School of Agriculture, Policy & Development

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The role of cultural beliefs in shaping farmers' behavioural decisions to adapt to drought risks in Gaza Province – Southern Mozambique

Thesis submitted for the degree of Doctor of Philosophy

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Declaration of Authorship

I hereby declare that this Report is my own authorship and the use of all material from other sources has been properly and fully acknowledged. I take full responsibility for the contents thereof.

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(Daniela Salite)

May 2019

Abstract

Drought has had an adverse effect on farmers' agricultural activities, livestock production, health and livelihoods. Therefore, adaptation of the agricultural sector is urgent to reduce farmers' vulnerability, enhance their resilience and adapt to drought. Several factors have affected farmers' adaptation to drought, such as socio-economic, technical, institutional and cultural. However, this study aims to explore the under-researched role of cultural beliefs in shaping these farmers' behavioural decisions to adapt to drought. To undertake this, the study takes the case of small-scale rain-fed farmers in the southern province of Gaza, Mozambique. Findings show that farmers have a limited knowledge and understanding of climate change, and lack scientific information about drought. Instead, many farmers believe that drought is a punishment from God or their ancestors for some wrongdoing. Nonetheless, the farmers find a variety of explanations for the wrongdoing, which are based on their value-laden perceptions of morally wrong occurrences that are taking place nationwide.

The findings also show that farmers' implement reactive responses to deal with the causes and the impacts of drought. However, farmers' cultural beliefs influence the timing and order of implementation of two types of response. Firstly, farmers usually implement collective responses to correct the perceived wrongdoing, ask for forgiveness and rain from God and/or their ancestors through the medium of traditional ceremonies and prayer. These responses bind farmers together in solidarity in times of drought as they are driven by their common need for rainfall for their agricultural activities. The responses thus act as a psychological support system for farmers in their attempts to deal with the causes of drought, and to recover from the hardship. Secondly, farmers, often on an individual basis, implement diverse strategies to reduce the impacts of drought through activities to generate income, and to secure immediate food needs or help from the government, family and friends. Farmers' choices of these types of responses and their level of vulnerability are not only driven by their cultural practices, but also by the socio-economic and institutional environment in which they live. Although all the above

reactive strategies are not yet helping farmers to adapt to drought, results do not demonstrate culture as a barrier to adaptation in the first instance. Rather, the approach with which drought adaptation strategies are designed and implemented is what dictates whether or not culture will constitute a barrier or help. Therefore, the study emphasises the crucial need to understanding farmers' cultural dimensions of adaptation and further incorporate them in the design and implementation of drought adaptation strategies in order to increase farmers' support and engagement with them and the likelihood of a successful adaptive outcome.

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Dedication

I dedicate this thesis to my father who passed away in 1997. He was the kindest, most admirable, lovable and inspirational person. He was, indeed, a true example of how a human being should be. There are no words that could describe how proud I am for being his daughter. Although he is not here physically, I know he is up there looking after his loved ones. Love and miss you!

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List of Acronyms and Abbreviations

AGRICAB – A framework for enhancing EO capacity for Agriculture and Forest Management in Africa

AM – Ante Meridiem (Before noon)

AMS – American Meteorological Society

AIDS – Acquired Immune Deficiency Syndrome

^{o}C – degree Celsius

CARE – Cooperative for Assistance and Relief Everywhere

CBT – Chibuto

CCT – Cultural Cognition Thesis

C&D – Culture and Development

CGIAR – Consultative Group for International Agricultural Research

Crosstabs – Cross tabulations

COSACA – Consortium of Concern Worldwide, Oxfam, Save the Children and CARE

CSC – Commonwealth Scholarship Commission

DRR – Disaster Risk Reduction

ENSO – El Niño Southern Oscillation

EM-DAT – Emergency Events Database

F – Female

FAO – Food and Agriculture Organization

FDD – Fundo de Desenvolvimento Distrital (District Development Fund)

Fig. – Figure

FRELIMO – Frente de Libertacao de Mocambique (Mozambique Liberation Front)

GDG – Governo do Distrito de Guija (Government of Guija District)

GFDRR – Global Facility for Disaster Reduction and Recovery

GJ – Guija

HDI – Human Development Index

HIV – Human Immunodeficiency Virus

ICL – Interview with the Community Leader

IFAD – International Fund for Agricultural Development

IFRC – International Federation of Red Cross and Red Crescent Societies

IGOV – Interview with the Government

IIB- Interview with an Institutional Body

INAM – Instituto Nacional de Meteorologia (National Meteorological Institute)

INE – Instituto National de Estatistica (National Statistic Institute)

INGC – Instituto Nacional de Gestao de Calamidades (Nacional Institute for Disaster Management)

IPCC – Intergovernmental Panel on Climate Change

IPNI – International Plant Nutrition Institute

ISDR – International Strategy for Disaster Reduction

km – Kilometer

MAE – Ministerio da Administracao Estatal (Ministry of State Administration)

MASA – Ministerio de Agricultura e Seguranca Alimentar (Ministry of Agriculture and Food Security)

MICOA – Ministerio para a Coordenacao da Accao Ambiental (Ministry for the Coordenation of Environmental Action)

Mid – in the middle of

MINAG – Ministerio de Agricultura (Ministry of Agriculture)

MITADER – Ministerio da Terra, Ambiente e Desenvolvimento Rural (Ministry of Land, Environment and Rural Development)

n – number of variables

NAPA – National Adaptation Plan of Action

NGOs – Non-Governmental Organizations

OECD – Organization for Economic Co-operation and Development

e.g. – exampli gratia (for example)

Oxfam – Oxford Committee for Famine Relief

p. – page

PARP – Plano para a Reducao da Pobreza (Poverty Reduction Plan)

PEDSA – Plano Estrategico para o Desenvolvimento do Sector Agrario (Strategic Plan for the Development of the Agricultural Sector)

PNISA – Plano National de Investimento do Sector Agrario (National Agriculture Investment Plan)

PROAGRI – Programa Nacional da Agricultura (National Agricultural Plan)

RENAMO – Resistencia Nacional Mocambicana (Mozambican National Resistance)

SDAE – Servico Distrital de Actividades Economicas (District Service for Economical Activities)

SSA – Sub-Saharan Africa

SPSS – Statistical Package for Social Sciences

TPB – Theory of Planned Behaviour

UN – United Nations

UNDP – United Nations Development Programme

UNESCO – United Nations Educational, Scientific, and Cultural Organization

UK – United Kingdom

USA – Unites States of America

WFNC – World Forum on Natural Capital

WFP – World Food Programme

WMA – World Medical Association

WMO – World Meteorological Organization

WVI – World Vision International

ZM – *Zea mays*

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1 Introduction

This study explores the role of cultural factors, particularly beliefs, in the way small-scale farmers perceive the causes, consequences and potential solutions to drought events and how their perception affects their behavioural decisions to adapt to drought. The study also examines how and why, given the existence of diverse factors influencing small-scale scale farmers adaptation to drought, cultural beliefs are important factors in the adaptation process. The study focuses on the case of Mozambique where drought is the most common natural disaster, causing harsh impacts on rain-fed agriculture, which constitutes the main economic activity in the country. This introductory chapter presents background information on the stressor under study in order to clarify the need for adaptation and establish the context of this study. The chapter also presents the research gaps and rationale, aims and objectives, as well as the justification for the selection of the study site.

1.1 Background

Small-scale rain-fed agriculture is the main economic activity, source of income and livelihood for many rural poor communities in the world (FAO, 2004; Sheffield *et al*. 2014). However, erratic rainfall and frequent drought events have increasingly limited rain-fed agricultural activities in the last decades. Empirical evidence from observations show that drought incidence and dry areas have increased in frequency, severity, and duration in the world since 1950, particularly in the tropics and subtropics, due to changing climatic conditions and documented increases in extreme weather events (IPCC, 2007; Mishra and Desai, 2006; Schmuck, 2013). In addition, human activities such as deforestation, overgrazing, overuse, and modification in the use of agricultural lands, as well as poor water resources management are also exacerbating drought situation in the world (Mishra and Singh, 2010; Odle and Ocko, 2013).

Currently, about 28% of the land surface of the earth experiences drought at any point in time, and more than 50% of the terrestrial earth is susceptible to drought each year (Calow *et al.* 2010; Shiferaw *et al.* 2014). Specifically, Sub-Saharan Africa (SSA) is one of the regions most prone to drought, desertification and climate extremes, with at least 60% of the region vulnerable[1] and possibly 30% highly vulnerable to drought and 41% of the population living in drought-prone areas (Esikuri, 2005; IPCC, 2012, p. 253; Svendsen *et al.* 2009). Although drought accounts for less than 20% of natural disasters in the region (8% globally), it affects roughly 80% of the population (Sheffield *et al.* 2014; Shiferaw *et al.* 2014). In fact, drought is considered the natural hazard that directly affects more people than any other hazards (Wilhite *et al.* 2007).

Agriculture is the main economic activity of more than 70% of the population in SSA, of whom around 95% cultivate crops under rain-fed conditions (Biazin *et al.* 2012; CGIAR, 2018). Thus, drought has caused a significant decline in rain-fed food production and availability, making it insufficient to feed its growing population of 1.061 billion (Bilham, 2011; Devereux, 2007; World Bank, 2018b). In extreme cases, drought has caused total crop failure, aggravating the food availability situation (Mishra and Singh, 2010; Shiferaw *et al.* 2014). These extreme consequences of drought, if combined with limited resources, poor governance and market systems, inappropriate policies, and insufficient food aid and safety nets, can further lead to food insecurity, famine, conflicts, epidemics, mortality, and migration (Below *et al.* 2012; Muller, 2014; Udmale *et al.* 2014).

In addition, due to the strong link between rain-fed agriculture and the region's economy, drought has been seen as an impediment to the reduction of the high poverty incidence of 48% (Olinto and Uematsu, 2013), which is considered the highest regional share of the world's extreme poor population

[1] Vulnerability is much dependent on the level of dependency of the economy on rain and the adequacy of the risk management and infrastructure systems to deal with natural hazards (Esikuri, 2005).

(Chimhowu, 2013). Drought is also seen as an impediment to achieving food security, and long-term development of most countries in the region, thus explaining the region's persistent vulnerability (Below et al. 2012; Bingen *et al.* 2003; Deressa *et al.* 2009). Therefore, Calow *et al.* (2010) contend that poverty and food insecurity are increasingly "Africanised." According to FAO (2017a), food insecurity is linked to the current high number (224 million) of undernourished people in SSA. What is more, due to climate change, drought episodes and the extreme high temperatures that often accompany droughts are projected to increase between 1.5°C - 2°C by 2030 – 2040; thus, it is expected that crop production in SSA will be adverserly affected, and specifically that yields will reduce by 40 – 80% (World Bank, 2013). Therefore, adaptation is crucial to protect the livelihoods of the rain-fed farmers in the region, and ensure their food security (Bryan *et al.* 2009; Jones *et al.* 2010).

Although adaptation is not historically a new phenomenon to human beings, adapting to the observed rapid and continuous climate and environmental change is becoming increasingly important, urgent and challenging, mainly for developing countries. This is because of these countries' dependency on rainfall for their livelihoods and their persistent adaptation deficit, i.e., higher exposure and vulnerability to drought, and lower adaptive capacity when compared to rich countries (Moser and Ekstrom, 2010). Thus, this highlights the importance of understanding factors influencing the adaptation process and the drivers of adaptation actions towards developing sustainable adaptation strategies to severe drought impacts, as well as facilitating the implementation of these strategies to further overcome food insecurity and other drought-related impacts.

1.2 Study gap and rationale

Several studies on adaptation have been conducted across the world to reinforce the crucial importance of farmers' adaptation to the changing climate and environment to protect their livelihoods

and ensure their food security. These studies have described the types of adaptation, approaches to study adaptation, adaptation options, costs, and drivers, and have suggested what is required for a successful adaptation (e.g., Bryan *et al.* 2009; Hisali et al. 2011; Jin and Wang, 2016; Vincent, 2007). However, despite the extensive literature, what determines adaptation still poorly understood (Below *et al.* 2012; Gbetibouo, 2009; Harmer and Rahman, 2014). Most of these studies have focused on technical adaptation strategies, socio-economic factors, resources and access to information as drivers to the implementation of adaptation options. However, while these factors may determine farmers' financial and cognitive capabilities to adapt, it is now well recognized that adaptation to the changing climate and environment is a complex, heterogeneous and continuous process influenced by a range of factors and conditions at multiple scales (Moser and Ekstrom, 2010; Smit and Wandel, 2006). Some of these factors are more hidden and often forgotten in adaptation contexts such as perception, cultural and social norms, knowledge, values, beliefs, rules, and religion (Adger *et al.* 2007, 2009; Artur and Hilhorst, 2012; IFRC, 2014, p. 121).

Indeed, despite not having adequate economic and technological resources at their disposal, most rural communities have a long record of livelihoods, activities and procedures that they have developed and changed in their everyday lives to monitor, observe, protect and manage their natural resources under environmental uncertainty (Bridgewater and Arico, 2002; Kashima, 2010; Tompkins *et al*. 2010). These communities have been changing their behaviour, creating diverse coping practices and production systems to minimize risks, adjusting themselves and responding to the changing environment, weather and climate based on their foundations in local knowledge and culture (Adger *et al.* 2007; Tompkins *et al*. 2010). In fact, culture is integral to all aspects of human existence, it constitutes people's identity, personality, and made tools, inserted in human's predominant forms of production, consumption, lifestyles and social organization (Hall *et al.* 2003; IFRC, 2014, p.17).

Although culture is derived from a Latin word that means “till of the land” (Hofstede, 2010, p.5), what constitutes culture is still controversial, since it has been variously conceptualised and used in different contexts, and all concepts are contested (Boggs *et al.* 2004; IFRC, 2014, p.13). For instance, Cosgrove and Jackson (1987, p. 99) define culture as “the medium through which people transform the mundane phenomenon of the material world into a world of significant symbols to which they give meanings and attach value.” Whereas, according to Hofstede (2010, p. 3–4), “in most western languages culture commonly means civilization or refinement of the mind (resulting from for example education, art, and literature) that distinguishes the members of one group or category of people from others.” Nonetheless, for this study, culture constitutes a set of shared things that are distinct of a society, which was learned from their ancestors, adjusted over time in order to fit the changing environment, transmitted to the descendants for its maintenance and as their inherited tools to cope with their world and with one another.

Culture shapes communities’ relationship with the environment, the common way their members think, communicate, give meaning to symbols and behave, the way they perceive, understand, identify, experience, and prioritize risks, mediate responses and means of implementation (Adger *et al.* 2009, 2013; Hulme 2009). Therefore, cultural factors have been increasingly recognized as constituting both a facilitator and inhibitor of communities’ adaptation to the changing environment and climate, over generations (Adger, 2003; 2013; Halloran, 2004; IFRC, 2014, p. 40; Roncoli *et al.* 2009). Surprisingly, despite these insights, cultural dimensions of adaptation are still not well researched and are rarely taken into consideration in the design and implementation of modern adaptation strategies (Adger *et al.* 2007, 2009; IPCC, 2007). This neglectfulness regarding the cultural dimension of adaptation has resulted in the low participation of the targeted group, low or below expected success rates and maladaptive outcomes of the strategies (Adger *et al.* 2013; IFRC 2014, p. 121; Kuehne, 2014). As stated by Ensor and Berger (2009, p. 230), “changes should be developed from within culture rather

than from without." Indeed, Brennan *et al.* 2009 findings suggested that the extent to which communities' endorsed and engaged with external efforts and the resulting outcomes depended on the compatibility of the efforts with their culture. Nonetheless, institutional barriers to adaptation have also not yet received adequate attention and acknowledgment (Jones and Boyd, 2011).

Therefore, this study intends to address and fill the gap in research by developing a comprehensive understanding of cultural factors that may promote or inhibit farmers' adaptation. However, because culture is vast and complex, this study will mostly focus on exploring and understanding the influence of diverse cultural (religious and non-religious) beliefs on adaptation. Emphasis is mostly given to cultural beliefs because of the influence those beliefs have in the way people perceive their surrounding natural environment, including the perception and interpretation of the causes for natural hazards and associated risks, perception of their own capacity to adapt, which will guide their motivation to act, as well as how they should respond to risks (IFRC, 2014, p. 40; Persson *et al.* 2015). To do so, the study aims to first develop a better understanding of the nature of farmers' cultural beliefs for the causes of drought and appropriate responses. This understanding is also pertinent to learn how those beliefs and the underlying reasonings are formed, why they are followed and how they influence farmers' perceptions of nature, worldviews and lives. The understanding is also relevant to understand why, how and when people decide to take measures to respond to drought and the reasons behind their choices of responses. Indeed, the literature demonstrates that there is a necessity for additional research into the socio-psychological aspects of farmers' beliefs about changes, examining the links between those beliefs and farmers' stances on changes, how those beliefs are formed and why they are followed (Kuehne, 2014).

