schultz, W. (2009). *Future scenarios for the UK food system: a toolkit for thinking ahead*, Bristol, UK: Food Ethics Council, ISBN-10: 0954921844.
- Steele, B.D. (2019). Dietary dictocrats of EAT-Lancet, https://benjamindavidsteele.wordpress.com/2019/01/21/dietary-dictocrats-of-eat-lancet/ [accessed 15th April 2019].
- Steele, E.M., Popkin, B.M., Swinburn, B. and Monteiro, C.A. (2017). The share of ultra-processed foods and the overall nutritional quality of diets in the US: evidence from a nationally representative cross-sectional study, *Population Health Metrics*, Vol. 15, No. 1, p.6, doi: 10.1186/s12963-017-0119-3.
- Steele, S. and Sarcevic, L. (2019). Corporations are funding health and nutrition research – here's why you should be worried, *The Conversation*, 8th May, https://theconversation.com/corporations-are-funding-health-and-nutrition-research-heres-why-you-should-be-worried-116698 [accessed 15th April 2019].
- Steele, S., Ruskin, G., McKee, M. and Stuckler, D. (2019). Always read the small print: a case study of commercial research funding, disclosure and agreements with Coca-Cola, *Journal of Public Health Policy*, Vol. 40, pp.273-285, https://doi.org/10.1057/s41271-019-00170-9 [accessed 15th April 2019].
- Steenhuis, I.H.M., Waterlander, W.E. and de Mul, A. (2011). Consumer food choices - the role of price and pricing strategies, *Public Health Nutrition*, Vol. 14, No. 12, pp.2220-2226, doi:10.1017/S1368980011001637.
- Stefani, G., Tiberti, M., Lombardi, G.V., Cei, L. and Sacchi, G. (2017). Public food procurement: a systematic literature review, *International Journal on Food System Dynamics*, Vol. 8, No. 4, pp.270-283, doi: 10.18461/ijfsd.v8i4.842.
- Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O. and Ludwig, C. (2015a). The trajectory of the Anthropocene: the great acceleration, *The Anthropocene Review*, Vol. 2, Iss. 1, pp.81-98, https://doi.org/10.1177/2053019614564785 [accessed 15th April 2019].
- Steffen, W., Persson, Å., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., Crumley, C., Crutzen, P., Folke, C., Gordon, L., Molina, M., Ramanathan, V., Rockström, J., Scheffer, M., Schellnhuber, H. and Svedin, U. (2011). The anthropocene: from global change to planetary stewardship, *AMBIO*, Vol. 40, No. 7, pp.739-761, doi: https://doi-org.mmu.idm.oclc.org/10.1007/s13280-011-0185-x.
- Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., de Wit, C.A., Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M., Ramanathan, V., Reyers, B. and Sorlin, S. (2015b). Planetary boundaries: guiding human development on a changing planet, *Science*, Vol. 347, No. 6223, p.1259855, doi: 10.1126/science.1259855.
- Steffen, W., Rockström, J., Richardson, K., Lenton, T.M., Folke, C., Liverman, D., Summerhayes, C.P., Barnosky, A.D., Cornell, S.E., Crucifix, M., Donges, J.F., Fetzer, I., Lade, S.J., Scheffer, M., Winkelmann, R. and Schellnhuber, H.J. (2018). Trajectories of the earth system in the anthropocene, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 33, pp.8252-8259, doi: 10.1073/pnas.1810141115.

- Stegeman, I., Strube, R., Bell, R., Zvěřinová, I. and Staatsen, B. (2019). A future for all to INHERIT: taking integrated action on the environment, health and equity, *European Journal of Public Health*, Vol. 29, Iss. Suppl. 4, November, ckz185.390, https://doi.org/10.1093/eurpub/ckz185.390.
- Stehfest, E., Bouwman, L., van Vuuren, D.P., den Elzen, M.J.G., Eickhout, B. and Kabat, P. (2009). Climate benefits of changing diet, *Climatic Change*, Vol. 95, pp.83-102, doi: 10.1007/s10584-008-9534-6.
- Steinberger, J.K. (2020). Your money or your life? The carbon-development paradox, *Environmental Research Letters*, Vol. 15, No. 4, 044016, https://doi.org/10.1088/1748-9326/ab7461.
- Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. and de Haan, C. (2006). *Livestock's long shadow – environmental issues and options*, Livestock, Environment and Development (LEAD) Initiative, http://www.virtualcentre.org [accessed 15th April 2019].
- Stephens, E.C., Jones, A.D. and Parsons, D. (2018). Agricultural systems research and global food security in the 21st century: an overview and roadmap for future opportunities, *Agricultural Systems*, Vol. 163, pp.1-6, https://doi.org/10.1016/j.agsy.2017.01.011 [accessed 15th April 2019].
- Stephens, N., Di Silvio, L., Dunsford, I., Ellis, M., Glencross, A. and Sexton, A. (2018). Bringing cultured meat to market: technical, socio-political, and regulatory challenges in cellular agriculture, *Trends in Food Science & Technology*, Vol. 78, pp.155-166, https://doi.org/10.1016/j.tifs.2018.04.010 [accessed 15th April 2019].
- Steptoe, A. (1999). Motivational factors as mediators of socio-economic variations in dietary intake patterns, *Psychology and Health*, Vol. 14, No. 3, pp.391-402, https://doi.org/10.1080/08870449908407336 [accessed 15th April 2019].
- Stern, C., Jordan, Z. and McArthur, A. (2014). Developing the review question and inclusion criteria, *American Journal of Nursing*, Vol. 114, pp.53-56, doi: 10.1097/01.NAJ.0000445689.67800.86.
- Stern, N. (2013). The structure of economic modelling of the potential impacts of climate change: grafting gross underestimation of risk onto already narrow science models, *Journal of Economic Literature*, Vol. 51, No. 3, pp.838-859, http://personal.lse.ac.uk/sternn/128nhs.pdf.
- Stern, N.H. (2006). *The economics of climate change: the Stern review*, Cambridge, UK: Cambridge University Press, http://www.lse.ac.uk/GranthamInstitute/publication/the-economics-of-climate-change-the-stern-review/ [accessed 15th April 2019].
- Stevens, C. (2010). Linking sustainable consumption and production: the government role, *Natural Resources Forum*, Vol. 34, pp.16-23, https://doi.org/10.1111/j.1477-8947.2010.01273.x [accessed 15th April 2019].
- Stevenson, C.M., Puleston, C.O., Vitousek, P.M., Chadwick, O.A., Haoa, S. and Ladefoged, T.N. (2015). Rapa Nui population before European contact, *Proceedings of the National Academy of Sciences*, 201420712, doi: 10.1073/pnas.1420712112.

- Stevenson, P. (2018). *A better Brexit for farm animals - what the Government must do to protect welfare standards*, Food Research Centre Food Brexit Briefing, June, London, UK: Centre for Food Policy, City, University of London, www.foodresearch.org.uk [accessed 15th April 2019].
- Stewart, B.A. and Lal, R. (2017). The nitrogen dilemma: food or the environment, *Journal of Soil and Water Conservation*, Vol. 72, No. 6, pp.124A-128A, doi:10.2489/jswc.72.6.124A.
- Stewart, B.D., Burns, C., Hejnowicz, A.P., Gravey, V., O'Leary, B.C., Hicks, K., Farstad, F.M. and Hartley, S.E. (2019). Making Brexit work for the environment and livelihoods: Delivering a stakeholder informed vision for agriculture and fisheries, *People and Nature*, Vol. 1, pp.442-456, https://doi.org/10.1002/pan3.10054 [accessed 15th April 2019].
- Stewart, K. and Cole, M. (2019). Fast-food chains use cute animal toys to market meat to children – new vegan ranges pose a dilemma, *The Conversation*, 4th January, https://theconversation.com/fast-food-chains-use-cute-animal-toys-to-market-meat-to-children-new-vegan-ranges-pose-a-dilemma-109338 [accessed 15th April 2019].
- Steyn, J.M., Franke, A.C., van der Waals, J.E. and Haverkort, A.J. (2016). Resource use efficiencies as indicators of ecological sustainability in potato production: a South African case study, *Field Crops Research*, Vol. 199, pp.136-149, http://dx.doi.org/10.1016/j.fcr.2016.09.020 0378- [accessed 11th April 2020].
- Stiglitz, J. (2019). It's time to retire metrics like GDP. They don't measure everything that matters, *The Guardian*, 24th November, https://www.theguardian.com/commentisfree/2019/nov/24/metrics-gdp-economic-performance-social-progress [accessed 15th April 2019].
- Stockholm Environment Institute (2016). *Strategy 2015-2019*, Stockholm, Sweden: Stockholm Environment Institute.
- Stockmann, U., Adams, M.A., Crawford, J.W., Field, D.J., Henakaarchchi, N., Jenkins, M., Minasny, B., McBratney, A.B., deCourcelles, V.d.R., Singh, K. Wheeler, I., Abbott, L., Angers, D.A., Baldock, J., Bird, M., Brookes, P.C., Chenug, C. Jastrow, J.D., Lal, R., Lehmann, J., O'Donnell, A.G., Parton, W.J., Whitehead, D. and Zimmermann, M. (2013). The knowns, known unknowns and unknowns of sequestration of soil organic carbon, *Agriculture, Ecosystems & Environment*, Vol. 164, pp.80-99, https://doi.org/10.1016/j.agee.2012.10.001 [accessed 15th April 2019].
- Stokes, L. (2015). Electoral backlash against climate policy: a natural experiment on retrospective voting and local resistance to public policy, *American Journal of Political Science*, Vol. 60, pp.958-974, https://doi.org/10.1111/ajps.12220 [accessed 15th April 2019].
- Stokstad, E. (2011). Sustainability - seafood eco-label grapples with challenge of proving its impact, *Science*, Vol. 334, 11th November, p.746, doi: 10.1126/science.334.6057.746.
- Stoll, J.S. and Johnson, T.R. (2015). Under the banner of sustainability - the politics and prose of an emerging US federal seafood certification, *Marine Policy*, Vol. 51, pp.415-422, http://dx.doi.org/10.1016/j.marpol.2014.09.027 [accessed 15th April 2019].

- Stoll-Kleeman, S. and O'Riordan, T. (2015). The sustainability challenges of our meat and dairy diets, *Environment: Science and Policy for Sustainable Development*, Vol. 57, No. 3, pp.34-48, doi: 10.1080/00139157.2015.1025644.
- Stone, S.B., Almada, A.A. and Myers, S.S. (2017). A call for planetary health case studies, *The Lancet*, Vol. 390, 4th November, p.2024, https://doi.org/10.1016/S0140-6736(17)32756-3 [accessed 15th April 2019].
- Storlazzi, C.D., Gingerich, S.B., van Dongeren, A., Cheriton, O.M., Swarzenski, P.W., Quataert, E., Voss, C.I., Field, D.W., Annamalai, H., Piniak, G.A. and McCall, R. (2018). Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding, *Science Advances*, Vol. 4, No. 4, eaap9741, doi: 10.1126/sciadv.aap9741.
- Strauss, B.H., Kulp, S. and Levermann, A. (2015). *Mapping choices: carbon, climate, and rising seas, our global legacy*, Climate Central Research Report, Princeton, USA: Climate Central, www.climatecentral.org [accessed 11th April 2019].
- *StreetAuthority* (2015). How the death of meat could impact your portfolio, *StreetAuthority*, 22nd January, http://www.nasdaq.com/article/how-the-death-of-meat-could-impact-your-portfolio-cm435607#ixzz3S5X6DiCV [accessed 15th April 2019].
- Strona, G., Stringer, S.D., Vieilledent, G., Szantoi, Z., Garcia-Ulloa, J. and Wich, S.A. (2018). Small room for compromise between oil palm cultivation and primate conservation in Africa, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 115, No. 35, pp.8811-8816, www.pnas.org/cgi/doi/10.1073/pnas.1804775115 [accessed 15th April 2019].
- Strutt & Parker (2019). *Yield results harvest 2019*, London, UK: Strutt & Parker Estate Agents, https://rural.struttandparker.com/article/strutt-parker-yield-results-harvest-2019/ [accessed 15th January 2020].
- Strzepek, K. and Boehlert, B. (2010). Competition for water for the food system, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2927-2940, https://doi.org/10.1098/rstb.2010.0152 [accessed 15th April 2019].
- Stuckler, D. and Nestle, M. (2012). Big food, food systems, and global health, *PLoS Medicine*, Vol. 9, No. 6, pp.e1001242, doi:10.1371/journal.pmed.1001242.
- Stuckler, D., McKee, M., Ebrahim, S. and Basu, S. (2012). Manufacturing epidemics: the role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco, *PLoS Medicine*, Vol. 9, e1001235, https://doi.org/10.1371/journal.pmed.1001235 [accessed 11th April 2019].
- Stylianou, N., Guibourg, C. and Briggs, H. (2018). Climate change food calculator - what's your diet's carbon footprint? *BBC News*, 13th December, https://www.bbc.co.uk/news/science-environment-46459714 [accessed 15th April 2019].

- Subuh, S.A., Meuwissen, M.P.M., Ingenbleek, P.T.M., Hofstede, G-J., and Backus. G.B.C. (2008). *Security and robustness in food supply chains*, Wageningen, The Netherlands: Wageningen University, http://edepot.wur.nl/3038 [accessed 15th April 2019].
- Sukhdev, P., May, P. and Muller, A. (2016). Fix food metrics, *Nature*, Vol. 540, No. 7631, pp.33-34, https://www.nature.com/news/fix-food-metrics-1.21050 [accessed 15th April 2019].
- Suksa-ard, C. and Raweewan, M. (2011). Sustainability of local food supply chain in the new theory agriculture, *Proceedings of the Fifth Asian Conference on Sustainability, Energy and the Environment 2015*, Volume: ACSEE2015, Art Center of Kobe, Kobe, Kansai Region, Japan ACSEE 2015.
- Sulpis, O., Boudreau, B.P., Mucci, A., Jenkins, C., Trossman, D.S., Arbic, B.K. and Key, R.M. (2018). Current $CaCO_3$ dissolution at the seafloor caused by anthropogenic CO_2, *Proceedings of the National Academy of Sciences*, Vol. 115, No. 46, pp.11700-11705, doi: 10.1073/pnas.1804250115.
- Sultan, B. (2012). Global warming threatens agricultural productivity in Africa and South Asia, *Environmental Research Letters*, Vol. 7, pp.041001, doi:10.1088/1748-9326/7/4/041001.
- Sumaila, U.R., Ebrahim, N., Schuhbauer, A., Skerritt, D., Li, Y., Kim, H.S., Mallory, T.G., Lam, V.W.L. and Pauly, D. (2019). Updated estimates and analysis of global fisheries subsidies, *Marine Policy*, Vol. 109, 103695, https://doi.org/10.1016/j.marpol.2019.103695 [accessed 15th April, 2020].
- Sumaila, U.R., Khan, A., Teh, L., Watson, R., Tyedmers, P. and Pauly, D. (2010). Subsidies to high seas bottom trawl fleets and the sustainability of deep-sea demersal fish stocks, *Marine Policy*, Vol. 34, No. 3, pp.495-497, https://doi.org/10.1016/j.marpol.2009.10.004 [accessed 15th April 2019].
- Sumaila, U.R., Khan, A., Watson, R. and Munro, G. (2007). The world trade organization and global fisheries sustainability, *Fisheries Research*, Vol. 88, No. 1-3, pp.1-4, doi: 10.1016/j.fishres.2007.08.017.
- SumOfUs (2018b). *Vacuuming Antarctica for Krill - the Corporations plundering the Earth's last frontier*, New York, USA: SumOfUs, www.sumofus.org [accessed 15th April 2019].
- Sun, F., Dai, Y. and Yu, X. (2017). Air pollution, food production and food security: a review from the perspective of food system, *Journal of Integrative Agriculture*, Vol 16, Numb 12, pp.2945-2962, https://doi.org/10.1016/S2095-3119(17)61814-8 [accessed 15th April 2019].
- Sun, J., Mooney, H., Wu, W., Tang, T., Tong, Y., Xu, Z., Huang, B., Cheng, Y., Yang, X., Wei, D. and Zhang, F. (2018). Importing food damages domestic environment: evidence from global soybean trade, *Proceedings of the National Academy of Sciences of the United States of America*, 201718153, doi: 10.1073/pnas.1718153115 [accessed 15th April 2019].
- Sun, Y., You, W., Almeida, F., Estabrooks, P. and Davy, B. (2017). The effectiveness and cost of lifestyle interventions including nutrition education for diabetes prevention: a systematic review and meta-analysis, *Journal of the Academy of Nutrition and Dietetics,* Vol. 117, No. 3, pp.404-421.e36, doi: 10.1016/j.jand.2016.11.016.
- Sundaram, J.K. (2014). Tackling the nutrition challenge: a food systems approach, *Development*, Vol. 57, No. 2, pp.141-146, doi: https://doi.org/10.1057/dev.2014.63 [accessed 15th April 2019].

- Sundbo, J. (2016). Food scenarios 2025 - drivers of change between global and regional, *Futures*, Vol. 83, pp.75-87, doi: http://dx.doi.org/10.1016/j.futures.2016.03.003.
- Sundkvist, Å., Milestad, R. and Jansson, A.M. (2005). On the importance of tightening feedback loops for sustainable development of food systems, *Food Policy*, Vol. 30, pp.224-239, doi:10.1016/j.foodpol.2005.02.003.
- Sundström, J.F., Albihn, A., Boqvist, S., Ljungvall, K., Marstorp, H., Martiin, C., Nyberg, K., Vågsholm, I., Yuen, J., Magnusson, U. and Sveriges lantbruksuniversitet (2014). Future threats to agricultural food production posed by environmental degradation, climate change, and animal and plant diseases – a risk analysis in three economic and climate settings, *Food Security*, Vol. 6, No. 2, pp. 201-215, https://doi.org/10.1007/s12571-014-0331-y [accessed 15th April 2019].
- Supran, G. and Oreskes, N. (2017). Assessing ExxonMobil's climate change communications (1977–2014), *Environmental Research Letters*, Vol. 12, pp.084019, https://doi.org/10.1088/1748-9326/aa815f [accessed 15th April 2019].
- Sušnik, J. (2018). Data-driven quantification of the global water-energy-food system, *Resources, Conservation, and Recycling*, Vol. 133, pp.179-190, https://doi.org/10.1016/j.resconrec.2018.02.023 [accessed 15th April 2019].
- Sustain (2007). *Eat well and save the planet: a guide for consumers on how to eat greener, healthier and more ethical food*, December, London, UK: Sustain - the alliance for better food and farming, http://www.sustainweb.org [accessed 15th April 2019].
- Sustain (2013). The Sustain guide to good food, London, UK: Sustain - the alliance for better food and farming, https://www.sustainweb.org/publications/the_sustain_guide_to_good_food/ Accessed on 10/04/2019 [accessed 15th April 2019].
- Sustain (2014). *Good food at work - how your organisation can improve health and sustainability and help create a food and farming system fit for the future*, London, UK: Sustain - the alliance for better food and farming, http://www.sustainweb.org [accessed 15th April 2019].
- Sustain (2018). *Better food and farming integral to climate goals*, London, UK: Sustain - the alliance for better food and farming, http://www.sustainweb.org [accessed 15th April 2019].
- Sustain (2018). *Submission to Trade Bill Committee food prices*, 29th January, London, UK: Sustain - the alliance for better food and farming, http://www.sustainweb.org [accessed 15th April 2019].
- Sustain (2018). Tell your MP we don’t want Bad Food Britain now. Taking back control means that we should keep sensible standards that are already in place, and work in future to make them even better when we leave Europe, London, UK: Sustain - the alliance for better food and farming,
- Sustainable Development Commission (2011). *Looking Back, Looking Forward Sustainability and UK Food Policy 2000-2011*, London, UK: Sustainable Development Commission.
- Sustainable Food Trust (2015). *Soil degradation – a major threat to humanity*, Bristol, UK: Sustainable Food Trust, http://sustainablefoodtrust.org [accessed 15th April 2019].

- Sustainable Food Trust (2017a). *A tale of two chickens*, Bristol, UK: Sustainable Food Trust, http://sustainablefoodtrust.org/articles/a-tale-of-two-chickens/ [accessed 15th April 2019].
- Sustainable Food Trust (2017b). *The hidden cost of UK food*, Bristol, UK: Sustainable Food Trust, https://sustainablefoodtrust.org/articles/hidden-cost-uk-food/ [accessed 15th April 2019].
- Sustainable Food Trust (2019a). EAT-Lancet report's recommendations are at odds with sustainable food production, Bristol, UK: Sustainable Food Trust, https://sustainablefoodtrust.org/articles/eat-lancet-reports-recommendations-are-at-odds-with-sustainable-food-production/ [accessed 15th April 2019].
- Sustainable Food Trust (2019b). Every year, 4.5 million tonnes of UK grown fresh fruit and vegetables are lost to aesthetic grading. Selecting produce for retail, based on its appearance, means that up to 50% of carrots produced will never reach a shop, Bristol, UK: Sustainable Food Trust, https://sustainablefoodtrust.org/articles/battle-of-the-brave-root-the-story-of-the-carrot/ [accessed 15th April 2019].
- Sustainia (2015). *The food producers of tomorrow are health providers*, Copenhagen, Denmark: Monday Morning, www.sustainia.me [accessed 15th April 2019].
- Sutherland, W.J., Freckleton, R.P., Godfray, H.C.J., Beissinger, S.R., Benton, T., Cameron, D.D., Carmel, Y., Coomes, D.A., Coulson, T., Emmerson, M.C., Hails, R.S., Hays, G.C., Hodgson, D.J., Hutchings, M.J., Johnson, D., Jones, J.P.G., Keeling, M.J., Kokko, H., Kunin, W.E., Lambin, X., Lewis, O.T., Malhi, Y., Mieszkowska, N., Milner-Gulland, E.J., Norris, K., Phillimore, A.B., Purves, D.W., Reid, J.M., Reuman, D.C., Thompson, K., Travis, J.M.J., Turnbull, L.A., Wardle, D.A. and Wiegand, T. (2013). Identification of 100 fundamental ecological questions, *Journal of Ecology*, Vol. 101, No. 1, pp.58-67, https://doi.org/10.1111/1365-2745.12025 [accessed 15th April 2019].
- Sutton, C. and Dibb, S. (2013). *Prime cuts: valuing the meat we eat*, London and Brighton: WWF and Food Ethics Council, http://assets.wwf.org.uk/downloads/prime_cuts_food_report_feb2013.pdf.
- Suweis, S., Carrb, J.A., Maritan, A., Rinaldo, A. and D'Odorico, P. (2015). Resilience and reactivity of global food security, *Proceedings of the National Academy of Sciences of the United States*, Vol. 112, pp.22, https://doi.org/10.1073/pnas.1507366112 [accessed 15th April 2019].
- Suweis, S., Rinaldo, A., Maritan, A. and D'Odorico, P. (2013). Water-controlled wealth of nations, *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 110, No. 11, pp.4230-4233, https://doi.org/10.1073/pnas.1222452110 [accessed 15th April 2019].
- Swaminathan, M.S. (2012). Role of Genetic Modification in developing climate smart agriculture to ensure sustained food security, *Agricultural Research*, Vol. 1, No. 4, pp.295-298, doi: https://doi.org/10.1007/s40003-012-0041-7.
- Swaminathan, M.S. and Bhavani, R.V. (2013). Food production and availability - essential prerequisites for sustainable food security, *Indian Journal of Medical Research*, Vol. 138, September, pp.383-391.

- Swannell, R. (2016). *Food futures: from business as usual to business unusual*, Our food future, FSA, WWF, https://blogs.wwf.org.uk/blog/green-sustainable-living/food-futures-from-business-as-usual-to-business-unusual/ [accessed 15th April
- Swidler, A. and Watkins, S.C. (2009). Teach a man to fish - the sustainability doctrine and its social consequences, *World Development*, Vol. 37, No. 7, pp.1182–1196, doi:10.1016/j.worlddev.2008.11.002.
- Swinburn, B. (2019). *Power dynamics in 21st-century food systems*, Nutrients, Vol. 11, 2544, doi:10.3390/nu11102544.
- Swinburn, B., Sacks, G., Hall, K., McPherson, K., Finegood, D., Moodie, M. and Gortmaker, S. (2011). The global obesity pandemic: shaped by global drivers and local environments, *The Lancet*, Vol. 378, No. 9793, pp.804-814, doi: 10.1016/S0140-6736(11)60813-1.
- Swinburn, B.A., Kraak, V.I., Allender, S., Atkins, V.J., Baker, P.I., Bogard, J.R., Brinsden, H., Calvillo, A., De Schutter, O., Devarajan, R., Ezzati, M., Friel, S., Goenka, S., Hammond, A., Hastings, G., Hawkes, C., Herrero, M., Hovmand, P.S., Howden, M., Jaacks, L.M., Kapetanaki, A.B., Kasman, M., Kuhnlein, H.V., Kumanyika, S.K., Larijani, B., Lobstein, T., Long, M.W., Matsudo, V.K.R., Mills, S.D.H., Morgan, G., Morshed, A., Nece, P.M., Pan, A., Patterson, D.W., Sacks, G., Shekar, M., Simmons, G.L., Smit, W., Tootee, A., Vandevijvere, S., Waterlander, W.E., Wolfenden, L. and Dietz, W.H. (2019). The global syndemic of obesity, undernutrition, and climate change: The Lancet Commission report, *The Lancet*, 27th January, *The Lancet*, Vol. 393, pp.791–846, doi:https://doi.org/10.1016/S0140-6736(18)32822-8.
- Swinnen, J., Knops, L. and van Herck, K. (2013). *Food price volatility and EU Policies*, Research Brief No. 16, May, The Political Economy of Food Price Policy, http://www.wider.unu.edu/research/current-programme/en_GB/Political-Economy-of-Food/ [accessed 15th April 2019].
- Syahruddin, N. and Kalchschmidt, M. (2011). Sustainable supply chain management in the agricultural sector: a literature review, *International Journal of Engineering Management and Economics*, Vol. 3, Iss. 3, doi: 10.1504/IJEME.2012.049894.
- Synbiowatch (2016). *Synthetic algae doesnt solve palm oil problems*, Washington, USA: Friends of the Earth U.S., http://www.syntheticisnotnatural.com/ecover-petition/synthetic-algae-not-solution-palm-oil/ [accessed 15th April 2019].
- Tacoli, C., Bukhari, B. and Fisher, S. (2013). *Urban poverty, food security and climate change*, Human Settlements Working Paper No.37, March, London, UK: International Institute for Environment and Development, http://pubs.iied.org/10623IIED.html [accessed 15th April 2019].
- Tacon, A.G.J. (2006). Global overview on the use of fish meal and fish oil in industrially compounded aquafeeds, *Aquaculture*, Vol. 285, Iss. 1-4, pp.146-158, https://doi.org/10.1016/j.aquaculture.2008.08.015 [accessed 15th April 2019].
- Tadesse, G., Algieri, B., Kalkuhl, M. and von Braun, J. (2014). Drivers and triggers of international food price spikes and volatility, *Food Policy*, Vol. 47, pp.117–128, http://dx.doi.org/10.1016/j.foodpol.2013.08.014 [accessed 15th April 2019].

- Taelman, S.E., De Meester, S., Van Dijk, W., da Silva, V. and Dewulf, J. (2015). Environmental sustainability analysis of a protein-rich livestock feed ingredient in The Netherlands: Microalgae production versus soybean import, *Resources, Conservation and Recycling*, Vol. 101, pp.61-72, http://dx.doi.org/10.1016/j.resconrec.2015.05.013 [accessed 11th April 2020].
- Takle, E.S., Gustafson, D., Beachy, R., Nelson, G.C., Mason-D'Croz, D. and Palazzo, A. (2013). US food security and climate change: agricultural futures, *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 7, No. 2013-34, pp.1, http://www.economics-ejournal.org/economics/discussionpapers/2013-17 [accessed 15th April 2019].
- Talati, Z., Pettigrew, S., Neal, B., Dixon, H., Hughes, C., Kelly, B. and Miller, C. (2017). Consumers' responses to health claims in the context of other on-pack nutrition information: a systematic review, *Nutrition Reviews*, Vol. 75, No. 4, pp.260-273, doi: 10.1093/nutrit/nuw070.
- Tan, K.T., Lee, K.T., Mohamed, A.R. and Bhatia, S. (2009). Palm oil – Addressing issues and towards sustainable development, *Renewable and Sustainable Energy Reviews*, Vol. 13, pp.420-427, doi:10.1016/j.rser.2007.10.001.
- Tan, R.R. (2016). Decision analysis for sustainable systems: making smarter choices for the planet, *Clean Technologies and Environmental Policy*, Vol. 18, Iss. 5, pp 1245–1246, https://doi.org/10.1007/s10098-016-1253-5 [accessed 15th April 2019].
- Tanentzap, A.J., Lamb, A., Walker, S. and Farmer, A. (2015). Resolving conflicts between agriculture and the natural environment, *PLOS Biology*, Vol. 13, No. 9, e1002242, doi: 10.1371/journal.pbio.1002242.
- Tang, K.L., Caffrey, N.P., Nóbrega, D.B., Cork, S.C., Ronksley, P.E., Barkema, H.W., Polachek, A.J., Ganshorn, H., Sharma, N., Kellner, J.D., Checkley, S.L. and Ghali, W.A. (2019). Comparison of different approaches to antibiotic restriction in food-producing animals: stratified results from a systematic review and meta-analysis, *BMJ Global Health*, Vol. 4, No. 4, e001710, doi: 10.1136/bmjgh-2019-001710.
- Tang, K.L., Caffrey, N.P., Nóbrega, D.B., Susan C Cork, S.C., Ronksley, P.E., Barkema, H.W., Polachek, A.J., Ganshorn, H., Sharma, N., Kellner, J.D. Checkley, S.L. and Ghali, W.G. (2019). Comparison of different approaches to antibiotic restriction in food-producing animals: stratified results from a systematic review and meta-analysis, *BMJ Global Health*, Vol. 4, e001710, doi:10.1136/bmjgh-2019-001710.
- Taniguchi, M., Masuhara, N. and Teramoto, S. (2018). Tradeoffs in the water-energy- food nexus in the urbanizing Asia-Pacific region, *Water international*, Vol. 43; No. 6, pp.892-903, https://doi.org/10.1080/02508060.2018.1516104 [accessed 15th April 2019].
- Tansey, G. (2013). *Sustainable intensification – miracle or mirage*, 18th February, London, UK: Chatham House Royal Institute of International Affairs.
- Tapia, C., Abajoa, B., Feliua, E., Mendizabala, M., Martineza, J.A., Fernándeza, J.G., Laburua, T. and Lejarazua, A. (2017). Profiling urban vulnerabilities to climate change - an indicator-based vulnerability assessment for European cities, *Ecological Indicators*, Vol. 78, pp.142-155, http://dx.doi.org/10.1016/j.ecolind.2017.02.040 [accessed 15th April 2019].

- Tapsell, L.C., Neale, E.P., Satija, A. and Hu, F.B. (2016). Foods, nutrients, and dietary patterns: interconnections and implications for dietary guidelines, *Advances in Nutrition*, Vol. 7, No. 3, pp.445-454, https://doi.org/10.3945/an.115.011718 [accessed 15th April 2019].
- Tapsell, S.M., Tunstall, S.M. and Wilson, T. (2003). *Banbury and Kidlington four years after the flood, an examination of the long-term health effects of flooding*, London, UK: Middlesex University Flood Hazard Research Centre.
- *Taste Shropshire* (2007). Flying into controversy, *Taste Shropshire*, Autumn, p.16.
- Tatum, M. (2015a). Global cooling, *The Grocer*, 6th June, pp.30-33.
- Tatum, M. (2015b). Talking trash, *The Grocer*, 24th January, pp.28-30.
- Tatum, M. (2015c). Wrap asking for £20k to join Courtalds 2025, *The Grocer*, 19th September, p.6.
- Tatum, M. (2018). Modern slavery: the human cost of cheap food? *The Grocer*, 25th October, https://www.thegrocer.co.uk/pay/modern-slavery-the-human-cost-of-cheap-food/573120.article [accessed 11th April 2019].
- Taub, D., Miller, B. and Allen, H. (2008). Effects of elevated CO_2 on the protein concentration of food crops: a meta-analysis, *Global Change Biology*, Vol. 14, pp.565-575, https://doi.org/10.1111/j.1365-2486.2007.01511.x [accessed 15th April 2019].
- Taylor, D.H. (2006). Strategic considerations in the development of lean agri-food supply chains - UK pork sector, *Supply Chain Management: An International Journal*, Vol. 11, No. 3, pp.271-280, doi: 10.1108/13598540610662185.
- Taylor, D.H. and Fearne, A. (2006). Towards a framework for improvement in the management of demand in agri-food supply chains, *Supply Chain Management: An International Journal*, Vol. 11, Iss. 5, pp.379-384, http://dx.doi.org/10.1108/13598540610682381 [accessed 15th April 2019].
- Taylor, K. (2019). 10 trends will decide how we eat in 2019, according to Whole Foods, *Business Insider*, 2nd January, https://www.businessinsider.com/whole-foods-top-food-trends-in-2019-2018-11?r=US&IR=T [accessed 15th April 2019].
- Taylor, S.F.W., Roberts, M.J., Milligan, B. and Ncwadi, R. (2019). Measurement and implications of marine food security in the Western Indian Ocean: an impending crisis? *Food Security*, Vol. 11, No. 6, pp.1395-1415, https://doi.org/10.1007/s12571-019-00971-6 [accessed 11th April 2020].
- Tearfund (2019). *No time to waste: tackling the plastic pollution crisis before it's too late*, report by Tearfund, Fauna & Flora International (FFI), WasteAid and The Institute of Development Studies (IDS), https://learn.tearfund.org/~/media/files/tilz/circular_economy/2019-tearfund-consortium-no-time-to-waste-en.pdf?la=en [accessed 15th April 2019].
- TEEB (2015). *The Economics of Ecosystems and Biodiversity*, The Economics of Ecosystems and Biodiversity, Geneva, Switzerland: UN Environment, http://www.teebweb.org/ [accessed 15th April 2019].