1.3 Study area – why Mozambique?

Mozambique was chosen as the study location because it is one of the most vulnerable countries in the world to natural disasters (e.g., floods, droughts, and cyclones) and climate change (Feed the Future, 2011; INGC, 2009). The country has a vulnerability index[2] of 70.11%, ranking 9th out of 15 countries with the highest vulnerability globally, and ranking 7th among the African countries in the list (Kirch *et al.* 2017, p. 17). Reports show that the risk of occurrence of natural disasters has increased in frequency, intensity, severity, and duration over the past few decades in the country due to the changing climatic conditions and augmentation of extreme weather events (Artur and Hilhorst, 2012; UNDP, 2012). This increased risk positioned Mozambique in 44th out of 171 countries with risk[3] of occurrence of natural disasters, and in 17th among African countries (Kirch *et al.* 2017, p. 40).

Drought, which is the focus of the study, is the most common and devastating natural phenomenon affecting the country (UNDP, 2012), since subsistence agriculture is the main economic activity there, practiced by roughly 80% of the population of 28 861 863 (GFDRR, 2011; INE, 2017), of whom 95% are rain-fed small-scale farmers (Arndt *et al.* 2011). Therefore, it has been argued that natural disasters have had a contribution in shaping the country's poverty and vulnerability situation (Artur and Hilhorst, 2012). In fact, despite a significant reduction in poverty level in the country over the past two decades, it remains very high (54.7%) (Irish aid, 2018), with 46.1% of people living below the poverty line, i.e., on less than US$1.90 (World Bank, 2018a). The majority of the poor people live in rural areas, which inhabits around 70% of the Mozambican population (Irish aid, 2018). The poverty situation associated with the poor housing conditions[4] in which the majority of rural people live, their deficient nutrition and food insecurity conditions, and dependence on aid in the aftermath of disasters were some of the

[2] The vulnerability index calculation was based on the level of susceptibility, coping and adaptive capacity (Kirch *et al.* 2017, p. 8).

[3] The disaster risk index calculation was based on the level of exposure and vulnerability (Kirch *et al.* 2017, p. 8).

[4] Most rural poor live in mud huts with grass roof.

contributing factors to put the country in the second position among the top 15 countries with the highest susceptibility[5] to natural disasters worldwide (Kirch *et al.* 2017, p. 17).

The fact that 41.3 % of the population is illiterate (UNESCO, 2015) and only 11% of farmers have access to extension assistance (MASA, 2014) constrains farmers' knowledge related to the scientific explanation about the occurrence of drought and technological responses to drought. Thus, because the scientific explanation is not largely known or understood, Artur and Hilhorst (2012) explain that farmers find alternative explanations for the increased occurrence of drought and other natural disasters, which are based on their cultural beliefs of the power of supernatural forces (God, ancestors, and witchcraft) in causing these disasters. This makes the country suitable to explore and understand cultural beliefs about the causes of drought, and the role of those beliefs in framing farmers' behavioural adaptation to drought. Additionally, the presence of Non-Governmental Organizations (NGOs) implementing drought-related adaptation programs in partnership with the Government gives an opportunity to the study to explore the interaction between these actors and farmers, and the role of these actors and cultural beliefs in the outcome of the strategies and farmers' vulnerability levels.

The southern and central regions of the country are the most affected by drought (Fig. 1.1). Particularly, the southern province of Gaza is almost all extremely prone to drought; therefore, the province was purposefully selected for the study. Frequent drought periods became part of the province history over the past few decades, occurring 7 out of 10 years (Uaiene, 2008). The province has a tropical semi-arid, and arid climate and the annual mean rainfall is below 1,000 mm (average from 300 to 500 mm per year) occurring in a series of isolated rain days and locations, barely exceeding 50 rain days per year, and with significant variation in level and distribution between and throughout years. However,

[5] Susceptibility refers to the probability of suffering damage in the event of disaster (Kirch *et al.*, 2017, p. 9).

the rainfall period usually is from October to April with a mid-season dry spell often occurring during this period, and falling during critical periods of crop growth (Brito *et al.* 2009).

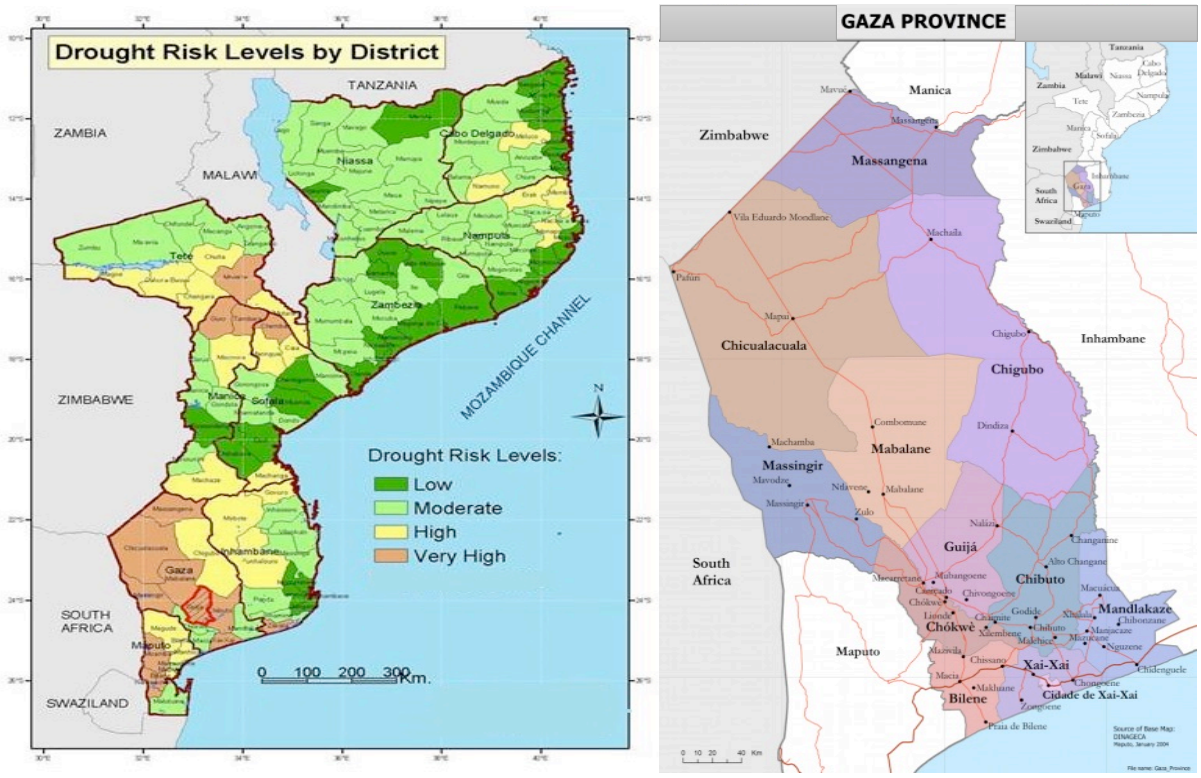

Figure 1.1 Study area (Source: Mozindico, 2010 and UNDP, 2012).

Some areas of the province receive an annual rainfall of around 400 mm; therefore, drought there constitutes a chronic problem, leading to high risks of drought-related losses. What is more, the inland and coastal soils of the province are sandy and have a high level of evaporation, which contributes to reducing the quantity of water available for sustainable plant growth. All these factors combined with the low soil fertility of the sandy soils, have reduced the province's potential for crop production when compared to other provinces of the country (Brito *et al.* 2009). This reduced potential is aggravated upon the occurrence of drought events, and thereby leads to risk of crop failure of up to 75%, and consequently food insecurity issues, mainly in the interior parts of the province, (MASA, 2011). Overall, these conditions, associated with the high illiteracy level of 32% (UNESCO, 2015), make the province ideal for the study.

1.4 Research Aim and Objectives

The study aims to assess how cultural factors, particularly beliefs, influence small-scale farmers' behavioural adaptation to drought. The results of this study might be helpful for policymakers, researchers, NGOs, donor agencies, program designers and other stakeholders concerned with drought impacts on farmers in Mozambique. The results might aid in the design and implementation of the most suitable, integrative, proactive, effective, culturally sensitive and long-term drought adaptation strategies in the country towards reducing the vulnerability and enhancing the overall adaptive capacity and resilience of the population to future drought risks. Moreover, some of the insights may be useful and adapted to other communities in similar environmental risks in the country and further produce more general findings to understand and address cultural considerations in other countries. The research objectives are as follows:

a) Assess the impacts of droughts on small-scale farmers

- Assess the spatial and temporal occurrence of drought events (observed meteorological data over the past 50 years and farmers memories);
- Ascertain the ways small-scale farmers perceive drought existence, acuteness and risks, and factors driving their perceptions;
- Compare the observed meteorological data with small-scale farmers' perceptions of drought events;
- Identify categories (e.g., women or men, young or adult, rich or poor, educated or non-educated, religious or non-religious) of farmers affected by drought events, why and how they have been affected over time and space;
- Identify farmers' drought adaptation (or non-adaptation) strategies and factors driving their decisions choices of those strategies – how and why they perform them, who make decisions and when;

- Assess the effectiveness of those adaptation strategies.

b) Assess the role of cultural (religious and non-religious) beliefs in shaping (individual and collective) farmers' behaviour towards adaptation responses to drought

- Identify farmers' diverse cultural beliefs about how the natural environment works, and factors influencing the formation of those beliefs;
- Assess the role of those beliefs in framing the ways they perceive drought existence, acuteness, risks, and possible solutions;
- Understand how farmers' perception of drought risks affect their behavioural intentions to adapt;
- Understand the ways farmers' diverse cultural beliefs influence the decision-making processes by which they identify, select and prioritise drought risks and implement adaptation responses, including who makes decisions;
- Examine how different cultural beliefs and consequent behaviour contribute to increase and/or decrease farmers' capacity to adapt and respond to drought;
- Assess the ways farmers are, or are not changing their beliefs, behaviours, and practices to adapt and respond to drought.

c) Assess to what extent cultural beliefs and practices are taken into consideration in the national drought adaptation strategies

- Identify technological drought adaptation strategies being implemented at national, regional and local levels;
- Assess to what extent cultural beliefs and practices are taken into consideration in the design of drought adaptation policies, programs, planning and implementation of the strategies; and how it is influencing farmers' capacity to adapt and respond to drought;
- Assess how cultural beliefs influence farmers' behaviour regarding the uptake of scientific

evidence and explanation about drought causes and risks as well as the adoption and implementation of technological adaptation strategies;

- Understand the interaction between farmers, government, institutions and other stakeholders in responses and adaptation strategies to droughts; and the corresponding outcomes and the influence of cultural beliefs on that;
- Identify the best strategies to improve and increase the collaboration between farmers and those stakeholders involved in the adaptation process for better outcomes.

1.5 Outline of the thesis

This thesis comprises of 7 chapters which are organized as follows:

Chapter 2 - reviews the literature related to risks and impacts of natural disasters (especially drought), environmental and climate change, and factors affecting farmers' adaptation to these stressors. The chapter starts by describing the stressors, risks, and impacts of drought, then the factors that determine adaptation. Here, the focus is given to understanding the crucial role of culture in farmers' lives and how cultural beliefs are important determinants of farmers' decisions and behavioural intentions to take adaptation actions and their choices of responses to facilitate or inhibit the implementation of adaptation actions at both local and institutional levels. Lastly, the chapter presents a conceptual framework of the key factors influencing small-scale farmers' adaptation to drought and the relationship between them, which forms the basis of the study.

Chapter 3 – presents the methodology used to conduct the study. It describes the study approach and design, the fieldwork location, the unit of analysis, the methods and tools used for data collection,

validation, and analysis. It also describes the ethical considerations taken into account and the challenges and setbacks faced during the research.

Chapter 4 – explores first the diverse methods farmers use to predict drought. Then focus is given to developing a comprehensive understanding of the traditional methods used by farmers to predict drought. Third, through farmers' perceptions and viewpoints, the chapter explores the dynamics (regarding the accuracy and reliability) of the methods under the current weather and conditions of climate uncertainty and variability and the consequences of that. Lastly, it discusses the opportunities the methods can bring to reduce the current and future exposure and vulnerabilities to drought for the less privileged groups of farmers who live in places where there is no location-specific meteorological station to timely monitor and communicate drought, or who have limited access to scientific forecasts, as is the case for most rural farmers in Mozambique.

Chapter 5 – explores small-scale farmers' (traditional and religious) cultural beliefs about the causes of drought events and the distinct and under-explored repertoire of reasoning behind their beliefs. It also explores the dynamics and co-existence of farmers' beliefs and the factors which drive them, and show how some of the reasoning is static, while others are mutable, based on their observation and perception of the negative, unexpected, or harmful recent or current events which happen in their surrounding environment, and which they believe could be avoided or prevented. Then, it discusses how, besides helping them explain the occurrence of drought, farmers' beliefs and reasoning influence their perception of their own capacity to adapt, their motivation to respond, and their behavioural responses. Additionally, as farmers' beliefs are socially-constructed, the chapter also explores the influence of social groups and subjective norms on their choices of response and the corresponding outcomes.

Chapter 6 – presents farmers' responses to drought, as well as assessment of the role of cultural beliefs on their responses. Before delving into that, the chapter first shows how farmers have been adversely affected by drought and why the impacts are memorable and strong enough to trigger their need of responses. Then, it presents the diverse responses farmers implement in order to collectively tackle the causes and to individually reduce the impacts of drought. Third, the paper unveils the factors influencing farmers' behavioural responses and choices of responses and vulnerability by assessing how farmers' responses are formed, the role of cultural beliefs and other socio-cultural, economic and institutional factors in the formulation of responses, the interconnection among these factors and the outcomes. A key purpose of the assessment is to show how farmers' choices of individual responses and their level of vulnerability are a reflection of the interconnection of these factors, which also contributes to reinforce and endure farmers' beliefs.

Chapter 7 – presents the conclusion of the thesis. The chapter provides a summary of the key findings of the study regarding the objectives, followed by a discussion of the empirical, theoretical, and policy implications of the study. Lastly, the chapter provides some considerations for future studies.

2 Literature Review and Conceptual Framework

2.1 Introduction

The following chapter provides a summary of the main themes highlighted in the literature related to the role of culture, especially cultural beliefs, in framing farmers' understanding of the causes of natural disasters (especially drought), as well as environmental and climate change. It also focuses on the way farmers are impacted by drought and their responses to it as well as other non-cultural factors which also affect farmers' adaptation. This is to understand further how cultural factors are important in farmers' decision-making processes and choices of response. Before delving into that, for a better understanding of the stressor, the first Section presents a brief description of what constitutes drought (definition, characteristics, and classification), and assesses why drought constitutes a risk. It also explores the impacts of drought, particularly to poor small-scale farmers who depend on rain-fed agriculture for their livelihoods (objective 1). Drawing on that, the second Section explores the determinants and the processes of adaptation, as well as the factors affecting farmers' decisions to take actions to reduce their vulnerability and adapt to drought. Here, a distinction between adaptive and coping capacity is also made in order to facilitate the understanding of the types of responses being implemented by farmers. The third Section focuses on understanding the crucial role of culture in farmers' lives and how important are cultural beliefs in shaping farmers' decisions and behavioural intentions to take adaptation actions and their choices of responses (objective 2). This Section also explores how cultural beliefs can facilitate or inhibit the implementation of adaptation actions at both local (objective 2) and institutional levels (objective 3). The last Section presents a conceptual framework that forms the basis for this study. The conceptual framework presents the stressor under study (drought), key factors influencing small-scale farmers' adaptation to drought and the relationship between them as well as the scale and actors of adaptation.

2.2 Understanding the stressor

2.2.1 Concept, characteristics, and types of drought

Concept of drought

Drought is a creeping and complex natural hazard, generally defined as an extended period (months or years), in which precipitation is less than the annual average, resulting in scarcity of water for environmental functions and human activities (Rouault and Richard, 2005; Udmale *et al.* 2014). However, despite this general definition, what constitutes drought continues to be challenging to understand since its concept may differ by sector and region, due to differences in water demand, hydro-meteorological and socio-economic factors (AMS, 2013). The definition of drought may also vary from people to people, according to what makes the events memorable to them, which is mostly linked to the negative impacts of the events in their activities, livelihoods, and well-being (Slegers, 2008; Urquijo and De Stefano; 2016). For instance, for agricultural purposes, drought is defined as a shortage of precipitation over an extended period, resulting in the sub-optimal availability of water and soil moisture for adequate plant growth and transpiration (Rouault and Richard, 2005; Wilhite *et al.* 2014). For this study, the general definition of drought was adopted since the impacts of drought on farmers go beyond their agricultural activities. The drought meanings to farmers participating in this study are explored.

While these above definitions are conceptual definitions of drought to facilitate people's comprehension of the concept of drought, there is also an operational[6] definition of drought, which helps people to identify the onset, cessation, and degree of severity of a drought by comparing the current conditions to the historical average, usually based on a 30-year record (recommendation from the World

[6] "Operational definition of drought attempts to identify the precise characteristics and thresholds that define the nature of a drought episode (Wilhite, 2000, p.9)."

Meteorological Organization). When operationalizing the definition, the characteristics of drought are usually considered (Monacelli, 2005). This is the focus of the next section.

Drought Characteristics

The absence of a precise and objective definition of drought continues to create much confusion in certain situations, as well as disagreement within the scientific and policy-making community about the criteria to determine its characteristics. This has constituted an obstacle to this community to understanding drought, the onset until it has become well established, and cessation. This leads to indecision about the existence of drought, the degree of severity, and thus contributes to inaction (Mishra and Desai, 2006; Wilhite *et al.* 2014). Additionally, the confusion about what constitutes drought often leads to mistake drought with water scarcity, aridity, dry spell, water shortage or overexploitation (Van Loon *et al.* 2016). Thus, to understand this mistake, the meanings of the terms are presented in Table 2.1.