- TEEB (2018a). *Measuring what matters in agriculture and food systems: a synthesis of the results and recommendations of TEEB for Agriculture and Food's Scientific and Economic Foundations report*, The Economics of Ecosystems and Biodiversity, Geneva: UN Environment.
- TEEB (2018b). *TEEB for agriculture & food - scientific and economic foundations*, The Economics of Ecosystems and Biodiversity, Geneva, Switzerland: UN Environment.
- Tefft, J., Jonasova, M., Adjao, R. and Morgan, A. (2017). *Food systems for an urbanizing world*, The World Bank / Food and Agriculture Organization of the United Nations.
- Teicholz, N. (2019). Majority of EAT-Lancet authors (>80%) favored vegan-vegetarian diets, 24th January, ninateicholz.com/majority-of-eat-authors-vegan-vegetarian/ [accessed 15th April 2019].
- Teixeira, E.I., Fischer, G., Van Velthuizen, H., Walter, C. and Ewert, F. (2011). Global hot-spots of heat stress on agricultural crops due to climate change, *Agricultural and Forest Meteorology*, Vol. 170, pp.206-215, https://doi.org/10.1016/j.agrformet.2011.09.002 [accessed 15th April 2019].
- Teka, O., Mallick, B. and Vogt, J. (2009). Climate change and agricultural production – analysis of interrelationship and evaluation of food security in coastal area of Benin, *IOP Conference Series: Earth and Environmental Science*, Vol. 6, No. 47, pp.472016.
- *Telegraph*, *The* (2019). Feeding the future - fixing the world's faulty food system, *The Telegraph*, https://www.telegraph.co.uk/news/feeding-the-future/ [accessed 15th April 2019].
- Temme. E.H.M., Bakker, H.M.E., Seves, S.M., Verkaik-Kloosterman, J., Dekkers, A.L., van Raaij, J.M.A. and Ocké, M.C. (2015). How may a shift towards a more sustainable food consumption pattern affect nutrient intakes of Dutch children, *Public Health Nutrition*, Vol. 18, pp.2468-2478, doi:10.1017/S1368980015002426.
- Tempels, T., Verweij, M. and Blok, V. (2017). Big Food's ambivalence - seeking profit and responsibility for health, *Public Health Ethics*, Vol 107, No. 3, pp.402-406, doi:10.2105/AJPH.2016.303601.
- Tencati, A. and Zsolnai, L. (2012). Collaborative enterprise and sustainability - the case of slow food, *Journal of Business Ethics*, Vol. 110, pp.345-354, doi: 10.1007/s10551-011-1178-1.
- Tendall, D., Joerin, J., Kopainsky, B., Edwards, P., Shreck, A., Le, Q.B., Kruetlia, P., Grant, M. and Six, J. (2015). Food system resilience: defining the concept, *Global Food Security*, Vol. 6, pp.17-23, http://dx.doi.org/10.1016/j.gfs.2015.08.0012211-9124 [accessed 15th April 2019].
- Ter Kulve, P. (2015). How can we feed the world while protecting the environment? *World Economc Forum*, 20th April, https://www.weforum.org/agenda/2015/04/how-can-we-feed-the-world-while-protecting-the-environment/ [accessed 15th April 2019].
- Terazono, E. (2016). Accord on eco-labelling boosts sustainable fishing, *Financial Times*, 30th November, https://www.ft.com/content/871be9f8-a76d-11e6-8898-79a99e2a4de6 [accessed 15th April 2019].

- Tessema, W.K., Ingenbleek, P., van Tilburg, A. and van Trijp, C.M.H. (2008). Managing marginal lands: including pastoralists in chains and networks, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands, http://edepot.wur.nl/3063 [accessed 15th April 2019].
- Thapa, J.R. and Lyford, C.P. (2014). Behavioral economics in the school lunchroom: can it affect food supplier decisions? A systematic review, *International Food and Agribusiness Management Review*, Vol. 17, Special Issue A, pp.187-208.
- The Children's Society (2014). *Feeding Britain - a strategy for zero hunger in England, Wales, Scotland and Northern Ireland*, report of the All-Party Parliamentary Inquiry into Hunger in the United Kingdom, ISBN: 978-1-899783-48-9, The Children's Society, www.foodpovertyinquiry.org [accessed 15th April 2019].
- The Collective Psychology Project (2017). *A larger us*, https://www.collectivepsychology.org/wp-content/uploads/2019/05/A-Larger-Us.pdf [accessed 15th April 2019].
- The High Level Panel of Experts on Food Security and Nutrition. (2017). *Nutrition and Food Systems*, Rome, Italy: Committee on World Food Security.
- *The Land* (2014). Towards ten billion, *The Land*, Vol.17, Winter 2014-15, pp20-21, https://www.thelandmagazine.org.uk/articles/towards-ten-billion [accessed 11th April 2019].
- The role of ruminants in sustainable diets, https://webinarsolutions.tv/permalink/l125cfe524066qt402fj/ [accessed 15th April 2019].
- The Royal Society (2009). *Reaping the benefits - science and the sustainable intensification of global agriculture*, London, UK: The Royal Society, ISBN: 978-0-85403-784-1,
- The World Bank (2019). *The future of the World's population in 4 charts*, https://blogs.worldbank.org/opendata/future-world-s-population-4-charts [accessed 15th April 2019].
- Theurl, M.C., Hörtenhuber, S.J., Lindenthal, T. and Palme, W. (2017). Unheated soil-grown winter vegetables in Austria: greenhouse gas emissions and socio-economic factors of diffusion potential, *Journal of Cleaner Production*, Vol. 151, pp.134-144, https://doi.org/10.1016/j.jclepro.2017.03.016 [accessed 11th April 2020].
- Thiault, L., Mora, C., Cinner, J.E., Cheung, W.W.L., Graham, N.A.J., Januchowski-Hartley, F.A., Mouillot, D., Sumaila, U.R. and Claudet, J. (2019). Escaping the perfect storm of simultaneous climate change impacts on agriculture and marine fisheries, *Science Advances*, Vol. 5, no. 11, eaaw9976, doi: 10.1126/sciadv.aaw9976.
- Thijssens, T., Bollen, L. and Hassink, H. (2016). Managing sustainability reporting: many ways to publish exemplary reports, *Journal of Cleaner Production*, Vol. 136, pp.86-101, https://doi.org/10.1016/j.jclepro.2016.01.098 [accessed 15th April 2019].
- Thirsk, J. (2002). *Rural England: a history of the landscape*, Oxford, UK: Oxford University Press.

- Thomas, D. (2007). The mineral depletion of foods available to us as a nation (1940-2002): a review of the 6th edition of McCance and Widdowson, *Nutrition and Health*, Vol. 19, pp.21-55, doi: 10.1177/026010600701900205.
- Thomas, S.M., Ledgard, S.F. and Francis, G.S. (2005). Improving estimates of nitrate leaching for quantifying New Zealand's indirect nitrous oxide emissions, *Nutrient Cycling in Agroecosystems,* Vol. 73, pp.213-226, https://doi.org/10.1007/s10705-005-2476-8 [accessed 15th April 2019].
- Thomas, T. and Rosegrant, M. (2015). Climate change impact on key crops in Africa: using crop models and general equilibrium models to bound the predictions. In: Elbehri, A. (ed) (2015). *Climate change and food systems: global assessments and implications for food security and trade*, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), ISBN 978-92-5-108699-5.
- Thompson, B. (2015). Global food strategies for healthy and sustainable food choices, *13th National Panhellenic Conference of Nutrition and Dietetics and 2nd Panhellenic Congress of Clinical Nutrition*, Athens, Greece, 27th November, 2015.
- Thompson, C., Clarke, G., Clarke, M. and Stillwell, J. (2012). Modelling the future opportunities for deep discount food retailing in the UK, *The International Review of Retail, Distribution and Consumer Research*, Vol. 22, No.2, pp.143-170, doi: 10.1080/09593969.2011.652645.
- Thompson, J. (2017). Salmon open flood gates for human consumption of GM animals, *Financial Times*, 7th December, https://www.ft.com/content/ab9b81ae-c94e-11e7-8536-d321d0d897a3 [accessed 15th April 2019].
- Thomson, K., Hillier-Brown F., Todd A., McNamara C., Huijts T. and Bambra C. (2018). The effects of public health policies on health inequalities in high-income countries: an umbrella review, *BMC Public Health*, Vol. 18, No. 869, doi: 10.1186/s12889-018-5677-1.
- Thomson, M., Kentikelenis, A. and Stubbs, T. (2017). Structural adjustment programmes adversely affect vulnerable populations: a systematic-narrative review of their effect on child and maternal health, *Public Health Reviews*, Vol. 38, No. 1, doi: 10.1186/s40985-017-0059-2.
- Thorburn, P.J., Boote, K.J., Nendel, C., Rötter, R.P. and Ewert, F. (2018). Recent advances in crop modelling to support sustainable agricultural production and food security under global change, *European Journal of Agronomy*, Vol. 100, pp.1-3, https://doi.org/10.1016/j.eja.2018.10.009 [accessed 15th April 2019].
- Thornton, J. (2018). Why your water footprint doesn't matter, *The Conversation*, 1st October, https://theconversation.com/why-your-water-footprint-doesnt-matter-104152 [accessed 15th April 2019].
- Thornton, P. (2012). *Recalibrating food production in the developing world: global warming will change more than just the climate*, CCAFS Policy Brief no. 6, CGIAR Research Program on Climate Change, Agriculture and Food Security, https://cgspace.cgiar.org/handle/10568/24696 [accessed 15th April 2019].

- Thornton, P.K. (2010). Livestock production – recent trends, future prospects, *Philosophical Transactions of the Royal Society B: Biological Sciences*, Vol. 365, pp.2853-2867, doi:10.1098/rstb.2010.0134.
- Thornton, P.K., Kristjanson, P., Förch, W., Barahona, C., Cramer, L. and Pradhan, S. (2018). Is agricultural adaptation to global change in lower-income countries on track to meet the future food production challenge? *Global Environmental Change*, Vol. 52, pp.37-48, https://doi.org/10.1016/j.gloenvcha.2018.06.003 [accessed 15th April 2019].
- Thornton, P.K., van de Steeg, J., Notenbaert, A. and Herrero, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: a review of what we know and what we need to know, *Agricultural Systems*, Vol. 101, pp.113-127, https://doi.org/10.1016/j.agsy.2009.05.002 [accessed 15th April 2019].
- Thornton, P.K., Whitbread, A., Baedeker, T., Cairns, J., Claessens, W.B., Bunn, C., Friedmann, M., Giller, K.E., Herrero, M., Howden, M., Kilcline, K., Nangia, V., Ramirez-Villegas, J., Kumar, S., West, P.C. and Keating, B. (2018). A framework for priority-setting in climate smart agriculture research, *Agricultural Systems*, Vol. 167, pp.161-175, doi: 10.1016/j.agsy.2018.09.009.
- Thorsøe, M.H. (2015). Maintaining trust and credibility in a continuously evolving organic food system, *Journal of Agricultural and Environmental Ethics*, Vol. 28, pp.767-787, doi: 10.1007/s10806-015-9559-6.
- Thow, A.M., Downs, S. and Jan, S. (2014). A systematic review of the effectiveness of food taxes and subsidies to improve diets: understanding the recent evidence, *Nutrition Reviews*, Vol. 72, No. 9, pp.551-565, doi: 10.1111/nure.12123.
- Thow, A.M., Jan, S. and Leedeer, S. (2010). The effect of fiscal policy on diet, obesity and chronic disease: a systematic review, *Bulletin of the World Health Organisation*, Vol. 88, No. 8, pp.609-614, doi: 10.2471/BLT.09.070987.
- Thurstan, R.H. and Roberts, C.M. (2014). The past and future of fish consumption: Can supplies meet healthy eating recommendations? *Marine Pollution Bulletin*, Vol. 89, No. 1-2, pp.5-11, https://doi.org/10.1016/j.marpolbul.2014.09.016 [accessed 15th April 2019].
- Thurstan, R.H., Brockington, S. and Roberts, C.M. (2010). The effects of 118 years of industrial fishing on UK bottom trawl fisheries, *Nature Communications*, Vol. 1, No. 2, pp.15, https://doi.org/10.1038/ncomms1013 [accessed 15th April 2019].
- Thyberg, K.L. and Tonjes, D.J. (2016). Drivers of food waste and their implications for sustainable policy development, *Resources Conservation and Recycling*, Vol. 106, pp.110-123, https://doi.org/10.1016/j.resconrec.2015.11.016 [accessed 15th April 2019].
- Tian, J., Bryksa, B.C. and Yada, R.Y. (2016). Feeding the world into the future – food and nutrition security: the role of food science and technology, *Frontiers in Life Science*, Vol. 9, No. 3, pp.155-166, doi: 10.1080/21553769.2016.1174958.
- Tiboris, M. (2017). Can we survive sustainability? *Ethics, Policy & Environment*, Vol. 20, No. 3, pp.255-258, doi: 10.1080/21550085.2017.1374040.

- Tichenor, N.E. and Leach, A.M. (2017). Informing a sustainable food future, *Environmental Research Letters*, Vol. 12, No. 11, http://iopscience.iop.org/article/10.1088/1748-9326/aa8eff [accessed 15th April 2019].
- Tickler, D., Meeuwig, J.J., Palomares, M-L., Pauly, D., and Zeller, D. (2018). Far from home: distance patterns of global fishing fleets, *Science Advances*, Vol. 4, pp.eaar3279, doi: 10.1126/sciadv.aar3279.
- Tiffin, R. (2011). *Diet and sustainability key to feeding the world*, 24th January, Reading, UK: University of Reading Centre for Food Security at Reading, http://www.reading.ac.uk/news-archive/press-releases/pr345098.html [accessed 15th April 2019].
- Tigchelaar, M., Battisti, D.S., Naylor, R.L. and Ray, D.K. (2018). Future warming increases probability of globally synchronized maize production shocks, *Proceedings of the National Academy of Science*, 11th June, 201718031, https://doi.org/10.1073/pnas.1718031115 [accessed 15th April 2019].
- Tijhuis, M.J., de Jong, N., Pohjola, M.V., Gunnlaugsdóttir, H., Hendriksen, M., Hoekstra, J., Holm, F., Kalogeras, N., Leino, O., van Leeuwen, F.X.R., Luteijn, J.M., Magnússon, S.H., Odekerken, G., Rompelberg, C., Tuomisto, J.T., Ueland, Ø., White, B.C. and Verhagen, H. (2012). State of the art in benefit–risk analysis: food and nutrition, *Food and Chemical Toxicology*, Vol. 50, pp.5-25, doi: 10.1016/j.fct.2011.06.010.
- Tillman, D. (1999). Global environmental impacts of agricultural expansion: the need for sustainable and efficient practices, *Proceedings of the National Academy of Sciences*, Vol. 96, pp.5995-6000, https://doi.org/10.1073/pnas.96.11.5995 [accessed 15th April 2019].
- Tilman, D. and Clark, M. (2014). Global diets link environmental sustainability and human health, *Nature*, Vol. 515, pp.518-522, doi: 10.1038/nature13959.
- Tilman, D., Balzer, C., Hill, J. and Befort, B.L. (2011). Global food demand and the sustainable intensification of agriculture, *Proceedings of the National Academy of Sciences*, Vol. 108, No. 50, pp.20260-20264, doi/10.1073/pnas.1116437108.
- Tilman, D., Clark, M., Williams, D.R., Kimmel, K., Polasky, S. and Packer, C. (2017). Future threats to biodiversity and pathways to their prevention, *Nature*, Vol. 546, pp.73-81, https://doi.org/10.1038/nature22900 [accessed 15th April 2019].
- Tilman, G.D., Cassman, K.G., Matson, P.A., Naylor, R.L. and Polasky, S. (2002). Agricultural sustainability and intensive production practices, *Nature*, Vol. 418, pp.671-677, https://doi.org/10.1038/nature01014 [accessed 15th April 2019].
- Timmer, C.P. (2009). Behavioral dimensions of food security, *Proceedings of the National Academy of Sciences*, Vol. 109, pp.12315-12320, doi: 10.1073/pnas.0913213107.
- Timmer, C.P. (2010). Preventing food crises using a food policy approach, *The Journal of Nutrition (Supplement: The Impact of Climate Change, the Economic Crisis, and the Increase in Food Prices on Malnutrition)*, pp.224S-228S, doi:10.3945/jn.109.110379.

- Timmer, C.P. (2010). Reflections on food crises, *Food Policy*, Vol. 35, pp.1-11, doi:10.1016/j.foodpol.2009.09.002.
- Timperley, J. (2017). Seven things that need to happen to keep global temperature rise below 2°C*, Carbon Brief*, 21st March, https://www.carbonbrief.org/seven-things-that-need-happen-keep-global-temperature-two-celcius [accessed 15th April 2019].
- Ting, K-H., Lin, K-L., Jhan, H-T., Huang, T-J., Wang, C-M. and Liu, W-H. (2015). Application of a sustainable fisheries development indicator system for Taiwan's aquaculture industry, *Aquaculture*, Vol. 437, pp.398-407, http://dx.doi.org/10.1016/j.aquaculture.2014.12.030 [accessed 15th April 2019].
- Tirado, M.C., Clarke, R., Jaykus, L.A., McQuatters-Gollop, A. and Frank, J.M. (2010). Climate change and food safety: a review, *Food Research International*, Vol. 43, No. 7, pp.1745-1765, https://doi.org/10.1016/j.foodres.2010.07.003 [accessed 15th April 2019].
- Tisdell, C. (1999). Overview of environmental and sustainability issues in aquaculture, *Aquaculture Economics & Management*, Vol. 3, No. 1, pp.1-5, doi: 10.1080/13657309909380228.
- Tittler, R. (1977). The English fishing industry in the sixteenth century: the case of Great Yarmouth, *Albion: A Quarterly Journal Concerned with British Studies*, Vol. 9, No. 1, pp.40-60, doi: 10.2307/4048218.
- Tjärnemo, H. and Södahl, L. (2015). Swedish food retailers promoting climate smarter food choices—trapped between visions and reality? *Journal of Retailing and Consumer Services*, Vol. 24, pp.130-139, https://doi.org/10.1016/j.jretconser.2014.12.007 [accessed 15th April 2019].
- Tobi, R.C.A., Harris, F., Rana, R. Kerry A. Brown, K.A., Quaife, M. and Green, R. (2019). Sustainable diet dimensions. Comparing consumer preference for nutrition, environmental and social responsibility food labelling: a systematic review, *Sustainability*, Vol. 11, Iss. 23, pp.6575, https://doi.org/10.3390/su11236575 [accessed 15th April 2020].
- Tobler, C., Visschers, V.H.M. and Siegrist, M. (2011). Eating green: consumers' willingness to adopt ecological food consumption behaviors, *Appetite*, Vol. 57, Iss. 3, pp. 674-682, https://doi.org/10.1016/j.appet.2011.08.010 [accessed 15th April 2019].
- Tol, R.S.J. (2002). Estimates of the damage costs of climate change part ii: dynamic estimate, *Environmental and Resource Economics*, Vol. 21, pp.135-160, https://doi.org/10.1023/A:1014539414591 [accessed 15th April 2019].
- Tol, R.S.J. (2002). Estimates of the damage costs of climate change part i: benchmark estimates, *Environmental and Resource Economics*, Vol. 21, pp.47–73, https://doi.org/10.1023/A:1014500930521 [accessed 15th April 2019].
- Tol, R.S.J. (2009). The economic effects of climate change, *Journal of Economic Perspectives*, Vol. 23, No. 2, Spring, pp.29-51, https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.23.2.29 [accessed 15th April 2019].

- Tol, R.S.J. (2016a). Comment on 'Quantifying the consensus on anthropogenic global warming in the scientific literature', *Environmental Research Letters*, Vol. 11, No. 4, pp.1-6, 048001, doi:10.1088/1748-9326/11/4/048001 [accessed 15th April 2019].
- Tol, R.S.J. (2016b). Debating climate economics: a response to Ackerman's critique of climate damage modelling, *Energy Research & Social Science*, Vol. 17, pp.165-166, doi: http://dx.doi.org/10.1016/j.erss.2016.04.006 [accessed 15th April 2019].
- Tol, R.S.J. (2018). Policy brief - leaving an emissions trading scheme: implications for the United Kingdom and the European Union, *Review of Environmental Economics and Policy*, Vol. 12, No. 1, pp.183-189, https://doi.org/10.1093/reep/rex025 [accessed 15th April 2019].
- Tol, R.S.J. (2018). The economic impacts of climate change, *Review of Environmental Economics and Policy*, Vol. 12, No. 1, pp.4-25, https://doi.org/10.1093/reep/rex027 [accessed 15th April 2019].
- Toles, T. (2018). A last call to save the planet. But, really, so what, *Washington Post*, 8th October, https://www.washingtonpost.com/ [accessed 15th April 2019].
- Tollefson, J. (2016). Precipitation extremes are affecting even arid parts of the world, study shows, *Nature*, 7th March, doi:10.1038/nature.2016.19508.
- Tollina, K. and Vej, J. (2012). Sustainability in business - understanding meanings, triggers and enablers, *Journal of Strategic Marketing*, Vol. 20, No. 7, pp.625-641, https://doi.org/10.1080/0965254X.2012.711347 [accessed 15th April 2019].
- Tom, M.S., Fischbeck, P.S. and Hendrickson, C.T. (2016). Energy use, blue water footprint, and greenhouse gas emissions for current food consumption patterns and dietary recommendations in the US, *Environment Systems & Decisions*, Vol. 36, pp.92-103, doi:10.1007/s10669-015-9577-y.
- Tomlinson, I. (2013). Doubling food production to feed the 9 billion: a critical perspective on a key discourse of food security in the UK, *Journal of Rural Studies*, Vol. 29, pp. 81-90, doi: 10.1016/j.jrurstud.2011.09.001 [accessed 10th March 2017].
- Tones, S. (2019). Horticulture. In: *Brexit prospects for UK horticulture trade*, AHDB Horizon Market Intelligence, February, Stoneleigh, UK: Agriculture and Horticulture Development Board, https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/HortBitsize190206_WEB.pdf [accessed 15th April, 2019].
- Torjesen, I. (2019). WHO pulls support from initiative promoting global move to plant based foods, *British Medical Journal*, Vol. 365, doi: https://doi.org/10.1136/bmj.l1700 [accessed 15th April 2019].
- Török, T.J., Tauxe, R.V., Wise, R.P., Livengood, J.R., Sokolow, R., Mauvais, S., Birkness, K.A., Skeels, M.R., Horan, J.M. and Foster, L.R. (1997). A large community outbreak of salmonellosis caused by intentional contamination of restaurant salad bars, *Journal of the American Medical Association*, Vol. 278, No. 5, pp.389-395, doi: 10.1001/jama.1997.03550050051033.
- Torquebiau, E. (Ed.) (2016). *Climate change and agriculture worldwide*, Springer Netherlands, doi: 10.1007/978-94-017-7462-8.

- Tørris, C. and Mobekk, H. (2019). Improving cardiovascular health through nudging healthier food choices: a systematic review, *Nutrients,* Vol. 11, No. 10, pp.2520, doi: 10.3390/nu11102520.
- Toynbee, P. (2017). No wonder farmers fear the Brexit wolf in sheep's clothing, *The Guardian*, Opinion, 1st August, https://www.theguardian.com/commentisfree/2017/aug/01/farmers-brexit-wolf-sheep-voted-leave-eu-subsidy-tory-enemies [accessed 15th April 2019].
- Trace, S. (2014). Improving food security - why agro-ecological approaches to farming are vital if we are to maintain genetic diversity and grow a genuinely food-secure world, *The Economist*, 8th July,
- Trace, S. (2015). Adapting to climate change, *The Economist*, 11th February, http://www.economistinsights.com/energy/opinion/adapting-climate-change [accessed 15th April 2019].
- Traoré, M., Thompson, B. and Thomas, G. (2012). *Sustainable nutrition security: restoring the bridge between agriculture and health*, Rome, Italy: Food and Agriculture Organization of the United Nations.
- Trase Yearbook (2018). *Sustainability in forest-risk supply chains: spotlight on Brazilian soy*, http://resources.trase.earth/documents/TraseYearbook2018_ExecutiveSummary.pdf [accessed 15th April 2019].
- Tripathi, A., Kumar, D., Tripathi, D.K., Chauhana, D.K., Nira, C., Kumar, N. and Singh, G.S. (2016). Paradigms of climate change impacts on some major food sources of the world: a review on current knowledge and future prospects, *Agriculture, Ecosystems & Environment*, Vol. 216, pp.356-373, doi: 10.1016/j.agee.2015.09.034.
- Trnka, M., Hlavinka, P. and Semenov, M.A. (2015). Adaptation options for wheat in Europe will be limited by increased adverse weather events under climate change, *Journal of the Royal Society Interface*, Vol. 12, 20150721, pp.112, https://doi.org/10.1098/rsif.2015.0721 [accessed 15th April 2019].
- Trnka, M., Rotter, R.P., Ruiz-Ramos, M., Kersebaum, K.C., Olesen, J.E., Zalud, Z. and Semenov, M.A. (2014). Adverse weather conditions for European wheat production will become more frequent with climate change, *Nature Climate Change*, Vol. 4, pp.637-643, https://doi.org/10.1038/nclimate2242 [accessed 15th April 2019].
- Troell, M., Naylor, R., Metian, M., Beveridge, M., Tyedmers, P., Folke, C., Österblom, H., de Zeeuw, A., Scheffer, M., Nyborg, K., Barrett, S., Crépin, A-S., Ehrlich, P., Levin, S., Xepapadeas, T., Polasky, S., Arrow, K., Gren, Å., Kautsky, N., Mäler, K-G., Taylor, S. and Walker, B. (2014). Does aquaculture add resilience to the global food system? *Proceedings of the National Academy of Sciences*, Vol. 111, pp.13257-13263, https://doi.org/10.1073/pnas.1404067111 [accessed 15th April 2019].
- Trott, P. and Simms, C. (2017). An examination of product innovation in low- and medium-technology industries - cases from the UK packaged food, *Research Policy*, Vol. 46, Iss. 3, pp.605-623, https://doi.org/10.1016/j.respol.2017.01.007 [accessed 15th April 2019].

- Trowsdale, A., Housden T., and Meier, B. (2017). Seven charts that explain the plastic pollution problem, *BBC News*, 10th December, http://www.bbc.co.uk/news/science-environment-42264788 [accessed 15th April 2019].
- Trudge, C. (2016). *Six steps back to the land. Why we need small mixed farms and millions more farmers*, Cambridge, UK: Green Books, ISBN-10: 0857841238.
- Truelove, H. and Parks, C. (2012). Perceptions of behaviours that cause and mitigate global warming and intentions to perform these behaviours, *Journal of Environmental Psychology*, Vol. 32, No. 3, pp.246-259, https://doi.org/10.1016/j.jenvp.2012.04.002 [accessed 15th April 2019].
- Trujillo, P., Piroddi, C. and Jacquet, J. (2012). Fish farms at sea: the ground truth from google earth, *PLoS One*, Vol. 7, No. 2, e30546, doi:10.1371/journal.pone.0030546.
- TSB (2011). *Competitive briefing - sustainable protein production*, London, UK: Technology Strategy Board.
- Tubb, C. and Seba, T (2019). *Rethinking food and agriculture 2020-2030: the second domestication of plants and animals, the disruption of the cow, and the collapse of industrial livestock farming*, September, A RethinkX Sector Disruption Report, www.rethinkx.com [accessed 15th April 2019].
- Tubiello, F.N., Salvatore, M., Ferrara, A.F., House, J., Federici, S., Rossi, S., Biancalani, R., Golec, R.D.C., Jacobs, H., Flammini, A., Prosperi, P., Cardenas-Galindo, P., Schmidhuber, J., Sanchez, M.J.S., Srivastava, N. and Smith, P. (2015). The contribution of agriculture, forestry and other land use activities to global warming, 1990-2012, *Global Change Biology*, Vol. 21, pp.2655-2660, https://doi.org/10.1111/gcb.12865 [accessed 15th April 2019].
- Tubiello, N., Biancalani, R., Salvatore, M., Rossi, S. and Conchedda, G. (2016). A worldwide assessment of greenhouse gas emissions from drained organic soils, *Sustainability*, Vol. 8, doi:10.3390/su8040371.
- Tukker, A., Bulavskaya, T., Giljum, S., de Koning, A., Lutter, S., Simas, M., Stadler, K. and Wood, R. (2014). *The global resource footprint of nations: carbon, water, land and materials embodied in trade and final consumption calculated with EXIOBASE 2.1*, Leiden/Delft/Vienna/Trondheim, ISBN: 978-3-200-03637-6.
- Tukker, A., Emmert, S., Charter, M., Vezzoli, C., Eivind, S., Lahlou, S., Andersen, M.M., Theo, G., and Tischner, U. (2008). Fostering change to sustainable consumption and production: an evidence based view (A framework for policy and action for sustainable consumption and production), *Journal of Cleaner Production*, Vol. 16, Iss. 11, pp.1218-1225, https://doi.org/10.1016/j.jclepro.2007.08.015 [accessed 15th April 2019].
- Tukker, A., Huppes, G., Guinée, J., Heijungs, R., de Koning, A., van Oers, L., Suh, S., Geerken, T., Van Holderbeke, M., Jansen, B. and Nielsen, P. (2006). Environmental Impact of Products (EIPRO). *Analysis of the life cycle environmental impacts related to the final consumption of the EU-25*, European Commission: Joint Research Centre, Institute for Prospective Technological Studies.

- Tullis, P. (2019). How the world got hooked on palm oil, *The Guardian*, 19th February, https://www.theguardian.com/news/2019/feb/19/palm-oil-ingredient-biscuits-shampoo-environmental [accessed 15th April 2019].
- Tulloch, L. (2013). On science, ecology and environmentalism, *Policy Futures in Education*, Vol. 11, pp.100-114, https://doi.org/10.2304/pfie.2013.11.1.100 [accessed 15th April 2019].
- Tuomisto, H.L. (2019). The eco-friendly burger: could cultured meat improve the environmental sustainability of meat products? *EMBO Reports*, Vol. 20, No. 1, doi: 10.15252/embr.201847395.
- Tuomisto, H.L., Scheelbeek, P.F.D., Chalabi, Z., Green, R., Smith, R.D. Haines, A. and Dangour, A.D. (2017). Effects of environmental change on agriculture, nutrition and health: a framework with a focus on fruits and vegetables, *Wellcome Open Research*, Vol. 2, No. 21, doi: 10.12688/wellcomeopenres.11190.2.
- Turbutt, C., Richardson, J. and Pettinger, C. (2019). The impact of hot food takeaways near schools in the UK on childhood obesity: a systematic review of the evidence, *Journal of Public Health*, Vol. 41, Iss. 2, pp.231-239, doi: 10.1093/pubmed/fdy048.
- Turner, G. (2014). *Is global collapse imminent?* MSSI Research Paper No. 4, Melbourne Sustainable Society Institute, Melbourne, Australia: The University of Melbourne, ISBN: 978 0 7340 4940 7.
- Turner, G. and Alexander, C. (2014). Limits to growth was right: new research shows we're nearing collapse, *The Guardian*, 2nd September, https://www.theguardian.com/commentisfree/2014/sep/02/limits-to-growth-was-right-new-research-shows-were-nearing-collapse [accessed 15th April 2019].
- Turner, G.M., Larsen, K., Candy, S., Ogilvy, S., Ananthapavan, J., Moodie, M., James, S.W., Friel, S., Ryan, C.J. and Lawrence, M.A. (2018). Squandering Australia's food security – the environmental and economic costs of our unhealthy diet and the policy Path We're On, *Journal of Cleaner Production*, Vol. 195, pp.1581-1599, doi:10.1016/j.jclepro.2017.07.072.
- Turner, S.W.D., Hejazi, M., Calvin, K., Kyle, P. and Kim, S. (2019). A pathway of global food supply adaptation in a world with increasingly constrained groundwater, *Science of the Total Environment*, Vol. 673, pp.165-176, https://doi.org/10.1016/j.scitotenv.2019.04.070 [accessed 15th April 2019].
- Turney, C., Palmer, J. and Maslin, M. (2018). Anthropocene began in 1965, according to signs left in the world's 'loneliest tree', *The Conversation*, 19th February, https://theconversation.com/anthropocene-began-in-1965-according-to-signs-left-in-the-worlds-loneliest-tree-91993 [accessed 15th April 2019].
- Turra, C. (2018). Sustainability of rare earth elements chain: from production to food – a review, *International Journal of Environmental Health Research*, Vol. 28, No. 1, pp.23-42, doi: 10.1080/09603123.2017.1415307.

- Turton, R., Bruidegom, K., Cardi, V., Hirsch, C.R. and Treasure, J. (2016). Novel methods to help develop healthier eating habits for eating and weight disorders: a systematic review and meta-analysis, *Neuroscience and Biobehavioral reviews,* Vol. 61, pp.132-155, doi:10.1016/j.neubiorev.2015.12.008.
- Tutwiler (2017). Chips, chocolate and coffee – are food crops facing mass extinction, too? *The Guardian*, 26th September, https://www.theguardian.com/environment/2017/sep/26/chips-chocolate-and-coffee-our-food-crops-face-mass-extinction-too [accessed 15th April 2019].
- Tutwiler, A., Padulosi, S. and Hunter, D. (2017). Securing sustainable and nutritious food systems through mainstreaming agricultural biodiversity: an interdisciplinary study, *The Lancet*, Vol. 389, No. 2, pp.S22, https://doi.org/10.1016/S0140-6736(17)31134-0 [accessed 15th April 2019].
- Tutwiler, M.A. (2015). Bringing biodiversity into the green revolution equation, *Global Food Security Challenges*, Milano Università degli Studi di Milano, 7th-8th August.
- Tyczewska, A., Wozniak, E., Gracz, J., Kuczynski, J. and Twardowski, T. (2018). Towards food security: current state and future prospects of agrobiotechnology, *Trends in Biotechnology*, Vol. 36, No. 12, pp.1219-1229, doi:https://doi.org/10.1016/j.tibtech.2018.07.008.
- U.N.D.S.A. (2015). *Probabilistic population projections based on the world population prospects: the 2015 revision, key findings and advance tables*, The United Nations Population Division of the Department of Economic and Social Affairs, Population Division, Working Paper ESA/P/WP.241, New York, USA: United Nations.
- Uitto, J.I. (2016). The environment-poverty nexus in evaluation - implications for the Sustainable Development Goals, *Global Policy*, Vol. 7, Iss. 3, September, doi: 10.1111/1758-5899.12347.
- UK Cabinet Office (2019). Food an analysis of the issues, The Strategy Unit, January 2008,
- UK Climate Change Risk Assessment (2017). *Evidence Report*,
- UK Health Forum (2018). Fresh start - a framework for healthy and sustainable diets in the UK — recommendations for action, London, UK: UK Health Forum, http://ukhealthforum.org.uk/ [accessed 15th April 2019].
- UK Health Forum (2018). Fresh start - a framework for healthy and sustainable diets in the UK — situational analysis, London, UK: UK Health Forum, http://ukhealthforum.org.uk/ [accessed 15th April 2019].
- UK Health Forum (2018). *Fresh start: a framework for healthy and sustainable diets in the UK — policy options review*, London, UK: UK Health Forum, ISBN: 978-1-874279-19-8, http://ukhealthforum.org.uk/ [accessed 15th April 2019].
- UK Roundtable on Sustainable Soya (2019). *Annual progress report, 2019*, Dorchester, UK: Efeca Consultants, https://www.efeca.com/ [accessed 11th June, 2020].

- UKHACC (2016). *A breath of fresh air, addressing climate change and air pollution together for health*, London, UK: UK Health Alliance on Climate Change, www.ukhealthalliance.org [accessed 11th April 2019].
- UKHACC (2019a). *Briefing on the Environment Bill (2nd Reading)*, London, UK: UK Health Alliance on Climate Change, http://www.ukhealthalliance.org/wpcontent/uploads/2019/11/UKHACC-Environment-Bill-Briefing-Second-Reading.pdf [accessed 15th April 2019].
- UKHACC (2019b). US withdrawal from climate agreement puts health at risk around the world, London, UK: UK Health Alliance on Climate Change, http://www.ukhealthalliance.org/us-withdrawal-from-climate-agreement-puts-peoples-health-at-risk/ [accessed 15th April 2019].
- UKHACC (2020). *Health and climate change: co-benefits*, London, UK: UK Health Alliance on Climate Change, http://www.ukhealthalliance.org/health-climate-change/ [accessed 11th April 2020].
- UKSSD (2018). *Measuring up - how the UK is performing on the UN Sustainable Development Goals – Executive Summary*, London, UK: UK Stakeholders for Sustainable Development (UKSSD), https://www.ukssd.co.uk/measuringup [accessed 15th April 2019].
- UK-US Taskforce (2015). *Extreme weather and global food system resilience*, The Global Food Security programme, UK, www.foodsecurity.ac.uk/assets/pdfs/extreme-weather-resilience-of-global-food-system.pdf [accessed 15th April 2019].
- Ullah, H., Nagelkerken, I., Goldenberg, S.U. and Fordham, D.A. (2018). Climate change could drive marine food web collapse through altered trophic flows and cyanobacterial proliferation, *PLOS Biology*, Vol. 16, No. 1, pp.e2003446, doi.org/10.1371/journal.pbio.2003446.
- Ulrich von Weizsäcker, E. and Wijkman, A. (2018). *Come on! Capitalism, short-termism, population and the destruction of the planet*, Winterthur, Switzerland: Club of Rome, ISBN 978-1-4939-7418-4.
- Umar, M.S., Jennings, P. and Urmee, T. (2013). Strengthening the palm oil biomass - renewable energy industry in Malaysia, *Renewable Energy*, Vol. 60, pp.107-115, http://dx.doi.org/10.1016/j.renene.2013.04.010 [accessed 15th April 2019].
- UN (1987). *Our Common Future: Report of the World Commission on Environment and Development*, Oxford, UK: Oxford University Press, http://www.un-documents.net/our-common-future.pdf [accessed 15th April 2019].
- UN (2011). Ban urges leaders to show greater commitment to agreement on climate change, Geneva, Switzerland: United Nations, https://news.un.org/en/story/2011/09/387382 [accessed 15th April 2019].
- UN (2012). *The future we want*, Resolution adopted by the General Assembly on 27th July 2012, 11th September, Geneva, Switzerland: United Nations, https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf [accessed 15th April 2019].

- UN (2012). *Toolkit and guidance for preventing and managing land and natural resources conflict*, Geneva, Switzerland: United Nations Interagency Framework Team for Preventive Action.
- UN (2015a). *Agenda for Sustainable Development web*, Geneva, Switzerland: United Nations.
- UN (2015b). *Life below water - why it matters*, prepared for the third meeting of the Global Ocean Commission, November, Geneva, Switzerland: United Nations.
- UN (2015c). Preventing our oceans from becoming dumps, Geneva, Switzerland: United Nations, https://www.youtube.com/watch?v=uCXEHrmEYpM&feature=youtu.be [accessed 11th April 2019].
- UN (2015d). *Sustainable development goal for the global ocean*, Geneva, Switzerland: United Nations.
- UN (2015e). Sustainable Development Goals, Geneva, Switzerland: United Nations, http://www.un.org/sustainabledevelopment/hunger/ [accessed 15th April 2019].
- UN (2015f). Sustainable Development Goals, Geneva, Switzerland: United Nations, www.un.org/ sustainabledevelopment/sustainable-development-goals/ [accessed 15th April 2019].
- UN (2015g). *World Population Prospects, the 2015 Revision*, Geneva, Switzerland: United Nations Department of Economic and Social Affairs, Population Division, http://esa.un.org/unpd/wpp/ [accessed 15th April 2019].
- UN (2017a). *Report of the Special Rapporteur on the right to food*, 24th January, Geneva, Switzerland: United Nations.
- UN (2017b). *Sustainable consumption and production*, Geneva, Switzerland: United Nations, http://www.un.org/sustainabledevelopment/sustainable-consumption-production/ [accessed 15th April 2019].
- UN (2018a). *Hunger and food security*, Geneva, Switzerland: United Nations, http://www.un.org/sustainabledevelopment/hunger/ [accessed 15th April 2019].
- UN (2018b). *Water shortages could affect 5bn people by 2050*, Geneva, Switzerland: United Nations.
- UN (2019). High-Level Political Forum Goals in Focus - Goal 12: ensure sustainable consumption and production, Geneva, Switzerland: United Nations, https://unstats.un.org/sdgs/report/2018/goal-12/ [accessed 15th April 2019].
- UN- WWAP (2018). *The United Nations World Water Development Report 2018: nature-based solutions for water*, United Nations World Water Assessment Programme/UN-Water, Paris, United Nations Educational, Scientific and Cultural Organization (UNESCO).
- UNCCD (2016). *Sustainable food production: facts and figures*, Bonn, Germany: United Nations Convention to Combat Desertification, https://knowledge.unccd.int/publications/sustainable-food-production-facts-and-figures [accessed 15th April 2019].
- UNCCD (2017). *Global land outlook*, First Edition, Bonn, Germany: United Nations Convention to Combat Desertification.
- UNCSD (2011). *Food security and sustainable agriculture*, Rio de Janeiro, Brazil: United Nations Conference on Sustainable Development.

- UNCSD (2011). *The transition to a green economy - benefits, challenges and risks from a sustainable development perspective*, United Nations Conference on Trade and Development (UNCTAD), United Nations Environment Programme (UN Environment), United Nations Department of Economic and Social Affairs (UN DESA).
- UNCTAD (2013). *Wake up before it is too late: make agriculture truly sustainable now for food security in a changing climate,* trade and environment review 2013, Geneva: UN Conference on Trade and Development, http://unctad.org/en/PublicationsLibrary/ditcted2012d3_en.pdf [accessed 15th April 2019].
- UNDP (2014). *Sustaining human progress: reducing vulnerabilities and building resilience*, Human Development Report 2014, New York, United Nations Development Programme.
- Unearthed (2018). US plastic waste is causing environmental problems at home and abroad, https://unearthed.greenpeace.org/2018/10/05/plastic-waste-china-ban-united-states-america/ [accessed 15th April 2019].
- UNEP (2009). *Assessing biofuels: towards sustainable production and use of resources*, Geneva, Switzerland: United Nations Environment Programme.
- UNEP (2010). ABC of SCP clarifying concepts on sustainable consumption and production, Geneva, Switzerland: United Nations Environment Programme, https://www.oneplanetnetwork.org/sites/default/files/10yfp-abc_of_scp-en.pdf [accessed 15th April 2019].
- UNEP (2010). *Assessing the environmental impacts of consumption and production: priority products and materials*, Geneva, Switzerland: United Nations Environment Programme.
- UNEP (2012). *Avoiding future famines - strengthening the ecological foundation of food security through sustainable food systems*, Geneva, Switzerland: United Nations Environment Programme.
- UNEP (2015). *Product sustainability information - state of play and way forward*, Geneva, Switzerland: United Nations Environment Programme.
- UNEP (2018). *Emissions gap report 2018*, Geneva, Switzerland: United Nations Environment Programme.
- UNEP (2019). Collaborative framework for food systems transformation: a multi-stakeholder pathway for sustainable food systems, United Nations Environment Programme, ISBN: 978-92-807-3753-0, http://www.oneplanetnetwork.org/ sustainable-food-system
- UNEP (2020). *Goodlife Goals Manual*, Vernier, Switzerland: United Nations Environment Programme / United Nations Educational, Scientific and Cultural Organization (UNESCO), https://wedocs.unep.org/handle/20.500.11822/26433 [accessed 15th April 2019].
- UNHCR (2018). *Forced displacement in 2017*, Geneva, Switzerland: United Nations High Commissioner for Refugees.
- Unilever (2010). *Sustainable agriculture code*, Kingston upon Thames, UK: Unilever PLC.
- Unilever (2012). *Sustainable living - customers & suppliers*, Kingston upon Thames, UK: Unilever PLC.

- Unilever (2014). *Unilever marketing and advertising principles for responsible food and beverage marketing*, Kingston upon Thames, UK: Unilever PLC.
- Unilever (2016). Making food go further: a joint ambition for a zero food waste Britain, Kingston upon Thames, UK: Unilever PLC.
- Union of Concerned Scientists (2019). Champions of breakfast - how cereal-makers can help save our soil, support farmers, and take a bite out of climate change, https://blog.ucsusa.org/elliott-negin/how-can-cereal-makers-help-save-our-soil-support-farmers-and-take-a-bite-out-of-climate-change [accessed 15th April 2019].
- United Nations (2015). *Paris Agreement*, United Nations Treaty Collection, treaties.un.org/doc/Publication/MTDSG/Volume%20II/Chapter%20XXVII/XXVII-7-d.en.pdf [accessed 15th April 2019].
- United Nations Framework Convention on Climate Change (2018). *Climate; get the big picture*, https://unfccc.int/resource/bigpicture/ [accessed 15th April 2019].
- United Nations, Department of Economic and Social Affairs, Population Division (2017). *World population prospects 2017*, https://population.un.org/wpp/ [accessed 15th April 2019].
- United States Department of Agriculture (2017). *Food Composition Databases*, http://ndb.nal.usda.gov [accessed 15th April 2019].
- United States Government (2015). *Administration announces actions to protect communities from the impacts of climate change*, https://www.whitehouse.gov/the-press-office/2015/04/07/ fact-sheet-administration-announces-actions-protect-communitiesimpacts-2015 [accessed 11th April 2019].
- University of Connecticut (2019). The power of empathy in product development: Consideration of an end-user's feelings is a potent tool for developing products, *Science Daily*, 28th May, www.sciencedaily.com/releases/2019/05/190528120334.htm [accessed 15th April 2019].
- University of Washington (2017). Food photos help Instagram users with healthy eating, *ScienceDaily*, 26th April, www.sciencedaily.com/releases/2017/04/170426130410.htm [accessed 15th April 2019].
- UNSCN (2016). *Investments for healthy food systems - a framework analysis and review of evidence on food system investments for improving nutrition*, Implementing the Framework for Action of the Second International Conference on Nutrition, September, Rome, Italy: United Nations System Standing Committee on Nutrition.
- Upadhyay, V.K. and Sachdeva, K. (2010). Climate change and food security: priority concerns in Indian agricultural sector, *International Journal of Applied Environmental Sciences*, Vol. 5, No. 4, pp.553-557.
- Urban Food Futures (2019). Lessons from New York urban food policy, *Urban Food Futures*, March, https://urbanfoodfutures.com/author/albaneurbanfoodfutures/ [accessed 15th April 2019].
- Uren, S. (2014). Tea 2030 - a model of collaboration, *The Grocer*, 22nd February, p.20.

- Urquhart, C. and Kuznetsova, O. (2014). Editorial - special issue on new paradigms in business - engaging for sustainability, *Social Business*, Vol. 4, No. 1, pp.1-6, http://dx.doi.org/10.1362/204440814X13948909253668 [accessed 15th April 2019].
- Urquhart, G., Chomentowski, W., Skole, D. and Barber, C. (2012). Tropical deforestation 2001, *NASA Earth Observatory*, https://msu.edu/user/urquhart/rainforest/Content/deforestation.html [accessed 15th April 2019].
- US Department of Energy (2017). *Alternative fuels data center, Maps and Data*, http://www.afdc.energy.gov/data/ [accessed 15th April 2019].
- USDA (2016). *A guide to smart snacks in school*, Food & Nutrition Service, Washington, USA, https://www.fns.usda.gov/tn/guide-smart-snacks-school [accessed 15th April 2019].
- USDA (2020). PSD Online, https://apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery [accessed 15th April 2020].
- USDARS (2010). *Nutrient database for standard reference*, Release 23, USDA Agricultural Research Service, http://www.ars.usda.gov/ba/bhnrc/ndl [accessed 15th April 2019].
- USDH and USDA (2015). *Dietary guidelines for Americans, 2015–2020*, 8th Edition, U.S. Department of Health and Human Services and U.S. Department of Agriculture, Washington, USA: U.S. Government Printing Office, https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf [accessed 15th April 2019].
- USGCRP (2018). *Impacts, risks, and adaptation in the United States: fourth national climate assessment*, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. Washington, DC: U.S. Global Change Research Program, doi: 10.7930/NCA4.2018.
- Utne, I.B. (2008). Are the smallest fishing vessels the most sustainable - trade-off analysis of sustainability attributes, *Marine Policy*, Vol. 32, pp.465-474, doi:10.1016/j.marpol.2007.09.016.
- Vaccari, D.A., Powers, S.M. and Liu, X. (2019). Demand-driven model for global phosphate rock suggests paths for phosphorus sustainability, *Environmental Science & Technology*, Vol. 53, No. 17, pp.10417-10425, doi: 10.1021/acs.est.9b02464.
- Vaclavinkova, K. (2012). Food made of organic food as a means of sustainability in a caring economics, *China-USA Business Review*, Vol. 11, No. 10, October, pp.1367-1377, ISSN 1537-1514.
- Vaitkeviciute, R., Ball, L.E. and Harris, N. (2015). The relationship between food literacy and dietary intake in adolescents: a systematic review, *Public Health Nutrition*, Vol. 18, Iss. 4, pp.649-658, doi: 10.1017/S1368980014000962.
- Valadés, P.S-P., Posada de la Paz, P.M., de Andre´s Copa, P., Ribota, O.G. and Borda, I.A. (2003). Toxic oil syndrome - survival in the whole cohort between 1981 and 1995, *Journal of Clinical Epidemiology*, Vol. 56, pp.701-708, doi: 10.1016/S0895-4356(03)00119-7.
- Valenta, O. (2015). Core drivers of change for future of healthy lives and diets, *Ergo*, Vol. 10, No. 4, pp.21-28, doi: https://doi.org/10.1515/ergo-2015-0011 [accessed 15th April 2019].

- Valin, H., Sands, R.D., van der Mensbrugghe, D., Nelson, G.C., Ahammad, H., Blanc, E., Bodirsky, B., Fujimori, S., Hasegawa, T., Havlik, P., Heyhoe, E., Kyle, P., Mason-D'Croz, D., Paltsev, S., Rolinski, S., Tabeau, A., van Meijl, H., von Lampe, M. and Willenbockel, D. (2014). The future of food demand: understanding differences in global economic models, *Agricultural Economics*, Vol. 45, pp.51-67, doi:10.1111/agec.12089.
- Valizadeh, J., Ziaei, S.M. and Mazloumzadeh, S.M. (2014). Assessing climate change impacts on wheat production (a case study), *Journal of the Saudi Society of Agricultural Sciences*, Vol. 13, Iss. 2, pp.107-115, https://doi.org/10.1016/j.jssas.2013.02.002 [accessed 15th April 2019].
- Valli, C., Rabassa, M., Johnston, B.C., Kuijpers, R., Prokop-Dorner, A., Zajac, J., Storman, D., Storman, M., Bala, M.M., Solà, I., Zeraatkar, D., Han, M.A., Vernooij, R.W.M., Guyatt, G.H. and Alonso-Coello, P. (2019). Health-related values and preferences regarding meat consumption: a mixed-methods systematic review, Annals of Internal Medicine, Vol. 171, No. 10, pp.742-755, doi:10.7326/M19-1326.
- van Berkum, S., Dengerink, J. and Ruben, R. (2018). The food systems approach: sustainable solutions for a sufficient supply of healthy food, Memorandum 2018-064, Wageningen, The Netherlands: Wageningen Economic Research.
- van de Kamp, M.E., Seves, S.M. and Temme, E.H.M. (2018). Reducing GHG emissions while improving diet quality: exploring the potential of reduced meat, cheese and alcoholic and soft drinks consumption at specific moments during the day, BMC Public Health, Vol. 20, No. 18(1), pp.264, doi: 10.1186/s12889-018-5132-3.
- van de Kamp, M.E., van Dooren, C., Hollander, A., Geurts, M., Brink, E.J., van Rossum, C., Biesbroek, S., de Valk, E., Toxopeus, I.B. and Temme, E.H.M. (2018). Healthy diets with reduced environmental impact? The greenhouse gas emissions of various diets adhering to the Dutch food based dietary guidelines, Food Research International, Vol. 104, pp.14-24, https://doi.org/10.1016/j.foodres.2017.06.006 [accessed 15th April 2019].
- van den Bosch, F., Oliver, R., van den Berg, F. and Paveley, N. (2014). Governing principles can guide fungicide-resistance management tactics, *Annual Review of Phytopathology*, Vol. 52, pp.175-195, doi:10.1146/annurev-phyto-102313-050158.
- van der Leeuw, S. (2018). Closing remarks: novel approaches to complex societal change and sustainability, *Sustainability Science*, Vol. 13, No. 6, pp.1589-1596, https://doi.org/10.1007/s11625-018-0581-2 [accessed 15th April 2019].
- van der Linden, S.L., Leiserowitz, A.A., Feinberg, G.D. and Maibach, E.W. (2015). The scientific consensus on climate change as a gateway belief: experimental evidence, *PLoS One*, Vol. 10, Iss. 2, e0118489, doi:10.1371/journal.pone.0118489.
- Van Der Ploeg, J.D. (2010). The food crisis, industrialized farming and the imperial regime, *Journal of Agrarian Change*, Vol. 10, No. 1, pp.98-106, https://doi.org/10.1111/j.1471-0366.2009.00251.x.

- van der Ven, H., Rothacker, C. and Cashore, B. (2018). Do eco-labels prevent deforestation? Lessons from non-state market driven governance in the soy, palm oil, and cocoa sectors, *Global Environmental Change*, Vol. 52, pp.141-151, https://doi.org/10.1016/j.gloenvcha.2018.07.002 [accessed 11th April 2020].
- van der Zee, B. (2017). UK is 30-40 years away from 'eradication of soil fertility', warns Gove, *The Guardian*, 24th October, https://www.theguardian.com/environment/2017/oct/24/uk-30-40-years-away-eradication-soil-fertility-warns-michael-gove [accessed 15th April 2019].
- Van Dijck, J. and Poell, T. (2013). Understanding social media logic, *Media and Communication*, Vol. 1, pp.2-14, doi: http://dx.doi.org/10.17645/mac.v1i1.70.
- van Dooren, C. (2018). *Simultaneous optimisation of nutritional quality and environmental sustainability of diets*, PhD thesis, Amsterdam, The Netherlands: Vrije Universiteit Netherlands Nutrition Centre, doi: 10.13140/RG.2.2.35539.07202.
- van Dooren, C., Marinussen, M., Blonk, H., Aiking, H. and Vellinga, P. (2014). Exploring dietary guidelines based on ecological and nutritional values - comparison of six dietary patterns, *Food Policy*, Vol. 44, pp.36-46, http://dx.doi.org/10.1016/j.foodpol.2013.11.002 [accessed 15th April 2019].
- van Drecht, A., Bouwman, F., Knoop, J.M., Beusen, A.H.W. and Meinardi, C.R. (2003). Global modeling of the fate of nitrogen from point and nonpoint sources in soils, groundwater, and surface water, *Global Biogeochemical Cycles*, Vol. 17, No. 1115, https://doi.org/10.1029/2003GB002060 [accessed 15th April 2019].
- van Hoof, L., Fabi, G., Johansen, V., Steenbergen, J., Irigoien, X., Smith, S., Lisbjerg, D. and Kraush, G. (2019). Food from the ocean; towards a research agenda for sustainable use of our oceans' natural resources, *Marine Policy*, Vol. 105, pp.44-51, https://doi.org/10.1016/j.marpol.2019.02.046 [accessed 15th April, 2020].
- van Hoof, L., Fabi, G., Johansen, V., Steenbergen, J., Irigoien, X., Smith, S. (2019). Food from the ocean; towards a research agenda for sustainable use of our oceans' natural resources, *Marine Policy*, Vol. 105, pp.44-51, https://doi.org/10.1016/j.marpol.2019.02.046 [accessed 15th April 2019].
- van Ittersum, M.K. (2016). Crop yields and global food security. Will yield increase continue to feed the world? *European Review of Agricultural Economics*, Vol. 43, Iss. 1, pp. 191-192, https://doi.org/10.1093/erae/jbv034 [accessed 15th April 2019].
- Van Kernebeek, H.R.J., Oosting, S.J., Feskens, E.J.M., Gerber, P.J. and De Boer, I.J.M. (2014). The effect of nutritional quality on comparing environmental impacts of human diets, *Journal of Cleaner Production*, Vol. 73, pp.88-99, https://doi.org/10.1016/j.jclepro.2013.11.028 [accessed 15th April 2019].
- Van Loo, E.J., Hoefkens, C. and Verbeke, W. (2017). Healthy, sustainable and plant-based eating: perceived (mis)match and involvement-based consumer segments as targets for future policy, *Food Policy*, Vol. 69, pp.46-57, doi: 10.1016/j.foodpol.2017.03.001.

- van Meijl, H. and Achterbosch, T. (2015). *The future of food and nutrition security in developing countries*, Global food security challenges, ICAE pre-conference, 7th July.
- van Meijl, H., Havlik, P., Lotze-Campen, H., Stehfest, E., Witzke, P., Domíınguez, I.P., Bodirsky, B.L., van Dijk, M., Doelman, J., Fellmann, T., Humpenöder , F., Koopman, J.F.L., Müller, C., Popp, A., Tabeau, A., Valin, H. and van Zeist, W-J. (2018). Comparing impacts of climate change and mitigation on global agriculture by 2050, *Environmental Research Letters*, Vol. 13, No. 6, 064021, doi: 10.1088/1748-9326/aabdc4.
- Van Middelaar, C.E., Berentsen, P.B.M., Dijkstra, J. and De Boera, J.M. (2013). Evaluation of a feeding strategy to reduce greenhouse gas emissions from dairy farming: the level of analysis matters, *Agricultural Systems*, Vol. 121, pp.9-22, https://doi.org/10.1016/j.agsy.2013.05.009 [accessed 15th April 2019].
- van Oort, P.A.J. and Zwart, S.J. (2018). Impacts of climate change on rice production in Africa and causes of simulated yield changes, *Global Change Biology*, pp.1029-1045, doi: 10.1111/gcb.13967.
- Van Passel, S. (2013). Food miles to assess sustainability: a revision, *Sustainable Development*, Vol. 21, pp.1-17, doi: 10.1002/sd.
- Van Passel, S., Massetti, E. and Mendelsohn, R. (2016). A Ricardian analysis of the impact of climate change on European agriculture, *Environmental and Resource Economics*, Vol. 67, Iss. 4, pp.725-760, doi: 10.1007/s10640-016-0001-y.
- van Reenen, E. (2019). *Final Report – GHG costs and benefits on different land classes*, Prepared for the Interim Climate Change Committee, Feilding, NewZealand: AgFirst Manawatu-Whanganui Ltd., www.agfirst.co.nz [accessed 11th April 2019].
- van Rijswijk, W. and Frewer, L.J. (2011). Consumer needs and requirements for food and ingredient traceability information, *International Journal of Consumer Studies*, Vol. 36, pp.282-290, doi: 10.1111/j.1470-6431.2011.01001.x.
- van Schalkwyk, M.C.I., Barlow, P., Stuckler, D., Rae, M., Lang, T., Monnet, T.H.J. and McKee, M. (2019). Assessing the health effects of a “no deal” Brexit, *British Medical Journal*, Vol. 366, l5300, doi: 10.1136/bmj.l5300.
- van Tongeren, F., van Meijl, H. and Surry, Y. (2001). Global models applied to agricultural and trade policies: a review and assessment, *Agricultural Economics*, Vol. 26, pp.149-172, https://doi.org/10.1016/S0169-5150(00)00109-2 [accessed 15th April 2019].
- van Vark, C. (2014). 10 drivers for sustainability in global food production and consumption, *Guardian Professional*, 17th October, http://futuresforumvgs.blogspot.com/2014/10/sustainable-food-production-and.html [accessed 15th April 2019].

- van Vuuren, D.P., Stehfest, E., Gernaat, D.E., Berg, M., Bijl, D.L., Boer, H.S., Daioglou, V., Doelman, J.C., Edelenbosch, O.Y., Harmsen, M. and Hof, A.F. (2018). Alternative pathways to the 1.5°C target reduce the need for negative emission technologies, *Nature Climate Change*, Vol. 8, pp.391-397, doi:10.1038/s41558-018-0119-8.
- van Wagenberg, C.P.A., Backus, G.B.C., Urlings, H.A.P. and van der Vorst, J.G.A.J. (2008). Impact of testing accuracy on incentive mechanisms - optimal control actions for Mycobacterium avium in the pork supply chain, *Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks*, 28th-30th May, Ede, the Netherlands.
- Van Zanten, H.H.E., Herrero, M., Hal, O.V., Röös, C., Muller, A., Garnett, T., Gerber, P.J., Schader, C. and De Boer, I.J.M. (2018). Defining a land boundary for sustainable livestock consumption, *Global Change Biology*, Vol. 24, pp.4185-4194, https://doi.org/10.1111/gcb.14321 [accessed 15th April 2019].
- van't Veer, P., Poppe, K.J. and Fresco, L.O. (2017). *Towards a European food and nutrition policy*, Wageningen; The Netherlands, Wageningen University, https://edepot.wur.nl/423602 [accessed 15th April 2019].
- Vanberge, G. (2017). *New world disorder – the next 20 years: hope or despair?* Capitalism in the 21st Century, *World Financial Review*, 5th May, http://www.worldfinancialreview.com/?p=17024 [accessed 15th April 2019].
- Vandergeten, E., Azadi, H., Teklemariam, D., Nyssen, J., Witlox, F. and Vanhaute, E. (2016). Agricultural outsourcing or land grabbing: a meta-analysis, *Landscape Ecology*, Vol. 31, No. 7, pp.1395-1417, doi: 10.1007/s10980-016-0365-y.
- Vanderhaegen, K., Akoyi, K.T., Dekoninck, W., Jocqué, R., Muys, B., Verbist, B. and Maertens, M. (2018). Do private coffee standards 'walk the talk' in improving socio-economic and environmental sustainability? *Global Environmental Change*, Vol. 51, pp.1-9, https://doi.org/10.1016/j.gloenvcha.2018.04.014 [accessed 11th April 2020].
- Vanderlee, L., Goorang, S., Karbasy, K., Vandevijvere, S. and L'Abbé, M.R. (2019). Policies to create healthier food environments in Canada: experts' evaluation and prioritized actions using the healthy food environment policy index (Food-EPI), *International Journal of Environmental Research and Public Healt*h, Vol. 16, No. 22, p.4473, doi: 10.3390/ijerph16224473.
- Vandevelde, M. (2017). J Sainsbury criticised over move to drop Fairtrade label from tea, *Financial Times*, 23rd May, https://www.ft.com/content/b0a5ba16-3fdd-11e7-82b6-896b95f30f58 [accessed 15th April 2019].
- Vanham, D. (2018). The water footprint of the EU: quantification, sustainability and relevance, *Water International*, Vol. 43, No. 6, pp.731-745, https://www.tandfonline.com/doi/full/10.1080/02508060.2018.1516097 [accessed 15th April 2019].

- Vanham, D., Comero, S., Gawlik, B.M. and Bidoglio, G. (2018). The water footprint of different diets within European sub-national geographical entities, *Nature Sustainability*, Vol. 1, pp.518-525, https://doi.org/10.1038/s41893-018-0133-x [accessed 15th April 2019].
- Vanham, D., Hoekstra, A.Y. and Bidoglio, G. (2013). Potential water saving through changes in European diets, *Environment International*, Vol. 61, pp.45-56, https://doi.org/10.1016/j.envint.2013.09.011 [accessed 15th April 2019].
- Vanham, D., Mekonnen, M.M. and Hoekstra, A.Y. (2013). The water footprint of the EU for different diets, *Ecological Indicators*, Vol. 32, pp.1-8, http://dx.doi.org/10.1016/j.ecolind.2013.02.020 [accessed 15th April 2019].
- Vardoulakis, S. and Heaviside, C. (eds) (2012). *Health effects of climate change in the UK 2012: current evidence, recommendations and research gaps*, September, Chilton, Didcot, UK: Centre for Radiation, Chemical and Environmental Hazards (Health Protection Agency), ISBN 978-0-85951-723-2.
- Varijakshapanicker, P., Mckune, S., Miller, L., Hendrickx, S., Balehegn, M., Dahl, G.E. and Adesogan, A.T. (2019). Sustainable livestock systems to improve human health, nutrition, and economic status, *Animal Frontiers*, Vol. 9, Iss. 4, pp.39-50, https://doi.org/10.1093/af/vfz041 [accessed 15th April 2019].
- Varotsos, C.A. and Efstathiou, M.N. (2019). Has global warming already arrived? *Journal of Atmospheric and Solar-Terrestrial Physics,* Vol. 182, pp.31-38, doi: https://doi.org/10.1016/j.jastp.2018.10.020 [accessed 15th April 2019].
- Vasilakopoulos, P., O'Neill, F.G., and Marshall, C.T. (2011). Misspent youth - does catching immature fish affect fisheries sustainability, *ICES Journal of Marine Science*, Vol. 68, pp.1525-1534, doi:10.1093/icesjms/fsr075.
- Vasilakopoulos, P., O'Neill, F.G. and Marshall, C.T. (2016). The unfulfilled potential of fisheries selectivity to promote sustainability, *Fish and Fisheries*, Vol. 17, No. 2, pp.399-416, https://doi.org/10.1111/faf.12117 [accessed 11th April 2020].
- Vásquez, F., Vita, G. and Müller, D.B. (2018). Food security for an aging and heavier population, *Sustainability*, Vol. 10, No. 3683, https://doi.org/10.3390/su10103683 [accessed 15th April 2019].
- Vassallo, P., Bastianoni, S., Beiso, I., Ridolfi, R. and Fabiano, M. (2007). Emergy analysis for the environmental sustainability of an inshore fish farming system, *Ecological Indicators*, Vol. 7, No. 2, pp.290-298, https://doi.org/10.1016/j.ecolind.2006.02.003 [accessed 15th April 2019].
- Vaughan, A. (2018). Conservatives' 25-year green plan: main points at a glance, *The Guardian*, 11th January, https://www.theguardian.com/environment/2018/jan/11/conservatives-25-year-green-plan-main-points-at-a-glance [accessed 15th April 2019].
- Vaughan, A. (2020). Antarctica's doomsday glacier is melting. Can we save it in time? *New Scientist*, 15th January, https://www.newscientist.com/article/mg24532650-900-antarcticas-doomsday-glacier-is-melting-can-we-save-it-in-time/ [accessed 15th April 2019].

- Vázquez, A.M. and González, P.A. (2015). Collective symbolic capital and sustainability: governing fishing communities in a knowledge economy, *Marine Policy*, Vol. 53, pp.21-26, https://doi.org/10.1016/j.marpol.2014.11.014 [accessed 15th April 2019].
- Vecchio, R. and Cavallo, C. (2019). Increasing healthy food choices through nudges: a systematic review, *Food Quality and Preference*, Vol. 78, No. 103714, https://doi.org/10.1016/j.foodqual.2019.05.014 [accessed 15th April 2020].
- Veen, E.J., Derkzen, P. and Wiskerke, J.S.C. (2012). Motivations, reflexivity and food provisioning in alternative food networks case studies in two medium-sized towns in the Netherlands, *International Journal of Sociology of Agriculture and Food*, Vol. 19, No. 3, pp.365-382.
- Veldhuizen, L.J.L., Berentsen, P.B.M. and Bokkers, E.A.M. (2015). Social sustainability of cod and haddock fisheries in the northeast Atlantic, *Journal of Cleaner Production*, Vol. 94, pp.76-85, https://doi.org/10.1016/j.jclepro.2015.01.078 [accessed 15th April 2019].
- Veldhuizen, L.J.L., Berentsen, P.B.M., Bokkers, E.A.M. and de Boer, I.J.M. (2015). A method to assess social sustainability of capture fisheries: an application to a Norwegian trawler, *Environmental Impact Assessment Review*, Vol. 53, pp.31-39, https://doi.org/10.1016/j.eiar.2015.04.002 [accessed 15th April 2019].
- Vellinga, T.V., Blonk, H., Marinussen, M., van Zeist, W.J., de Boer, I.J.M. and Starmans, D. (2013). *Methodology used in feedprint: a tool quantifying greenhouse gas emissions of feed production and utilization*, Wageningen UR Livestock Research, http://edepot.wur.nl/254098 [accessed 15th April 2019].
- Velthof, G.L., Lesschen, J.P., Webb, J., Pietrzak, S., Miatkowski, Z., Kros, J., Pinto, M. and Oenema, O. (2010). The impact of the Nitrates Directive on gaseous N emissions: effects of measures in nitrates action programme on gaseous N emissions, Contract ENV.B.1/ETU/2010/0009, Alterra, Wageningen UR, The Netherlands.
- Venn, A. (2018). Courts can play a pivotal role in combating climate change, *The Conversation*, 12th October, https://theconversation.com/courts-can-play-a-pivotal-role-in-combating-climate-change-10472. [accessed 15th April 2019].
- Venn, L., Kneafsey, M., Holloway, L., Cox, R., Dowler, E. and Tuomainen, H. (2006) Researching European 'alternative' food networks: some methodological considerations, *Area*, Vol. 38, No 3, pp.248-258, http://wrap.warwick.ac.uk/33045 [accessed 15th April 2019].
- Verain, M., Dagevos, H. and Antonides, G. (2015). Sustainable food consumption: product choice or curtailment, *Appetite*, Vol. 91, pp.375-384, http://dx.doi.org/10.1016/j.appet.2015.04.055 [accessed 15th April 2019].
- Verain, M.C.D., Bartels, J., Dagevos, H., Sijtsema, S.J., Onwezen, M.C. and Antonides, G. (2012). Segments of sustainable food consumers - a literature review, *International Journal of Consumer Studies*, Vol. 36, pp.123-132, doi: 10.1111/j.1470-6431.2011.01082.x.