Table 2.1: Terminologies mistaken with drought

Term	Definition
Aridity or dryness	Long-term dryness, which is a permanent feature of the climate of an area, the meagre annual rainfall is much lower than the potential evaporation (Nicholson, 2011, p. 3; Smakhtin and Schipper, 2008).
Dry spell	A dry period for abnormal consecutive days, resulting in a soil water deficit and consequent water stress to crops. A dry spell is shorter and less severe than drought (Barron *et al.* 2003).
Water scarcity	Long-term imbalance between the demand and supply of water as a result of the high average demand, shortfall in the average availability, and/or issues with the supply of water. This condition does not need to have a climatic origin or to be a temporary (Van Loon et al. 2016).
Water shortage or stress	Acute lack of water for social-economic, or environmental needs, caused by the reduced supply of water rather than demand (Van Loon et al. 2016).
Overexploitation	Long-term overuse of water resources, which results in a gradual depletion of water availability (Van Loon et al. 2016). This condition can be attributed to reasons such as population growth, extensive agricultural and industrial use of water (Smakhtin, and Schipper, 2008).

The difference between drought and the conditions presented in the Table lies in their timescale and drivers. For instance, while aridity is a permanent climatic feature of an area, drought is a temporary

condition, which can be a feature of climate or human-induced (Smakhtin, and Schipper, 2008; Van Loon *et al.* 2016). In fact, drought does not only differ in its characteristics from other conditions, but also from other drought events. Each drought event has distinct climatic characteristics, extent, and impacts (Wilhite *et al.* 2014), and they differ from one another in three essential features: intensity, duration, and spatial coverage (Wilhite *et al.* 2014). Drought **Intensity** relates to the degree of the shortfall in precipitation, soil moisture or water storage deficit over a specified period and/or the severity of impacts associated with the shortfall (Degefu and Bewket, 2014; Wilhite *et al.* 2014).

The **duration** represents the length of time that a drought episode lasts. While other natural hazards are brief and short-lived, because of its creeping nature, drought is a more gradual phenomenon, slowly taking hold of an area and tightening its grip with time (quite often increases in intensity with longer duration). This sometimes makes drought challenging to recognize. A drought can be short, lasting just up to a few months, or in severe cases, it can persist and last for several years or even decades (mega-droughts) before climatic conditions return to normal (Mishra and Desai, 2006; Wilhite *et al.* 2014). Some regions (e.g., Southern Europe, West and Southern Africa) have experienced prolonged and intense drought events while others have registered shorter, less intense and less frequent droughts (e.g., Central North America and Northwestern Australia) (IPCC, 2012, p. 8). The recurrent interval between drought events is the frequency. Drought can also be permanent, seasonal or unpredictable. Permanent drought is typical of the driest climates; where despite the scatter vegetation being adapted to the arid conditions, crop production requires irrigation. Unpredictable drought mostly occurs in humid and sub-humid climates and is linked to an abnormal and irregular rainfall failure (Britannica Academic, 2017). While seasonal drought is characteristic of climates with well-defined rainfall and dry seasons; with drought occurring during the dry season, thus agricultural activities are adjusted accordingly to cultivate crops during the rainy season. The latter is common in Southern Africa where the

Meteorological Departments have in place a seasonal climate outlook for forecasting drought (Trambauer *et al.* 2015).

The **Spatial coverage** refers to the extent of a drought event, i.e., whether a drought event affects a small or large area (Degefu and Bewket, 2014). Usually severe and extreme drought events tend to extend to wider areas, such as most of a continent (Dai, 2011), as the example of the devastating 1991/92 summer drought in Southern and Eastern Africa, which covered an area of 2.6×10^6 miles^2 (around 33% of the area), affecting nearly 24 million people (Unganai and Kogan, 1998). In some cases, mostly during summer, drought may be invisible; this happens when high summer temperatures lead to high evaporation and transpiration rates, making even frequent rainfall not enough to restore the amount of water lost; thereby resulting in water deficiency that reduces crop yields (Britannica Academic, 2017).

The intensity, duration, and spatial coverage, together with the demands of human activities and vegetation on an area's water supplies, determine the severity of the socioeconomic and environmental impacts of drought (Degefu and Bewket, 2014; Wilhite, 2000). However, the areas affected by severe drought are rarely static during the course of the event, they evolve gradually, and the epicentre shifts from season to season, making it challenging to quantify the consequences of drought and provision of disaster aid in relation to other types of disasters, since these impacts can slowly pass through economies and the environment for extended periods (Wilhite *et al.* 2014). Therefore, it is important to classify drought according to the dominant impacts and timescale of the event, in order to facilitate the quantification of its impacts, as described below.

Classification of Droughts

According to the dominant impacts and timescale of the event, droughts are often grouped into four general types: meteorological or climatological, agricultural, hydrological, and socio-economic droughts (AMS, 2013). All these types of droughts originate from a deficiency of precipitation (Wilhite *et al.* 2014), which in temperate regions is attributed to the prolonged presence of a high-pressure system called a blocking high, while in many parts of the world is attributed to fluctuation in the Earth's climate system due to strong and extensive interactions between the ocean and atmosphere, called El Niño or La Niña (Blackwell and Manar, 2016). El Niño is related to the warming of sea surface temperature that occurs every few years, causing drought in the central and western Pacific (e.g., Southern Africa; Southeast Asia, and western coast of South America), while La Niña describe the opposite, the cooler-than-normal sea surface temperature, which is linked to drought in the eastern side of the Pacific (e.g., Ecuador, Peru, and the southern United States). Together 'El Niño and La Niña form the inter-annual phases of the El Niño Southern Oscillation (ENSO) (Met Office, 2017). However, other factors such as high winds, high temperatures, and low relative humidity may exacerbate drought severity (Wilhite, 2000). Human activities can also worsen the effects of drought for the excessive irrigation, deforestation, overgrazing, poor land management methods[7] as well as improper soil conservation techniques[8] (Mishra and Singh, 2010; Odle and Ocko, 2013). The links between the climatic and non-climatic factors causing the four types of drought are shown in Fig. 2.1.

[7] Poor land management methods can cause the reduction of water retention capacity of the soil (Mishra and Singh, 2010).

[8] Improper soil conservation techniques lead to soil degradation (Odle and Ocko, 2013).

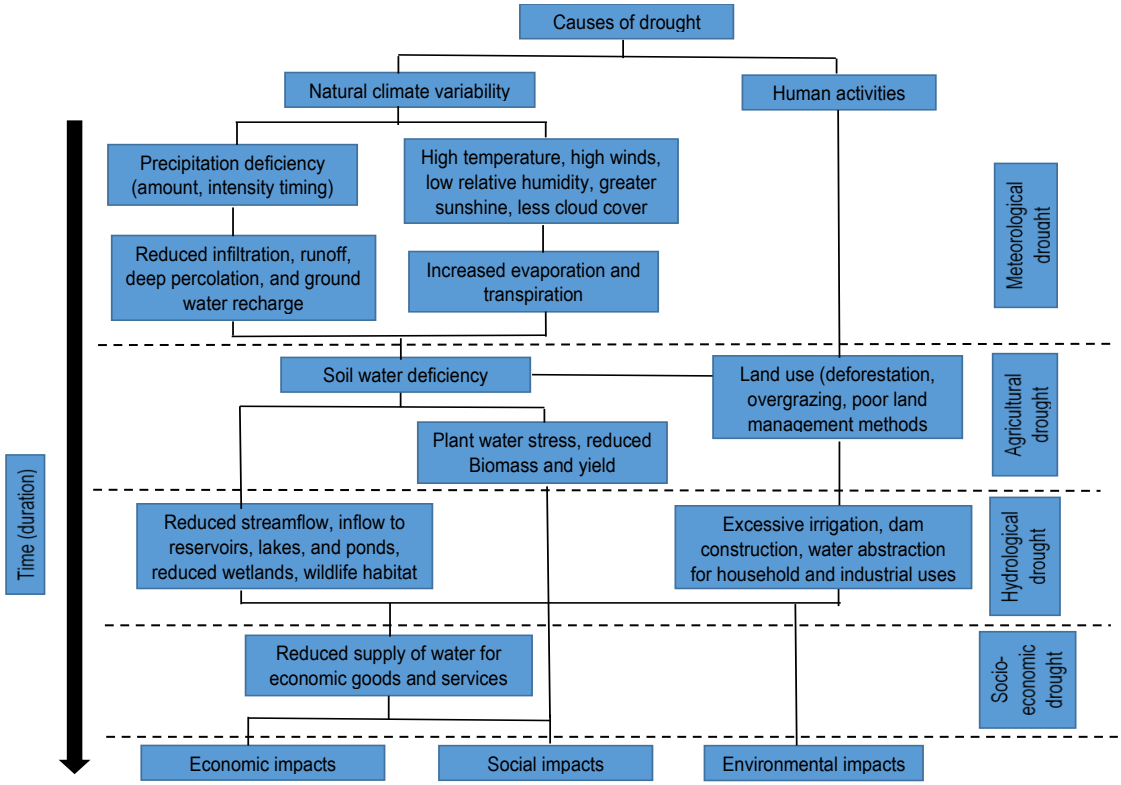

Figure 2.1: Drought types, causal factors and their usual sequence of occurrence (Source: adapted from the National Drought Mitigation Center, n.a. and Van Loon et al., 2016).

Hydrological drought is not directly concerned with shortfalls in precipitation but with the substantial depletion of natural and artificial surface or subsurface discharges and water resources, resulting for instance in the reduction of the supply of water for irrigation, hydro-electrical power generation, and other household and industrial uses (AMS, 2013; Mishra and Singh, 2010; Wilhite *et al.* 2014). Thus, due to all these activities' dependence on surface water resources, this type of drought, which lags behind the occurrence of meteorological and agricultural droughts, is considered the most important one (AMS, 2013). *Socio-economic drought* is the failure of water resources systems to meet water demands for an economic good or service, which is dependent on precipitation (e.g., water and hydroelectric power) as a consequence of a weather-related shortfall in the supply of water (AMS, 2013; Mishra and Singh, 2010; Wilhite *et al.* 2014).

To capture the impacts of drought on ecosystems, a more recent effort focused on the concept of *Ecological drought*. Crausbay *et al.* (2017) and the National Drought Mitigation Center (n.a.) defined Ecological drought as a prolonged and widespread deficit in naturally available water supplies (including changes in natural and managed hydrology) that creates multiple stresses across ecosystems *and triggers feedbacks in natural and/or human systems*. In this study, agricultural and hydrological drought were considered due to the impacts of these kinds of droughts on human activities and well-being, as well as livestock rearing.

2.2.2 Drought risks and impacts for small-scale farmers

Among all the weather-induced disasters (e.g., droughts, floods, and tropical cyclones), drought is historically the most devastating environmental phenomenon in terms of socio-economic, environmental, human activities, and livelihoods impacts that have long-term implications (FAO, 2004; Sheffield *et al*. 2014). This has been further aggravated by growing water demand (Mishra and Singh, 2010). Since 1900 around 718 droughts have been registered globally, affecting more than 2.4 billion people, and causing the death of around 12 million of them. Specifically, in Africa, it affected more than 415 million people and killed approximately 0.5 million people (EM-DAT, 2018). What is more, droughts have caused global losses worth (average $6–$8) billions of dollars annually, accounting for roughly 24 percent of all losses from major weather events, therefore positioning it as one of the costliest and most widespread natural hazards (AMS, 2013; Chakrabarti *et al.* 2014).

In southern Africa, drought is a chronic problem and has adversely caused an increasingly complex web of direct (primary) and indirect (secondary) impacts (Table 2.2). However, not all the impacts listed in the Table 2.2 happen with every drought (FAO, 2004). Direct impacts are usually those that are primarily caused by drought, such as the reduction of crop productivity (yield quantity and quality) or even crop failure; reduction in water levels, increase of fire hazard and livestock mortality. The

consequences of the direct impacts represent the indirect impacts. For instance, a decrease in crop productivity may cause a reduction in income, increased food prices, unemployment, migration, and trigger disaster relief programs. Thus, the consequences of indirect impacts often are worse than the direct impacts (FAO, 2004; Wilhite *et al.* 2007).

Table 2.2: Impact of drought in southern Africa (Source: FAO, 2004, adapted from Vogel et al. 1999)

Type of Impacts	Social	Environmental	Economic
Direct (Primary Impacts)	Disrupted distribution of water resources	Increased damage to natural habitats	Reduced business with retailers
	Increased quest for water	Reduced forest, crop, and rangeland productivity	Food and energy shortages
	Marginal lands become unsustainable	Reduced water levels	Loss of crops for food and income
	Reduced grazing quality and crop yields	Reduced cloud cover	Reduction of livestock quality
	Employment layoffs	Increased daytime temperature	Water scarcity
	Increased food insecurity	Increased evapotranspiration	Loss of jobs, income and property
	Increased pollutant concentrations	More dust and sandstorms	Less income from tourism and recreation
	Inequitable drought relief	Decreased soil productivity	Forced financial loans
	Increased forest and range fires	Decreased water resources	
	Increased urbanization	Reduced water quality	
Indirect (Secondary Impacts)	Migration, resettlement	Loss of biodiversity	Increased prices for farming commodities
	Increased conflicts between water users	Reduced income and food shortages	Drastic price increases; expensive imports/substitutes
	Poverty, unemployment	Lower accessibility to water	Increased expense of buying food, loss of income
	Overstocking; reduced quality of living	Plant scorching	Sale of livestock at a reduced market price
	Reduced or no income	Increased fire hazard	Increased transport costs
	Malnutrition and famine; civil strife and conflict	Crop-withering and dying	Deepening poverty; increased unemployment
	Public health risks	Increased soil erosion; increased air pollution	Increased capital shortfall
	Social unrest, distrust	Desertification and soil degradation (topsoil erosion)	Increased debt; increased credit risk for financial institutions
	Increased threat to human and animal life	Lack of water for feeding and drinking	
	Social pressure, reduced safety	More waterborne diseases	

Although drought directly affects agricultural and non-agricultural sectors, in many developing countries agriculture is typically considered the first and most affected sector due to its strong link to the rest of the economy, and the rural poor farmers' high dependence on rain-fed agriculture for their livelihoods (FAO, 2004; Wilhite *et al.* 2014). Globally, drought has caused an annual reduction in maize yield of around 15%, representing more than 20 million tonnes of grain loss (CGIAR, 2009). In Southern Africa, maize yields have stagnated at little over 1 tons/ha (the lowest yield in the region), and under drought stress, the yields can decrease up to half (Fisher, 2015). As a result, most farmers face problems of food shortage and reduced incomes, leading them to have difficulties in feeding their families and to fulfill other commitments (FAO 2004; Shiferaw *et al.* 2014). This situation increases the need for post-disaster assistance by the government and donors in the form of emergency food aid to alleviate food shortages, drought rehabilitation or mitigation (Wilhite, 2000). For instance, the last drought occurring in most parts of Africa (2015 -2016) left 6.2 million people in acute need of assistance in Somalia, 8.5 million in Ethiopia and 1.5 million in Mozambique (Relief Web, 2016; 2018a, 2018b).

In extreme cases, drought can result in humans' malnutrition that leads to their deaths, and mass migrations among rural communities (Degefu and Bewket, 2014). Moreover, extremely high temperatures that often accompany droughts have also significantly contributed to increasing crop and yield losses, as well as widespread livestock mortality (Lobell *et al.* 2015). As previously mentioned, warming of around 2°C is predicted to happen globally in the next 20 to 30 years if the necessary measures to reduce global warming are not taken. Under this scenario, losses of around 40-80 percent can be expected on maize, millet, and sorghum yields in sub-Saharan Africa (World Bank, 2013). Therefore, this scenario reinforces the need for farmers to adapt to future drought. The factors that shape farmers adaptation to drought and other natural hazards are explored next.

2.3 Adaptive capacity and drought

2.3.1 Determinants of adaptation

Adaptation actions in small-scale agriculture are crucial to reduce farmers' vulnerability and increase their capacity to adapt to the adverse impacts of rainfall variability and change, to protect their livelihoods and reduce food insecurity (Bryan *et al.* 2009; Jones *et al.* 2010). The IPCC (2012, p. 559) defines adaptation as "the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities." Although the definition of adaptation is still controversial for not considering non-climatic factors (e.g. socio-economic, technical, institutional and cultural) that may hinder the adaptation process (Moser and Ekstrom, 2010), this IPCC definition is widely used by researchers in the climate change field (e.g., Adger *et al.* 2007; Deressa *et al.* 2009; Jones and Boyd, 2011; Jones *et al.* 2010; Shackleton *et al.* 2015; Stringer *et al.* 2009).

Indeed, in practice, adaptation is a complex and continuous process that involves incremental changes or adjustments in social, physical and environmental processes, perceptions of risks, practices, actions, and decisions, and attitudes to manage or reduce potential risks or to realise new opportunities (Tompkins *et al.* 2010). Moser and Ekstrom (2010) and Risbey *et al.* (1999) identified a set of interrelated steps involved in adaptation process. These steps are: detect the problem, collect information about the problem to become more familiarized with it, reflect about the problem, evaluate and select options to respond to the problem, implement the selected options, and monitor and evaluate the results of the implemented options to assess whether they are as expected. Nonetheless, limits or barriers to adaptation can arise at any of these steps, as farmers' decision-making processes and adaptation behaviours are highly complex, and are influenced by a variety of interlinked climatic and non-climatic factors that determine their agricultural choices (Below *et al.* 2012; Deressa *et al.* 2009). Some of the non-climatic factors affecting farmers' adaptation are relatively obvious (e.g., financial and technical) and others are hidden and often forgotten (e.g., cognitive, behavioural, and

cultural factors). However, Adger *et al.* (2007) argue that these limits and barriers are essentially subjective and contingent on the values of diverse groups. On this account, the limits and barriers may differ between groups.

Therefore, in response to climatic events, Adger *et al.* (2007) explain that adaptation practices can take different forms, and can be applied in isolation or combination:

- Scale: spatial (local, regional, national) or temporal (responses to current variability, based on past adaptations to historical climates; medium and long-term observation of trends in climate; and proactive planning in response to long-term climate change);
- Sector: water resources, agriculture, tourism, public health, and so on;
- Type of action: physical, technological, investment, regulatory, market;
- Actors: national or local government, international donors, the private sector, NGOs, local communities and individuals;
- Duration[9]: short or long-term.

These forms and steps of adaptation practices, especially for the agricultural sector, are relevant for this study to have a clearer understanding of the types, steps and duration of adaptation practices (previously and currently) implemented by the Government, NGOs and small-scale farmers and the corresponding outcomes. In fact, several adaptation practices have been implemented through these actors and at multiple scales and durations (Jones *et al.* 2010). For instance, adaptation practices implemented by the Government and international organizations around the world are portrayed as proactively planned with anticipation through, for example, programmes, policies and National

[9] Smithers and Smit (1997) refer to short-term responses as tactical actions based on daily or weekly managerial decisions to respond to immediate stimuli and to long-term responses as strategic actions for being more enduring and often anticipatory adjustments that, in some way, reorient the characteristics of the activity in question.

Adaptation Programme of Action (Osbahr *et al.* 2008). However, in Southern Africa, adaptation mostly takes the form of reactive, poorly coordinated and untimely responses to a stressor (e.g., food aid and free, or subsidized, seed distribution in the aftermath of drought), which Wilhite *et al.* (2014) describe as "crisis management." Such kind of short-term responses are deemed to do little or nothing to reduce the vulnerability of poor people to the impacts of future droughts, as they fail to keep pace with what is required in order to manage the crisis while at the same time building farmers' self-reliance (Wilhite, 2000). This further contributes to increasing poverty and hampers the development progress of the region (Cunguara and Hanlon 2012; FAO, 2004). Therefore, current drought policies have increasingly focused on moving from the reactive and incremental[10] types of responses to proactive and transformational[11] types by reducing drought risk in the agricultural sector, improving people's levels of self-reliance, and stabilizing income (Park *et al.* 2012; Wilhite, 2000).

Taking into account the importance of transformation, the IPCC (2012) have developed approaches to adaptation and disaster risk management, which can be overlapping and pursued simultaneously, to reduce and manage disaster risk and increase resilience in a changing climate (Fig. 2.2). They define resilience as "the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions" (IPCC, 2012, p. 5). Folke *et al.* (2010) argue that deliberate transformational changes require resilience thinking in assessing the advantages of the current versus potentially alternative stability domains, and in developing resilience of the new domain. Transformations draw on resilience from multiple scales and make use of experience with and knowledge of crisis as windows of opportunity to facilitate

[10] Incremental adaptation does not require major decisions or information to maintain its functions (Park *et al.* 2012).

[11] Transformational adaptation requires significant system's changes to enhance its capacity to achieve the desired outcome (Park *et al.* 2012).

changes and build the resilience of the new domain. Smaller scales transformational changes allow resilience at larger scales.

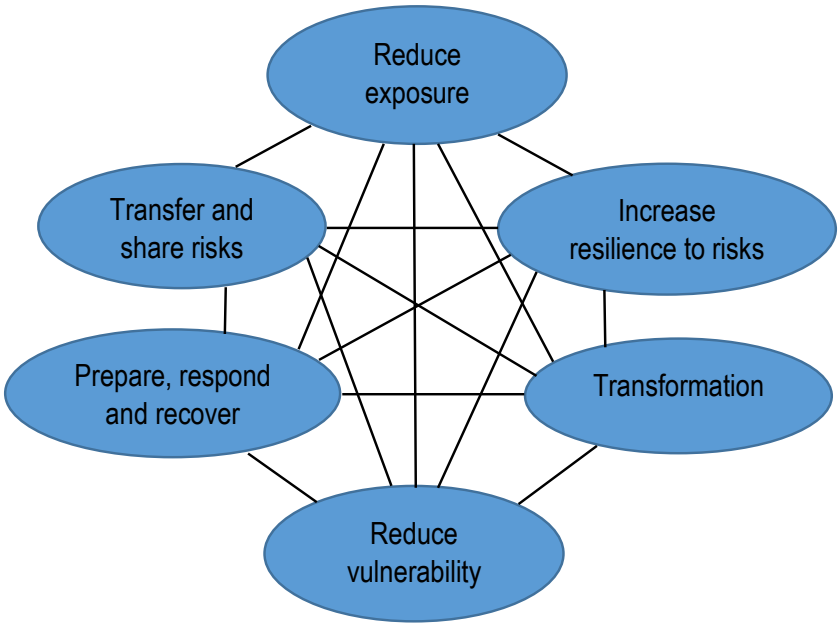

Figure 2.2: Adaptation and disaster risk management approaches in a changing climate (source: IPCC, 2012, p. 6). Transformation is facilitated through increased emphasis on adaptive management, learning, innovation, and leadership to promote a more sustainable and resilient future.

On the other hand, at the local level, Below *et al.* (2015) identified around 104 drought adaptation practices implemented by African farmers. Some of them are used all over the continent, and others in particular regions (Tambo and Abdoulaye, 2012), as what may constitute effective adaptation varies across and within regions (Osbahr *et al.* 2008). Nonetheless, diversification within (e.g., crop production variation and use of improved crop varieties that are resistant to drought) and beyond agriculture (e.g., off-farm income and remittances from migrating relatives) are the most used strategies by farmers to reduce drought risk and increase their well-being (Deressa *et al.* 2009; Eriksen *et al.* 2009). However, due to poverty and livelihood shocks, most rural populations in Africa remain physically and economically isolated with little access to markets, credit facilities or other necessary resources required to invest in improved technologies or diversification, therefore constraining their capacity and

initiative to implement long-term adaptive responses (Cunguara *et al.* 2011; Tambo and Abdoulaye, 2012). Thus, taking into account farmers' constraints to the capacity and initiative to adapt, the next sub-section explores the differences between adaptation and coping strategies, as well as between adaptive capacity and coping capacity in order to facilitate an understanding of the types of responses to drought implemented by farmers depending on their capacities.

2.3.2 Adaptation/adaptive capacity versus coping/coping capacity

Adaptation is usually a result of planned actions, a constant and long-term process to deal with future constraints, thus learning, reinventing and reorganizing are the key features for long-term survival (see Table 2.3 for more detailed distinctions). Those who are able to rapidly and easily anticipate, respond to, and recover from risks, as well as to make necessary changes are considered to have high ''capacity to adapt'' or ''adaptability'' (Denevan, 1983). Those who are not able to this, are considered to have high vulnerability (Adger *et al*. 2007; Jones and Boyd, 2011). Therefore, adaptation is closely related to the concepts of vulnerability and adaptive capacity, and indeed adaptation is considered a manifestation, reflection and end result of adaptive capacity (Smit and Wandel, 2006).

Adaptive capacity represents potential rather than actual adaptation, and its presence is central to enable farmers themselves to make appropriate adjustments to adapt to current and future risks (Jones *et al.* 2010; Vincent, 2007). Therefore, adaptive capacity is often used in interchange with resilience (Smit and Wandel, 2006), since it is argued that one way of increasing a society's resilience is by increasing their adaptive capacity to recover from stresses and to prepare for potential changes (Meybeck et al. 2012). Adaptive capacity is context-specific and varies among social groups and individuals; thus, some individuals may easily adapt to changes and others may not. Nonetheless, having a high capacity to adapt does not necessarily mean that individuals will take adaptation actions to reduce their vulnerability (Moser and Ekstrom, 2010; Vincent, 2007). Individuals' actions will depend

on a combination of the strengths, attributes, opportunities and resources available that can be effectively used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities (Adger *et al.* 2007; IPCC, 2007, p. 556; Smit and Wandel, 2006).

Table 2.3: Dimensions of coping and adaptation (source: modified from IPCC, 2012, p. 51)

Dimension	Coping	Adaptation
Exigency	Survival in response to immediate, uncommon significant stress according to individuals' socio-economic conditions (Blaikie et al. 2004, p. 6). The exploration of the positive opportunities that the selected strategy can bring in long-term often does not constitute the goal (Cooper et al. 2008)	Reorientation in response to recent events or expected change in the future, usually without specific reference to resource limitations (IPCC, 2012, p. 51), but people's abilities and intentions to adjust (Smith and Wendel, 2006) and exploit the perceived beneficial opportunities of adjusting (IPCC, 2001, p. 72).
Constraint	Survival is pre-eminent, and tactics are limited by the available knowledge of the risks and actions to take, experience, assets (both material resource and social support system) and risk tolerance of the decision-makers. Reinvention is not a primary concern (Bankoff, 2013; Bryan et al. 2009). The degree of exposure, the nature, scale and severity of the stimuli may also be constraining (Adger *et al.* 2007; Smithers and Smit, 1997).	Long-term adjustment is the key, which is constrained by the socio-cultural, cognitive, behavioural, economic, political, technological and institutional factors, and uncertainty regarding the intensity, frequency, and duration of future impacts (Adger et al. 2007; IPCC, 2012, p. 51). Resistance to change, being comfortable with the way things are done – stick to tradition (Donnelly et al. 2009), and optimism that environmental conditions in the future will not worsen may also restrain long-term actions (Gifford, 2011).
Reactivity	Decisions to cope are primarily tactical and motivated by the protection or enhancement of the level of well-being and safety goal (Adger, 2005; Edwards-Jones, 2006).	The focus is on strategic decision to proactively anticipate and address change (Füssel, 2007), even if spurred by recent events perceived as further forewarning change (IPCC, 2012, p. 51).
Orientation	Past successful tactics and limitations guide current actions (Adger et al. 2007; Bankoff, 2013). Look at what others (e.g. family, friends, neighbours and social groups) or role models are doing for guidance (Donnelly *et al.* 2009).	Assess future conditions and strategies, perceptions of risk, past events and tactics are relevant to trigger and facilitate adjustment, though some experts believe past and future orientation can overlap and blend (Adger et al. 2005; Chen, 1991).

Coping strategies are reactive, momentary and short-term. They help to deal with constraints, maintain the system and its functions, and survive (IPCC, 2012; p. 558; Smit and Wandel, 2006). The extent to which a system has the ability to mobilize and use available skills, resources and opportunities to deal with stressors is referred to as 'coping capacity' (IPCC, 2012, p. 558). Although some coping strategies may reduce risks and be turned into longer-term strategies over time (Jones *et al.* 2010), they may lead to an increase in exposure and vulnerability to long-term climate change – known as

'maladaptation' (Adger *et al.* 2005; Jones *et al.* 2010). The humanitarian discourse suggests that individuals can deal with some degree of destabilization, and at a certain point reach a capacity limit (IPCC, 2012, p. 73). For instance, Lipton and Ravallion (1995) explain that individuals can reduce their coping capacity and increase their vulnerability to stressors by repeatedly using their available coping mechanisms without giving the mechanisms sufficient time for recovery. One such example given by Jones *et al.* (2010) is firewood collection and coal making, which despite being useful strategies for communities surviving under stress, they may also be environmentally damaging, unsustainable and jeopardize the future availability of the resources.

While this brings a definite need for developing long-term and sustainable strategies for farmers, and the environment, without jeopardizing the resources for future generations, what specifically determines farmers' capacity to adapt and how the factors influence their ability to translate their adaptive capacity into actions continues to be a subject of discussion within the scientific community (Adger *et al.* 2007; Murphy *et al.* 2016). Building on this continuing discussion, the following section will explore some of the factors that are deemed to influence farmers' decisions to take actions.

2.4 Drivers of farmers' decision to take adaptation actions

Although there are several studies on understanding the numerous factors that affect smallholder farmers' decision-making and behaviour, the process involving decision-making response and adaptive behaviour is still not well understood (Gbetibouo, 2009; Williams *et al.* 2013). There have been a limited number of empirical quantitative analyses on the multiple factors that have influenced farmers' individual decisions to adapt, especially addressing characteristics of adaptation processes that are particular to a place (Jain *et al.* 2015; Vincent, 2007). This includes studies on how farmers' climate change beliefs, values and perceptions of risk impact their plans for the future (Adger *et al.* 2009;

Wheeler *et al.* 2012). Most of the studies on decision-making response place more emphasis on areas within disciplinary lenses such as technology adoption, economics, anthropology, psychology and behaviour constraints (Ajzen, 2002; Armitage and Connor, 2001). Thus, this study aims to contribute to the climate change adaptation literature by looking at the context-specific factors that affect farmers' decision-making processes, choices of responses and related outcomes, with emphasis on the role of cultural beliefs.

Decision-making refers to the evaluation of available choices to find the preferable ones (Roberts, 2015), thereby it is denoted as a process (IPCC, 2007, p. 720). Decisions to adapt are made at various levels, i.e., by individuals and groups within society, often in response to extreme weather and climatic events affecting their activities, livelihoods, and natural resources, or on a larger scale by organizations and governments on behalf of society, and in some occasions in anticipation of changes (Adger *et al.* 2003; Below *et al.* 2012). Roberts (2015) states that individual and group decisions involve a number of external (e.g., climate and environmental conditions, environmental and agricultural policies) and internal variables (e.g., values, beliefs, preferences, personal knowledge, risk tolerance, goals and trust in agents of change). However, other authors have emphasised that before taking any decision regarding whether or not to respond to a stressor, a person needs to perceive the existence of risk and their own capacity to take actions to adapt to the stressor (Grothmann and Patt, 2005; Patt and Schröter, 2008. This topic is the focus of the next section.

2.4.1 The Influence of farmers' perception of risk on their decision to adapt

Perception of risks is a necessary predecessor for the adoption of adaptation measures (Arbuckle *et al.* 2013). Perception is a dynamic and value-laden term that refers to awareness of a stressor and the range of subjective judgments, beliefs, and attitudes people make about the characteristics, harshness and adverse impacts of the stressor (Leiserowitz, 2006; Regassa and Stoecker, 2014). The IPCC

(2012, p. 5) defines risk as "the likelihood over a specific time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with the vulnerable social conditions, leading to widespread adverse human material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery."

Consensus among scholars is still limited regarding the differences and similarities in perceptions of risk, and related attitudes and behaviours among socio-economic groups under the same environment conditions (Anderson *et al.* 2007). Nonetheless, what scholars seem to agree on is that the most common perception is that temperature is increasing while precipitation is decreasing (Deressa *et al.* 2009; Kibue *et al.* 2015; Osbahr *et al.* 2011; Roco *et al.* 2014). As rain-fed agriculture is extremely vulnerable to climatic variations, farmers perceive the reduced rainfall accompanied by high temperatures as accelerating the depletion of soil moisture, reducing yields if occurring during critical stages of crop development and increasing the incidence of pests and diseases. These perceptions therefore affect farmers' choices of crops and varieties to plant, planting dates and agricultural activities to minimise yield losses (Deressa *et al.* 2009; Osbahr *et al.* 2011). This study also explores farmers' perceptions of rainfall and temperature trends, and environmental changes, and links to their farming activities.

Weber (2010) noted that due to the abstruse statistical nature of risks, individuals' perceptions of risk and its severity do not seem to match the scientific explanation. For instance, Sleger (2008) gives the example of farmers in semi-arid East Africa who considered drought as the main factor decreasing their agricultural productivity, while scientists identified soil degradation as the main reason. In fact, recent research on public perception of risk found that public perceptions are not only influenced by scientific evidence and technical explanation about the risk but by their *past experiences* and

accumulated knowledge about changes and variability in climate and environmental conditions, and their associated impacts on their activities and lives (Patt and Schröter, 2008, Leiserowitz, 2006). Through knowledge and experience, people's beliefs about risks get much stronger and more real (Van Paassen, 2004), which can serve to facilitate actions by people who are less risk-averse (Jain *et al.* 2015). Through beliefs, people understand their environment, and in turn, the environment shapes their beliefs and cognitive competencies (Muro and Jeffrey, 2008). This topic is further discussed in the next sub-section.