- Verbeke, W. (2015). Profiling consumers who are ready to adopt insects as a meat substitute, *Food Quality and Preference*, Vol. 39, pp.147-155, http://dx.doi.org/10.1016/j.foodqual.2014.07.008 [accessed 15th April 2019].
- Verbeke, W., Vanhonacker, F., Sioen, I., Van Camp, J. and De Henauw, S. (2007). Perceived importance of sustainability and ethics related to fish: a consumer behaviour perspective, *Ambio*, Vol. 36, No. 7, pp.580-585, http://www.jstor.org/stable/25547816 [accessed 15th April 2019].
- Verdict (2018). Plastic waste in the ocean is set to treble within a decade, London, UK: Verdict https://www.verdict.co.uk/plastic-waste-in-ocean-treble/ [accessed 15th April 2019].
- Verghese, K., Crossin, E., Clune, S., Lockrey, S., Williams, H., Rio, M. and Wikstrom, F. (2014). The greenhouse gas profile of a "Hungry Planet"; quantifying the impacts of the weekly food purchases including associated packaging and food waste for three families. In: *19th IAPRI World Conference on Packaging*. Victoria University, Melbourne.
- Verhagen, H., Tijhuis, M.J., Gunnlaugsdóttir, H., Kalogeras, N., Leino, O., Luteijn, J.M., Magnússon, S.H., Odekerken, G., Pohjola, M.V., Tuomisto, J.T., Ueland, Ø., White, B.C. and Holm, F. (2012). State of the art in benefit–risk analysis: Introduction, *Food and Chemical Toxicology*, Vol. 50, pp.2-4, doi: 10.1016/j.fct.2011.06.007.
- Verma, J.P. and Jaiswal, D.K. (2015). Issues and challenges about sustainable agriculture production for management of natural resources to sustain soil fertility and health, *Journal of Cleaner Production*, Vol. 107, pp.793-794, doi: 10.1016/j.jclepro.2015.04.130.
- Vermeer, W.M., Alting, E., Steenhuis, I.H.M. and Seidell, J.C. (2009). Value for money or making the healthy choice - the impact of proportional pricing on consumers' portion size choices, *European Journal of Public Health*, Vol. 20, No. 1, pp.65-69, doi:10.1093/eurpub/ckp092.
- Vermeir, I. and Werbeke, W. (2006). Sustainable food consumption - exploring the consumer attitude – behavioral intention gap, *Journal of Agricultural and Environmental Ethics*, Vol. 19, pp.169-194, doi: 10.1007/s10806-005-5485-3.
- Vermeulen, S., Wellesley, L., Airey, S., Singh, S., Agustina, R., Izwardy, D. and Saminarsih, D. (2019). *Healthy diets from sustainable production: Indonesia*, London, UK: Chatham House / The Hoffmann Centre for Sustainable Resource Economy, https://www.chathamhouse.org/publication/healthy-diets-sustainable-production-indonesia [accessed 15th April 2019].
- Vermeulen, S., Zougmoré, R., Wollenberg, E., Thornton, P., Nelson, G., Kristjanson, P., Kinyangi, J., Jarvis, A., Hansen, J., Challinor, A., Campbell, B. and Aggarwal, P. (2012a). Climate change, agriculture and food security: a global partnership to link research and action for low-income agricultural producers and consumers, *Current Opinion in Environmental Sustainability*, Vol. 4, No. 1, pp.128-133, https://doi.org/10.1016/j.cosust.2011.12.004 [accessed 15th April 2019].

- Vermeulen, S.J., Aggarwal, P.K., Ainslie, A., Angelone, C., Campbell, B.M., Challinor, A.J., Hansen, J.W., Ingram, J.S.I., Jarvis, A., Kristjanson, P., Lau, C., Nelson, G.C., Thornton, P.K. and Wollenberg, E. (2012b). Options for support to agriculture and food security under climate change, *Environmental Science & Policy*, Vol. 15, Iss. 1, 2012, pp.136-144, https://doi.org/10.1016/j.envsci.2011.09.003.
- Vermeulen, S.J., Campbell, B.M. and Ingram, S.J.I. (2012c). Climate change and food systems, *Annual Review of Environment and Resources*, Vol. 37, pp.195-222, doi: 10.1146/annurev-environ-020411-130608.
- Vermeulen, S.J., Challinor, A.J., Thornton, P.K., Campbell, B.M., Eriyagama, N., Vervoort, J.M., Kinyangi, J., Jarvis, A., Läderach, P., Ramirez-Villegas, J., Nicklin, K.J., Hawkins, E. and Smith, D.R. (2013). Addressing uncertainty in adaptation planning for agriculture, *Proceedings of the National Academy of Sciences*, Vol. 110, pp.8357-8362, https://doi.org/10.1073/pnas.1219441110.
- Verney, J. (2019). Rising sea expected to swallow much of Lincolnshire by 2050, *Lincolnshire Reporter*, 12th November, https://lincolnshirereporter.co.uk/2019/11/rising-sea-expected-to-swallow-much-of-lincolnshire-by-2050/ [accessed 15th April, 2020].
- Verschuuren, J. (2016). The Paris Agreement on climate change: agriculture and food security, *European Journal of Risk Regulation*, Vol. 7, No. 1, pp.54-57, doi: https://doi.org/10.1017/S1867299X00005389 [accessed 15th April 2019].
- Vervoort, J.M., Thornton, P.K., Kristjanson, P., Förch, W., Ericksen, P.J., Kok, K., Ingram, J.S.I., Herrero, M., Palazzo, A., Helfgott, A.E.S., Wilkinson, A., Havlík, P., Mason-D'Croz, D. and Jost, C. (2014). Challenges to scenario-guided adaptive action on food security under climate change, *Global Environmental Change,* Vol. 28, pp.383-394, https://doi.org/10.1016/j.gloenvcha.2014.03.001 [accessed 15th April 2020].
- Vetőné, Z.V. (2014). Sustainability and consumption structure - environmental impacts of food consumption clusters, *International Journal of Consumer Studies*, Vol. 38, pp.529-539, doi: 10.1111/ijcs.12130.
- Vetter, S.H., Sapkota, T.B., Hillier, J., Stirling, C.M, Macdiarmid, J.I., Aleksandrowicz, L., Green, R., Joy, E.J.M., Dangour, A.D. and Smith, P. (2017). Greenhouse gas emissions from agricultural food production to supply Indian diets: implications for climate change mitigation, *Agriculture, Ecosystems & Environment*, Vol. 237, pp.234-241, https://doi.org/10.1016/j.agee.2016.12.024 [accessed 15th April 2019].
- Vetter, S.H., Sapkota, T.B., Hillier, J., Stirling, C.M, Macdiarmid, J.I., Aleksandrowicz, L., Green, R., Joy, E.J.M., Dangour, A.D. and Smith, P. (2019). Corrigendum to "Greenhouse gas emissions from agricultural food production to supply Indian diets: implications for climate change mitigation, *Agriculture, Ecosystems & Environment*, Vol. 237, pp.234-241, doi: 10.1016/j.agee.2018.11.012.
- Victor, P.A. (2011). Growth, degrowth and climate change: a scenario analysis, *Ecological Economics*, Vol. 84, doi: 10.1016/j.ecolecon.2011.04.013.

- Vida, S., Durocher, M., Ouarda, T.B.M.J. and Gosselin, P. (2012). Relationship between ambient temperature and humidity and visits to mental health emergency departments in Québec, *Psychiatric Services*, Vol. 63, No. 11, pp.1150-1153, doi: 10.1176/appi.ps.201100485.
- Vidal Legaz, B., Maia De Souza, D., Teixeira, R.F.M., Anton, A., Putman, B. and Sal, S. (2017). Soil quality, properties, and functions in life cycle assessment: an evaluation of models, *Journal of Cleaner Production*, Vol. 140, pp.502-515, https://doi.org/10.1016/j.jclepro.2016.05.077 [accessed 15th April 2019].
- Vidal, J. (2010). 10 ways vegetarianism can help save the planet, *The Observer*, 18th July, pp.52-57, https://www.theguardian.com/lifeandstyle/2010/jul/18/vegetarianism-save-planet-environment [accessed 15th April 2019].
- Vidal, J. (2010). UN warns of looming worldwide food crisis in 2013: global development, *The Observer*, 13th October, https://www.theguardian.com/global-development/2012/oct/14/un-global-food-crisis-warning [accessed 15th April 2019].
- Vieira, L.C., Serrao-Neumann, S., Howes, M. and Mackey, B. (2018). Unpacking components of sustainable and resilient urban food systems, *Journal of Cleaner Production*, Vol. 200, pp.318-330, https://doi.org/10.1016/j.jclepro.2018.07.283 [accessed 15th April 2019].
- Vieux, F., Darmon, N., Touazi, D. and Soler, L.G. (2012). Greenhouse gas emissions of self-selected individual diets in France: changing the diet structure or consuming less? *Ecological Economics*, Vol. 75, pp.91-101, https://doi.org/10.1016/j.ecolecon.2012.01.003 [accessed 15th April 2019].
- Vieux, F., Perignon, M., Gazan, R. and Darmon, N. (2018). Dietary changes needed to improve diet sustainability: are they similar across Europe? *European Journal of Clinical Nutrition*, Vol. 72, No. 7, pp.951-960, https://doi.org/10.1038/s41430-017-0080-z [accessed 15th April 2019].
- Vieux, F., Soler, L.G., Touazi, D. and Darmon, N. (2013). High nutritional quality is not associated with low greenhouse gas emissions in self-selected diets of French adults, *American Journal of Clinical Nutrition*, Vol. 97, No. 3, pp.569-583, doi: 10.3945/ajcn.112.035105.
- Vigo, J. (2018). The under-reported ecological disaster of meat, *The Ecologist*, 4th June, https://theecologist.org/2018/jun/04/under-reported-ecological-disaster-meat {accessed 15th April 2019].
- Vilella, F., Neves, M.F., Senesi, S., Barilatti, M., Palau, H. and Dulce, E. (2008). Strategic management in the argentine dairy supply chain, Proceedings of the 8th International Conference on Management in AgriFood Chains and Networks, 28th-30th May, Ede, the Netherlands.
- Villasante, S., Morato, T., Rodriguez-Gonzalez, D., Antelo, M., Österblom, H., Watling, L., Nouvian, C., Gianni, M. and Macho, G. (2012). Sustainability of deep-sea fish species under the European Union Common Fisheries Policy, *Ocean & Coastal Management*, Vol. 70, pp.31-37, https://doi.org/10.1038/s41430-017-0080-z [accessed 15th April 2019].

- Viner, D., Rawlins, M., Allison, I., Howarth, C. and Jones, A. (2015). *Climate change and business survival,* Croydon, UK: Mott Macdonald, www.mottmac.com [accessed 15th April 2019].
- Vinnari, M. and Tapio, P. (2012). Sustainability of diets: from concepts to governance, *Ecological Economics*, Vol. 74, pp.46-54, https://doi.org/10.1016/j.ecolecon.2011.12.012 [accessed 15th April 2019].
- Vins, H., Bell, J., Saha, S. and Hess, J. (2015). The mental health outcomes of drought: a systematic review and causal process diagram, *International Journal of Environmental Research and Public Health*, Vol. 12, 13251, doi: 10.3390/ijerph121013251.
- Vira, B., Wildburger, C. and Mansourian, S. (2015). *Forests, trees and landscapes for food security and nutrition – a global assessment report*, IUFRO World Series Vol. 33, Vienna, Austria: International Union of Forest Research Organizations (IUFRO).
- Virgili, A. (2020). Fast and lethal, the Black Death spread more than a mile per day, *National Geographic*, 23rd April, https://www.nationalgeographic.com/history/magazine/2015/10-11/fast-lethal-black-death-spread-mile-per-day/
- Virtanen, Y., Kurppa, S., Saarinen, M., Katajajuuri, J-M., Usva, K., Mäenpää, I., Mäkelä, J., Juha Grönroos, J. and Nissinen, A. (2011). Carbon footprint of food – approaches from national input–output statistics and a LCA of a food portion, *Journal of Cleaner Production*, Vol. 19, Iss. 16, pp.1849-1856, https://doi.org/10.1016/j.jclepro.2011.07.001 [accessed 15th April 2019].
- Visram, S. and Hashem, K. (2016). *Energy drinks – what's the evidence?* 21st July, London, UK: City University London, Centre for Food Policy: Food Research Collaboration, www.foodresearch.org.uk [accessed 11th April 2019].
- Visser, O. (2015). Finance and the global land rush Understanding the growing role of investment funds in land deals and large-scale farming, *Canadian Food Studies*, Vol. 2, No. 2, pp.278-286, doi: 10.15353/cfs-rcea.v2i2.122.
- Vitari, C. and David, C. (2017). Sustainable management models: innovating through Permaculture, *Journal of Management Development*, Vol. 36, Iss. 1, pp.14-36, https://doi.org/10.1108/JMD-10-2014-0121 [accessed 15th April 2019].
- Vittersø, G. and Tangeland, T. (2015). The role of consumers in transitions towards sustainable food consumption, *Journal of Cleaner Production*, Vol. 92, pp.91-99, http://dx.doi.org/10.1016/j.jclepro.2014.12.055 [accessed 15th April 2019].
- Vivero-Pol, J.L. (2017). Food as commons or commodity - exploring the links between normative valuations and agency in food transition, *Sustainability*, Vol. 9, No. 442, doi:10.3390/su9030442.
- Vivero-Pol, J.L. (2017). The idea of food as commons or commodity in academia. A systematic review of English scholarly texts, *Journal of Rural Studies*, Vol. 53, pp.182-201, doi: 10.1016/j.jrurstud.2017.05.015.

- Vlek, P.L.G., Khamzina, A., and Tamene, L. (eds.) (2017). *Land degradation and the Sustainable Development Goals: Threats and potential remedies*, CIAT Publication No. 440, Nairobi, Kenya: International Center for Tropical Agriculture (CIAT).
- Voedingscentrum (2018). Duurzaam eten, https://www.voedingscentrum.nl/encyclopedie/duurzamereten.aspx [accessed 15th April 2019].
- Vogliano, C., Steiber, A. and Brown, K. (2015). Linking agriculture, nutrition, and health: the role of the registered dietitian nutritionist, *Journal of the Academy of Nutrition and Dietetics*, Vol. 115, No. 10, pp.1710-1714, doi: https://doi.org/10.1016/j.jand.2015.06.009.
- Volenzo, T.E., Odiyo, J.O. and Obiri, J. (2019). Greenhouse gas emissions as sustainability indicators in agricultural sectors' adaptation to climate change: policy implications, *Jàmbá: Journal of Disaster Risk Studies*, Vol. 11, No. 1, doi: 10.4102/jamba.v11i1.576.
- Volpe, J.P., Gee, J.L.M., Ethier, V.A., Beck, M., Wilson, A.J. and Stoner, J.M.S. (2013). Global Aquaculture Performance Index (GAPI): the first global environmental assessment of marine fish farming, *Sustainability*, Vol. 5, No. 9, pp.3976-3991, doi: 10.3390/su5093976.
- von Braun, J. (2007). *The world food situation - new driving forces and required actions*, Washington, USA: International Food Policy Research Institute.
- von Braun, J. (2008). *Food and financial crises - implications for agriculture and the poor*, Washington, USA: International Food Policy Research Institute.
- von Ehrenstein, O.S., Ling, C., Cui, X., Cockburn, M., Park, A.S., Yu, F., Wu, J. and Ritz, B. (2019). Prenatal and infant exposure to ambient pesticides and autism spectrum disorder in children - population based case-control study, *British Medical Journal*, Vol. 364, doi: https://doi.org/10.1136/bmj.l962 [accessed 15th April 2019].
- von Grebmer, K., Bernstein, J., de Waal, A., Prasai, N., Yin, S. and Yohannes, Y. (2015). 2*015 Global Hunger Index: armed conflict and the challenge of hunger*, Bonn, Washington, USA, and Dublin: Welthungerhilfe, International Food Policy Research Institute, and Concern Worldwide.
- Von Grebmer, K., Saltzman, A., Birol, E., Wiesmann, D., Prasai, N., Yin, S., Yohannes, Y. and Menon, P. (2014). *2014 Global Hunger Index: The Challenge of Hidden Hunger*, Bonn/Washington/Dublin: International Food Policy Research Institute (IFPRI).
- Voss-Fels, K.P., Stahl, A. and Hickey, L.T. (2019). Q&A: modern crop breeding for future food security, *BMC Biology*, Vol. 17, No. 8, https://doi.org/10.1186/s12915-019-0638-4 [accessed 15th April 2019].
- Vyas, U.K. and Cannon, S.E. (2008). Shifting the sustainability paradigm from advocacy to good business, *Real Estate Issues*, Vol. 33, No. 3, pp.1-7, https://www.cre.org/real-estate-issues/shifting-sustainability-paradigm-advocacy-good-business/ [accessed 15th April 2019].
- Vyvyan, C. (2004) Diets - eat, drink, man, woman, *Chemical World*, 15th May, pp.12-16.

- Wach, E. (2018). Rise of the 'megafarms': how UK agriculture is being sold off and consolidated. Rise of the 'megafarms': how UK agriculture is being sold off and consolidated, *The Conversation*, 5th October, https://theconversation.com/rise-of-the-megafarms-how-uk-agriculture-is-being-sold-off-and-consolidated-104019 [accessed 15th April 2019].
- Wada, Y., van Beek, L.P.H., van Kempen, C.M., Reckman, J.W.T.M., Vasak, S. and Bierkens, M.F.P. (2010). Global depletion of groundwater resources, *Geophysical Research Letters*, Vol. 37, No. 20, L20402, doi:10.1029/2010GL044571.
- Waddington, S.R., Li, X., Dixon, J., Hyman, G. and de Vicente, M.C. (2010). Getting the focus right: Production constraints for six major food crops in Asian and African farming systems, *Food Security*, Vol. 2, pp.27-48, https://doi.org/10.1007/s12571-010-0053-8 [accessed 15th April 2019].
- Wagner, G., Kåberger, T., Olai, S., Oppenheimer, M., Rittenhouse, K., Sterner, T., Energy policy - Push renewables to spur carbon pricing, *Nature*, Vol. 525, 3rd September, pp.27-29, doi:10.1038/525027a.
- Wagner, Z., Heft-Neal, S., Bhutta, Z.A., Black, R.E., Burke, M. and Bendavid, E. (2019). Back to the root causes of war: food shortages – Authors' reply, *The Lancet*, Vol. 393, No. 10170, pp. 982-982, doi: 10.1016/S0140-6736(19)30013-3.
- Waheed, R., Chang, D., Sarwar, S. and Chen, W. (2018). Forest, agriculture, renewable energy, and CO_2 emission, *Journal of Cleaner Production*, Vol. 172, pp.4231-4238, https://doi.org/10.1016/j.jclepro.2017.10.287 [accessed 15th April 2019].
- Waite, T.D. (2017). The English national cohort study of flooding and health: cross-sectional analysis of mental health outcomes at year one, *BMC Public Health*, Vol. 17, 129, https://doi.org/10.1186/s12889-016-4000-2 [accessed 15th April 2019].
- Wald, N. and Hill, D.P. (2016). Rescaling alternative food systems: from food security to food sovereignty, *Agriculture and Human Values*, Vol. 33, No. 1, pp.203-213, https://doi.org/10.1007/s10460-015-9623-x [accessed 15th April 2019].
- Waldman, K.B. and Kerr, J.M. (2014). Limitations of certification and supply chain standards for environmental protection in commodity crop production, *Annual Review of Resource Economics*, Vol. 6, pp.429-449, https://doi.org/10.1146/annurev-resource-100913-012432 [accessed 15th April 2019].
- Wale, M. (2014). The countryside's under threat says CWF boss, *Farm Business*, 7th March, p.36.
- Wale, M. (2015). Do we feed to many antibiotics to animals, *Farm Business*, 14th Auguest, p.20.
- Walker, D.A. (2009). Biofuels, facts, fantasy, and feasibility, *Journal of Applied Phycology*, Vol. 21, pp.509-517, https://doi.org/10.1007/s10811-009-9446-5 [accessed 15th April 2019].
- Walkland, C. (2015). Organic feed prices weather Ukraine loss, *The Grocer*, 10th October, p.18.
- Wall, T. (2019). Inches from disaster: crisis faces Britain's crumbling coastline, *The Guardian*, 1st December, https://www.theguardian.com/environment/2019/dec/01/climate-crisis-leaves-british-coastlines-inches-from-disaster [accessed 15th April 2020].
- Wallace-Wells, D. (2017). The uninhabitable earth: famine, economic collapse, a sun that cooks us: what

climate change could wreak — sooner than you think, *New York Magazine*, 10th July, http://nymag.com/daily/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html [accessed 15th April 2019].

- Wallach, D., Mearns, L.O., Ruane, A.C., Rötter, R.P. and Asseng, S. (2016). Lessons from climate modeling on the design and use of ensembles for crop modelling, *Climatic Change*, Vol. 139, pp.551, https://doi-org.ezproxy.mmu.ac.uk/10.1007/s10584-016-1803-1 [accessed 15th April 2019].
- Walls, H., Baker, P., Chirwa, E. and Hawkins, B. (2019). Food security, food safety and healthy nutrition: are they compatible? *Global Food Security*, Vol. 21, pp.69-71, https://doi.org/10.1016/j.gfs.2019.05.005 [accessed 11th April 2020].
- Walls, H.L., Johnston, D., Tak, M., Dixon, J., Hanefeld, J., Hull, E. and Smith, R.D. (2018). The impact of agricultural input subsidies on food and nutrition security: a systematic review, *Food Security*, Vol. 10, No. 6, pp.1425-1436., doi: 10.1007/s12571-018-0857-5.
- Walters, S. and Stoelzle Midden, K. (2018). Sustainability of urban agriculture: vegetable production on green roofs, *Agriculture*, Vol. 8, No. 11, pp.168, doi: 10.3390/agriculture8110168,
- Wang, C., Ghadimi, P., Lim, M.K. and Tseng, M-L. (2019). A literature review of sustainable consumption and production: a comparative analysis in developed and developing economies, *Journal of Cleaner Production*, Vol. 206, pp.741-754, https://doi.org/10.1016/j.jclepro.2018.09.172 [accessed 15th April 2019].
- Wang, D., Lia, D. and O'Brien, C. (2009). Optimisation of traceability and operations planning - an integrated model for perishable food production, *International Journal of Production Research*, Vol. 47, No. 11, pp.2865-2886, doi: 10.1080/00207540701725075.
- Wang, G. and Gunasekaran, A. (2017). Modeling and analysis of sustainable supply chain dynamics, *Annals of Operations Research*, Vol. 250, No. 2, pp.521-536, https://doi.org/10.1007/s10479-015-1860-2 [accessed 15th April 2019].
- Wang, H. and Horton, R. (2015). Tackling climate change: the greatest opportunity for global health, *The Lancet*, Vol. 386, Iss. 10006, pp.1798-1799, http://dx.doi.org/10.1016/S0140-6736(15)60931-X [accessed 15th April 2019].
- Wang, L., Duan, W., Qu, D. and Wang, S. (2018). What matters for global food price volatility? *Empirical Economics*, Vol. 54, pp.1549-1572, https://doi.org/10.1007/s00181-017-1311-9 [accessed 15th April 2019].
- Wang, X-L., Wang, W., Guan, Y-S., Xian, Y-R., Huang, Z-X., Feng, H-Y. and Chen, Y. (2018). A joint use of emergy evaluation, carbon footprint and economic analysis for sustainability assessment of grain system in China during 2000–2015, *Journal of Integrative Agriculture*, Vol 17, No. 12, pp.2822-2835, https://doi.org/10.1016/S2095-3119(18)61928-8 [accessed 15th April 2019].

- Wang, Y. and Serventi, L. (2019). Sustainability of dairy and soy processing: a review on wastewater recycling, *Journal of Cleaner Production*, Vol. 237, pp.117821, https://doi.org/10.1016/j.jclepro.2019.117821 [accessed 11th April 2020].
- Wang, Y., Lehane, C., Ghebremeskel, K. and Crawford, M.A. (2010). Modern organic and broiler chickens sold for human consumption provide more energy from fat than protein, *Public Health Nutrition*, Vol. 13, No. 3, pp.400-408, doi: 10.1017/ S1368980009991157.
- Warner, A. (2017). *The truth about fat*, London, UK: Oneworld Publications, ISBN: 9781786075130.
- Wasley, A., Davies, M., Child, D. and Harvey, F. (2017). UK has nearly 800 livestock mega farms, investigation reveals, *The Guardian*, 17th July, https://www.theguardian.com/environment/2017/jul/17/uk-has-nearly-800-livestock-mega-farms-investigation-reveals [accessed 15th April 2019].
- Wasley, A., Heal, A. and Lainio, M. (2013). Deadly gas: cutting farm emissions in half could save 3,000 lives a year, *The Bureau Investigates*, 13th June, https://www.thebureauinvestigates.com/stories/2019-06-13/deadly-gas-ammonia-cutting-farm-emissions-could-save-3000-lives-a-year [accessed 15th April 2019].
- Waste & Resources Action Programme (2017) Food waste in primary production – a preliminary study on strawberries and lettuces, Defra SCF0307 / WRAP OIN006-001, Waste & Resources Action Programme.
- Waterlander, W.E., NiMhurchua, C., Eyles, H., Vandevijvere, S., Cleghorn, C., Scarborough, P., Swinburn, B. and Seidell, J. (2018). Food futures: developing effective food systems interventions to improve public health nutrition, *Agricultural Systems*, Vol. 160, pp.124-131, http://dx.doi.org/10.1016/j.agsy.2017.01.006 [accessed 15th April 2019].
- Waters, C.N., Zalasiewicz, Z., Summerhayes, C., Barnosky, A.D., Poirier, C., Gałuszka, A., Cearreta, A., Edgeworth, M., Ellis, E.C., Ellis, M., Jeandel, C., Leinfelder, R. and McNeill, J.R. (2016). The Anthropocene is functionally and stratigraphically distinct from the Holocene, *Science*, Vol. 351, No. 6269, aad2622, doi: 10.1126/science.aad2622.
- Wathes, C.M., Buller, H., Maggs, H. and Campbell, M.L. (2013). Livestock production in the UK in the 21st century: a perfect storm averted? Animals, Vol. 3, No. 3, pp.574-583, doi: 10.3390/ani3030574.
- Watkiss P., Cimato, F., Hunt, A. and Morley, B. (2016). *Climate change impacts on the future cost of living* (SSC/CCC004), York, UK: Joseph Rowntree Foundation.
- Watson, F. and Mwatsama, M. (2018). *Fresh start: a framework for health and sustainable diets in the UK – Situational Analysis*, London, UK: UK Health Forum, http://ukhealthforum.org.uk/our-legacy/ [accessed 15th April 2019].
- Watson, F. and Mwatsama, M. (2018). *Fresh start: A framework for health and sustainable diets in the UK – Situational Analysis*, London, UK: UK Health Forum.

- Watson, J.E.M., Darling, E.S., Venter, O., Maron, M., Walston, J., Possingham, H.P., Dudley, N., Hockings, M., Barnes, M. and Brooks, T.M. (2015). Bolder science needed now for protected areas, *Conservation Biology*, Vol. 30, pp.243-248, https://doi.org/10.1111/cobi.12645 [accessed 15th April 2019].
- Watson, R., McCarthy, J.J., Canziani, P., Nakicenovic, N. and Hisas, L. (2019). *The truth behind the climate pledges*, Buenos Aires, Argentina: Fundación Ecológica Universal FEU-US, https://feu-us.org/behind-the-climate-pledges/ [accessed 15th April 2019].
- Watson, R.A. and Tidd, A.N. (2018). Mapping nearly a century and a half of global marine fishing: 1869 to 2015, *Marine Policy*, Vol. 93, pp.171-177, https://doi.org/10.1016/j.marpol.2018.04.023 [accessed 15th April 2019].
- Watson, R.T., Zinyowera, M.C. and Moss, R.H. (eds.) (1996). *Climate change 1995: impacts, adaptations and mitigation of climate change - scientific-technical analysis*, Cambridge, UK: Cambridge University Press.
- Watts, G. and Anderson, M. (eds) (2016). *Water climate change impacts report card - 2016 edition*, Living with Environmental Change, ISBN 978-0-9934074-1-3, https://epsrc.ukri.org/research/ourportfolio/themes/livingwithenvironmentalchange/ [accessed 15th April 2019].
- Watts, G., Battarbee, R., Bloomfield, J., Crossman, J., Daccache, A., Durance, I., Elliott, J., Garner, G., Hannaford, J. and Hannah, D. (2015). Climate change and water in the UK – past changes and future prospects, *Progress in Physical Geography: Earth and Environment*, Vol. 39, No. 1, pp.7-11, https://hdl.handle.net/2134/17683 [accessed 15th April 2019].
- Watts, J. (2017). Lincolnshire's coast and farms will sink with 3°C of warming, *The Guardian*, 3rd November, https://www.theguardian.com/environment/2017/nov/03/lincolnshires-coast-and-farms-will-sink-with-3c-of-warming [accessed 15th April 2019].
- Watts, J. (2019). Human society under urgent threat from loss of Earth's natural life, Scientists reveal 1 million species at risk of extinction in damning UN report, *The Guardian*, 6th May, https://www.theguardian.com/environment/2019/may/06/human-society-under-urgent-threat-loss-earth-natural-life-un-report [accessed 15th April 2019].
- Watts, N., Adger, W.N., Agnolucci, P., Blackstock, J., Byass, P., Cai, W., Chaytor, S., Colbourn, T., Collins, M., Cooper, A., Cox, P.M., Depledge, J., Drummond, P., Ekins, P., Galaz, V., Grace, D., Graham, H., Grubb, M. and Costello, A. (2015). Health and climate change: policy responses to protect public health, *The Lancet*, Vol. 386, Iss. 10006, pp.1861-1914, doi: https://doi.org/10.1016/S0140-6736(15)60854-6.
- Watts, N., Adger, W.N., Ayeb-Karlsson, S., Bai, Y., Byass, P., Campbell-Lendrum, D., Colbourn, T., Cox, P., Davies, M., Depledge, M., Depoux, A., Dominguez-Salas, P., Drummond, P., Ekins, P., Flahault, A., Grace, D., Graham, H., Haines, A., Hamilton, I., Johnson, A., Kelman, I., Kovats, S., Liang, L., Lott, M., Lowe, R., Luo, Y., Mace, G., Maslin, M., Morrissey, K., Murray, K., Neville, T., Nilsson, M., Oreszczyn, T., Parthemore, C., Pencheon, D., Robinson, E., Schütte, S., Shumake-Guillemot, J., Vineis, P., Wilkinson, P.,

Wheeler, N., Xu, B., Yang, J., Yin, Y., Yu, C., Gong, P., Montgomery, H. and Costello, A. (2016). The Lancet Countdown: tracking progress on health and climate change, *The Lancet*, 14th November, Vol. 389, Iss. 10074, pp.1151-1164, http://dx.doi.org/10.1016/S0140-6736(16)32124-9 [accessed 15th April 2019].

- Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Belesova, K., Berry, H., Bouley, T., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Chambers, J., Daly, M., Dasandi, N., Davies, M., Depoux, A., Dominguez-Salas, P., Drummond, P., Ebi, K.L., Ekins, P., Montoya, L.F., Fischer, H., Georgeson, L., Grace, D., Graham, H., Hamilton, I., Hartinger, S., Hess, J., Kelman, I., Kiesewetter, G., Kjellstrom, T., Kniveton, D., Lemke, B., Liang, L., Lott, M., Lowe, R., Sewe, M.O., Martinez-Urtaza, J., Maslin, M., McAllister, L., Mikhaylov, S.J., Milner, J., Moradi-Lakeh, M., Morrissey, K., Murray, K., Nilsson, M., Neville, T., Oreszczyn, T., Owfi, F., Pearman, O., Pencheon, D., Pye, S., Rabbaniha, M., Robinson, E., Joacim Rocklöv, J., Saxer, O., Schütte, S., Semenza, J.C., Shumake-Guillemot, J., Steinbach, R., Tabatabaei, M., Tomei, J., Trinanes, J., Wheeler, N., Wilkinson, P., Gong, P., Montgomery, H. and Costello, A. (2018a). The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come, *The Lancet*, Vol. 392, Iss. 10163, pp.2479-2514, doi: https://doi.org/10.1016/S0140-6736(18)32594-7.
- Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Belesova, K., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Capstick, S., Chambers, J., Dalin, C., Daly, M., Dasandi, N., Davies, M., Drummond, P., Dubrow, R., Ebi, K.L., Eckelman, M., Ekins, P., Escobar, L.E., Montoya, L.F., Georgeson, L., Graham, H., Haggar, P., Hamilton, I., Hartinger, S., Hess, J.,Kelman, I., Kiesewetter, G., Kjellstrom, T., Kniveton, D., Lemke, B., Liu, Y., Lott, M., Lowe, R., Odhiambo Sewe, M., Martinez-Urtaza, J., Maslin, M., McAllister, L., McGushin, A., Jankin Mikhaylov, S., Milner, J., Moradi-Lakeh, M., Morrissey, K., Murray, K., Munzert, S., Nilsson, M., Neville, T., Oreszczyn, T., Owfi, F., Pearman, O., Pencheon, D., Phung, D., Pye, S., Quinn, R., Rabbaniha, M., Robinson, E., Rocklöv, J., Semenza, J.C., Sherman, J., Shumake-Guillemot, J., Tabatabaei, M., Taylor, J., Trinanes, J., Wilkinson, P., Costello, A., Gong, P. and Montgomery, H. (2019). The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate, *The Lancet*, 13th November, doi:https://doi.org/10.1016/S0140-6736(19)32596-6.
- Watts, N., Amann, M., Ayeb-Karlsson, S., Belesova, K., Bouley, T., Boykoff, M., Byass, P.,Cai, W., Campbell-Lendrum, D.,Chambers, J., Cox, P.M., Daly, M., Dasandi, N., Davies, M., Depledge, M., Depoux, A., Dominguez-Salas, P., Drummond, P., Ekins, P., Flahault, A., Frumkin, H.,Georgeson, L., Ghanei, M., Grace, D., Graham, H.,Grojsman, R., Haines, A.,Hamilton, I., Hartinger, S. Johnson, A., Kelman, I., Kiesewetter, G., Kniveton, D., Liang, L., Lott, M., Lowe, R., Mace, G., Sewe, M.O., Maslin, M., Mikhaylov, S., Milner, J., Latifi, A.M., Moradi-Lakeh, M., Morrissey, K., Murray, K., Neville, T., Nilsson, M., Oreszczyn, T., Owfi, F., Pencheon, D., Pye, S., Rabbaniha, M., Robinson, E., Rocklöv, J., Schütte, S., Shumake-Guillemot, J., Steinbach, R., Tabatabaei, M., Wheeler, N., Wilkinson, P., Gong, P., Montgomery, H. and Costello, A. (2018b). The Lancet Countdown on health and climate change: from 25 years of inaction to

a global transformation for public health, *The Lancet*, Vol. 391, Iss. 10120, pp.581-630, doi:https://doi.org/10.1016/S0140-6736(17)32464-9.

- WBCSD (2008). *Agric Ecosystems - facts and trends*, Conches-Geneva, World Business Council for Sustainable Development (WBCSD), www.wbcsd.org [accessed 15th April 2019].
- Wearmouth, R. (2017). US farmers using double the amount of antibiotics of UK industry, stoking post-Brexit food safety fears - we will return to an era when millions of lives could be lost every year to simple infections, *Huffington Post*, 24th November, http://www.huffingtonpost.co.uk/entry/antibiotics-us-farmers-brexit_uk_5a12ae25e4b045cf43725e51 [accessed 15th April 2019].
- Weathers, M. and Kendall, B. (2015). Developments in the framing of climate change as a public health issue in US newspapers, *Environmental Communication*, Vol. 10, No. 5, pp.593-611, https://doi.org/10.1080/17524032.2015.1050436 [accessed 15th April 2019].
- Webb, N.P., Marshall, N.A., Stringer, L.C., Reed, M.S., Chappell, A. and Herrick, J.E. (2017). Land degradation and climate change: building climate resilience in agriculture, *Frontiers In Ecology And The Environment,* Vol. 15, No. 8, pp.450-459, https://doi.org/10.1002/fee.1530 [accessed 15th April 2019].
- Webber, D. (2013). It's not just retail that has to give up its palm oil, *The Grocer*, 30th March, p.22.
- Weber, C.L. and Matthews, H.S. (2008). Food-miles and the relative climate impacts of food choices in the United States, *Environmental Science & Technology*, Vol. 42, No. 10, pp.3508-3513, doi: 10.1021/es702969f.
- Webster, B. (2020). Foreign trawlers double their time in protected waters as Brexit nears, The Times, 11th June, https://www.thetimes.co.uk/article/foreign-trawlers-double-their-time-in-protected-waters-as-brexit-nears-smnsfwnrb [accessed 11th June, 2020].
- Webster, D.G. (2016). *Beyond the tragedy of global fisheries*, London, UK: The MIT Press, ISBN: 9780262029551.
- Webster, E. and Zumbansen, P. (2018). Introduction: transnational food (in)security, *Transnational Legal Theory*, Vol. 9, No. 3-4, pp.175-190, https://doi.org/10.1080/20414005.2018.1581718 [accessed 15th April 2019].
- Webster, J. and Watson, R.T. (2002). Analyzing the past to prepare for the future - writing a literature review, *MIS Quarterly*, Vol. 26, No. 2, pp. xiii-xxiii, http://www.jstor.org/stable/4132319 [accessed 15th April 2019].
- Webster, M., Ginnetti, J., Walker, P., Coppard, D. and Kent, R. (2008). *The humanitarian costs of climate change*, Feinstein International Center, http://fic.tufts.edu/assets/humanitarian-cost-of-climate-change-2008.pdf [accessed 15th April 2019].
- Webster, P. (2019). Canada's updated food guide promotes mindful eating, *The Lancet*, Vol. 393, No. 10170, pp.e5-e5, doi: 10.1016/S0140-6736(19)30202-8.
- WEF (2013). *Sustainable consumption - stakeholder perspective*, Geneva, Switzerland: World Economic Forum, ISBN 92-95044-45-2.

- WEF (2016). *The new plastics economy - rethinking the future of plastics*, Geneva, Switzerland: World Economic Forum.
- WEF (2018b). *The system initiative on shaping the future of food security and agriculture*, Geneva, Switzerland: World Economic Forum.
- WEF (2019d). *Meat: the future series - alternative proteins*, White Paper, January, Geneva, Switzerland: World Economic Forum,
- WEF (2019e). The Global Risks Report 2019, 14th Edition, Geneva, Switzerland: World Economic Forum,
- Wegren, S.K. and Elvestad, C. (2018). Russia's food self-sufficiency and food security: an assessment, *Post-Communist Economies*, Vol. 30, No. 5, pp.565-587, https://doi.org/10.1080/14631377.2018.1470854 [accessed 15th April 2019].
- Wei, S., Bai, Z.H., Chadwick, D., Hou, Y., Qin, W., Zhao, Z.Q., Jiang, R.F. and Ma, L. (2018). Greenhouse gas and ammonia emissions and mitigation options from livestock production in peri-urban agriculture: Beijing – a case study, *Journal of Cleaner Production*, Vol. 178, pp.515-525, https://doi.org/10.1016/j.jclepro.2017.12.257 [accessed 15th April 2019].
- Weidema, B.P., Bauer, C., Hischier, R., Mutel, C., Nemecek, T., Reinhard, J., Vandenbo, C. and Wernet, G. (2013). The ecoinvent database: overview and methodology, www.ecoinvent.org [accessed 15th April 2019].
- Wein, L.M., Liu, Y. and Bloom, B.R. (2005). Analysing a bioterror attack on the food supply - the case of botulinum toxin in milk, *Proceedings of the National Academy of Sciences*, Vol. 102, No. 28, pp.9984-9989, http://www.jstor.org/stable/3376090 [accessed 15th April 2019].
- Weinbren, E. (2018). Insects: the new hipster protein? *The Guardian*, 1st February, https://www.thegrocer.co.uk/reports/digital-features/protein-report-2018/insects-the-new-hipster-protein/562745.article [accessed 15th April 2019].
- Weinroth, M.D., Belk, A.D. and Belk, K.E. (2018). History, development, and current status of food safety systems worldwide, *Animal Frontiers*, Vol. 8, No. 4, pp.9-15, https://doi.org/10.1093/af/vfy016 [accessed 15th April 2019].
- Weinzettel, J., Hertwich, E.G., Peters, G.P., Steen-Olsen, K. and Galli, A. (2013). Affluence drives the global displacement of land use, *Global Environmental Change*, Vol. 23, pp.433-438, https://doi.org/10.1016/j.gloenvcha.2012.12.010 [accessed 15th April 2019].
- Weis, T. (2015). Meatification and the madness of the doubling narrative, *Canadian Food Studies*, Vol. 2, No. 2, pp.296-303, doi: 10.15353/cfs-rcea.v2i2.105.
- Weiss, F. and Leip, A. (2012). Greenhouse gas emissions from the EU livestock sector: A life cycle assessment carried out with the CAPRI model, *Agriculture, Ecosystems & Environment*, Vol. 149, pp.124-134, https://doi.org/10.1016/j.agee.2011.12.015 [accessed 15th April 2019].

- Weitz, N., Strambo, C., Kemp-Benedict, E. and Nilsson, M. (2017). Closing the governance gaps in the water-energy-food nexus: insights from integrative governance, *Global Environmental Change*, Vol. 45, pp.165-173, https://doi.org/10.1016/j.gloenvcha.2017.06.006 [accessed 15th April 2019].
- Welch, J.R., Vincent, J.R., Auffhammer, M., Moya, P.F., Dobermann, A. and Dawe, D. (2010). Rice yields in tropical/subtropical Asia exhibit large but opposing sensitivities to minimum and maximum temperatures, *Proceedings of the National Academy of Sciences*, Vol. 107, No. 33, pp.14562-14567, doi: 10.1073/pnas.1001222107.
- Welch, R.M. and Graham, R.D. (1999). A new paradigm for world agriculture: meeting human needs, *Field Crops Research*, Vol. 60, pp.1-10, https://doi.org/10.1016/S0378-4290(98)00129-4 [accessed 15th April 2019].
- Welcomme, R.L., Cowx, I.G., Coates, D., Béné, C., Funge-Smith, S., Halls, A. and Lorenzen, K. (2010). Inland capture fisheries, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2881-2896, https://doi.org/10.1098/rstb.2010.0168 [accessed 15th April 2019].
- Weldegebriel, H.T. (2005). Imperfect price transmission: is market power really to blame? *Journal of Agricultural Economics,* Vol. 55, Iss. 1, pp.101-114, https://doi.org/10.1111/j.1477-9552.2004.tb00082.x [accessed 15th April 2019].
- Wellcome Trust (2015). *Global food matters: an appetite for engaging with research*, London: Wellcome Trust, www.wellcome.ac.uk [accessed 15th April 2019].
- Wellesley, L., Happer, C. and Froggatt, A. (2015). *Changing climate, changing diets - pathways to lower meat consumption*, London, UK: The Royal Institute of International Affairs, https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/CHHJ3820%20Diet%20and%20climate%20change%2018.11.15_WEB_NEW.pdf [accessed 15th April 2019].
- Wells, J.C., Sawaya, A.L., Wibaek, R., Mwangome, M., Poullas, M.S., Yajnik, C.S. and Demaio, A. (2019). The double burden of malnutrition: aetiological pathways and consequences for health, *The Lancet*, Vol. 395, No. 10217, doi:https://doi.org/10.1016/S0140-6736(19)32472-9.
- Wells, K. and Nicholas J. Clark, N.J. (2019). Host specificity in variable environments, *Trends in Parasitology*, Vol. 35, No. 6, pp.452-465, doi: 10.1016/j.pt.2019.04.001.
- Weltin, M., Zasada, I., Piorr, A., Debolini, M., Geniaux, G., Perez, O.M., Scherer, L., Marco, L.T. and Schulp, C.J.E. (2018). Conceptualising fields of action for sustainable intensification: a systematic literature review and application to regional case studies, *Agriculture, Ecosystems & Environment*, Vol. 257, pp.68-80, https://doi.org/10.1016/j.agee.2018.01.023 [accessed 15th April 2019].
- Weltin, M., Zasada, I., Plogmann, J-M., Trau, F-N. and Piorr, A. (2018). Data on the scope of the literature on sustainable intensification 1997–2016: bibliography, geography and practical approaches, *Data in Brief*, Vol. 19, pp.1658-1660, https://doi.org/10.1016/j.dib.2018.06.029 [accessed 15th April 2019].

- Wernet, G., Bauer, C., Steubing, B., Reinhard, J., Moreno-Ruiz, E. and Weidema, B. (2016). The ecoinvent database version 3 (part I): overview and methodology, *International Journal of Life Cycle Assessment*, Vol. 21, pp.1218-1230, https://doi.org/10.1007/s11367-016-1087-8 [accessed 15th April 2019].
- West Lindsey District Council (2019). *Economic growth strategy 2014-2034*, Gainsborough, UK: West Lindsey District Council (WLDC).
- West, C., Croft, S., Dawkins, E., Warren, R. and Price, J. (2015). Identifying and exploring key commodity chains at risk from climate impacts. In: Kent, C. and Lewis, K. *AVOID2. WPF3: The impact of weather extremes on agricultural commodity price*s, https://www.avoid.uk.net/2016/03/the-impact-of-weather-extremes-on-agricultural-commodity-prices-f3/ [accessed 15th April 2019].
- West, C.D., Green, J.M.H. and Croft, S. (2018). Trase Yearbook 2018: sustainability in forest-risk supply chains: spotlight on Brazilian soy, No. 69, Stockholm, Sweden: Stockholm Environment Institute.
- West, P.C., Gerber, J.S., Engstrom, P.M., Mueller, N.D., Brauman, K.A., Carlson, K.M., Cassidy, E.M., Johnston, M., MacDonald, G.K., Ray, D.K. and Sieber, S. (2014). Leverage points for improving global food security and the environment, *Science*, Vol. 345, pp.325-328, doi: 10.1126/science.1246067.
- Westgren R.E. (1999). Delivering food safety, food quality, and sustainable production practices - the label rouge poultry system in France, *American Journal of Agricultural Economics*, Vol. 81, No. 5, pp.1107-1111, https://doi.org/10.2307/1244092 [accessed 15th April 2019].
- Westhoek, H., Lesschen, J.P., Rood, T., Wagner, S., De Marco, A., Murphy-Bokern, D., Leip, A., van Grinsven, H., Sutton, M.A. and Oenema, O. (2014). Food choices, health and environment: effects of cutting Europe's meat and dairy intake, *Global Environmental Change*, Vol. 26, pp.196-205, https://doi.org/10.1016/j.gloenvcha.2014.02.004 [accessed 15th April 2019].
- Wheeler, T. (2015). Climate change impacts on food systems and implications for climate-compatible food policies. In: Elbehri, A. (ed) (2015). *Climate change and food systems: global assessments and implications for food security and trade*, Rome, Italy: Food Agriculture Organization of the United Nations (FAO), ISBN 978-92-5-108699-5.
- Wheeler, T. and von Braun, J. (2013). Climate change impacts on global food security, *Science*, Vol. 341, No. 6145, pp.508-513, doi: 10.1126/science.1239402.
- Wheeler, T.R., Craufurd, P.Q., Ellis, R.H., Porter, J.R. and Prasad, P.V.V. (2000). Temperature variability and the yield of annual crops, *Agriculture, Ecosystems and Environment*, Vol. 82, 159-167, https://doi.org/10.1016/S0167-8809(00)00224-3 [accessed 15th April 2019].
- Which (2010). *Making sustainable food choices easier*, London, UK: The Consumers' Association, https://www.which.co.uk/policy/food/400/making-sustainable-food-choices-easier-which-report [accessed 11th April 2019].
- Which (2013a). *A taste for change*, London, UK: The Consumers' Association, https://www.which.co.uk/documents/pdf/a-taste-for-change---which-briefing---responsibility-deal-445309.pdf [accessed 15th April 2019].

- Which (2013b). *Consumers in 2030 forecasts and projections for life in 2030*, London, UK: The Consumers' Association, http://globaltrends.thedialogue.org/publication/consumers-in-2030-forecasts-and-projections-for-life-in-2030/ [accessed 15th April 2019].
- Whitfield, S. and Marshall, A. (2017). Defining and delivering 'sustainable' agriculture in the UK after Brexit: interdisciplinary lessons from experiences of agricultural reform, *International Journal of Agricultural Sustainability*, Vol. 15, No. 5, pp.501-513, https://doi.org/10.1080/14735903.2017.1337837 [accessed 15th April 2019].
- Whiting, P., Davies, P., Savović, J., Caldwell, D. and Churchill, R. (2013). *Evidence to inform the development of ROBIS, a new tool to assess the risk of bias in systematic reviews*, Bristol, UK: University of Bristol School of Social and Community Medicine, http://www.robis-tool.info [accessed 20th April, 2020].
- Whiting, P., Savović, J., Higgins, J.P.T., Caldwell, D.M., Reeves, B.C., Shea, B., Davies, P., Kleijnen, J. and Churchill, R. (2015). ROBIS: a new tool to assess risk of bias in systematic reviews was developed, *Journal of Clinical Epidemiology*, Vol. 69, pp.225-234, doi: 10.1016/ j.jclinepi.2015.06.005.
- Whitmarsh, D. and Palmieri, M.G. (2011). Consumer behaviour and environmental preferences: a case study of Scottish salmon aquaculture, *Aquaculture Research*, Vol. 42, pp.142-147, doi:10.1111/j.1365-2109.2010.02672.x.
- Whitmarsh, L. (2003). *Survey of environmental concerns*, http://doc.ukdataservice.ac.uk/doc/5345/mrdoc/pdf/5345userguide.pdf [accessed 15th April 2019].
- Whitmarsh, L. (2011). Scepticism and uncertainty about climate change: dimensions, determinants and change over time, *Global Environmental Change*, Vol. 21, No. 2, pp.690-700, https://doi.org/10.1016/j.gloenvcha.2011.01.016 [accessed 15th April 2019].
- Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A.G., de Souza Dias, B.F., Ezeh, A., Stephens, E.C., Jones, A.D. and Parsons, D. (2018). Agricultural systems research and global food security in the 21st century: an overview and roadmap for future opportunities, *Agricultural Systems*, Vol. 163, pp.1-6, https://doi.org/10.1016/j.agsy.2017.01.011 [accessed 15th April 2019].
- Whitmee, S., Haines, A., Beyrer, C., Boltz, F., Capon, A.G., de Souza Dias, B.F., Ezeh, A., Frumkin, H., Gong, P., Head, P., Horton, R., Mace, G.M., Marten, R., Myers, S.S., Nishtar, S., Osofsky, S.A., Pattanayak, S.K., Pongsiri, M.J., Romanelli, C., Soucat, A., Vega, J. and Yach, D. (2015). Safeguarding human health in the Anthropocene epoch - report of the Rockefeller Foundation-Lancet Commission on planetary health, *The Lancet*, Vol. 386, 14th November, pp.1973-2028, http://dx.doi.org/10.1016/S0140-6736(15)60901-1 [accessed 15th April 2019].
- Whittaker, M. (2017). *Productivity, prospects and priorities ahead of the Autumn statement*, https://www.resolutionfoundation.org/publications/revised-statement-productivity-prospects-and-priorities-ahead-of-the-autumn-budget/ [accessed 15th April 2019].

- WHO (2008). *Reducing your carbon footprint can be good for your health: a list of mitigating actions*, Geneva, Switzerland: World Health Organisation, https://www.who.int/globalchange/publications/factsheets/Kit2008_annex1_2.pdf?ua=1 [accessed 15th April 2019].
- WHO (2013). *Health 2020: a European policy framework supporting action across government and society for health and well-being*, Geneva, Switzerland: World Health Organisation, http://www.euro.who.int/__data/assets/pdf_file/0011/199532/Health2020-Long.pdf?ua=1 [accessed 15th April 2019].
- WHO (2014). *First global report on antibiotic resistance reveals serious, worldwide threat to public health*, Press release 30th April, Geneva, Switzerland: World Health Organisation.
- WHO (2015a). *Food security*, Geneva, Switzerland: World Health Organisation.
- WHO (2015b). *Health in 2015 from MDGs*, Millennium Development Goals to SDGs, Sustainable Development Goals, Geneva, Switzerland: World Health Organisation, ISBN 978 92 4 156511 0.
- WHO (2015c). *Health in 2015: from MDGs to SDGs*, Geneva, Switzerland: World Health Organization.
- WHO (2015d). *Risk communication applied to food safety: handbook*, Geneva, Switzerland: World Health Organisation, ISBN 978-92-5-109313-9.
- WHO (2015e). WHO publishes list of top emerging diseases likely to cause major epidemics, Geneva, Switzerland: World Health Organisation, https://www.who.int/medicines/ebola-treatment/WHO-list-of-top-emerging-diseases/en/ [accessed 15th April, 2019].
- WHO (2015f). *Did you know - by taking action on climate change you can strengthen public health*, Rome, Italy: Food and Agriculture Organization of the United Nations, https://www.who.int/globalchange/publications/didyouknow-health-professionals.pdf [accessed 15th April, 2019].
- WHO (2017a). United Nations decade of action on nutrition, Geneva, Switzerland: World Health Organisation, http://www.who.int/nutrition/decade-of-action/en/ [accessed 15th April 2019].
- WHO (2017b). World hunger again on the rise, driven by conflict and climate change, new UN report says. 815 million people now hungry – Millions of children at risk from malnutrition, Geneva, Switzerland: World Health Organisation, http://www.who.int/mediacentre/news/releases/2017/world-hunger-report/en/ [accessed 15th April 2019].
- WHO (2018a). *High levels of antibiotic resistance found worldwide, new data shows*, Press Release, 29th January, Geneva, Switzerland: World Health Organisation, https://www.who.int/mediacentre/news/releases/2018/antibiotic-resistance-found/en/ [accessed 15th April 2019].

- WHO (2018b). *A healthy diet sustainably produced*, reference number: WHO/NMH/NHD/18.12, November, Geneva, Switzerland: World Health Organization, https://www.who.int/nutrition/publications/nutrientrequirements/healhtydiet-information-sheet/en/ [accessed 15th April 2019].
- WHO (2019). *A world at risk - annual report on global preparedness for health emergencies*, Geneva, Switzerland: World Health Organisation, https://apps.who.int/gpmb/assets/annual_report/GPMB_annualreport_2019.pdf [accessed 15th April 2019].
- WHO (2020). *Novel Coronavirus – China*, Disease outbreak news update, Geneva, Switzerland: World Health Organisation, https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/ [accessed 15th April 2020].
- Wickramasinghe, K., Scarborough, P., Goldacre, M., Scarborough, P., Goldacre, M. and Rayner, M. (2013). Defining sustainable diets by comparing greenhouse gas emissions from different food groups: a systematic review, *The Lancet*, Vol. 382, Iss. S3, doi.org/10.1016/S0140-6736(13)62529-5.
- Wiebe, K., Lotze-Campen, H., Sands, R., Tabeau, A., van der Mensbrugghe, D., Biewald, A., Bodirsky, B., Islam, S., Kavallari, A. and Mason-D'Croz, D. (2015). Climate change impacts on agriculture in 2050 under a range of plausible socioeconomic and emissions scenarios, *Environmental Research Letters*, Vol. 10, No. 8, 085010 doi:10.1088/1748-9326/10/8/085010.
- Wiengarten, F., Humphreys, P., Cao, G., Fynes, B. and McKittrick, A. (2010). Collaborative supply chain practices and performance - exploring the key role of information quality, *Supply Chain Management: An International Journal*, Vol. 15, Iss. 6, pp.463-473, http://dx.doi.org/10.1108/13598541011080446 [accessed 15th April 2019].
- Wiggins, S., Keats, S. and Han, E. (2015). *The rising cost of a healthy diet*, London: The Overseas Development Institute, www.odi.org/rising-cost-healthy-diet [accessed 15th April 2019].
- Wijedasa, L.S., Jauhiainen, J., Könönen, M., Lampela, M., Vasander, H., LeBlanc, M-C., Evers, S., Smith, T.E.L., Yule, C.M., Varkkey, H., Lupascu, M., Parish, F., Singleton, I., Clements, G.R., Aziz, S.A., Harrison, M.E., Cheyne, S., Anshari, G.Z., Meijaard, E., Goldstein, J.E., Waldron, S., Hergoualc'h, K., Dommain, R., Frolking, S., Evans, C.D., Posa, M.R.C., Glaser, P.H., Suryadiputra, N., Lubis, R., Santika, T., Padfield, R., Kurnianto, S., Hadisiswoyo, P., Lim, T.W., Page, S.E., Gauci, V., van der Meer, P.J., Buckland, H., Garnier, F., Samuel, M.K., Kim Choo, L.N.L., O'Reilly, P., Warren, M., Suksuwan, S., Sumarga, E., Jain, A., Laurance, W.F., Couwenberg, J., Joosten, H., Vernimmen, R., Hooijer, A., Malins, C., Cochrane, M.A., Perumal, B., Siegert, F., Peh, K.S.-H., Comeau, L.-P., Verchot, L.V., Harvey, C.F., Cobb, A., Jaafar, Z., Wösten, H., Manuri, S., Müller, M., Giesen, W., Phelps, J., Ding, L.Y., Silvius, M., Wedeux, B.M.M., Hoyt, A., Osaki, M., Takashi, H., Takahashi, H., Kohyama, T.S., Haraguchi, A., Nugroho, N.P., Coomes, D.A., Le, P.Q., Dohong, A., Gunawan, H., Gaveau, D.L.A., Langner, A., Lim, F.K.S., Edwards, D.P., Giam, X., van der Werf, G., Carmenta, R., Verwer, C.C., Gibson, L., Grandois, L., Graham, L.L.B., Regalino, J., Wich, S.A., Rieley, J.,

Kettridge, N., Brown, C., Pirard, R., Moore, S., Capilla, B.R., Ballhorn, U. Hua, C.H. Hoscilo, A. Lohberger, S. Evans, T.A. Yulianti, N., Blackham, G., Onrizal Husson, S., Murdiyarso, D. Pangala, S. Cole, L.E.S. Tacconi, L., Segah, H., Tonoto, P., Lee, J.S.H., Schmilewski, G., Wulffraat, S., Putra, E.I., Cattau, M.E., Clymo, R.S., Morrison, R., Mijahid, A., Miettinen, J., Soo, C.L., Valpola, S., Wilson, D., D'Arcy, L., Gerding, M., Sundari, S., Thorton, S.A., Kalisz, B., Chapman, S.J., Mat Su, A.S., Basuki, I., Itoh, M., Traeholt, C., Sloan, S., Sayok, A.K. and Andersen, R. (2016). Denial of long-term issues with agriculture on tropical peatlands will have devastating consequences, *Global Change Biology*, Vol. 23, No. 3, pp.977-982, doi: 10.1111/gcb.13516.

- Wilcove, D.S. and Koh, L.P. (2010). Addressing the threats to biodiversity from oil palm agriculture, *Biodiversity and Conservation*, Vol. 19, pp.999-1007, https://doi.org/10.1007/s10531-009-9760-x [accessed 15th April 2019].
- Wild, B., Andersson, A., Bröder, L., Vonk, J., Hugelius, G., McClelland, J.W., Song, W., Raymond, P.A. and Gustafsson, O. (2019). Rivers across the Siberian Arctic unearth the patterns of carbon release from thawing permafrost, *Proceedings of the National Academy of Sciences*, Vol. 116, No. 21, pp.10280-10285, doi: 10.1073/pnas.1811797116.
- Wilde, P. (2015). Running out of food, *Health Affairs*, Vol. 34, No. 11, p.1999.
- Wildlife Conservation Society (2018). Indigenous peoples own or manage at least one quarter of world's land surface, *Science Daily*, 16th July, https://www.sciencedaily.com/releases/2018/07/180716130732.htm [accessed 15th April 2019].
- Wilhelmina, Q., Joost, J., George, E. and Guido, R. (2010). Globalization vs. localization global food challenges, *International Journal of Consumer Studies*, Vol. 34, pp.357-366, doi: 10.1111/j.1470-6431.2010.00868.x.
- Wilkes, A., Kiff, L., Wollenberg, E. and White, J. (2016). *Shifting food consumption to mitigate climate change is critical to fulfilling the Paris Agreement, but how?* CCAFS Info Note, Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), https://ccafs.cgiar.org/publications/shifting-food-consumption-mitigate-climate-change-critical-fulfilling-paris-agreement#.Xk-7dGj7TIV [accessed 15th April 2019].
- Wilkins, J.L. (2005). Eating right here: moving from consumer to food citizen, *Agriculture and Human Values*, Vol. 22, pp.269-273, https://doi.org/10.1007/s10460-005-6042-4 [accessed 15th April 2019].
- Wilkinson, D. (2018). Should vegans avoid avocados and almonds, *The Conversation*, 12th October, https://theconversation.com/should-vegans-avoid-avocados-and-almonds-104800 [accessed 15th April 2019].
- Willersinn, C., Mack, G., Mouron, P., Keiser, A. and Siegrist, M. (2015). Quantity and quality of food losses along the Swiss potato supply chain, *Waste Management*, Vol. 46, pp.120-132, http://dx.doi.org/10.1016/j.wasman.2015.08.033 [accessed 15th April 2019].

- Willett, W. (2001). *Eat, drink, and be healthy: the Harvard Medical School guide to healthy eating*, New York, USA: Simon and Schuster, ISBN-10: 0743266420.
- Willett, W., Rockström, J. and Loken, B. (2019b). Healthy diets and sustainable food systems – authors' reply, *The Lancet*, Vol. 394, No. 10194, pp.215-216, doi: 10.1016/S0140-6736(19)31101-8.
- Willett, W., Rockström, J. and Loken, B. (2019c). The EAT–Lancet Commission - a flawed approach – Authors' reply, *The Lancet*, Vol. 394, No. 10204, pp.1141-1142, doi: 10.1016/S0140-6736(19)31910-5.
- Willett, W., Rockström, J. and Loken, B. (2019d). Healthy diets and sustainable food systems – authors' reply, *The Lancet*, Vol. 394, No. 10194, pp.215-216, doi: 10.1016/S0140-6736(19)31101-8.
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., De Vries, W., Sibanda, L.M., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Reddy, K.S., Narain, S., Nishtar, S. and Murray, C.J.L. (2019a). Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems, *The Lancet*, 16th January, Vol. 393, No. 10170, pp.447-492, doi: https://doi.org/10.1016/S0140-6736(18)31788-4.
- Williams, A., Morris, J., Audsley, E., Hess, T., Goglio, P., Burgess, P., Chatterton, J., Pearn, K., Mena, C. and Whitehead, P. (2017). *Assessing the environmental impacts of healthier diets*, Final report to Defra on project FO0427, Cranfield, UK: School of Water, Energy and Environment, Cranfield University.
- Williams, A.G., Pell, E., Webb, J., Tribe, E., Evans, D., Moorhouse, E., Watkiss, P. (2008). *Comparative Life Cycle Assessment of food commodities procured for UK consumption through a diversity of supply chains*, Defra Project FO0103, Cranfield, UK: Cranfield University, http://randd.defra.gov.uk/Document.aspx?Document=FO0103_7899_FRA.doc [accessed 15th April 2019].
- Williams, H.C. (2004). How to reply to peer review comments when submitting papers for publication, *Journal of the American Academy of Dermatology*, Vol. 51, pp.79-83, doi: https://doi.org/10.1016/j.jaad.2004.01.049 [accessed 15th April 2019].
- Williams, P.A., Crespo, O., Abu, M. and Simpson, N.P. (2018). A systematic review of how vulnerability of smallholder agricultural systems to changing climate is assessed in Africa, *Environmental Research Letters*, Vol. 13, No. 10, 103004, doi: 10.1088/1748-9326/aae026.
- Williams, R. (2018). Food packaging chemical BPA 'found in digestive system of 86% of teenagers'. The European Commission says BPA affects hormones but others insist it has been well studied and found to be safe, *Sky News*, 4th February, https://news.sky.com/story/food-packaging-chemical-bpa-found-in-digestive-system-of-86-of-teenagers-11236098 [accessed 15th April 2019].
- Williams, S.N. and Nestle, M. (2015). Big Food - taking a critical perspective on a global public health problem, *Critical Public Health*, Vol. 25, No. 3, pp.245-247, http://dx.doi.org/10.1080/09581596.2015.1021298 [accessed 15th April 2019].

- Willis, G. (2012). *From field to fork: the value of England's local food webs*, London, UK: Campaign to Protect Rural England, https://www.cpre.org.uk/resources/farming-and-food/local-foods/item/2897-from-field-to-fork [accessed 15th April 2019].
- Willis, R. (2019). The stark truth about UK government climate action - there is no one in charge, *The Conversation*, 11th July, https://theconversation.com/the-stark-truth-about-uk-government-climate-action-there-is-no-one-in-charge-120187 [accessed 15th April 2019].
- Willows, N., Veugelers, P., Raine, K. and Kuhle, S. (2011). Associations between household food insecurity and health outcomes in the Aboriginal population (excluding reserves), *Health Reports*, Vol. 22, No. 2, p.15.
- Wilson, A.L., Buckley, E., Buckley, J.D. and Bogomolova, S. (2016). Nudging healthier food and beverage choices through salience and priming: evidence from a systematic review, *Food Quality and Preference*, Vol. 51, pp.47-64, https://doi.org/10.1016/j.foodqual.2016.02.009 [accessed 15th April 2020].
- Wilson, C. (2019). Everything you know about nutrition is wrong: why almost all food advice is fatally flawed, *New Scientist,* Vol. 3238, 10th July, pp.32-35, https://www.newscientist.com/article/mg24332380-000-why-everything-you-know-about-nutrition-is-wrong/ [accessed 15th April 2019].
- Wilson, E.O. (1985). The biological diversity crisis, *BioScience*, Vol. 35, No. 11, pp.700-706, doi: 10.2307/1310051.
- Wilson, P. (2003). Papers from a mini-symposium on competition in the food industry, *Journal of Agricultural Economics*, Vol. 54, No. 1, March, pp.85-87, doi: 10.1111/j.1477-9552.2003.tb00051.x.
- Wing, O.E.J., Bates, P.D., Smith, A.M., Sampson, C.C. Johnson, C.A., Fargione, J. and Morefield, P. (2018). Estimates of present and future flood risk in the conterminous United States, *Environmental Research Letters*, Vol. 13, 034023, doi.org/10.1088/1748-9326/aaac65.
- Winkler, J. (2012). Why soft drinks taxes will not work, *British Journal of Nutrition*, Vol. 10, pp.395-396, doi: https://doi.org/10.1017/S0007114511006477.
- Winkler, J. (2013). Brutal pragmatism on food, *British Medical Journal*, Vol. 346, f3728, https://www.bmj.com/content/346/bmj.f3728 [accessed 15th April 2019].
- Winter, K. (2018). Five key lessons other cities can learn from Cape Town's water crisis, *The Conversation*, https://theconversation.com/five-key-lessons-other-cities-can-learn-from-cape-towns-water-crisis-94045 [accessed 15th April 2019].
- Wirehn, L. (2018). Nordic agriculture under climate change: a systematic review of challenges, opportunities and adaptation strategies for crop production, *Land Use Policy*, Vol. 77, pp.63-74, https://doi.org/10.1016/j.landusepol.2018.04.059 [accessed 15th April 2019].
- Wirsenius, S., Azar, C. and Berndes, G. (2010). How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? *Agricultural Systems*, Vol. 103, pp.621-638, doi: 10.1016/j.agsy.2010.07.005.