2.4.1.1 The Influence of local knowledge on the perception of risks

Farmers are close observers of the natural environment and climate. This daily observation, dynamic interaction, interdependence and cumulative experience with the surrounding environment have provided farmers with knowledge and ability to understand the environment upon which their livelihood and survival depends, and to recognise changes within it (Kashima, 2010; Speranza *et al.* 2010; Tompkins *et al*., 2010). With such knowledge and ability, which are rooted in their culture, orally passed down through generations, farmers have developed multiple mechanisms (indicators and signs) to predict weather or seasonal climate variability for farming-related decisions, to deal with environmental stresses, and to foresee some non-climatic events, such as illness, good luck and a visitor's arrival (Green *et al.* 2010; Orlove *et al.* 2010). Thus, Berkes *et al.* (2000) contend that local knowledge is comprised of a hierarchical system of knowledge-practice-belief, and for this reason, local knowledge cannot be disconnected from the socio-cultural context from which it is derived and to which it is applied.

Some examples of the indicators used to forecast the weather and climate are the behaviour of plants and animals, strength and directions of winds, the sky colour, sun, and stars (Chang'a *et al.* 2010; Green *et al.* 2010; Lefale 2010). Such traditional indicators are also explored in this study as farmers

continue to rely on them for weather and climate predictions, even though they have access to contemporary forecasts through various sources (e.g. radio, family and peer groups), and despite the decline in the use, reliability and accuracy of traditional prediction as a result of the unprecedented and anthropogenic climate variability and change (Chisadza *et al.* 2013; Orlove *et al.* 2010). Indeed, farmers' traditional forecast methods has been increasingly recognized as an important knowledge system for farm level decision-making, especially in places without meteorological stations or with limited access to meteorological forecast.

On the other hand, besides the traditional forecast knowledge, farmers also have three types of knowledge distinguished by van der Linden (2015), which are positively and significantly related to general perceptions of risk. These are knowledge about the causes of, impacts of, and responses to drought. This knowledge, which is specific to their ecosystems, socio-cultural conditions, and experience, is what shapes farmers' vivid perceptions of risk, which, in turn, also shapes their knowledge (Weber, 2006), as well as their attitudes and behaviours towards risks (Lorenzoni *et al.* 2007). These three types of farmers' knowledge are also considered in this study, as they form the basis to understand farmers' contextual adaptation process. Taking African farmers' knowledge as an example, Slegers (2008) asserted that farmers have a diverse knowledge of the causes of drought and they can distinguish drought that they perceive as human-made from those of the supernatural domain[12].

In spite of the type of knowledge of the causes, driven by their personal experience with the impacts of drought, farmers have been continuously developing procedures to deal with the impacts. Farmers have been creating diverse coping practices and production systems to minimize drought risks,

[12] Drought of supernatural domain is the one perceived as being an act of God, ancestors or spirits (Slegers, 2008).

adjusting themselves and responding to drought based on their foundations in knowledge of responses to drought (Adger *et al.* 2007; Kashima, 2010; Tompkins *et al*., 2010). Therefore, Bryan *et al.* (2009) support that knowledge constitutes the first phase of the decision-making process to adapt. Conversely, Moser (2009) argues that the fact that individuals have knowledge, practice, and perhaps capacity and resources to undertake adaptation measures does not guarantee that they will act since there are some other critical factors that may prevent or delay the implementation of adaptation actions. Some of these critical factors are described in the next sub-sections.

2.4.1.2 The Influence of experience on the perception of risks

Personal experience is regarded as the single most crucial factor influencing an individual's perception of risks (van der Linden, 2015). Indeed, a review of adaptation issues in developing countries from Adger *et al.* (2003) has concluded that much adaptation in those countries will rely on experience from the past on dealing with climate-related risks. Other scholars (Gifford, 2011; Leiserowitz, 2006; Van Paassen, 2004) have supported this strong link between experience and perception of risks by stating that those who have personally experienced the impacts of a stressor tend to have higher and more accurate perception of risks, feel risks as being more real and immediate, and thus they tend to be more concerned about risks than those who have not experienced such events. Those concerns, in turn, may help to minimise some of the cognitive barriers to action (van der Linden, 2015; Weber 2006). Studies conducted by Leiserowitz (2006) and Lorenzoni and Pidgeon (2006) in the USA demonstrated that even though individuals were aware of the scientific explanation about environmental changes, and although they considered the source of information as reliable, those who had a personal experience with a stressor tended to perceive them more emotionally and be motivated to respond compared to those who did not.

Moreover, using drought as an example, Taylor *et al.* (1988) explain the relationship between experience and perception of drought (Fig. 2.3), which are explored in this study. They explained that previous experiences of drought events shape the *memory* an individual has of the event. Memorable drought events, in turn, may increase the perception of the associated risks (Slovic *et al.* 2000). However, memory is subjective, i.e., what individuals choose to retain in or delete from their minds differs between them (Ferrier and Haque, 2003), according to their personal constructs (Mertz *et al.* 2009; Osbahr *et al.* 2011), and the way they were affected by the event. As a result of this, some may, for instance, exaggerate certain events and forget others (Slegers, 2008). Moreover, events that happened in more recent years or that were more impressionable are recalled from memory, while in intermediate years they tend to be lost (Ferrier and Haque, 2003). Previous experiences and memory of the event influence the definitions that individuals give to drought (Taylor *et al.* 1988).

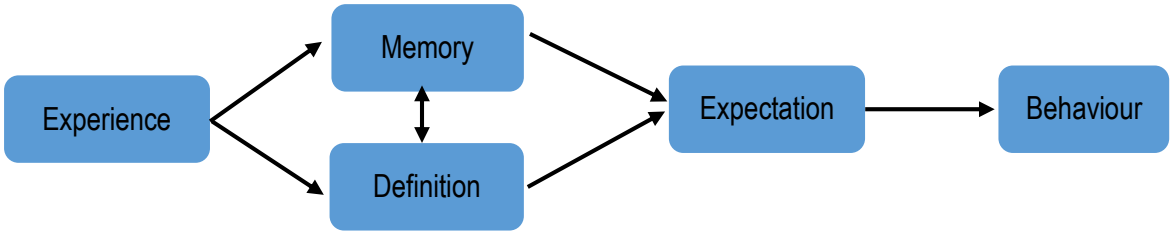

Figure 2.3: Elements shaping the perception of drought (Source: Slegers, 2008, adapted from Ajzen and Madden, 1986; Jones, 1990)

Additionally, what someone recognizes as drought depends on their environment (e.g., local climate), the drought characteristics (e.g., number of days without rain) and impacts (e.g., crop damage caused by rainfall deficiency) (Patt and Schröter, 2008). For instance, depending on the local climate (e.g., wet or dry), some people may interpret two weeks of interruption in rainfall during the rainy season as drought, while others may find it normal (Smakhtin and Schipper, 2008). On the other hand, rain-fed farmers may notice drought through the impact of the lack or deficiency of rainfall in their livelihood

activities, while farmers who have access to irrigation may only notice drought when they experience difficulties to irrigate their crops as a result of the reduction of water availability in their irrigation sources. Therefore, drought can have diverse meanings for different people, as explained previously. Furthermore, the way individuals define and remember drought influences their expectation (the belief that they will be exposed and valued things would be harmed) of future droughts. Expectations of changes also largely influence individuals' capacity to detect and interpret trends in the environments (Weber, 2010).

However, Taylor *et al.* (1988) explain that in cases when a farmer's experience restricts his or her capacity to detect changes in the environment, it may lead to an inappropriate or insufficient response to the variance. Hence, according to Traditional Economic Theory, the decisions people make are based on changes they expect in their level of well-being (Edwards-Jones, 2006). People's expectations, in turn, will shape their related behaviour (the way they act and react in a given circumstance), which, depending on their decision and alternatives, can be either reactive or pro-active (Grothmann and Patt; 2005; Sleger, 2008). Thus, behaviour is regarded as a good indicator of individuals' perception of the stressor (Slegers, 2008). Humans' explicit and implicit behaviours are also shaped by their beliefs and perceptions of changes and risks rather than by the actual patterns of the changes and risks (Adger *et al.* 2009; Mertz *et al.* 2009).

2.4.2 The influence of farmers' perceived adaptive capacity on their decision to adapt

Perceived adaptive capacity is correlated to a person's motivation to act, and their competence to execute the required action (Kroemker and Mosler, 2002). Although relatively little attention has been paid to the role of motivation in the process of adaptation, Frank *et al.* (2011) emphasize that whatever the stimulus a person experiences, any conscious decision to adapt requires motivation. Mitchell (1982, p. 81) refers to motivation as, ''the degree to which an individual wants and chooses to engage in

certain specified behaviours''. The availability of information alone is unlikely to motivate adaptation, as people may choose to not act even after receiving amplified risk-related information. They may, in fact, adjust their perceptions of risk according to their worldviews[13] (IFRC, 2014, p. 23; Patt and Schröter, 2008). Grothmann and Patt (2005) state that a person is motivated to act when there is a significant difference between what the person wants and expects to happen, as well as when the person perceives their own capacity to adapt. Usually people start to weigh the potential harm of a stressor and assess their own capability to prevent the harm when they reach a certain risk threshold; then once they perceive the risk, the negative impacts and their own capacity to adapt, they start the formulation of their possible responses to cope with or adapt to the stressor and then implement them (Frank *et al.* 2011; Maddison, 2007). Thus, motivation becomes one of those mental processes that provoke the activation and persistence of, and direct goal-oriented voluntary actions (Mitchell, 1982).

Therefore, perceived adaptive capacity is critical in determining people's motivation to undertake adaptive behaviour (Grothmann and Patt; 2005). However, the relationship between perceived capacity to adapt to risk and the resulting behaviour is not simple, direct, or linear (Slegers, 2008). As Bandura (1999) argues, people are not always aware of or believe in the scope of their objective action. Yet, there is a tendency for people to under or overestimate their ability to adapt to a stressor. If people's perceived risk and adaptive capacity is high, then strong motivation and favourable adaptive responses can be developed, as well as willingness to have an environmentally conscious behaviour (Comoe and Siegrist, 2013; Fishbein and Ajzen, 2011, p. 19). If people's perceived risk and adaptive capacity is low, then maladaptive responses and underestimation of their own adaptive capacity can happen, even though they may, in fact, have more capacity than they actually think and believe (Grothmann and Patt, 2005). Individuals' motivation can manifest itself through their attitudes by

[13] Worldview is the way individuals perceive the world, which can differ from person to person, although some align closely with one if a particular shared doctrine or beliefs dominate their perception of the world (IFRC, 2014, p. 38).

showing their level of satisfaction or dissatisfaction with certain information supplied and its sources. Individuals' motivation can also manifest through their behaviour by using the supplied information and implementing the adaptation choices (Frank *et al.* 2011). Several theories exist to explain people's motivation to act. One example is the Protection Motivation Theory developed by Rogers (1983) who postulated that people engage in adaptive actions when confronted with risks they feel as severe and vulnerable to, and by considering the possibilities of themselves managing these risks through response efficacy, cost and self-efficacy[14] (Fig. 2.4).

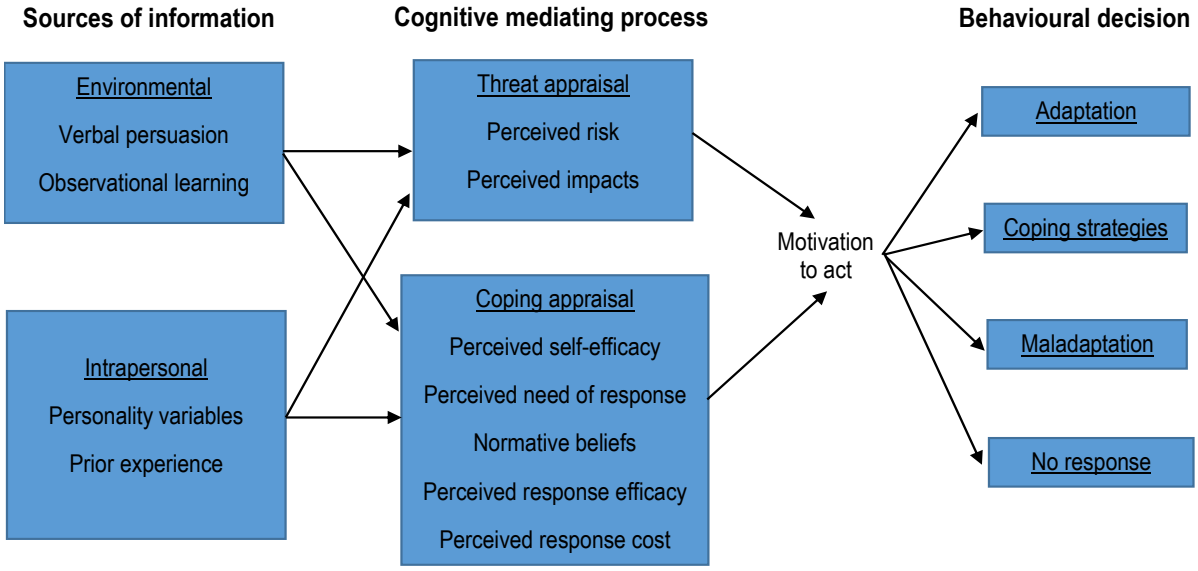

Figure 2.4: A schematic overview of Protection Motivation Theory (adapted from Prentice-Dunn and Roger, 1986 and Bubeck et al. 2018)

[14] According to Motivation Theory, much of individuals' actions can be explained through the perceived self-efficacy concept (Frank et al. 2011), defined by Bandura (1982, p. 122) as judgments of how well individuals can perform a set of actions needed to deal with prospective situations from which desired outcomes are anticipated.

In trying to uncover the environmental source of information described in the fig. 2.4, on one hand, Brown (2008) explains that individuals build up an understanding of their surrounding environment, and then make decisions about the way they should respond and behave in that environment. On the other hand, Segall *et al.* (1990, p.12) clarify that human behaviour is, "the product of learning, especially learning that comes from experience with others or with ideas, institutions, or other outcomes of others' behaviour (social stimuli), particularly others who have preceded them." Then, humans convert their learning into cognitive expressions and perform the behaviour if it is associated with any advantages, recompenses or incentives (Ajzen, 2012; Miller and Dollard, 1941, p. 2). Subsequently, through his *Social Learning Theory*, which was later labelled *Social Cognitive Theory*, Bandura (1977) explains that humans can acquire new patterns of behaviour through observational learning (when people shape their behaviour by observing significant others' behaviours); vicarious reinforcement (when people are repeatedly exposed to an observation, it can lead to a positive enhancement and hence change in their behaviour) and modelling (as mostly happens, when people's behaviours are learned, either inadvertently or deliberately, through the influence of others' that are considered example).

Notwithstanding, Muro and Jeffrey (2008) point out that not all learning based on observation and experiences leads to behavioural change. Individual's behaviour occurs in a social and cultural context (Segall *et al.* 1990, p.6) that may cause them to have limited volitional control over the behaviour in question – intrapersonal sources of information. Therefore, through his *Theory of Planned Behaviour* (Fig. 2.5), which is very relevant to the nature of this present study, Ajzen (1991) posits that an individual's intentions to execute a certain behaviour are influenced by the interaction of their attitudes towards the behaviour, subjective norms, and the perceived behavioural control. Attitudes towards the behaviour refer to the evaluation of the behaviour in question, based on social, material and psychological outcomes. Subjective norms relate to perception about the opinions and attitudes of significant people towards the behaviour of interest. Perceived behavioural control concerns

expectations about people's own capability and capacity to exert control over and execute an intended behaviour. The latter construct is equivalent to the concept of perceived self-efficacy (Ajzen, 2012), explained previously. The three factors, in turn, are a result of three kinds of beliefs: behavioural beliefs (beliefs about the probable outcomes of the intended behaviour and assessments of the outcomes), normative beliefs (beliefs about the normative expectations and actions of important referents and motivation to comply with these referents), and control beliefs (beliefs about the existence of powerful factors that may facilitate or inhibit the performance of the behaviour).