- Wirsenius, S., Hedenus, F. and Bryngelsson, D. (2017). Policy strategies for reducing the climate impact of food and agriculture. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.301-316, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Wise, T.A. (2013). *Can we feed the world in 2050*, Global Development and Environment Institute Working Paper No. 13-04, September, Medford, USA: Tufts University.
- Witt, A. (2014). Fighting invasive alien species to safeguard food security, *The Economist*, 10th November, https://eiuperspectives.economist.com/sustainability/fighting-invasive-alien-species-safeguard-food-security [accessed 15th April 2019].
- WMO (2019a). *WMO Statement on the status of the global climate in 2018*, Geneva, Switzerland: World Meteorological Organization, ISBN: 978-92-63-11130-2, https://sdg.iisd.org/news/wmo-statement-details-accelerating-climate-impacts-for-2018/ [accessed 28th March 2019].
- WMO (2019b). *Global climate in 2015-2019. Record greenhouse gas concentrations mean further warming*, Geneva, Switzerland: World Meteorological Organization, https://public.wmo.int/en/media/press-release/global-climate-2015-2019-climate-change-accelerates [accessed 15th April 2019].
- Woetzel, J. (2019). China’s changing eating habits weigh on country’s future, *McKinsey*, 13th February, https://www.mckinsey.com/business-functions/sustainability/our-insights/sustainability-blog/chinas-changing-eating-habits-weigh-on-countrys-future [accessed 15th April 2019].
- Woetzel, J., Sellschop, R., Chui, M., Ramaswamy, S., Nyquist, S., Robinson, H., Roelofsen, O., Rogers, M. and Ross, R. (2017). *Beyond the supercycle: how technology is reshaping supply and demand for natural resources*, Brussels: McKinsey & Company’s Global Energy & Materials Practice, https://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/how-technology-is-reshaping-supply-and-demand-for-natural-resources [accessed 15th April 2019].
- Wognum, P.M., Wever, M., Nijhoff-Savvaki, R., Trienekens, J.H. and Omta, O. (2008). *Towards a multi-dimensional framework for characterising and comparing pork chains*, Wageningen, The Netherlands: Wageningen University Department of Business Administration, https://edepot.wur.nl/3054 [accessed 15th April 2019].
- Wolf, J., Asrar, G. and West, T. (2017). Revised methane emissions factors and spatially distributed annual carbon fluxes for global livestock, *Carbon Balance and Management*, Vol. 12, No. 1, pp.8, doi: https://doi.org/10.1186/s13021-017-0084-y [accessed 15th April 2019].
- Wolf, M. (2019). Taking back control of UK agriculture includes the right to be stupid: British farm policy should not prioritise protecting agriculture over cheap food, *Financial Times*, 21st February, https://www.ft.com/content/35473410-35bf-11e9-bb0c-42459962a812 [accessed 15th April 2019].

- Wolf, W., Pérez-Domínguez, I., Rueda-Cantuche, J.M., Tukker, A., Kleijn, R., de Koning, A., Bausch-Goldbohm, S. and Verheijden, M. (2011). Do healthy diets in Europe matter to the environment? A quantitative analysis, *Journal of Policy Modeling*, Vol. 33, Iss. 1, pp.8-28, https://doi.org/10.1016/j.jpolmod.2010.10.009 [accessed 15th April 2019].
- Wong, J. (2019). The idea that there are only 100 harvests left is just a fantasy, New Scientist, 8th May, https://www.newscientist.com/article/mg24232291-100-the-idea-that-there-are-only-100-harvests-left-is-just-a-fantasy/ [accessed 15th May 2019].
- Wood, H., O'Connor, A., Sargeant, J. and Glanville, J. (2018). Information retrieval for systematic reviews in food and feed topics: a narrative review, *Research Synthesis Methods*, Vol. 9, No. 4, pp.527-539, https://doi.org/10.1002/jrsm.1289
- Wood, H., O'Connor, A., Sargeant, J. and Glanville, J. (2018). Information retrieval for systematic reviews in food and feed topics: a narrative review, *Research Synthesis Methods*, Vol 9. No. 4, pp.527-539, doi: 10.1002/jrsm.1289.
- Wood, S.A., Smith, M.R., Fanzo, J., Remans, R. and DeFries, R.S. (2018). Trade and the equitability of global food nutrient distribution, *Nature Sustainability*, Vol. 34, No. 1, pp.34-37, https://doi.org/10.1038/s41893-017-0008-6 [accessed 15th April 2019].
- Woodcock, B. (2017). Our research showed a controversial insecticide can harm bees – but it still has its uses, *The Conversation*, 6th July, https://theconversation.com/our-research-showed-a-controversial-insecticide-can-harm-bees-but-it-still-has-its-uses-80490 [accessed 15th April 2019].
- Woodcock, B.A., Isaac, N.J.B., Bullock, J.M., Roy, D.B., Garthwaite, D.G., Crowe, A. and Pywell, R.F. (2016). Impacts of neonicotinoid use on long-term population changes in wild bees in England, *Nature Communications*, Vol. 7, pp.12459, doi: 10.1038/ncomms12459.
- Woodhall, J. (2019). The dynamics of food systems – a conceptual model, *Foresight4Food*, 18th December, https://www.foresight4food.net/2019/12/18/the-dynamics-of-food-systems-a-conceptual-model/ [accessed 15th April, 2020].
- Woods, J., Williams, A., Hughes, J.K., Black, M. and Murphy, R. (2010). Energy and the food system, *Philosophical Transactions of The Royal Society B: Biological Sciences*, Vol. 365, Iss. 1554, pp.2991-3006, https://doi.org/10.1098/rstb.2010.0172 [accessed 15th April 2019].
- Woodward, A. (2016). Climate change—what health professionals might do about it, *The Lancet*, Vol. 386, No. 10007, 16th July, http://dx.doi.org/10.1016/S0140-6736(15)61216-8 [accessed 15th April 2019].
- Woodward, A. and Porter, J.R. (2016). Food, hunger, health, and climate change, *The Lancet*, Vol. 387, No. 10031, pp.1886-1887, http://dx.doi.org/10.1016/S0140-6736(16)00349-4 [accessed 15th April 2019].
- Worland, J. (2016). How climate change may affect your diet, *Time*, 2nd March, http://time.com/4244617/climate-change-dietary-patterns/ [accessed 15th April 2019].
- Worland, J. (2016). How drought and extreme heat are killing the world's crops, *Time*, 6th January, https://time.com/4170029/crop-production-extreme-heat-climate-change/ [accessed 15th April 2020].

- World Bank (2010). *World Development Bank Report 2010: Development and Climate Change*, Washington, USA: The World Bank.
- World Bank (2013a). *Fish to 2030: Prospects for Fisheries and Aquaculture*, Agriculture and Environmental Services, Discussion Paper 03, 83177-GLB, Washington, USA: The World Bank, http://www.fao.org/3/i3640e/i3640e.pdf [accessed 15th April 2019].
- World Bank (2013b). *Turn down the heat: climate extremes, regional impacts, and the case for resilience*, Washington, USA: The World Bank, http://documents.worldbank.org/curated/en/975911468163736818/pdf/784240WP0Full00D0CONF0to0June19090L.pdf [accessed 15th April 2019].
- World Bank (2016a). *Future of food: why healthy, safe and sustainable food is a basic necessity*, Washington, USA: The World Bank, http://live.worldbank.org/future-of-food-why-healthy-safe-and-sustainable-food-is-a-basic-necessity [accessed 15th April 2019].
- World Bank (2016b). *The cost of fire - an economic analysis of Indonesia’s 2015 fire crisis*, Washington, USA: The World Bank.
- World Bank (2016c). *Total greenhouse gas emissions*, Washington, USA: The World Bank.
- World Cancer Research Fund International - NCD Alliance (2017). *The link between food, nutrition, diet and non-communicable diseases*, London, UK: World Cancer Research Fund International.
- World Cancer Research Fund International (2014). *Food policy highlights from around the world*, London, UK: World Cancer Research Fund International.
- World Economic Forum (2017). *Shaping the future of global food systems: a scenarios analysis,* Geneva, Switzerland: World Economic Forum, http://www3.weforum.org/docs/IP/2016/NVA/WEF_FSA_FutureofGlobalFoodSystems.pdf [accessed 15th April 2019].
- World Hunger Organisation (2016). *World hunger and poverty statistics*, Geneva, Switzerland: World Health Organisation, http://www.worldhunger.org/2015-world-hunger-and-poverty-facts-and-statistics/ [accessed 15th April 2019].
- World Ocean Review (2013). *The future of fish – the fisheries of the future*, Hamburg, Germany: maribus gGmbH, www.maribus.com [accessed 15th April 2019].
- *World Ocean Review* (2016). The global hunt for fish, *World Ocean Review*, Hamburg, Germany: maribus gGmbH, https://worldoceanreview.com/en/wor-2/fisheries/state-of-fisheries-worldwide/ [accessed 15th April 2019].
- WorldHunger (2018). World hunger and poverty facts and statistics, Washington, USA: World Hunger Education Service, https://www.worldhunger.org/world-hunger-and-poverty-facts-and-statistics/#hunger-number [accessed 15th April 2019].
- Worm, B. (2016). Averting a global fisheries disaster, *Proceedings of the National Academy of Sciences*, Vol. 113, No. 18, pp.4895-4897, doi: 10.1073/pnas.1604008113.

- Worm, B. and Branch, T.A. (2012). The future of fish, *Trends in Ecology and Evolution*, Vol. 27, pp.594-599, https://doi.org/10.1016/j.tree.2012.07.005 [accessed 15th April 2019].
- Worsley, S. (2018). Which is the more sustainable lamb - homegrown or imported, https://www.thefoodrush.com/articles/homegrown-imported-sustainable-lamb/?mc_cid=aff4cc6ee4&mc_eid=a545eb9008 [accessed 15th April 2019].
- Worthy, M. (2011). *Broken markets: how financial market regulation can help prevent another global food crisis*, London, UK: World Development Movement (Global Justice Now).
- WRAP (2013). *Estimates of waste in the food and drink supply chain*, Banbury, UK: Waste and Resources Action Programme, http://www.wrap.org.uk/sites/files/wrap/Estimates%20of%20waste%20in%20the%20food%20and%20drink%20supply%20chain_0.pdf [accessed 15th April 2019].
- WRAP (2015). *Resource revolution: creating the future*, Banbury, UK: Waste and Resources Action Programme, http://www.wrap.org.uk/sites/files/wrap/WRAP-Plan-Resource-Revolution-Creating-the-Future.pdf [accessed 15th April 2019].
- WRAP (2017). Estimates of food surplus and waste arisings in the UK, Banbury, UK: Waste and Resources Action Programme, http://www.wrap.org.uk/sites/files/wrap/Estimates_%20in_the_UK_Jan17.pdf [accessed 15th April 2019].
- WRAP (2017). *Food futures from business as usual to business unusual*, Banbury, UK: Waste and Resources Action Programme.http://www.wrap.org.uk/content/food-futures [accessed 15th April 2019].
- WRAP (2017). *Food waste in primary production - a preliminary study on strawberries and lettuces*, Banbury, UK: Waste and Resources Action Programme.
- WRAP (2019). Food and Drink, Banbury, UK: Waste and Resources Action Programme, http://www.wrap.org.uk/food-drink [accessed 15th April 2019].
- Wren, G. (2019). What should 'next generation' dietary guidelines look like? *Sustainable Food Trust*, 20th December, https://sustainablefoodtrust.org/articles/what-should-next-generation-dietary-guidelines-look-like
- WRI (2016). *Food loss and waste accounting and reporting standard*, Washington, USA: World Resources Institute, https://www.wri.org/sites/default/files/REP_FLW_Standard.pdf [accessed 15th April 2019].
- WRI (2019). *Creating a sustainable food future - synthesis report*, Washington, USA: World Resources Institute,
- WRI (2019). *Creating a sustainable food future: a menu of solutions to feed nearly 10 billion people by 2050*, Washington, USA: World Resources Institute,
- Wrieden, W., Halligan, J., Goffe, L., Barton, K.L. and Leinonen, I. (2019). Sustainable diets in the UK—developing a systematic framework to assess the environmental impact, cost and nutritional quality of household food purchases, *Sustainability*, Vol. 11, No. 18, 4974, https://doi.org/10.3390/su11184974.

- Wrieden, W.L., Leinonen, I., Barton, K.L., Halligan, J. and Goffe, L. (2017). Is the UK diet sustainable? Assessing the environmental impact, cost and nutritional quality of household food purchases, *Proceedings of the Nutrition Society*, Vol. 76, No.OCE3, pp.E108, doi:10.1017/S0029665117001811.
- Wright, A., Smith, K.E. and Hellowell, M. (2017). Policy lessons from health taxes: a systematic review of empirical studies, *BMC Public Health*, Vol. 17, No. 1, 583, doi: 10.1186/s12889-017-4497-z.
- Wright, B. and Bragge, P. (2018). Interventions to promote healthy eating choices when dining out: a systematic review of reviews, *British Journal of Health Psychology*, Vol. 23, No. 2, pp. 278-295, doi: 10.1111/bjhp.12285.
- Wright, R. (2015). Milk - behind the headlines, *Farm Business*, 22nd May, p.12.
- Wu, S-H., Ho, C-T., Nah, S-L. and Chau, C-F. (2014). Global hunger - a challenge to agricultural, food, and nutritional sciences, *Critical Reviews in Food Science and Nutrition*, Vol. 54, No.2, pp.151-162, doi:10.1080/10408398.2011.578764.
- Wu, W. (2018). Sustainable crop rotation for improving crop productivity and environmental safety: a book review, *Journal of Cleaner Production*, Vol. 176, pp.555-556, doi: 10.1016/j.jclepro.2017.12.146.
- Wu, W., Yu, Q., You, L., Chen, K., Tang, H. and Liu, J. (2018). Global cropping intensity gaps: increasing food production without cropland expansion, *Land Use Policy*, Vol. 76, pp.515-525, https://doi.org/10.1016/j.landusepol.2018.02.032 [accessed 15th April 2019].
- WWF (2008). *City residents ranked by size of their food footprint*, Woking, UK: World Wide Fund for Nature, https://eastoxfordgroupe.files.wordpress.com/2008/10/food_footprint.pdf [accessed 15th April 2019].
- WWF (2008). *Environmental impacts of the UK food economy with particular reference to WWF Priority Places and the North-east Atlantic*, Woking, UK: World Wide Fund for Nature.
- WWF (2009). *How low can we go*, Woking, UK: World Wide Fund for Nature.
- WWF (2011a). *A balance of healthy and sustainable food choices*, Woking, UK: World Wide Fund for Nature.
- WWF (2011b). *Livewell a balance of healthy and sustainable food choices for France, Spain and Sweden Report*, Marseille, France: World Wide Fund for Nature, http://livewellforlife.eu/wp-content/uploads/2013/02/A-balance-of-healthy-and-sustainable-food-choices.pdf [accessed 15th April 2019].
- WWF (2012a). *Selling sustainability - In search of the retail business case for sustainable diets*, Woking, UK: World Wide Fund for Nature.
- WWF (2012b). *Selling sustainability: in search of the retail business case for sustainable diets*, Brook Lyndhurst Consultants.

- WWF (2015). From individual to collective action: exploring business cases for addressing sustainable food security, Woking, UK: World Wide Fund for Nature, http://assets.wwf.org.uk/downloads/wwf030_foodsustainability_exec_summary_online.pdf?_ga=2.155156144.907847972.1555420384-519230905.1553361462 [accessed 15th April 2019].
- WWF (2016a). *Food security: a toolkit for exploring frames and links to biodiversity*, Woking: WWF.
- WWF (2016b). *Living planet - full report*, Woking, UK: World Wide Fund for Nature.
- WWF (2017a). *Appetite for destruction: summary report*, Woking, UK: World Wide Fund for Nature, https://www.wwf.org.uk/sites/default/files/2017-10/WWF_AppetiteForDestruction_Summary_Report_SignOff.pdf [accessed 15th April 2019].
- WWF (2017b). *Eating for 2 degrees - new and updated Livewell Plates*, Woking, UK: World Wide Fund for Nature, https://www.wwf.org.uk/eatingfor2degrees [accessed 15th April 2019].
- WWF (2017c). *Eating for 2 degrees: new and updated livewell plates,* Revised edition, https://www.wwf.org.uk/sites/default/files/201709/WWF_Livewell_Plates_Full_Report_Sept2017_Web.pdf [accessed 15th April 2019].
- WWF (2017d). *Welcome to Livewell 2020 - 7 day sample menu*, Woking, UK: World Wide Fund for Nature.
- WWF (2017e). WWF responds: UK killer whale died with extreme levels of toxic pollutants, WWF News, 3rd May, https://www.wwf.org.uk/updates/uk-killer-whale-died-extreme-levels-toxic-pollutants-wwf-responds [accessed 15th April 2019].
- WWF (2018a). Food in a warming world: the changing foods on the British plate, Woking, UK: World Wide Fund for Nature.
- WWF (2018b). Living Planet Report – 2018, Woking, UK: World Wide Fund for Nature.
- WWF (2018c). *Sustainable food systems and diets - a review of multi-stakeholder initiatives*, Woking, UK: World Wide Fund for Nature.
- WWF (2019a). *Mitigating climate change impacts on food security from the ocean*, Woking, UK: World Wide Fund for Nature,
- WWF (2019b). *Want to hear an uncomfortable truth*, Woking, UK: World Wide Fund for Nature, https://twitter.com/i/status/1088398014778130432.
- WWF, Global Footprint Network, Institute of Zoology, Water Footprint Network (2018). *Living planet report 2018: Aiming higher*, Gland, Switzerland: WWF International, www.wwf.org.uk [accessed 15th April 2019].
- WWF-UK (2009). *One planet food strategy 2009–2012*, Godalming, UK: WWF UK, www.wwf.org.uk [accessed 15th April 2019].
- WWF-UK (2011). *Livewell - healthy people, healthy planet*, Woking, UK: World Wide Fund for Nature.
- WWF-UK (2015). *Food security: from individual to collective*, Woking, UK: World Wide Fund for Nature.

- WWF-UK (2015). *From individual to collective action*, Woking, UK: World Wide Fund for Nature.
- Wynes, S. and Nicholas, K.A. (2017). The climate mitigation gap: education and government recommendations miss the most effective individual actions, *Environmental Research Letters*, Vol. 12, 074024, https://doi.org/10.1088/1748-9326/aa7541.
- Xie, H., Perez, N., Anderson, W., Ringler, C. and You, L. (2018). Can Sub-Saharan Africa feed itself? The role of irrigation development in the region's drylands for food security, *Water International*, Vol. 43, No. 6, pp.796-814, https://doi.org/10.1080/02508060.2018.1516080 [accessed 15th April 2019].
- Xin, J., Zhao, L., Wu, T., Zhang, L., Li, Y., Xue, H., Xiao, Q., Wang, R., Xu, P., Visscher, T., Ma, X. and Jia, P. (2019). Association between access to convenience stores and childhood obesity: a systematic review, *Obesity Reviews*, doi: 10.1111/obr.12908.
- Xu, C., Kohler, T.A., Lenton, T.M. Svenning, J-C. and Scheffer, M. (2020). Future of the human climate niche, *Proceedings of the National Academy of Sciences*, May, 201910114; doi: 10.1073/pnas.1910114117.
- Xu, X. and Lan, Y. (2016). A comparative study on carbon footprints between plant- and animal-based foods in China, *Journal of Cleaner Production*, Vol. 112, Iss. 4, pp.2581-2592, https://doi.org/10.1016/j.jclepro.2015.10.059 [accessed 15th April 2019].
- Yach, D. (2008). The role of business in addressing the long-term implications of the current food crisis, *Globalization and Health*, Vol. 4, No. 12, doi: 10.1186/1744-8603-4-12.
- Yakovleva, N. (2007). Measuring the sustainability of the food supply chain: a case study of the UK, *Journal of Environmental Policy and Planning*, Vol. 9, No. 1, pp.75-100, https://doi.org/10.1080/15239080701255005 [accessed 15th April 2019].
- Yakovleva, N. and Flynn, A. (2009). *The food supply chain and innovation a case study of potatoes*, The Centre For Business Relationships, Accountability, Sustainability and Society, working paper series no. 15, Cardiff, UK Cardiff University Research Centre for Business Relationships, Accountability, Sustainability and Society (BRASS).
- Yakovleva, N., Sarkis, J. and Sloan, T. (2012). Sustainable benchmarking of supply chains - the case of the food industry, *International Journal of Production Research*, Vol. 50, No. 5, pp.1297-1317, http://dx.doi.org/10.1080/00207543.2011.571926 [accessed 15th April 2019].
- Yamamuro, M., Komuro, T., Kamiya, H., Kato, T., Hasegawa, H. and Kameda, Y. (2019). Neonicotinoids disrupt aquatic food webs and decrease fishery yields, *Science*, Vol. 366, No. 6465, pp.620-623.
- Yamazaki, S., Jennings, S., Grafton, R.Q. and Kompas, T. (2015). Are marine reserves and harvest control rules substitutes or complements for rebuilding fisheries, *Resource and Energy Economics*, Vol. 40, pp.1-18, http://dx.doi.org/10.1016/j.reseneeco.2015.01.001 [accessed 15th April 2019].
- Yang, S., Zhang, X., Feng, P., Wu, T., Tian, R., Zhang, D., Zhao, L., Xiao, C., Zhou, Z., He, F., Cheng, G. and Jia, P. (2020). Access to fruit and vegetable markets and childhood obesity: a systematic review, *Obesity Reviews*, doi: 10.1111/obr.12980.

- Yang, X., Chen, F., Lin, X., Liu, Z., Zhang, H., Zhao, J., Li, K., Ye, Q., Li, Y., Lv, S., Yang, P., Wu, W., Li, Z., Lal, R. and Tang, H. (2015). Potential benefits of climate change for crop productivity in China, *Agricultural and Forest Meteorology*, Vol. 208, pp.76-84, https://doi.org/10.1016/j.agrformet.2015.04.024 [accessed 15th April 2019].
- Yau, A., Adams, J. and White, M. (2018). Is food security associated with diet and health? A cross-sectional online panel of adults in the UK, *Lancet*, Vol. 392, No. 2, pp.S96-S96, https://doi.org/10.1016/S0140-6736(18)32073-7 [accessed 15th April 2019].
- Yawson, D.O., Mulholland, B.J., Ball, T., Adu, M.O., Mohan, S. and White, P.J. (2017). Effect of climate and agricultural land-use changes on UK feed barley production and food security to the 2050s, *Land*, Vol. 6, No. 4, pp.74, doi: 10.3390/land6040074.
- Ye, L., Tang, H., Wu, W., Yang, P., Nelson, G.C., Mason-D'Croz, D. and Palazzo, A. (2014). Chinese food security and climate change: agriculture futures, *Economics: The Open-Access*, Open-Assessment E-Journal, Vol. 8, No. 2014-1, pp.1, http://dx.doi.org/10.5018/economics-ejournal.ja.2014-1 [accessed 15th April 2019].
- Ye, Y., Cochrane, K., Bianchi, G., Willmann, R., Majkowski, J., Tandstad, M. and Carocci, F. (2013). Rebuilding global fisheries: the World Summit Goal, costs and benefits, *Fish and Fisheries*, Vol. 14, pp.174-185, http://dx.doi.org/10.5018/economics-ejournal.ja.2014-1 [accessed 15th April 2019].
- Yeni, F. and Alpas, H. (2017). Vulnerability of global food production to extreme climatic events, *Food Research International*, Vol. 96, pp. 27-39, https://doi.org/10.1016/j.foodres.2017.03.020 [accessed 15th April 2019].
- Yin-Ling, L. (2015). Boundary-work in science education: a case study of GM food, *British Educational Research Journal*, Vol. 42, pp.477-491, doi:10.1002/berj.3216.
- Yngve, A. (2009). A historical perspective of the understanding of the link between diet and coronary heart disease, *American Journal of Lifestyle Medicine*, Vol. 3, No. 1 Suppl., pp.35S–38S, doi: 10.1177/1559827609334887.
- Yngve, A. (2010). Editorial: dietary guidelines and goal-setting, *Public Health Nutrition*, Vol. 13, No. 8, pp.1149-1150, doi: 10.1017/S1368980010001692.
- Yngve, A. and Tseng, M. (2010). Dietary guidelines and goal-setting, *Public Health Nutrition*, Vol 13, pp.1149-1150, doi: 10.1017/S1368980010001692.
- Yoho, R.A. and Rittmann, B.E. (2018). Climate change and energy technologies in undergraduate introductory science textbooks, *Environmental Communication*, Vol. 1, doi: 10.1080/17524032.2018.1454337.
- *York University* (2019). Federal Budget 2019: this is not a national food policy, *York University*, 23rd March, https://foodpolicyforcanada.info.yorku.ca/2019/03/federal-budget-2019-this-is-not-a-national-food-policy/ [accessed 11th April 2020].

- Yost, K. (2017). How fishing seasons affect sustainability, *Sustainable Food Trust*, 23rd February, http://sustainablefoodtrust.org/articles/how-fishing-seasons-affect-sustainability/ [accessed 15th April 2019].
- YouGov (2019). *Is the future of food flexitarian?* 18th March, https://yougov.co.uk/topics/resources/articles-reports/2019/03/18/future-food-flexitarian [accessed 15th April 2019].
- Young, B. (2007). Close the food-safety gap with traceability, *The National Provisioner*, December, p.6.
- Young, R. (2017). The importance of grazing livestock for soil and food system resilience. In: D'Silva, J. and Webster, A.J.F. (eds) *The meat crisis: developing more sustainable production and consumption*, 2nd edition, pp.93-114, London, UK: Routledge, https://doi.org/10.4324/9781315562032, [accessed 11th April 2020].
- Young, R. (2017). The final nail in Roundup's coffin? *Sustainable Food Trust*, 23rd November, http://sustainablefoodtrust.org/articles/roundup/ [accessed 15th April 2019].
- Young, R. (2018a). Claims against meat fail to consider bigger picture, *Sustainable Food Trust*, 14th June, https://sustainablefoodtrust.org/articles/claims-against-meat-fail-to-see-bigger-picture/ [accessed 15th April 2019].
- Young, R. (2018b). Red meat and dairy good for the heart, *Sustainable Food Trust*, 30th August, https://sustainablefoodtrust.org/articles/red-meat-and-dairy-good-for-heart/ [accessed 15th April 2019].
- Young, R. (2019). Adding balance to the meat debate, *Sustainable Food Trust*, 5th February, https://sustainablefoodtrust.org/articles/adding-balance-to-the-meat-debate [accessed 15th April 2019].
- Young, S.L. (2015). When an invasive plant fails to invade, *Frontiers in Ecology and the Environment*, Vol. 13, pp.450-451, https://esajournals.onlinelibrary.wiley.com/doi/pdf/10.1890/1540-9295-13.8.450 [accessed 15th April 2019].
- Yu, Q., Wu, W., You, L., Zhu, T., Vliet, J., Verburg, P.H., Liu, Z., Lia, Z., Yang, P., Zhou, Q., Tang, H. (2017). Assessing the harvested area gap in China, *Agricultural Systems*, Vol. 153, pp.212-220, https://doi.org/10.1016/j.agsy.2017.02.003 [accessed 15th April 2019].
- Yuan, J., Li, W., Kopp, R.E. and Deng, Y. (2018). Response of subtropical stationary waves and hydrological extremes to climate warming in boreal summer, *Journal of Climate*, Vol. 31, pp.10165-10180, doi: 10.1175/JCLI-D-17-0401.1.
- Yunlong, C. and Smit, B. (1994). Sustainability in agriculture: a general review, *Agriculture, Ecosystems & Environment*, Vol. 49, pp.299-307, https://doi.org/10.1016/0167-8809(94)90059-0 [accessed 15th April 2019].
- Zabel, F., Putzenlechner, B. and Mauser, W. (2014). Global agricultural land resources - a high resolution suitability evaluation and its perspectives until 2100 under climate change conditions, *PLoS One*, Vol. 9, Iss. 9, pp.e107522, doi:10.1371/journal.pone.0107522.

- Zaçe, D., Di Pietro, M.L., Caprini, F., de Waure, C. and Ricciardi, W. (2020). Prevalence and correlates of food insecurity among children in high-income European countries: a systematic review, *Annali Dell'istituto Superiore Di Sanita*, Vol. 56, No. 1, pp.90-98, doi: 10.4415/ANN_20_01_13.
- Zagmutt, F.J., Pouzou, J.G. and Costard, S. (2019). The EAT–Lancet Commission - a flawed approach, *The Lancet*, Vol. 394, Iss. 10204, pp.1140-1141, doi:https://doi.org/10.1016/S0140-6736(19)31903-8.
- Zalasiewicz, J., Williams, M. and Hearing, T. (2018). Hothouse Earth: our planet has been here before – here's what it looked like, *The Conversation*, 13th August, https://theconversation.com/hothouse-earth-our-planet-has-been-here-before-heres-what-it-looked-like-101413 [accessed 15th April 2019].
- Zavaleta, C., Berrang-Ford, L., Ford, J., Llanos-Cuentas, A., Cárcamo, C., Ross, N.A., Lancha, G., Sherman, M. and Harper, S.L. (2018). Multiple non-climatic drivers of food insecurity reinforce climate change maladaptation trajectories among Peruvian Indigenous Shawi in the Amazon, *PLoS One*, Vol. 13, No. 10, e0205714, https://doi.org/10.1371/journal.pone.0205714.
- Zeebe, R.E., Ridgwell, A. and Zachos, J.C. (2016). Anthropogenic carbon release rate unprecedented during the past 66 million years, *Nature Geoscience*, Vol. 9, pp.325-329, doi:https://doi.org/10.1038/ngeo2681.
- Zeigler, R. (ed.) (2019). *Sustaining global food security: the nexus of science & policy*, Clayton, Australia: CSIRO Publishing.
- Zenk, S.N., Thatcher, E., Reina, M., Phulkerd, S., Lawrence, M., Vandevijvere, S., Sacks, G., Worsley, A. and Tangcharoensathien, V. (2015). Local food environments and diet-related health outcomes a systematic review of local food environments, body weight, and other diet-related health outcomes, *Local Food Environments: Food Access in America*, pp.167-204, doi: 10.1201/b17351-9.
- Zerbe, N. (2015). Plant genetic resources in an age of global capitalism, *Canadian Food Studies*, Vol. 2, No. 2, pp.194-200.
- Zhai, Z., Martínez, J.F., Beltran, V. and Martínez, N.L. (2020). Decision support systems for agriculture 4.0: survey and challenges, *Computers and Electronics in Agriculture*, Vol. 170, 105256, doi: 10.1016/j.compag.2020.105256.
- Zhang, C., Chen, X., Li, Y., Ding, W. and Fu, G. (2018). Water-energy-food nexus: concepts, questions and methodologies, *Journal of Cleaner Production*, Vol. 195, pp.625-639, https://doi.org/10.1016/j.jclepro.2018.05.194.
- Zhang, J., He, C., Chen, L. and Cao, S. (2018). Improving food security in China by taking advantage of marginal and degraded lands, *Journal of Cleaner Production*, Vol. 171, pp.1020-1030, https://doi.org/10.1016/j.jclepro.2017.10.110 [accessed 15th April 2019].
- Zhang, L., Rana, I., Shaffer, R.M., Taioli, E.T. and Sheppard, L. (2019). Exposure to Glyphosate-based herbicides and risk for non-hodgkin lymphoma: a meta-analysis and supporting evidence, *Mutation Research/Reviews in Mutation Research*, Vol. 781, pp.186-206, https://doi.org/10.1016/j.mrrev.2019.02.001 [accessed 15th April 2020].