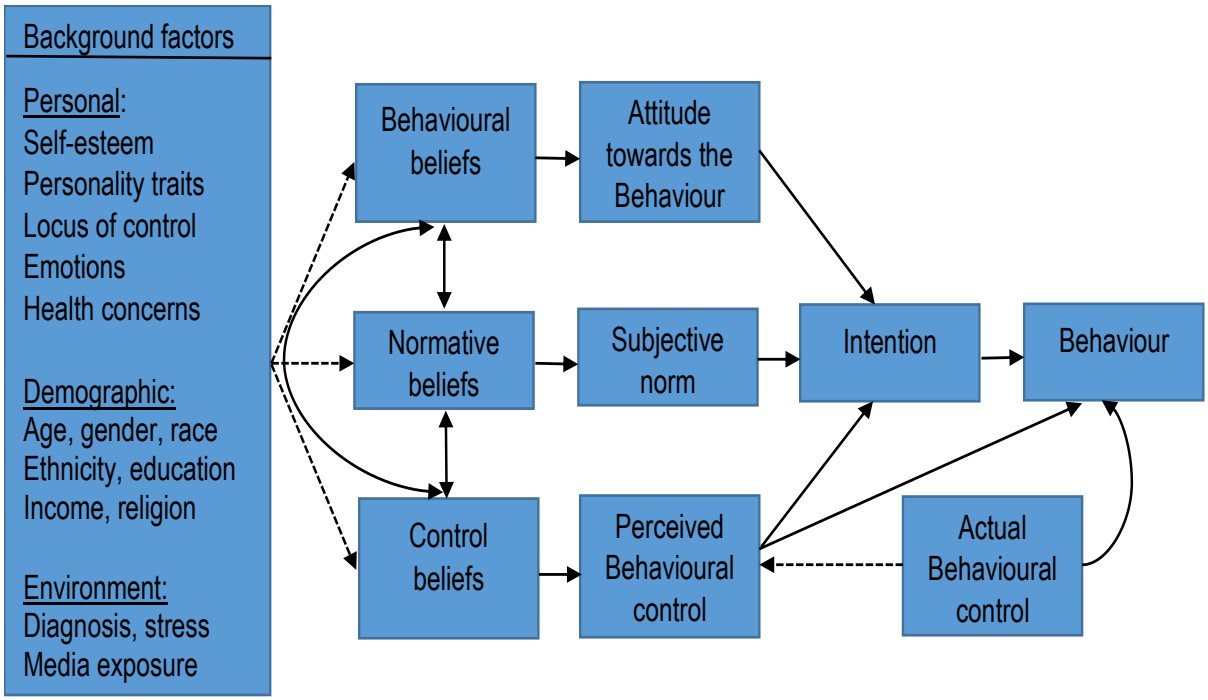

Figure 2.5: Theory of Planned Behaviour (Source: Ajzen, 1991; 2012)

Attitudes towards the behaviour, subjective norms and perceived behavioural control combined either form a positive or negative intention to perform the behaviour in question (Ajzen, 1991, 2002). Thus, intention, which encompasses the motivational factors influencing the future course of action to be executed (Bandura, 2001), is presumed to be the immediate precedent of behaviour. Intention is also deemed to indicate the extent of willingness that people have to try, or the degree of effort they would

give to execute the behaviour, and to prioritize the intended actions within their list of long-term preoccupations (Bord *et al.* 2000; Stamm *et al.* 2000). Therefore, a stronger intention is more likely to lead a person to have the willingness to try, and hence the greater will be the probability of the person to actually perform the intended behaviour (Ajzen, 1991; Ajzen and Madden, 1986).

On the other hand, some authors argue that even when people intend to act, several other factors may still influence their decision to translate their intentions into actions (Armitage and Conner, 2001; Jones and Boyd, 2011). It is generally assumed that when individuals do not believe that a particular behaviour will lead to the expected outcome, they are less likely to perform that behaviour (Bandura, 1997). Additionally, Ajzen (2012) reinforces that it is through beliefs that people obtain substantive information that they take into account in deciding whether or not to perform, a particular behaviour. Thus, individuals' beliefs, which are socio-culturally constructed, and factors influencing their beliefs have been increasingly gaining attention in adaptation and adoption studies (e.g., Carlton *et al.* 2016; Kuehne, 2014; Murphy *et al.* 2016; Vainio and Paloniemi, 2013; Wheeler *et al.* 2013). Drawing on this discussion, while at the same time acknowledging the crucial role of cultural beliefs in shaping behaviour, which forms the foundation of this study, the next sub-section explores the under-researched and often neglected role of cultural beliefs. The sub-section explores the influence of cultural beliefs in people's perceptions of their own capacity to respond to risks as well as their motivation to undertake adaptive behaviour, which has significant impacts of their adaptation.

2.5 Understanding culture and the role of cultural beliefs in adaptive actions

Culture has a myriad of significance in people's lives, since it influences the way they communicate, think, perceive, understand (Hall *et al.* 2003; Hofstede *et al.* 2010, p.4; IFRC, 2014, p.17), and give meanings to things, as well as how they experience and respond to key elements of the place and

environment which they inhabit (APA, 2003; Farmer *et al.* 2012; Haviland *et al.* 2013). Culture thus binds and distinguishes people from one another (Hofstede *et al.* 2010, p.6). These commonalities, which are transmitted and maintained from generation to generation, become people's way of life, the basis for their activities (Billington, 2001, p.159; Farmer *et al.* 2012; Hofstede *et al.* 2010, p.6), and shape their strategies to cope with their world and with one another (Hays, 1994; Hall *et al.* 2003). Culture also guides what people expect of each other, and how they make sense of each other's actions (Halloran, 2004, Hofstede *et al.* 2010, p.28; McDermott and O'Dell, 2001).

Culture is the outcome of the relationship between the social and natural environment, and supernatural forces (IFRC, 2014, p.18; Roncoli *et al.* 2009). Thus, Hoffman (2010) argues that both environmental problems and solutions are organizationally and culturally rooted. Because culture is socially constructed and expresses the characteristics of a society, culture is often used to describe some aspects that are shared and produced by people. Some examples are: Cultural aspects of risk perception; Negative culture of vulnerability; Culture of humanitarian concern; Culture of organizations/institutions and their responses; Culture of preventive actions to reduce risks; and Ways to create and maintain a 'Risk Management Culture,' a 'Safety Culture,' or an 'Adaptation Culture' (IPCC, 2012, p. 84). The meanings of these aspects are summarised in Table 2.4.

Table 2.4: Concepts used to describe culture

Concepts used to describe culture	Meaning
Cultural aspects of risk perception	As postulated in the Cultural Theory Principles, although sharing the same culture, individuals have diverse values and beliefs that shape their understanding of the world (worldviews), and consequently may define and respond to risk differently (Douglas and Wildavsky, 1983, p.1).
Negative culture of vulnerability	Constant practices that can increase vulnerability such as ignoring warning messages and choosing to stay in places of risk (IPCC, 2012, p. 308).
Culture of humanitarian concern	The practice of habitually developing initiatives to reduce the risks of and respond to stressors (IPCC, 2012, p. 348).
Culture of organizations/institutions and their responses	The mix of shared values, attitudes and patterns of behaviour that give the organisation/institution its particular character, on the basis of which the members make efforts to implement its strategies (Jasinskas *et al.* 2016).
Culture of preventive actions to reduce risks	Protective actions to minimize the impact of extreme events on themselves, their families, and their friends and neighbours (IPCC, 2012, p. 308) such as building strong houses to resist extreme climatic events.
Ways to create and maintain a 'Risk Management Culture	The creation of networks at the local level capable of performing risk assessment and mitigation (IPCC, 2012, p. 84).
Safety Culture	The ideas and beliefs that people share regarding risks and how to act safely (Glendon and Stanton, 2000).
Adaptation Culture	Capacity to constantly adapt to surprises. Flexibility is the key to learn about new surprises and choose responses actions to them (IPCC, 2012, p. 361).

As shown in Table 2.4, these aspects describe behaviour within a particular setting, which is a result of the attitude people have towards the implementation of the behaviour or the beliefs they have towards the resulting outcomes. Thus, considering the diversity of cultures globally, it is essential to understand different risk perceptions and corresponding behaviour in a cultural context (Marris *et al.* 1998). This will provide tools for identifying and understanding the contextual local community's problems and causes, their vulnerability, possible solutions, and the means of addressing them (Brennan *et al.* 2009), thus making it crucial to involve communities in the identification of these issues (Nyong *et al.* 2007). By doing so, it may encourage the communities to participate and take the leading role in the development and implementation of the adaptation strategies (Leck, 2011; Sheil *et al.* 2006). In addition, Dove (1988) argues that farmers are more likely to take part in and remain committed to efforts with which they identify, which are directly connected to and correspond to their needs, and which promote and preserve their culture (Brennan *et al.* 2009). What is more, the cultural way in which

knowledge can be socially constructed, disseminated and learned (e.g., through oral history, stories, myths, songs, lessons and arts) can be a very useful, cost-effective and successful platform for educating people in disaster risk prevention, reduction and management (Boillat and Berkes, 2013; IFRC, 2014, p. 51). Therefore, Kruger *et al.* (2015) argue that culture is the missing dimension for the success of the Disaster Risk Reduction (DRR). However, there is a need first to understand the culture of the local people that a DRR institution is revert and make the necessary adjustments to their projects in order to fit local people's culture, needs and priorities (IFRC, 2014, p. 79).

Culture also provides significance, structure and roles within society, including who makes decisions in the community and within the household and significance to groups within society (Halloran, 2004). However, in some cases, such roles limit the ability of some people to make decisions and implement certain adaptation strategies (Moser and Ekstrom, 2010). For example, women are often considered inferior to men, and their ideas are therefore often not supported, valued or respected. In addition, women often have fewer rights to resource ownership than men, which makes it even more difficult for them to carry out adaptation strategies by themselves (Adger *et al.* 2007; IFRC, 2014, p. 21). Moreover, the significance culture brings to a group, including the social capital[15] and the value the group attaches to the places they are living in (which often tend to be places that belonged to their families over generations) is what commonly stops people from moving to areas with potential to reduce their exposure to natural disasters. Thus, people have formed beliefs to explain the occurrence of natural disasters that will not require them to abandon everything but will allow them to continue living with risks (Donnelly *et al.* 2009).

[15] Social capital refers to networks, trust and reciprocity between people together with shared norms, values and understandings that facilitate coordination and co-operation within or among them, and influence their behaviour (Adger, 2003).

Most traditional African societies believe that almost everything in nature is infused with spiritual meanings that give power and significance to their actions (Golo & Yaro, 2013; Mawere, 2011, p. 40; Mbiti, 1975, p. 35). Thus, within the cultural structure, African societies see supernatural forces (e.g. God, ancestors and spirits) at the top of the hierarchy, regulating all activity in the universe, against which they cannot and should not do anything (Roncoli *et al.* 2009; Slegers, 2008). Hence, they closely associate the changes in their environments, or natural disasters, with supernatural forces believed to be manifesting their power in response to the violation of cultural, religious, moral, and social norms (Dei, 1994; Schipper, 2010).

Osbahr *et al.* (2011) and Pidgeon *et al.* (2003, p. 15) explain that for being a mental, mutable, and value-laden construct, perceptions may not reflect the actual evidence correctly and may attribute the cause of changes to wrong subjective factors (wrong perception) that socio-culturally shape their interpretation of the event. Therefore, cultural beliefs, which is the focus of this study, are presumed to precede facts in guiding individuals' mental models about how the natural universe works and have been increasingly recognized as influencing adaptation. Cultural beliefs influence the way people perceive, understand, identify and experience natural hazards and associated risks, their decisions, motivation and intrinsic behaviour to adapt, responses choices and means of implementation (IFRC, 2014, p. 40; Kahan *et al.* 2015; van der Linden; 2016; Weber, 2010). Acknowledging the crucial role of cultural beliefs in triggering the perception of risks and subsequent action, Jones (1990)'s designed a model to show this relationship between beliefs and perception that he labelled *Cultural Boundary* (Fig. 2.6).

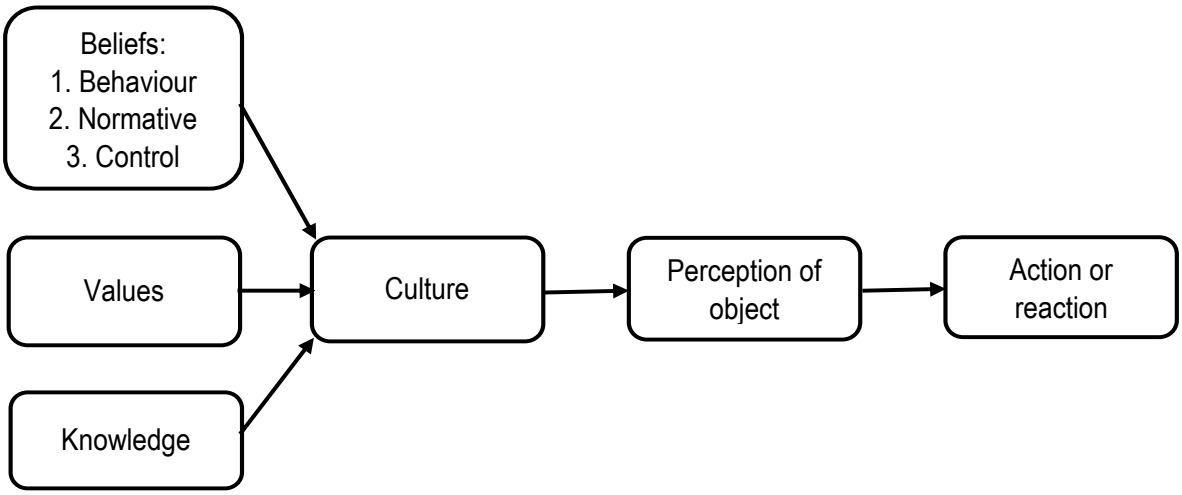

Figure 2.6: Factors influencing the formation of perception and subsequent (re)action (source: Jones, 1990).

Jones (1990) explains that values, beliefs, and knowledge-bases, which are filtered through culture, form the perception of an object. Then driven by their perception, the individual chooses, within a selection of behaviours, one or more behaviours in response (reaction) or chooses to take proactive decisions. The consistency of selection of the behaviours defines the individual's attitude towards the behaviours. All in all, the individual's response to their perception of the object is a direct result of their culture. This relationship, which is also recognised by Kahan *et al.* (2015) through their ''*Cultural Cognition Thesis*'' (CCT)[16], is particularly useful to this study as it will help to understand the role of cultural beliefs in shaping farmers' perception of drought and consequent behavioural responses.

It is argued that cultural beliefs can act as both a facilitator and inhibitor of adaptation to environmental and climate change and thus are a crucial part of any context of DRR (Adger *et al.* 2009; Jain *et al.* 2015; Wheeler *et al.* 2013). On the one hand, the social interaction and circumstances that form

[16] The CCT postulates that individuals rely extensively on cultural meanings in forming perceptions of risk (Kahan *et al.* 2015).

people's beliefs (Kahan *et al.* 2007) can act as a support system, social capital to action in times of stress (IFRC, 2014, p. 40), therefore being an indispensable 'glue' to enhance adaptive capacity (Adger, 2003). Additionally, such support systems can help people to find comfort to overcome stress, thus facilitating recovery (IFRC, 2014, p. 40). Some societies have intrinsic abilities to recover from adversities, while others have to learn how to build their resilience (Tompkins and Adger, 2004). However, the stronger the social organization is, the stronger might be the society's resilience to stresses, which is an important precondition of any sustainable response to stresses (IFRC, 2014, p. 79; Tompkins and Adger, 2004). On the other hand, the cultural belief that natural hazards are caused by supernatural forces, may lead people to have a sense of disempowerment and inaction against these forces (IFRC, 2014, p. 48; Roncolli *et al.* 2009), believing that their actions will not have any influence over the environmental conditions (Adger *et al.* 2013; Oltedal *et al.* 2004).

The misperception of the causes of natural disasters and their low perceived adaptive capacity may induce people to deny the existence of risks or make them meaningless, thus hindering their ability to make decisions and necessity to act in order to reduce risk impacts and their vulnerability (Adger *et al.* 2009; IFRC, 2014, p. 37; Persson *et al.* 2015). Thus, as humans dislike uncertainty and unknowns, guided by their beliefs, the instinct of these societies is usually to implement responses aimed to correct perceived wrongdoings, to make peace with the supernatural forces and ask for their needs, such as rainfall in case of drought (Jones, 2011). Some examples of such responses implemented in Mozambique are the performance of prayers and traditional ceremonies (Artur and Hilhorst, 2012).

Nonetheless, people's beliefs are often not taken into account and incorporated into DRR. Thus, because adaptation actions are essentially local, Adger (2010) and IFRC (2014, p. 186-87) view this neglectfulness as a barrier to social acceptability, uptake, and support of those interventions. As a consequence, it hinders the effectiveness of the strategies. Moreover, cultural beliefs may affect the

uptake of scientific evidence of changes (Shackleton *et al.* 2015). People may reject the evidence if it is not congruous with and threatens their beliefs, patterns of behaviour, and social organization and interaction, or accept the evidence if their beliefs are affirmed (Kahan, 2010; Kahan *et al.* 2015). In addition, IFRC (2014, p. 48) emphasise that, when people's beliefs about the causes of occurrence of environmental or climate change are ignored, more scientific information is unlikely to change their minds, but may reinforce their denial of the information and strengthen their commitment to faith to religion or supernatural forces.

Therefore, taking into account these diverse perspectives on the under-explored and under-estimated role of cultural beliefs in guiding farmers responses, this study intends to develop a better understanding of the power and nature of those beliefs, how they are formed, and why they are followed. This study also examines how cultural beliefs influence people's perceptions of risks, decisions to respond and the choices of decision over the other factors considered as drivers of decisions. Hence, to ease and guide the examination, the next sub-section illustrates the conceptual framework of the described factors influencing small-scale farmers' adaptation to drought and the relationships between them.

2.6 Conceptual Framework

The conceptual framework presented below (fig. 2.7), which is of my own construct, was essentially created based on information retrieved from the extensive literature related to culture, cultural dimensions of adaptation, natural hazards (especially droughts), climate change, adaptation, and related subjects. The framework intends to show the diverse factors that influence farmers' decisions to adapt to drought; the interaction among these factors, how farmers' cultural beliefs affect, and are affected by, these factors and how those beliefs also affect their adaptive behaviour and capacity. In

this framework, cultural beliefs act as the main axis that fundamentally affects all the other factors influencing farmers' adaptation. The framework is comprised of three parts: the stressor; factors that influence farmers' decisions to act; and the scale of adaptation and actors.

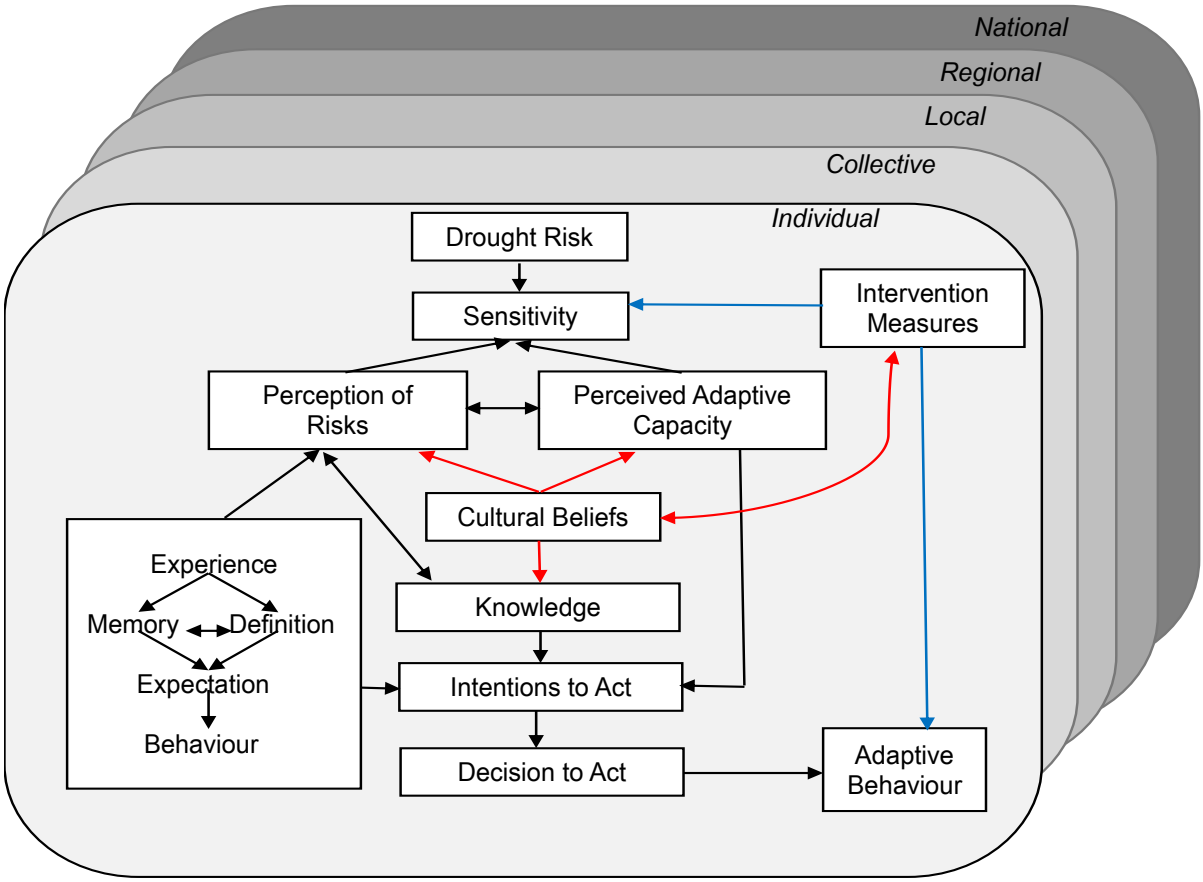

Figure 2.7: Conceptual framework of factors influencing adaptation to drought

The stressor

In order to make the conceptual framework more inclusive, clear and comprehensive, it was essential to include the stressor to which farmers have to adapt. Thus, the starting point of the framework is drought, which the study considers as a stressor due to the increasing threat and limitation to rain-fed farming activities in developing countries. Indeed, the occurrence (frequency, intensity, severity, and duration) of drought has risen over the past few decades (UNDP, 2012), and is expected to continually

increase under the current scenario of weather and climate change (World Bank, 2013). Specifically, because this study focuses on rain-fed farmers who are located in areas with a high likelihood of drought occurrence, there is a need for these farmers to adapt to drought in order to reduce their sensitivity and vulnerability to drought and increase the resilience of their livelihood systems and their resilience to cope with weather and climate uncertainty, thereby ensuring their food security. Sensitivity refers to "the degree to which farmers are adversely affected by drought stimuli" (IPCC, 2001, p. 89). There is also a need to understand farmers' decision-making process, i.e., factors influencing their decisions to adapt, because adaptation is complex and involves a set of decisions to manage or reduce potential risks of a stressor (Tompkins et al. 2010). Therefore, these factors constitute the components of the second part of the framework, which are presented next.

Factors influencing decision to adapt to drought

The second part of the framework is based on the steps involved in the adaptation process, as identified by Moser and Ekstrom (2010) and Risbey *et al.* (1999), and the limits that can arise during the decision-making process to adapt. Thus, the study considers perception of risk as the first stage, since farmers need to first perceive the existence of risk in order to start the formulation of any decision to adapt to drought. Although evidence and techinical explanation of risks may have some influence on perception of risk (Armitage and Conner, 2001), most poor rural farmers continue to have limited access to such information. Therefore, the study takes into account findings from previous research on public perception of risk (e.g., Patt and Schröter, 2008, Leiserowitz, 2006) that emphasise the role of past experiences and accumulated knowledge about the risk on people's perception.

Then, focusing on the relationship between experience and perception of drought, this study draws on Taylor's (1988) explanation of the elements shaping perception of drought (experience, memory, definition, and expectation) to look attentively to these elements that are deemed to contribute to

making drought risks feel more real and immediate. Looking at these elements can allow a place-specific timeline of the occurrence of drought events and facilitate the understanding of why the events are memorable (impacts), discern how farmers define drought and perceive trends in rainfall and risks to their activities, and the consequent behaviour. On the other hand, regarding the influence of accumulated knowledge on farmers' perceptions, the study takes into account the three types of knowledge (knowledge about the causes, impacts and responses) described by van der Linden (2015) and the socio-cultural context in which the knowledge is derived. The study also considers farmers' traditional knowledge of their environment that allows them to recognise drought and other changes in their environment, which are crucial to help them make farm-related decisions and deal with environmental stresses (Orlove *et al.* 2010).

Moreover, some authors (e.g., Grothman and Patt, 2005; Patt and Schröter, 2008) argue that before taking a decision to act, a person needs to perceive not only the existence of risk but also their own capacity to respond to risks. Thus, this study includes the influence of farmers' perceived adaptive capacity on their adaptive behaviour. Based on the way farmers perceive the drought characteristics, its severity and the adverse impacts, they will start measuring their own capacity to respond to drought effectively, and their estimation of their capacity will then add some weight on their motivation to act (Frank *et al.* 2011). Understanding farmers' worldviews and the way they perceive their own capacity to respond to drought is crucial to understand what incentivises them to engage in adaptive behaviour and to build their biophysical, economic and social resilience to better respond to drought. Nonetheless, although farmers' perception of risks and their own capacity to adapt are influenced by diverse factors, Kahan et al. (2015) explain through their Cultural Cognition Thesis that perception is value-laden. This is because individuals rely extensively on cultural meanings in forming them.

On the other hand, since according to Ajzen (1991), motivation to act is determined by intentions and decisions to act together, the study recurs to his Theory of Planned Behaviour to understand this interaction and the factors that influence the translation of decisions into actions. Despite the fact that the final decision is influenced by several factors such as financial factors, Ajzen (2012) enhances the role of cultural beliefs of the causes and appropriate responses to drought in giving substantive information that people take into consideration when taking the final decision to act. Although it is not demonstrated in the framework, within the role of cultural beliefs of appropriate responses to drought, this study also recognises the role of normative beliefs (e.g. social groups, friends and family) in shaping behavioural responses. Furthermore, even though the expected outcome is the adaptive behaviour, this study also acknowledges other outcomes that may arise from some constraints to farmers actions such as financial and cognitive capacity to adapt. Thus, the study considers a total of 4 possible outcomes, which are: adaptive behaviour, coping behaviour, maladaptive behaviour, and no response. In order to have a clearer understanding of the origin of the factors that constrain farmers' actions, the study looks at the types of adaptation implemented at different scales and actors, as discussed next.

The scale of adaptation and actors

Although small-scale farmers are the focus of this study, the study also considers the adaptation of government and NGOs. This is to take into account that decisions to adapt are not only taken at farmers' level but also at institutional level in behalf of farmers (Adger *et al.* 2003; Below *et al.* 2012). It is essential to understand the role of these actors and the outcomes of their actions in the adaptation process in order to look at the intervention measures (previously or being currently) implemented at the national, regional and local (district and community) level (fig. 2.8). At the community level, taking into account that although under the same environment, individual farmers perceive, are affected by, respond to and recover from risks differently (Douglas and Wildavsky, 1983, p.1), it is essential to

include a sub-level, individual and collective, to explore these differences. In fact, these spatial (national, regional and local level) and temporal (past and present) analogues have been increasingly used in several studies to gain more insights into adaptation processes regarding the chronology, duration, location, and extent of the exposure (IPCC, 2001).

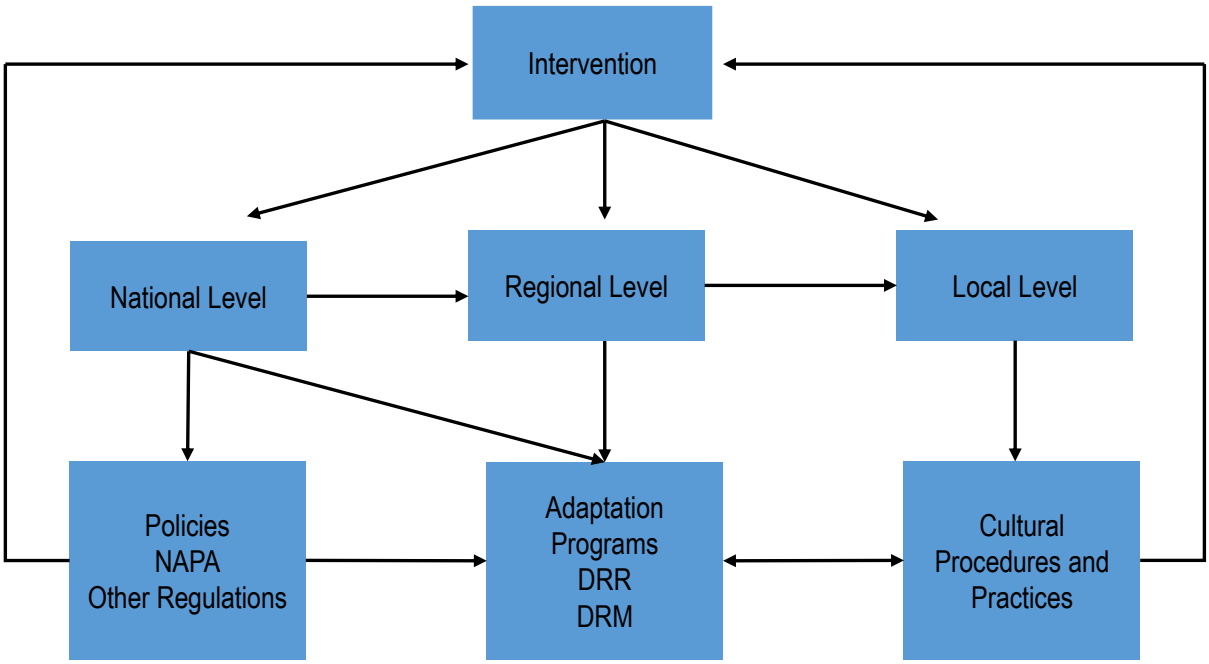

Figure 2.8: Drought interventions levels to be analysed

In order to understand how culturally-inclusive institutional adaptation strategies are, the study draws from the *Culture and Development* (C&D) discourse from Pieterse (1995), which postulates that development practices must take the politics out and be culturally specific. The use of spatial and temporal analogues can facilitate this understanding by allowing the exploration of how drought and other natural hazards are being handled in the country and the extent to which the country has a proactive vision of taking into account and including cultural dimensions in development programs, specifically adaptation program and planning and the resulting outcomes.

To do so, at national level, some relevant policies, NAPA and regulations in the country will be reviewed in order to understand the development practice approach in the country. At the regional level, the

study will explore drought intervention measures (e.g. drought adaptation programs, DRR and DRM) implemented in each region (North, South, and Centre) of Mozambique for comparative purposes. At the local level, the study will explore drought adaptation strategies being implemented at both district and communities. Specifically, at the community level, the study will explore the cultural procedures and practices being implemented by members of the communities.This can yield a clearer understanding of farmers' distinct cultural beliefs about the causes of and appropriate responses to drought, and how their beliefs and practices are affecting, and are being affected by, the implementation of technological intervention programs, and the outcomes of this interaction. For this purpose, the use of *risk management approach,* which has been increasingly recommended to assess adaptation at both national and local levels (Jones and Preston, 2011), is helpful, since it aims to identify, assess and take actions to reduce risk to an acceptable level under uncertainty. Nonetheless, taking actions is not the goal of this study, but to understand the context of adaptation to drought in Mozambique.

After highlighting in this conceptual framework the factors influencing farmers' decision to take actions and the interaction among these factors, the next chapter presents the methodology and methods employed to conduct this study.

3 Methodology

3.1 Introduction

Understanding people's culture, beliefs, behaviour, and the meanings they give to their lived experiences and associated responses is crucial to understand why people do things the way they do. This chapter describes the methodological choices made in order to undertake this study and achieve its aim and goals. It explains the approach and design of the research, selection of study sites, units of analysis, and the methods and tools used to collect data in the field. It also describes the ethical considerations taken into account, the challenges and setbacks faced during the research as well as how the data were analysed. In this chapter, a first person will be used since I am taking a reflexive position on the methodological process.

3.2 Research approach

To address the aim of this study, an interpretive framework was used. This helped to take into consideration the nature and complexity of cultural studies, as well as the epistemological[17] and ontological[18] assumptions that people interpret their world and reality based on historical and social practices (Rowlands, 2005). Interpretive framework constitutes the paradigm or beliefs and theoretical orientations that the researcher has to guide the process of research (Creswell, 2014). Specifically, the paradigm used was social constructivism, which is based on the idea that individuals by aiming to understand their world, develop varied and multiple subjective meanings[19] of their lived experiences.

[17] Epistemology concerns with the source and nature of knowledge, and the distinction between knowledge and belief (Crookes, 2012; Winch, 2002).

[18] Ontology is concerned with the distinction of different types of knowledge and their ties (relations, dependencies and predication) (Corazzon, 2018).

[19] The subjective meanings people develop are often a result of interaction with others and their specific historical and cultural norms (Creswell, 2014).

Thus, this leads the researcher to seek for a multiplicity of viewpoints rather than trying to narrow them down into small categories of viewpoints, thereby relying as much as possible on participants' points of view of the situation under study (Creswell, 2014).

This phenomenological dimension of social constructivism was crucial to enable me to understand the world and epistemological nature of small-scale farmers' beliefs and related behaviours, emotions and meanings they give to their lived experiences. Fieldwork was conducted for this purpose. According to Maxwell (2004), fieldwork can help to identify socio-cultural processes at the local level as they unfold over time and the mechanisms through which culture penetrates and changes human minds. Additionally, cultural perspectives which consist of beliefs and values that affect risk perception and environmental decision-making (Persson *et al.* 2015) were also used to explore the diversity in perceptions of the causes of drought and responses to drought across the participants. The study took into account that even when they share the same values and beliefs, participants produce their own selective view of the natural environment, which influences how they interpret and respond to risk (Douglas and Wildavsky, 1983, p.1).

The Systems Thinking approach was also essential to the study to assess the interaction between the diverse factors that affect farmers' adaptation. A system consists of a set of elements, and their interconnections (the way the elements relate to each other) and its function or purpose (Meadows, 2008, p. 11). Systems thinking involves a "set of synergistic analytic skills used to improve the capacity of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects" (Arnold and Wade, 2015, p. 675). Thus, by thinking about the factors that influence farmers' characteristics and responses to drought as a whole system rather than individual parts, it helped to identify and understand the elements of the system, and the way these elements are interconnected to each other. Then it was possible to discern the influence of the

elements of the system on farmers' behaviour and devise systemic modifications that are needed to help reducing farmers' vulnerability level and increasing their adaptive capacity and resilience.

3.3 Research design

A research design is the structure of the research, i.e., it provides specific directions for conducting the research, and involves all procedures, types of enquiry or strategies used within the approach (Creswell, 2014). It also involves all the issues faced in conducting the research, from the planning to the presentation of results (Punch, 2013) in order to address the research objectives. My previous knowledge about the country under study and past experience in working with small-scale farmers in different parts of the country contributed to the choice of design used in the research. However, aware of my positionality and the constructivist paradigm that guides this study, great efforts were made to manage my positionality to avoid affecting my role and the outcome of the research, as further explained in the Sub-section 3.8. This study used a flexible, inclusive, exploratory, and narrative-type inquiry design (Fig. 3.1). A flexible design, besides being useful for studying variables that are not quantitatively measurable (e.g., culture), it allowed me to have more freedom of revision during the data collection process (Boeije, 2009).