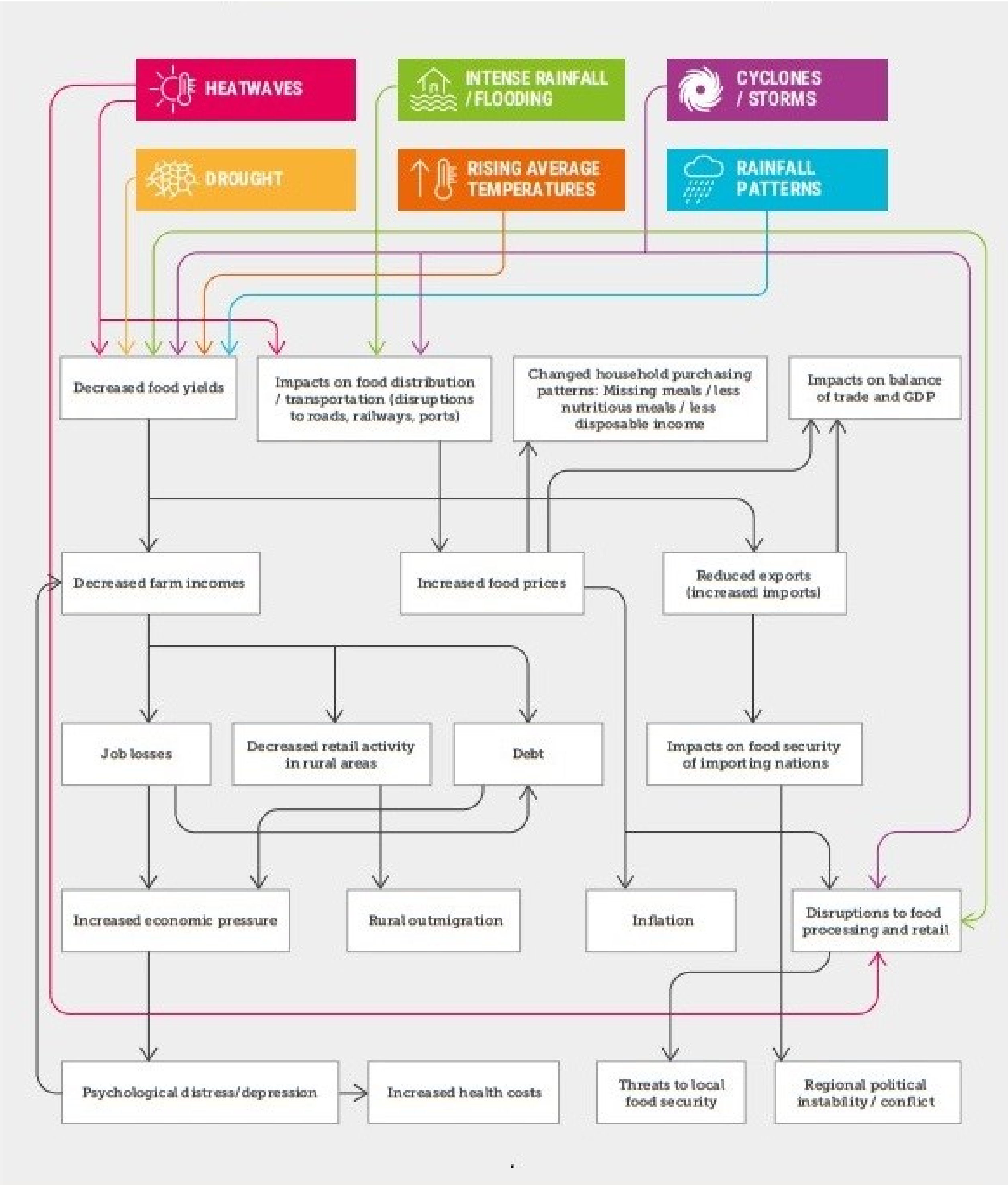
- Zhang, W., Ricketts, T.H., Kremen, C., Carney, C. and Swinton, S.M. (2007). Ecosystem services and dis-services to agriculture, *Ecological Economics*, Vol. 64, pp.253-260, doi:10.1016/j.ecolecon.2007.02.024.
- Zhang, X. and Wu, Z. (2015). Are there future ways for regenerative sustainability? *Journal of Cleaner Production*, Vol. 109, pp.39-41, https://doi.org/10.1016/j.jclepro.2015.09.131 [accessed 15th April 2019].
- Zhang, X., Davidson, E.A., Mauzerall, D.L., Searchinger, T.D., Dumas, P. and Shen, Y. (2015). Managing nitrogen for sustainable development, *Nature*, Vol. 528, pp.51-59, https://doi.org/10.1038/nature15743 [accessed 15th April 2019].
- Zhao, C., Liu, B., Piao, S., Wang, X., Lobell, D.B., Huang, Y., Huang, M., Yao, Y., Bassu, S., Ciais, P., Durand, J-L., Elliott, J., Ewert, F., Janssens, I.A., Li, T., Lin, E., Liu, Q., Martre, P., Müller, C., Peng, S., Peñuelas, J., Ruane, A.C., Wallach, D., Wang, T., Wu, D., Liu, Z., Zhu, Y., Zhu, Z. and Asseng, S. (2017). Temperature increase reduces global yields of major crops in four independent estimates, *Proceedings of the National Academy of Sciences*, Vol. 114, No. 35, pp.9326-9331, doi: 10.1073/pnas.1701762114.
- Zhou, X., Passow, F.H., Rudek, J., von Fisher, J.C., Hamburg, S.P. and Albertson, J.D. (2019). Estimation of methane emissions from the U.S. ammonia fertilizer industry using a mobile sensing approach, *Elementa: Science of the Anthropocene*, doi: 10.1525/elementa.358.
- Zhou, Y. and Staatz, J. (2016). Projected demand and supply for various foods in West Africa: implications for investments and food policy, *Food Policy*, Vol. 61, pp.198-212, https://doi.org/10.1016/j.foodpol.2016.04.002 [accessed 15th April 2019].
- Zhu, C., Kobayashi, K., Loladze, I., Zhu, J., Jiang, Q., Xu, X., Liu, G., Seneweera, S., Ebi, K.L., Drewnowski, A., Fukagawa, N.K. and Ziska, L.H. (2018). Carbon dioxide (CO_2) levels this century will alter the protein, micronutrients, and vitamin content of rice grains with potential health consequences for the poorest rice-dependent countries, *Science Advances*, Vol. 4, eaaq1012, pp.1-8, doi: 10.1126/sciadv.aaq1012.
- Zhu, X., Feng, Z., Sun, T., Liu, X., Tang, H., Zhu, J., Guo, W. and Kobayashi, K. (2011). Effects of elevated ozone concentration on yield of four Chinese cultivars of winter wheat under fully open-air field conditions, *Global Change Biology*, Vol. 17, pp.2697-2706, https://doi.org/10.1111/j.1365-2486.2011.02400.x [accessed 15th April 2019].
- Zhu, Z., Piao, S., Myneni, R.B., Huang, M., Zeng, Z., Canadell, J.G., Ciais, P., Sitch, S., Friedlingstein, P., Arneth, A., Cao, C., Cheng, L., Kato, E., Koven, C., Li, Y., Lian, X., Liu, Y., Liu, R., Mao, J., Pan, Y., Peng, S., Peñuelas, J., Poulter, B., Pugh, T.A.M., Stocker, B.D., Viovy, N., Wang, X., Wang, Y., Xiao, Z., Yang, H., Zaehle, S. and Zeng, N. (2016). Greening of the Earth and its drivers, *Nature Climate Change*, Vol. 6, pp.791-795, doi:10.1038/nclimate3004.
- Ziervogel, G. and Ericksen, P.J. (2010). Adapting to climate change to sustain food security, Wiley Interdisciplinary Reviews: *Climate Change*, Vol. 1, No. 4, pp.525-540, doi: 10.1002/wcc.56.
- Zilberman, D., Kaplan, S., Kim, E., Sexton, S. and Barrows, G. (201). Biotechnology and food security, *Journal of International Affairs*, Spring/Summer 2014, Vol. 67, No. 2, pp.91-105, https://www.jstor.org/stable/24461737 [accessed 15th April 2019].

- Zimmerer, K.S., de Haan, S., Jones, A.D., Creed-Kanashiro, H., Tello, M., Carrasco, M., Meza, K., Amaya, F.P., Cruz-Garcia G.S., Tubbeh, R. and Olivencia, Y.J. (2019). The biodiversity of food and agriculture (Agrobiodiversity) in the anthropocene: research advances and conceptual framework, *Anthropocene*, Vol. 25, 100192, https://doi.org/10.1016/j.ancene.2019.100192 [accessed 15th April 2019].
- Zimmermann, N., Symonds, P., Davies, M., Wilkinson, P., Dianati, K., Taylor, J. and Milner, J. (2018). Urban systems complexity in sustainability and health: an interdisciplinary modelling study, *The Lancet Planetary Health*, Vol. 2, Suppl. 1, p.S21, https://doi.org/10.1016/S2542-5196(18)30106-2.
- Ziska, L. and George, K. (2004). Rising carbon dioxide and invasive, noxious plants: potential threats and consequences, *World Resources Review*, Vol. 16, pp.427-447, https://www.ars.usda.gov/ARSUserFiles/80420520/FullTextPublicationspdf/Publications/ziska/potentialthreats.pdf [accessed 15th April 2019].
- Ziska, L. and Goins, E. (2006). Elevated atmospheric carbon dioxide and weed populations in glyphosate treated soybean, *Climate and Chemical Weed Management*, Vol. 46, pp.1354-1359, doi: 10.2135/cropsci2005.10-0378.
- Ziska, L.H., Pettis, J.S., Edwards, J., Hancock, J.E., Tomecek, M.B., Clark, A., Dukes, J.S., Loladze, I. and Polley, H.W. (2016). Rising atmospheric CO_2 is reducing the protein concentration of a floral pollen source essential for North American bees, *Proceedings of the Royal Society B*, Vol. 283, pp.20160414, doi: 10.1098/rspb.2016.0414.
- Ziv, G., Watson, E., Young, D., Howard, D.C., Larcom, S.T. and Tanentzap, A.J. (2018). The potential impact of Brexit on the energy, water and food nexus in the UK: a fuzzy cognitive mapping approach, *Applied Energy*, Vol. 210, pp.487-498, https://doi.org/10.1016/j.apenergy.2017.08.033 [accessed 15th April 2019].
- Zomer, R.J., Trabucco, A., van Straaten, O. and Bossio, D. (2006). *Carbon, land and water: a global analysis of the hydrologic dimensions of climate change mitigation through afforestation / reforestation*, Colombo, Sri Lanka: International Water Management Institute, IWMI Research Report 101, doi: http://dx.doi.org/10.3910/2009.101.
- Zoomers, A., van Noorloos, F., Otsuki, K., Steel, G. and van Westen, G. (2017). The rush for land in an urbanizing world: from land grabbing toward developing safe, resilient, and sustainable cities and landscapes, *World Development*, Vol. 92, pp.242-252, https://www-sciencedirect-com.ezproxy.mmu.ac.uk/science/article/pii/S0305750X16305484 [accessed 15th April 2019].
- zu Ermgassen, E.K.H.J., Balmford, A. and Salemdee, R. (2016). Reduce, relegalize, and recycle food waste, *Science*, Vol. 6293, No. 1526, doi: 10.1126/science.aaf9630.
- zu Ermgassen, S. and Yoh, N. (2019). We’re conservation scientists – here’s why we haven’t lost hope for the future, *The Conversation*, 24th January, https://theconversation.com/were-conservation-scientists-heres-why-we-havent-lost-hope-for-the-future-110155 [accessed 15th April 2019].

- Zurek, M., Hebinck, A., Leip, A., Vervoort, J., Kuiper, M., Garrone, M., Havlik, P., Heckelei, T., Hornborg, S., Ingram, J., Kuijsten, A., Shutes, L., Geleijnse, M., Terluin, I., Van't Veer, P., Wijnands, J., Zimmermann, A. and Achterbosch, T. (2018). *Assessing sustainable food and nutrition security of the eu food system—an integrated approach*, doi: 10.3390/su10114271.
- Zvereva, E.L. and Kozlov, M.V. (2006). Consequences of simultaneous elevation of carbon dioxide and temperature for plant-herbivore interactions: a metaanalysis, *Global Change Biology*, Vol. 12, pp.27-41, doi: 10.1111/j.1365-2486.2005.01086.x.

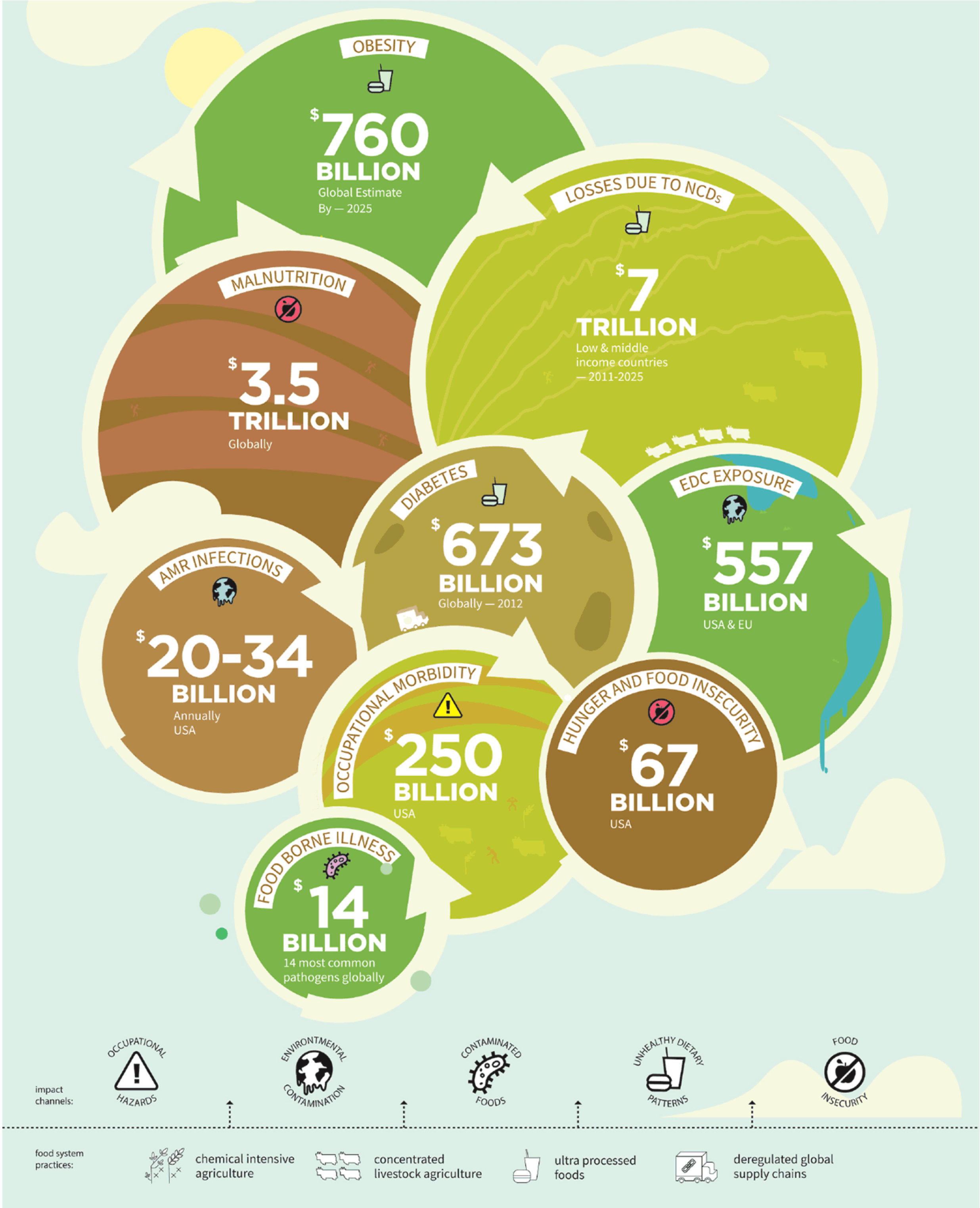
8. Appendices

8.1 Impacts of climate change on the food system



Source: Climate Council of Australia (2019).

8.2 The ballooning costs of health impacts

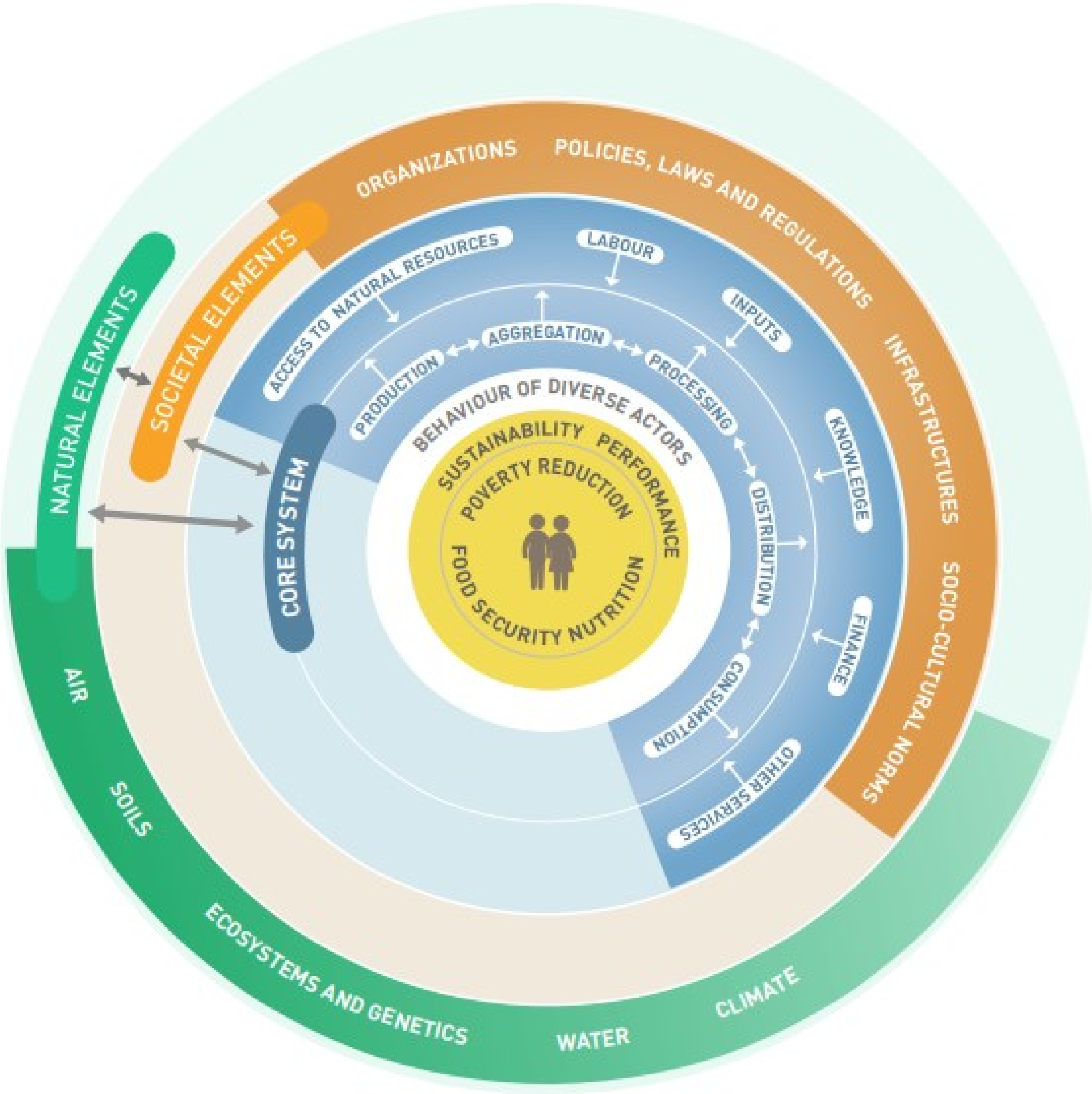


Source: IPES-Food (2017).

8.3 Conceptual framework for health impact assessment of a no-deal Brexit

Source: van Schalkwyk *et al.* (2019).

8.4 The Food and Agriculture Organization of the United Nations 'food system wheel'



Source: FAO (2018).

8.5 The United Nations 'Decade of Action on Nutrition (2016-2025)'

UNITED NATIONS DECADE OF
ACTION ON NUTRITION
2016-2025

World Health Organization

The Decade calls all Member States to act across six pillars for nutrition action based on the commitments of the Rome Declaration on Nutrition and the recommendations included in the Second International Conference on Nutrition (ICN2) Framework for Action (the ICN2 was held in Rome, Italy, on 19th -21st November 2014):

- Sustainable food systems for healthy diets
- Aligned health systems providing universal coverage of essential nutrition actions
- Social protection and nutrition education
- Trade and investment for improved nutrition
- Enabling food and breastfeeding environments
- Review, strengthen and promote nutrition governance and accountability

Source: WHO (2016).

8.6 The EAT-Lancet Commission planetary health plate

Source: Willett *et al.* (2019).

8.7 The Lancet Countdown indicators

Climate change impacts, exposures, and vulnerability

- 1.1: health and heat
- 1.1.1: vulnerability to extremes of heat
- 1.1.2: health and exposure to warming
- 1.1.3: exposure of vulnerable populations to heatwaves
- 1.1.4: change in labour capacity
- 1.2: health and extreme weather events
- 1.2.1: wildfires
- 1.2.2: flood and drought
- 1.2.3: lethality of weather-related disasters
- 1.3: global health trends in climate-sensitive diseases
- 1.4: climate-sensitive infectious diseases
- 1.4.1: climate suitability for infectious disease transmission
- 1.4.2: vulnerability to mosquito-borne diseases
- 1.5: food security and undernutrition
- 1.5.1: terrestrial food security and undernutrition
- 1.5.2: marine food security and undernutrition

Adaptation, planning, and resilience for health

- 2.1: adaptation planning and assessment
- 2.1.1: national adaptation plans for health
- 2.1.2: national assessments of climate change impacts, vulnerability, and adaptation for health
- 2.1.3: city-level climate change risk assessments
- 2.2: climate information services for health
- 2.3: adaptation delivery and implementation
- 2.3.1: detection, preparedness, and response to health emergencies
- 2.3.2: air conditioning—benefits and harms
- 2.4: spending on adaptation for health and health-related activities

Mitigation actions and health co-benefits

- 3.1: energy system and health
- 3.1.1: carbon intensity of the energy system
- 3.1.2: coal phase-out
- 3.1.3: low-carbon emission electricity
- 3.2: access and use of clean energy
- 3.3: air pollution, energy, and transport
- 3.3.1: exposure to air pollution in cities
- 3.3.2: premature mortality from ambient air pollution by sector
- 3.4: sustainable and healthy transport
- 3.5: food, agriculture, and health
- 3.6: mitigation in the health-care sector

Economics and finance

- 4.1: economic losses due to climate-related extreme events
- 4.2: economic costs of air pollution
- 4.3: investing in a low-carbon economy
- 4.3.1: investment in new coal capacity
- 4.3.2: investments in low-carbon energy and energy efficiency
- 4.3.3: employment in low-carbon and high-carbon industries
- 4.3.4: funds divested from fossil fuels
- 4.4: pricing greenhouse-gas emissions from fossil fuels
- 4.4.1: fossil fuel subsidies
- 4.4.2: coverage and strength of carbon pricing
- 4.4.3: use of carbon pricing revenues

Public and political engagement

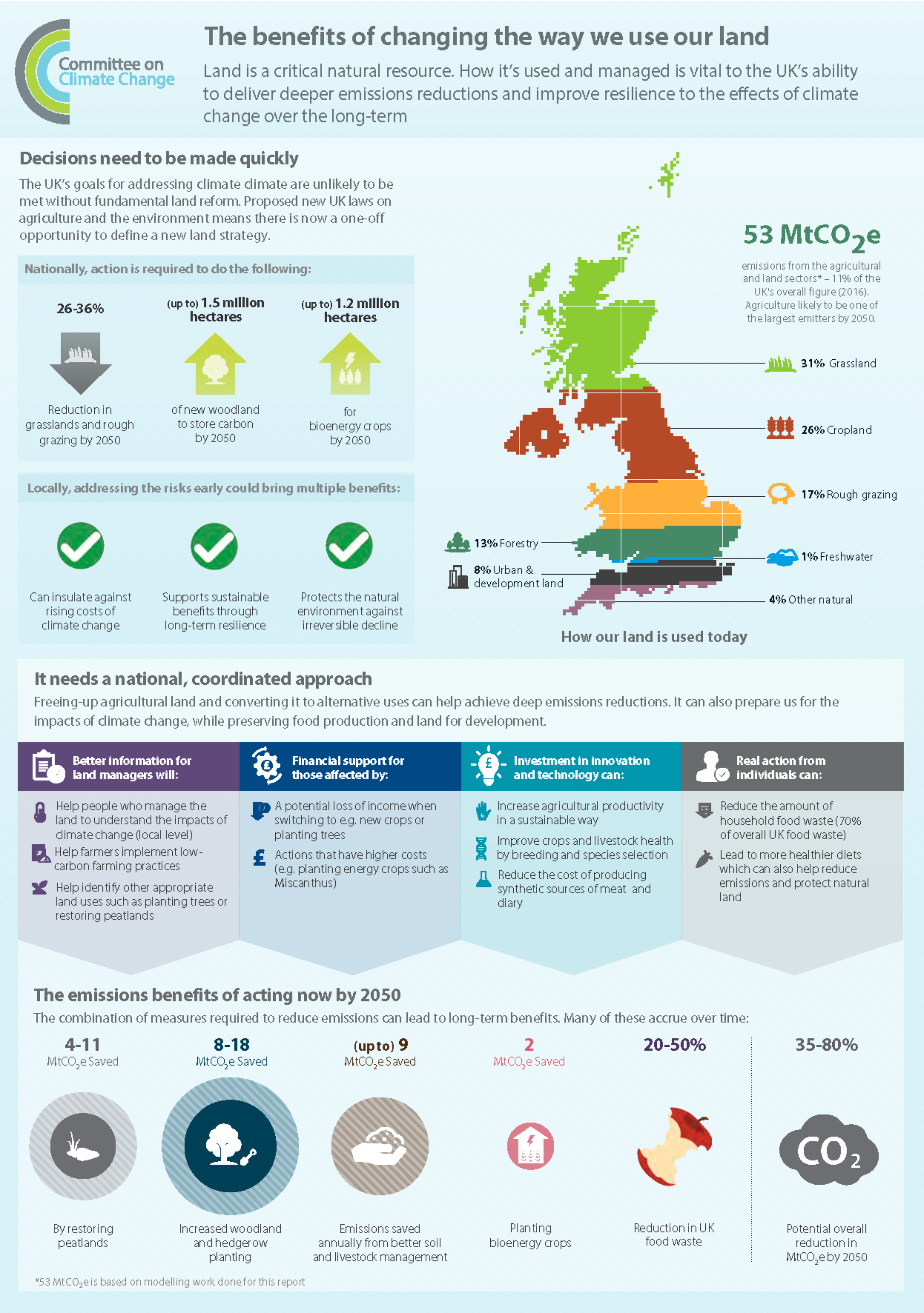
- 5.1: media coverage of health and climate change
- 5.2: individual engagement in health and climate change
- 5.3: engagement in health and climate change in the UN General Assembly
- 5.4: engagement in health and climate change in the corporate sector

Source: Watts *et al.* (2019).

8.8 Key historical events in modern nutrition science, with implications for current science and policy

Source: Mozaffarian *et al.* (2018)

8.9 The benefits of changing the way we use our land



Source: Committee on Climate Change (2018d; 2020).

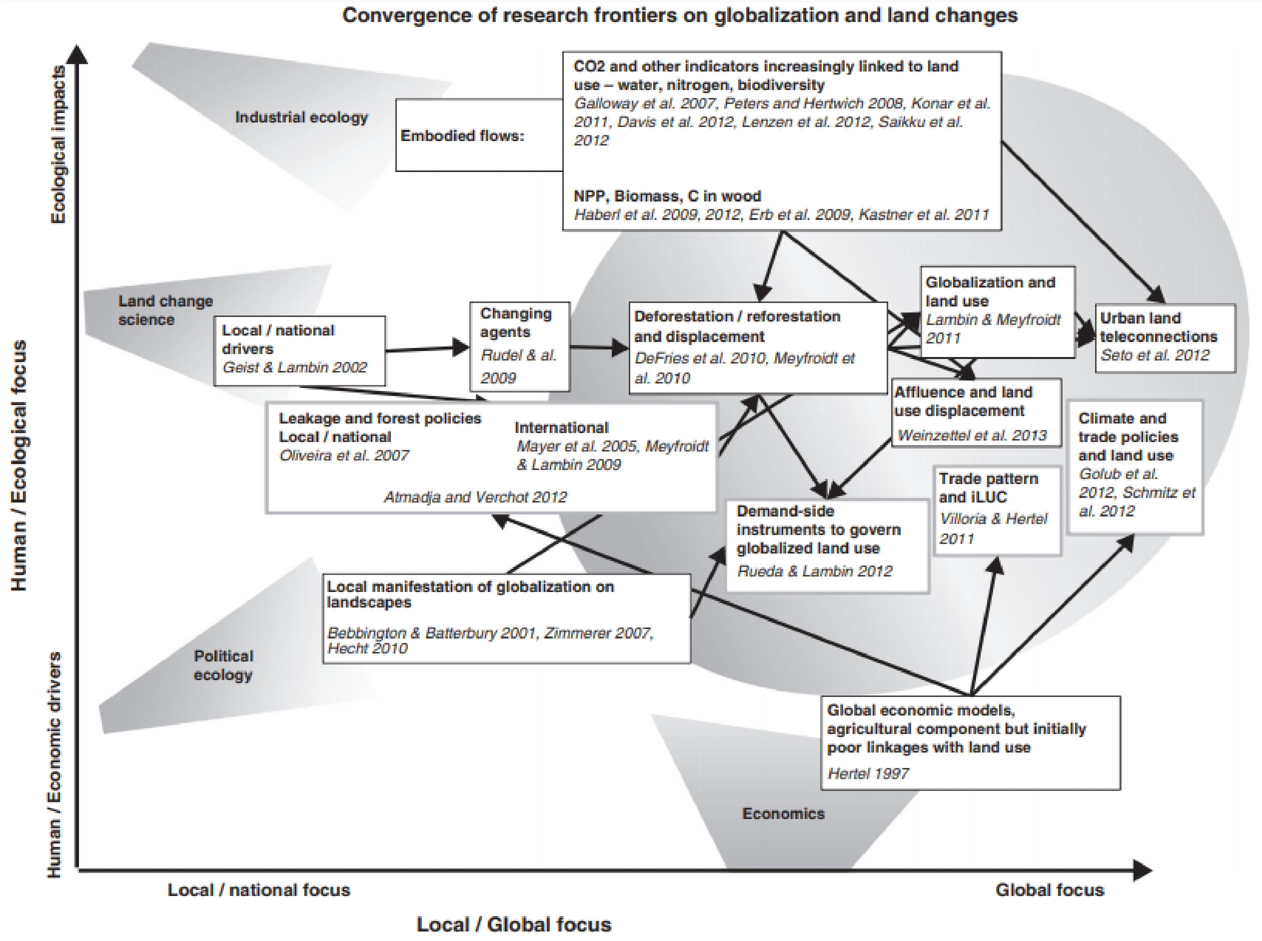
8.10 Potential policy 'families' for food-related adaptation and mitigation of climate change

Family	***Sub-family***	***Scale***	***Interventions***	***Examples***
Supply-side efficiency	Increasing agricultural efficiency and yields	I, N	Agricultural R&D	Investment in research, innovation, knowledge exchange, e.g., on genetics, yield gaps, resilience
		I, N	Supporting precision agriculture	Agricultural engineering, robotics, big data, remote sensing, inputs
		I, N	Sustainable intensification projects	Soils, nutrients, capital, labour
		N, R	Improving farmer training and knowledge sharing	Extension services, online access, farmer field schools, farmer-to-farmer networks (CABI 2019)
	Land-use planning	N, R,	Land-use planning for ecosystem services (remote sensing, ILK)	Zoning, protected area networks, multifunctional landscapes, 'land sparing' (Benton *et al.*, 2018; Jones *et al.*, 2013)
		N, R, L	Conservation agriculture programmes	Soil and water erosion control, soil quality improvement
			Payment for ecosystem services	Incentives for farmers/landowners to choose lower-profit but environmentally benign resource use,
	Market approaches	I, N	Mandated carbon cost reporting in supply chains; public/private incentivised insurance products	Carbon and natural capital accounts (CDP 2019), crop insurance
	Trade		Liberalising trade flows; green trade	Reduction in GHG emissions from supply chains
Raising profitability and quality	Stimulating markets for premium goods	N, R	Sustainable farming standards, agroecology projects, local food movements	Regional policy development, public procurement of sustainable food
Modifying demand	Reducing food waste	I, N, L	Regulations, taxes	'Pay-As-You-Throw (PAYT)' schemes; EU Landfill Directives;
		I, N, L	Awareness campaigns, education	FAO Global Initiative on Food Loss and Waste Reduction
		I, N	Funding for reducing food waste	Research and investment for shelf life, processing, packaging, cold storage
		I, N, L	Circular economy using waste as inputs	Biofuels, distribution of excess food to charities
	Reducing consumption of carbon intensive food	I, N, L	Carbon pricing for selected food commodities	Food prices reflective of GHG gas emissions throughout production and supply chain (Springmann *et al.*, 2017; Hasegawa *et al.*, 2018)
		I, N, L	Changing food choice through education	Nutritional and portion-size labelling, 'nudge' strategies (positive reinforcement, indirect suggestion) (Arno and Thomas, 2016)
		I, N, L	Changing food choices through money transfers	Unconditional cash transfers; e-vouchers exchanged for set quantity or value of specific, pre-selected goods (Fenn, 2018)
		N, L	Changing food environments through planning	Farmers markets, community food production, addressing 'food deserts' (Ross *et al.*, 2014)
	Combining carbon and health objectives	I, N, L	Changing subsidies, standards, regulations to healthier and more sustainably produced foods	USDA's 'Smart Snacks for School' regulation mandating nutritional guidelines (USDA, 2016) Incentivising production via subsidies (direct to producer based on output or indirect via subsidising inputs)
			Preventative versus curative public healthcare incentives	Health insurance cost reductions for healthy and sustainable diets
		I, N, L	Food system labelling	Organic certification, nutrition labels, blockchain ledgers (Chadwick, 2017)
		N, L	Education and awareness campaigns	School curricula; public awareness campaigns
		N, L	Investment in disruptive technologies (e.g., cultured meat)	Tax breaks for R&D, industrial strategies (EU, 2018)
		N, L	Public procurement	For health: Public Procurement of Food for Health (Caldeira *et al.*, 2017) Public Procurement Code (Mairie de Paris, 2015)

The column 'scale' refers to scale of implementation: International (I), national (N), sub-national-regional (R), and local (L).

Source: adapted from IPCC (2019).

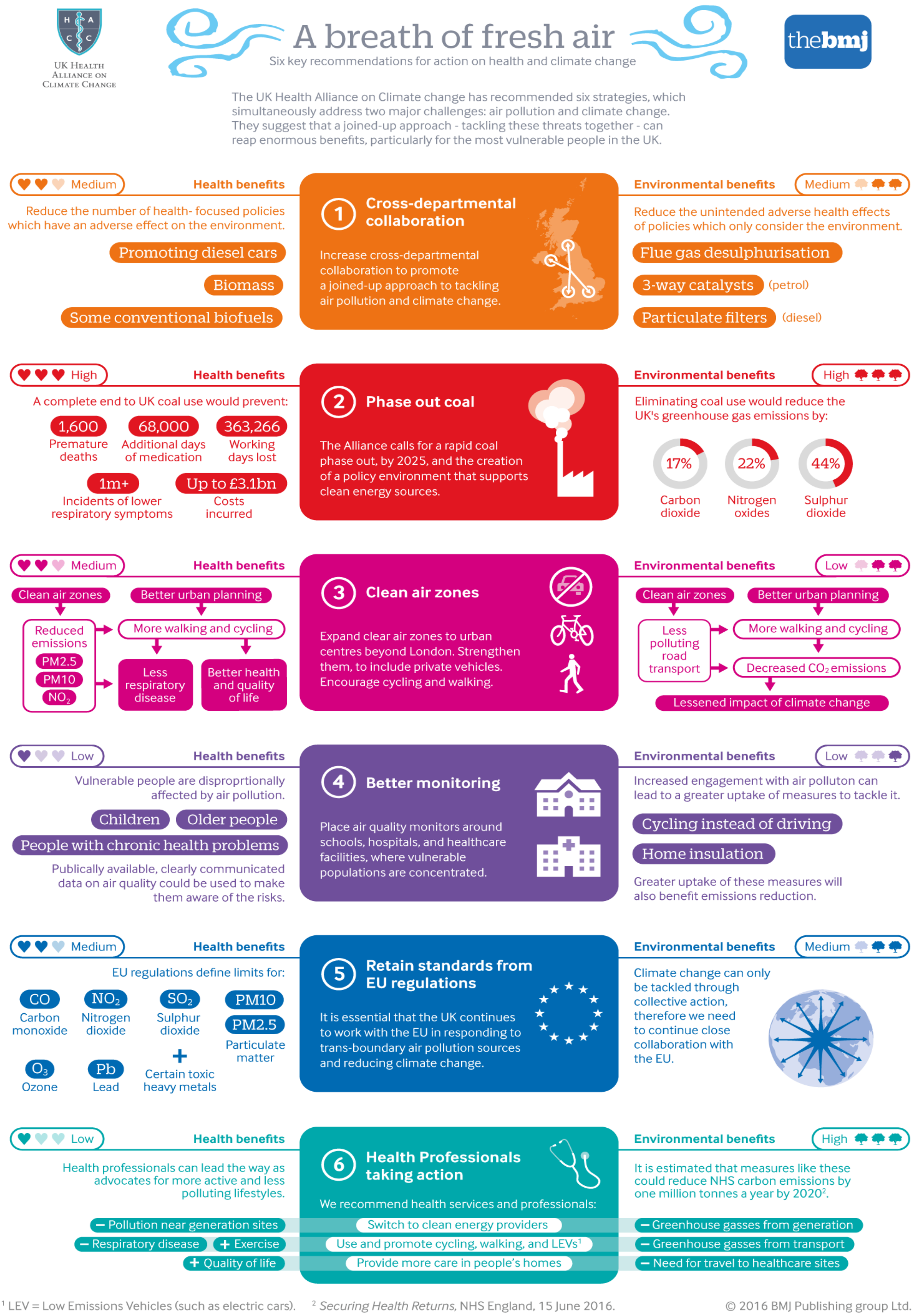
8.11 Convergence of research frontiers on globalisation and land changes, and land use displacement



Convergence of research frontiers on globalisation and land changes, and land use displacement. Arrows trace the evolution and cross-fertilization of research lines. The X axis situates research topics on a gradient from studies focused on local processes, to studies focused on global processes, with the middle being occupied by medium-range studies or studies explicitly linking local processes to global forces. The Y axis situates research topics on a gradient of focus from the human processes driving land changes, towards measuring and tracing environmental impacts. Some studies (with bolded border) are directly oriented towards the governance of linkages between globalization and land changes.

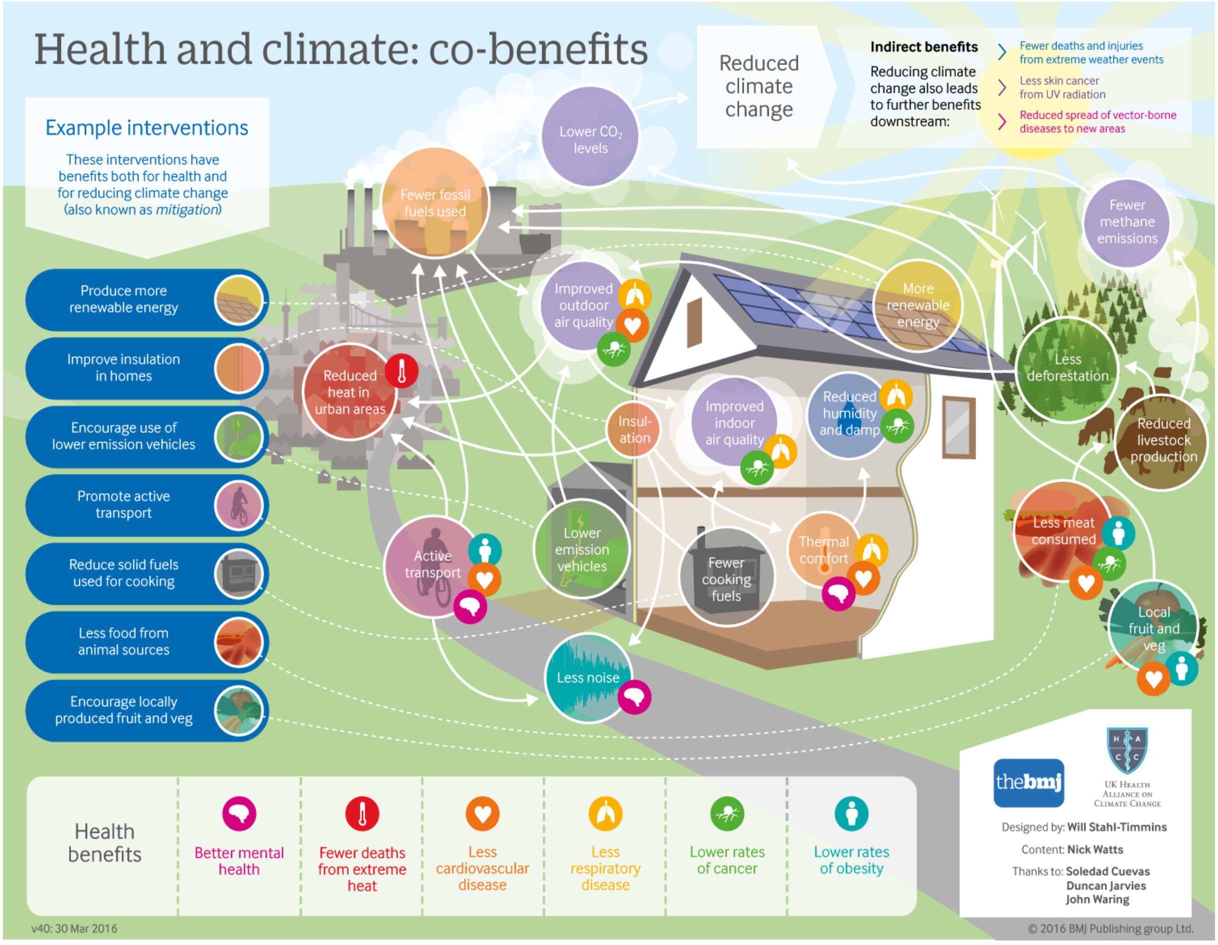
Source: Meyfroidt *et al*. (2013).

8.12 UK Health Alliance on Climate Change key recommendations



Source: UKHACC (2016).

8.13 The co-benefits of health and climate change in the UK



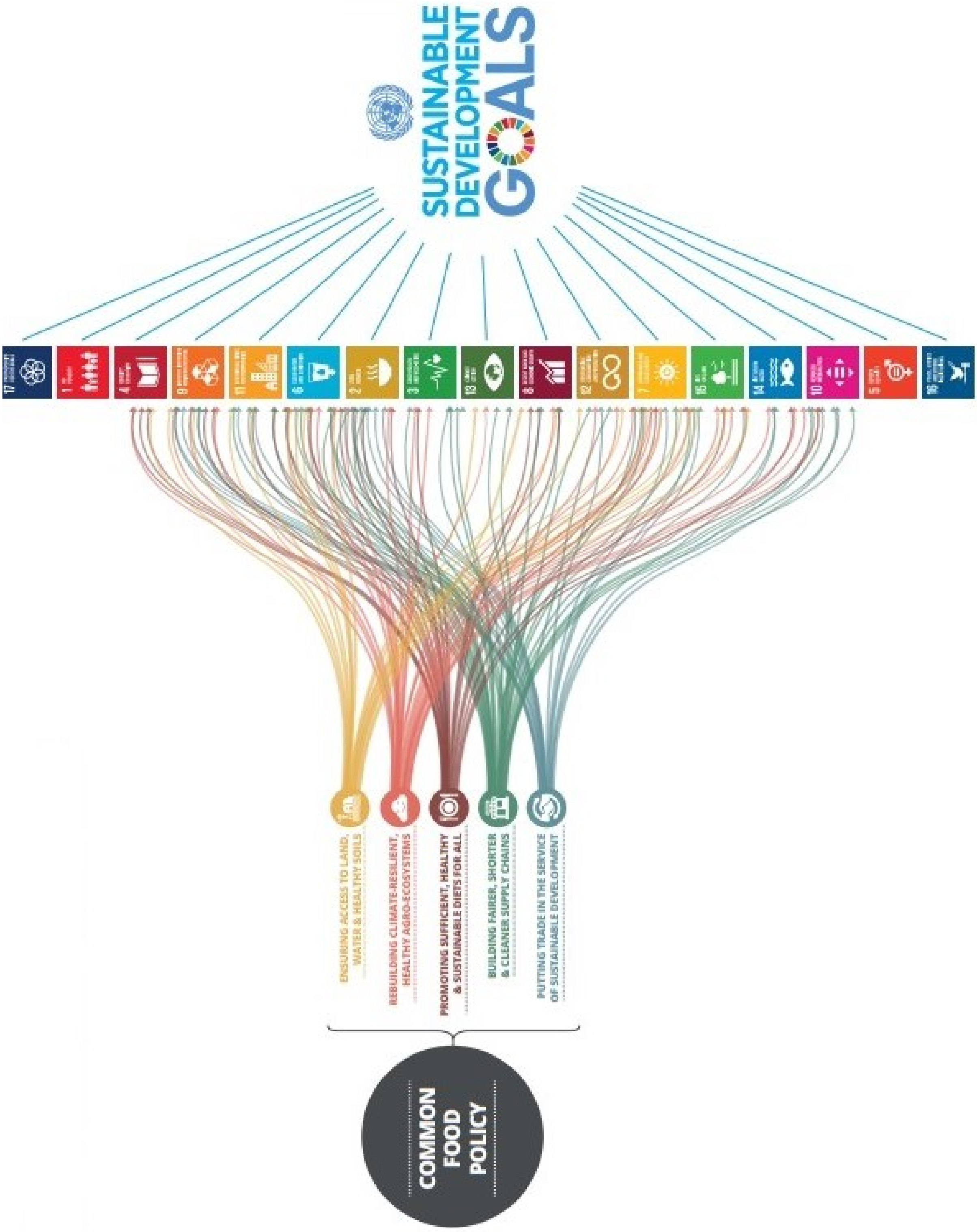
Source: UKHACC (2020).

8.14 Preliminary lessons from different policy approaches to sustainable diets

Policy approach	*Mode*	*What this means for advice*	*Examples*	*Lessons learned*
Orientation	Simplification	Guidelines focus on nutrition alone or possibly one other factor	Australian (2013) Guidelines; UK Cabinet Office (2008): energy + carbon; meat reduction strategies by China (2016) and UK (2016)	Pragmatic but reduces range of issues required for a good diet; has low 'threat'
	Complexity (multi-criteria)	Best fit with interdisciplinary sciences; guidelines are based on multiplicity of dietary impacts	Sweden (2009) Guidelines; Qatar (2014) Guidelines; German (2014) Sustainable Shopping; EU sustainable consumption and production (2012)	A multi-criteria approach is possible
	Core and periphery	A prime focus on nutrition with other issues less high profile	Brazil (2014) Guidelines	Nutrition focus with strong environmental underpinning and overt cultural messaging has retained policy support despite government change
	Incremental	Slow, steady accrual of policy advice to deliver complexity	The Netherlands since 2010	This is pragmatic and requires multi-agency engagement within and beyond the state
Engagement	Soft	Strong emphasis on consumer choice and measures such as education and labelling	Sweden (2015) cultural advice; Germany (2014) Sustainable Shopping; UK (2012) Green Food Principles	Engagement with food culture: soft approach. Although labelling is a favoured soft measure, it is hard to deliver on sustainable diets because it requires space and detail
	Hard	Use of fiscal, legal and regulation to shift norms	Qatar (2014); Brazil (2014)	Used to form regulations and contracts, etc.
	Choice-editing	Action is taken mostly within the food chain 'below the radar' before consumers see or buy the food	Carbon reduction programmes by many big food companies, e.g. Marks & Spencer (UK) Plan A	Policy engagement is unlikely to be achieved by science and evidence alone
Leadership	State	Government takes a facilitator role and offers guidelines to be used widely	Sweden (2009); China (2016) meat reduction strategy; UK (2012) Green Food Project	States have democratic legitimacy but outcomes depend on how far it can deliver; pronouncements can be made but not be followed up
	Business	Can have direct impact on food supply chains and what is offered to consumers	Single company actions, e.g. Barilla (2010) double pyramid; PepsiCo 50-in5; Marks & Spencer Plan A; intercompany actions, e.g. WBCSD (2017) FReSH initiative	Companies have sectoral interests, but this shows rising concern and preparedness to engage
	Civil society	CSO speak directly to their members and act as change agents	WWF (2011) and (2017) Livewell Plate; UK Eating Better Coalition	Can open up public interest and facilitate political commitment by winning policy support, showing sustainable diets are feasible

Source: Lang and Mason (2017).

8.15 How a common food policy helps meet the SDGs

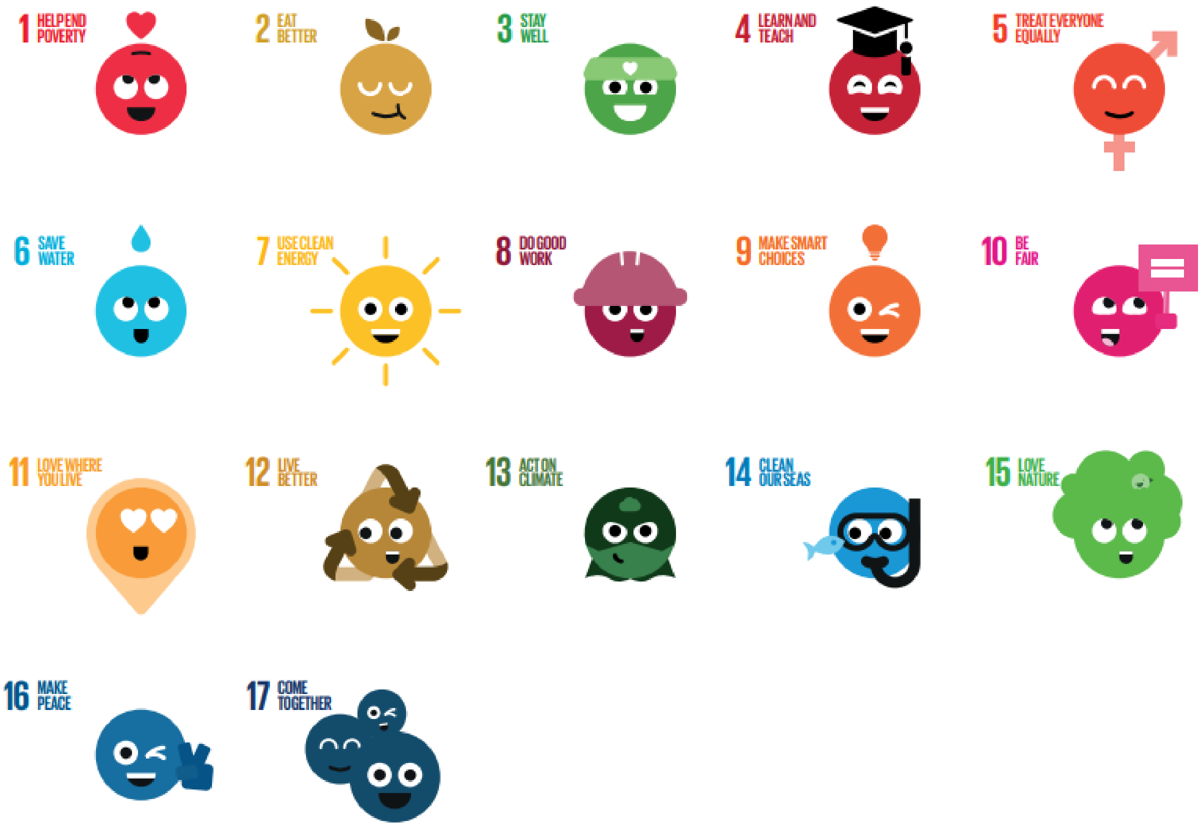


Source: De Schutter (2019).

8.16 Flora vegetable spread

Source: Upfield (2016).

8.17 The Good Life Goals - personal actions to support the Sustainable Development Goals



Source: UNEP (2020).

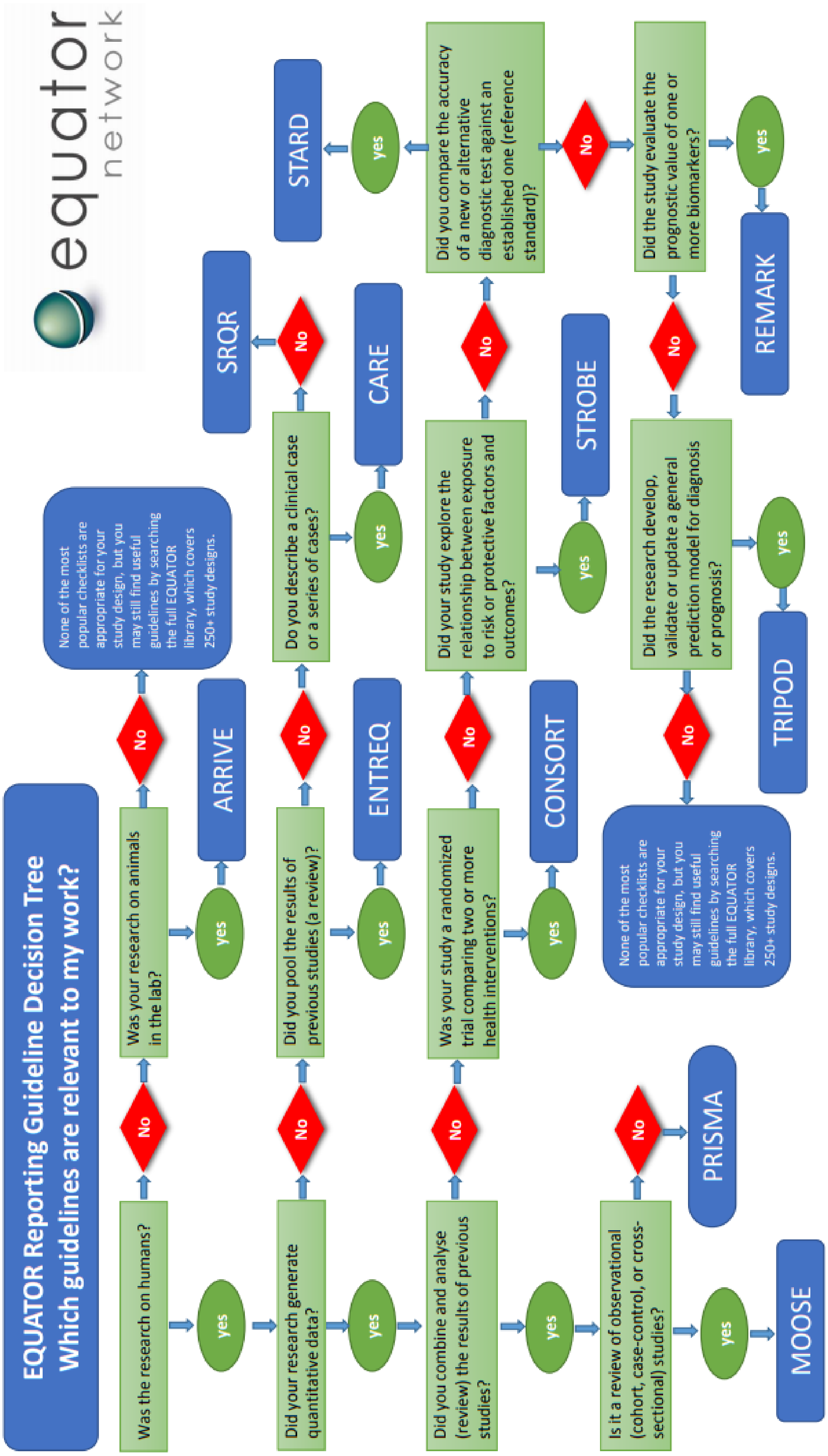
8.18 PRISMA 2009 Checklist

Section/topic	***#***	***Checklist item***	***Reported on page #***
Title			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
Abstract			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
Introduction			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	
Methods			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	

Section/topic	***#***	***Checklist item***	***Reported on page #***
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	
Results			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
Discussion			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	
Funding			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	

Source: Moher *et al*. (2009).

8.19 EQUATOR reporting guidelines decision tree



Source: EQUATOR Centre / University of Oxford (2015).

8.20 A food sustainability narrative for health professionals: an outline umbrella review protocol

Andrew P. Hollingsworth
Protocol v 1.0 – 20th April, 2020

Background	The essential prerequisites for a sustainable and healthy diet are complex, multi-faceted and interconnected. Existing literature calls for dietary change (Aleksandrowicz *et al*., 2016; Jones *et al*., 2016) and transformation (Lucas and Horton, 2019; Willett *et al*., 2019) to improve health (Blackstone *et al*., 2018; Milner *et al*., 2018; Archer and Lavie; 2019; Forouhi and Unwin, 2019; McCarthy and Li, 2019) and reduce environmental impacts (Scarborough *et al*., 2014; Hallström *et al*., 2015; Nelson *et al*., 2016) including from climate change (Florin and Allen, 2019) in order to safeguard future resources (Green *et al*., 2015; Knight, 2015; de Boer *et al*., 2018) and ensure food security (Macdiarmid *et al*., 2018). Further studies consider the policies and regulations (Joyce *et al*., 2014; Lang and Mason, 2018; Mwatsama, 2018) necessary to ensure that these diets are affordable to all (Rao *et al*., 2013; Wickramasinghe *et al*., 2013; Reynolds *et al*., 2019). This proposed umbrella review will synthesise what policies and regulations are needed to mitigate against the risks of climate change and environmental degradation to ensure future food systems provide sustainable, secure and healthy diets.
Review objectives	“What are the essential components for sustainable, secure and healthy diets?”
Methods	
• *Inclusion criteria*	For inclusion, reviews have to evaluate one or more of the essential prerequisites: food; climate change; environment; sustainability; health; food security; and, diet
• *Types of participants*	Participants include all age groups in any developed country (defined by OECD membership) and additional EU-28 members
• *Interventions*	All types of interventions will be included if they impact one or more of the essential prerequisites. Interventions could include upstream, population level, public health policies in food and nutrition that use fiscal policy, regulation, preventative intervention, behavioural (e.g. nudges, social media), provision of information (e.g. labels) or nutrition education
• *Outcomes / contexts*	The outcome to be examined in this umbrella review is sustainable and healthy diets. The FAO (2010) definition will be used: “*Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources*”. Context considered include nutritional status, food choices, food consumption, and dietary behaviour
• *Types of studies*	Systematic reviews and meta-analyses will be included. Primary research studies, observational studies, theoretical studies, opinion, and non-systematic reviews will not be included

• *Search strategy*	*Search term 1 systematic review (OR) meta (AND) search term 2 food (AND) search term 3 climat* OR change* (AND) search term 4 (AND) environment* OR sustain* OR health* OR secur* OR diet* The following databases will be searched from 2010 to the present: Web of Science; Scopus; and, Europe PMC*
• *Assessment of methodological quality*	The methodological quality of included reviews will be assessed using the JBI (2019) critical appraisal checklist tool. Reviews will not be excluded based on methodological quality. Quality assessment of individual interventions is beyond the scope of this umbrella review
• *Data collection*	A data extraction sheet will be used to extract information on the citation, type of review, participants, intervention, setting, relevant outcomes, databases searched, date range, number of studies included, instrument (if any) used to assess the quality of those studies, results, and any additional comments. This will follow the AMSTAR 2 guidance requirements for quality.
• *Data analysis*	Descriptive analyses will be performed for each systematic review and meta-analysis. If more than one review exists on the same intervention, differences in reported conclusions will be examined, with the most recent review retained. If a systematic review or meta-analysis includes more than one type of intervention, each type of intervention will be examined separately. A formal meta-analysis will be used providing that the nature of the data allows. If, however, the heterogeneous nature of the studies' settings, designs and outcome measures make this impractical, a narrative synthesis will be provided instead.
References	• Aleksandrowicz, L., Green, R., Joy, E.J.M., Smith, P., and Haines, A. (2016). The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: a systematic review, *PLoS One*, 11, 11, e0165797, doi:10.1371/journal. pone.0165797. • Archer, E. and Lavie, C.J. (2019). Healthy diets and sustainable food systems, *The Lancet*, Vol. 394, No. 10194, pp.214-215, doi: 10.1016/S0140-6736(19)31130-4. • Blackstone, N.T., El-Abbadi, N.H., McCabe, M.S., Griffin, T.S. and Nelson, M.E. (2018). Linking sustainability to the healthy eating patterns of the Dietary Guidelines for Americans: a modelling study, *The Lancet Planetary Health*, Vol 2, Iss 8, pp.e344-e352, https://doi.org/10.1016/S2542-5196(18)30167-0. • de Boer, J., de Witt, A. and Aiking, H. (2018). Help the climate, change your diet: a cross-sectional study on how to involve consumers in a transition to a low-carbon society, *Appetite*, Vol. 98 pp.19-27, https://doi.org/10.1016/j.appet.2015.12.001. • de Ruiter, H., Macdiarmid, J.I., Matthews, R.B. and Smith, P. (2018). Moving beyond calories and protein: micronutrient assessment of UK diets and land use, *Global Environmental Change*, Vol. 52, September, pp.108-116, https://doi.org/10.1016/j.gloenvcha.2018.06.007. • Florin, T.H. and Allen, D.W. (2019). Health and climate change, *The Lancet*, Vol. 393, Iss. 10187, pp.2196-2197, https://doi.org/10.1016/S0140-6736(19)30303-4. • Forouhi, N.G. and Unwin, N. (2019). Global diet and health: old questions, fresh evidence, and new horizons, *The Lancet*, 3rd April, doi: 10.1016/S0140-6736(19)30500-8. • Green, R., Milner, J., Dangour, A.D., Wilkinson, P., Haines, A., Chalabi, Z., Markandya, A., Spadaro, J. and Wilkinson, P. (2015). The potential to reduce greenhouse gas emissions in the UK through healthy and realistic dietary change, *Climate Change*, Vol. 129, No. 253, doi: 10.1007/s10584-015-1329-y. • Hallström, E., Carlsson-Kanyama, A. and Börjesson, P. (2015). Environmental impact of dietary change: a systematic review, *Journal of Cleaner Production*, Vol. 91, No. 1, pp.1-11, doi.org/10.1016/j.jclepro.2014.12.008.

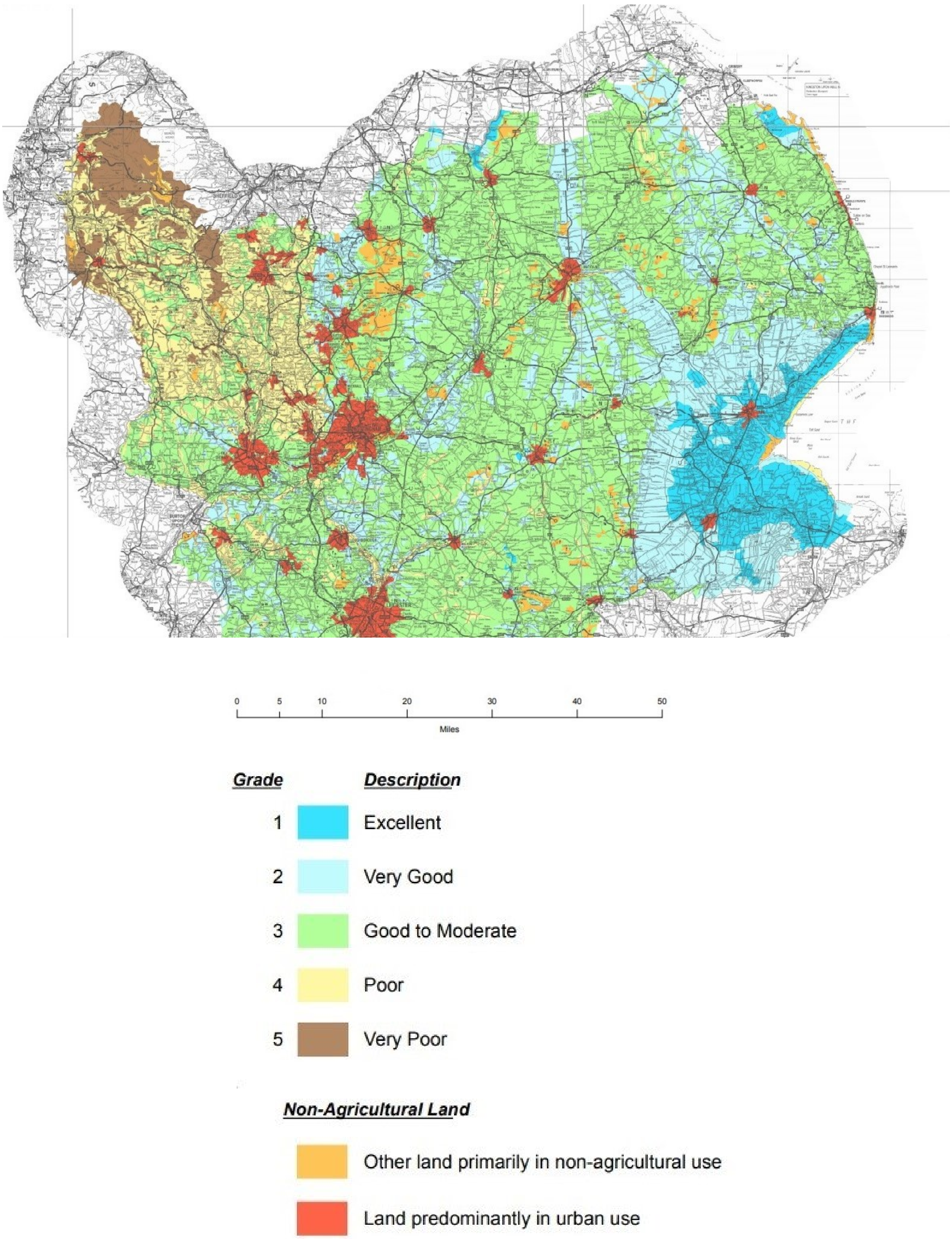
- JBI (2019). *Methodology for JBI umbrella reviews*, Adelaide, Australia: Joanna Briggs Institute.
- Jones, A.D., Hoey, L., Blesh, J., Miller, L., Green, A. and Shapiro, L.F. (2016). A systematic review of the measurement of sustainable diets, *Advances in Nutrition*, Vol. 7, Iss. 4, doi.org/10.3945/an.115.011015.
- Joyce, A., Hallett, J., Hannelly, T. and Carey, G. (2014). The impact of nutritional choices on global warming and policy implications: examining the link between dietary choices and greenhouse gas emissions, *Energy and Emission Control Technologies*, Vol. 2, pp.33-43, doi: 10.2147/EECT.S58518.
- Knight, J. (2015). Anthropocene futures - resources and sustainability, *The Anthropocene Review*, pp.1-7, doi:10.1177/2053019615569318.
- Lang, T. and Mason, P. (2018). Sustainable diet policy development: implications of multi-criteria and other approaches, 2008-2017, *Proceedings of the Nutrition Society*, Vol. 77, pp.331-346, doi: 10.1017/S0029665117004074.
- Lucas, T. and Horton, R. (2019). The 21st-century great food transformation, *The Lancet*, Vol. 393, No. 10170, pp.386-387, http://dx.doi.org/10.1016/S0140-6736(18)33179-9.
- Macdiarmid, J.I., Clark, H., Whybrow, S., de Ruiter, H. and McNeill, G. (2018). Assessing national nutrition security: the UK reliance on imports to meet population energy and nutrient recommendations, *PLoS One*, https://doi.org/10.1371/journal.pone.0192649.
- McCarthy, W.J. and Li, Z. (2019). Healthy diets and sustainable food systems, *The Lancet*, Vol. 394, No. 10194, pp.214-214, doi: 10.1016/S0140-6736(19)31109-2.
- Milner, J., Green, R., Dangour, A.D., Haines, A., Chalabi, Z., Spadaro, J., Markandya, A. and Wilkinson, P. (2014). Health effects of adopting low greenhouse gas emission diets in the UK, *British Medical Journal*, Vol. 5, e007364, doi: 10.1136/bmjopen-2014-007364.
- Mwatsama, M. (2018). *Fresh start: A framework for health and sustainable diets in the UK – Policy options review*, London: UK Health Forum.
- Nelson, M.E., Hamm, M.W., Hu, F.B., Abrams, S.A. and Griffin, T.S. (2016). Alignment of healthy dietary patterns and environmental sustainability: a systematic review, *Advances in Nutrition: An International Review Journal*, Vol. 7, Iss. 6, doi.org/10.3945/an.116.012567.
- Rao, M., Afshin, A., Singh, G. and Mozaffarian, D. (2013). Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis, *BMJ Open*, Vol. 3, No. 12, p.e004277, doi:10.1136/bmjopen-2013-004277.
- Reynolds, C.J., Horgan, G.W., Whybrow, S. and Macdiarmid, J.I. (2019). Healthy and sustainable diets that meet greenhouse gas emission reduction targets and are affordable for different income groups in the UK, *Public Health Nutrition*, pp.1-15, https://doi.org/10.1017/S1368980018003774.
- Scarborough, P., Appleby, P.N., Mizdrak, A., Briggs, A.D.M., Travis, R.C., Bradbury, K.E. and Key, T.J. (2014). Dietary greenhouse gas emissions of meat-eaters, fish-eaters, vegetarians and vegans in the UK, *Climatic Change*, Vol. 125, pp.179-192, doi: 10.1007/s10584-014-1169-1.
- Wickramasinghe, K., Scarborough, P., Goldacre, M., Scarborough, P., Goldacre, M. and Rayner, M. (2013). Defining sustainable diets by comparing greenhouse gas emissions from different food groups: a systematic review, *The Lancet*, Vol. 382, Iss. S3, doi.org/10.1016/S0140-6736(13)62529-5.
- Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clarke, M., Gordon, L.J., Franzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., Vries, W.D., Majele Sibanda, L., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Lartey, A., Fan, S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Reddy, K.S., Narain, S., Nishtar, S. and Murray, C.J.L. (2019). Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems, *The Lancet*, Vol. 393, 10170, pp.447-492.

8.21 **AMSTAR 2 guidance questionnaire**

	Question	*y / n*
1	Did the research questions and inclusion criteria for the review include the components of PICO?	
2	Did the report of the review contain an explicit statement that the review methods were established prior to conduct of the review and did the report justify any significant deviations from the protocol?	
3	Did the review authors explain their selection of the study designs for inclusion in the review?	
4	Did the review authors use a comprehensive literature search strategy?	
5	Did the review authors perform study selection in duplicate?	
6	Did the review authors perform data extraction in duplicate?	
7	Did the review authors provide a list of excluded studies and justify the exclusions?	
8	Did the review authors describe the included studies in adequate detail?	
9	Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?	
10	Did the review authors report on the sources of funding for the studies included in the review?	
11	If meta-analysis was justified did the review authors use appropriate methods for statistical combination of results?	
12	If meta-analysis was performed did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?	
13	Did the review authors account for Risk of Bias in individual studies when interpreting/ discussing the results of the review?	
14	Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	
15	If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?	
16	Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	

Source: AMSTAR (2020).
https://amstar.ca/docs/AMSTAR-2.pdf

8.22 Map of the Best and Most Versatile food producing land correlating with the Lincolnshire Fens



Source: Natural England (2020).