The study was inclusive, open to participants from different age groups, gender and education level to have a better representation of their different viewpoints. The exploratory design was crucial in helping me to have a deep understanding of the topic under study, since this kind of design is beneficial (and appropriate) to address subjects that involve a high level of uncertainty and ignorance about it, or when the topic under study is not very well understood due to, for instance, very little existing research on it (van Wyk, 2012). The exploratory design also helps to approach the topic under study from a different perspective to generate new and emerging insights (Leavy, 2017).

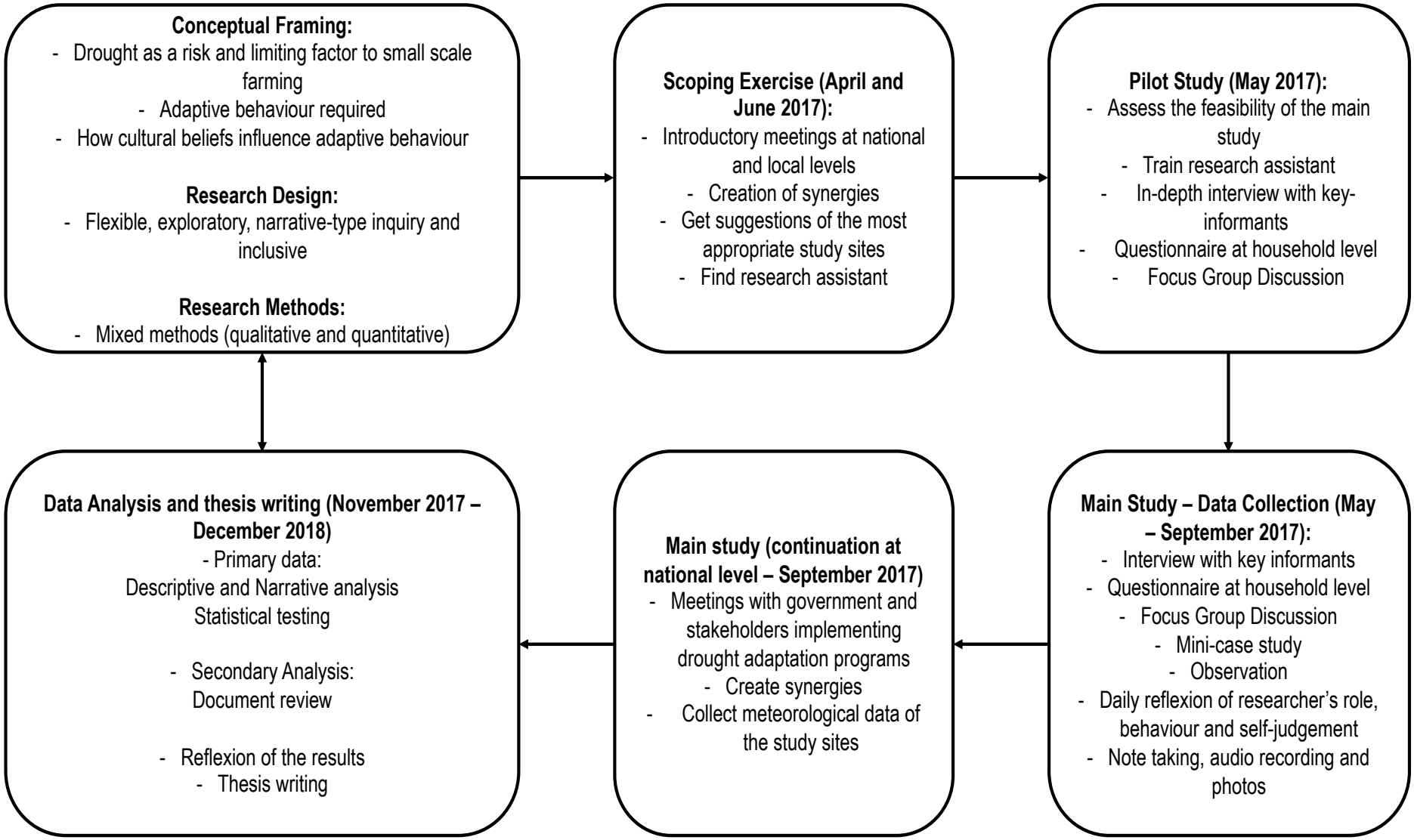

Figure 3.1: Research design and timeline (source: author construct)

The study also used narrative inquiry design, specifically narrative-type inquiry, to deeply explore life histories (narrative data) of participants' experiences with drought events and their beliefs about the causes, consequences, and solutions of droughts. This will help develop a better understanding of farmers' beliefs. Narrative-type inquiry collects as data from participants related to events, human activities, meanings of key events in their lives at individual and collective level and the cultural context in which they live. It also uses narrative analytic procedures to generate stories that are explanatory (Flick, 2007, p. 56; Hatch, 1995).

As showed in the Figure 3.1, in order to achieve the aims of the study, different methods and strategies were used during and after the fieldwork. These first consisted of the assessment of the study site and actors involved in drought-related adaptation programs, and the creation of the necessary conditions (e.g., synergies, approval and tools) for the implementation of the study. Then, the propitious conditions allowed the collection of the necessary data to explore the topic under study, which culminated with its analysis and elaboration of this thesis. These fieldwork methods and strategies used during and after the fieldwork are further discussed in Sections 3.6 and 3.8, respectively. Before delving into that, the next section provides a description of the study location.

3.4 Study location

Gaza province has an area of around 75 709 km², and a population of 1 446 654 (INE, 2017). The province is divided into eleven districts, of which eight are extremely vulnerable to drought, one is highly, and two are moderately vulnerable to drought (UNDP, 2012). Within the extremely vulnerable districts, two districts were selected for the research, which were Chibuto (Fig. 3.2) and Guija (Fig. 3.3), both located in the south-western part of Mozambique and belonging to the drainage of the Limpopo river basin, which is one of the main rivers in the country. As in the rest of the country, small-scale

subsistence farming is the main economic activity in both districts. The majority of farmers and the population in Chibuto (54.6%) and Guija (54.8%) are women (INE, 2013). This is mostly due to reasons of male labour migration to South Africa, or to other parts of the country as well as the significant number of cases of early death among men, mainly as a result of diseases such as malaria, pneumonia, diarrhoea, tuberculosis, and HIV – Aids.

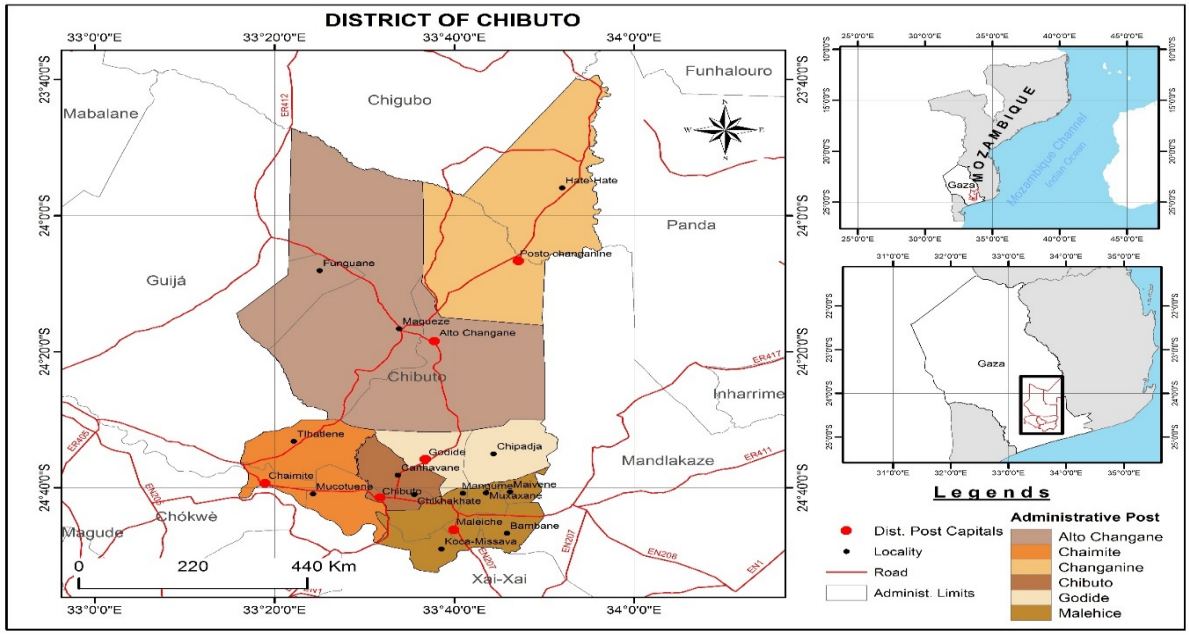

Figure 3.2: A map of Chibuto District (Source: author addition)

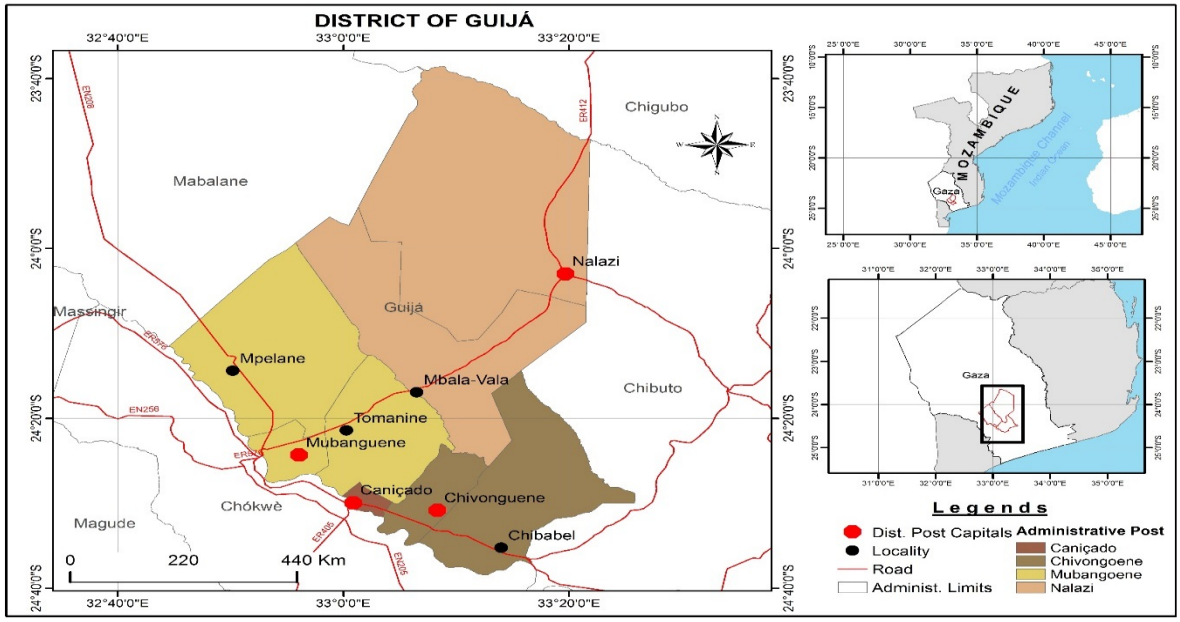

Figure 3.3: A map of Guija district (Source: author addition)

Annual rainfall in Chibuto and Guija is low and irregular, varying between 400 – 600 millimetres, making rain-fed agriculture very challenging for small-scale farmers, sometimes leading to food insecurity problems (Brito et al. 2009). Besides drought being the most frequent natural disaster, the districts are susceptible to floods and cyclones. Although these districts have a similar geographical location and total annual rainfall, they slightly differ in terms of agro-ecological conditions, the existence of meteorological stations and the number of stakeholders implementing drought-related programs (see Table 3.1). Chibuto has a tropical-arid climate and annual mean temperature of above 25^{o}C. The district has a functional meteorological station, which allowed the collection of historical meteorological data of rainfall and temperature. Besides the Government, only Red Cross is working in the district implementing climate change related-programs, including drought. Thus, there was a need to find a second study site that had more stakeholders that are implementing or have implemented drought adaption programs in order to explore the role of these programs on farmers' capacity to adapt to drought and how farmers' beliefs influence their behaviour towards the adoption of these programs. Therefore, this was one of the main reasons to selected Guija as the second study site.

Guija's climate is tropical dry semi-arid, and similar to Chibuto, the Government and Red Cross are also working in Guija with World Vision International and COSACA Consortium (composed of humanitarian organizations Concern, Oxfam, Save the Children and CARE). In addition, from 2009 – 2014, UNDP has implemented a drought adaptation program there named "Coping with drought and climate change." Involving a district which has previously benefited from a drought-related program with other that has not, aimed to compare the types of responses implemented by the districts and assess the influence of the drought-related intervention program on responses implemented by farmers in the district. In each district, two communities were selected for the study, in order to produce more robust, compelling and diverse findings. Initially, the plan was to select only one community per district; however, similarities in responses verified in the first community selected in Chibuto district showed

the need to find a second community there in order to diversify findings and avoid early data saturation. The same principle was used in the second study site, Guija. Information provided by the Government and the stakeholders during scoping exercise, interviews and informal conversations were crucial to select the communities for the study. For Chibuto district, the selected communities were Gomba and Magondzwene in Tlhatlhene Locality, Chaimite Administrative Post, and while in Guija were Mbala-Vala and Chimbembe in Nalazi and Chivonguene Administrative Posts, respectively.

Table 3.1: Characteristics of the study locations (source: author construct based on fieldwork data)

Characteristics of the study location	**Chibuto**		**Guija**	
Community	**Gomba**	**Magondzwene**	**Mbala-Vala**	**Chimbembe**
Type of climate	Tropical arid	Tropical arid	Tropical dry semi-arid	Tropical dry semi-arid
Vulnerability to drought	Extreme	Extreme	Extreme	Extreme
Total annual rainfall	400 – 600 mm	400 – 600 mm	400 – 600 mm	400 – 600 mm
Number of inhabitants	1102	1060	1140	2084
Language spoken	Xitsonga	Xitsonga	Xitsonga	Xitsonga
Most frequented church	Zion	Catholic	Zion	Assembly of God
Form of farmers' organization	Individual Small-scale rain-fed	Individual Small-scale rain-fed	Individual Small-scale rain-fed	Individual Small-scale rain-fed
Current presence of development actors	Government and Red Cross	Government and Red Cross	Government; Red Cross; Save the Children	Government; World Vision International (WVI)
Past presence of development actors	-	-	UNDP	-
Presence of food aid actors	World Food Program (WFP)	WFP	COSACA; WFP	COSACA; WFP
Existence of meteorological station	30km away (state)	10km away (private) 50km away (state)	-	-
Distance to the main town	30km (45min)	50km (60 – 70min)	40km (50min)	40km (75min)
Livelihood opportunities	-	Existence of a lake with salty water	-	-

As showed in Table 3.1, the differences between Gomba and Magondzwene communities lay in the distance to the main town and existence of a lake, which could provide an alternative form of subsistence to agriculture. Whereas, Mbala-Vala and Chimbembe, although sharing the same distance to the main town, the conditions of the road infrastructure differed, thus affecting the travel time, the availability and the cost of transport to the main town, and therefore the level of community isolation. Additionally, these communities differed in terms of the type of church frequented, which allowed to explore how the different churches influence their lives, activities and beliefs regarding the causes and responses to drought. The communities also differed regarding the past and current presence and types of Non-Governmental Organizations implementing drought-related programs.

All the above differences between these communities may lead to differences in access to opportunities such as information regarding the causes of and appropriate responses to drought, as well as inputs and improved techniques to respond to drought through the market or development programs. Therefore, they may influence the way these communities perceive, are affected by and respond to drought. In fact, Cunguara and Darnhofer (2011) found that the use of improved technologies and access to opportunities was significantly higher among rural Mozambican farmers living in communities closer to a tarred road or market. On the other hand, such proximity with a tarred road or market, and the exchange of information resulting from this proximity and access to drought-related programs may also influence farmers' culture.

Although Chibuto and Guija are in the Basin of Limpopo River, those communities have no access to the river because they are located in the interior. Thus, there is no opportunity for irrigation, forcing farmers to depend on rainfall for their farming activities, making them more vulnerable to drought. Poverty also adds an extra burden to their vulnerability situation. Additionally, access to water, including for household consumption is very limited and complicated, often forcing the inhabitants to

walk long distances or queue for hours in order to get it. Exceptionally, Magondzwene community has a lake, Bambene (fig. 3.4); however, the water is salty and is therefore, not suitable for agriculture but favours fishing. Nonetheless, the majority of the local inhabitants prefer farming instead of fishing. They only work as the fisherman helpers, pulling fishnets, when they face problems of hunger in exchange for fish or money. Fishing is usually practiced by people coming from different parts of the district. While in Mbala-Vala the periodical river was dry due the prolonged drought events. According to GDG (2012), the low rainfall level in the district makes the retention of water difficult in natural sources of water such as rivers, lakes, and streams as well as in artificial ones such as reservoirs.

Figure 3.4: Bambene Lake in Magondzwene, Chibuto (source: Author, June 2017)

3.5 Unit of analysis

As previously stated, small-scale farming remains the backbone of agriculture, food security and economic development in Africa (FAO, 2009) since small-scale farmers constitute the majority of farmers there. According to IFAD (2013), the general perception is that small-scale farmers are those who cultivate crops and rear livestock on small pieces of land, without the implementation of modern

and expensive technologies. However, what constitutes a small-scale farmer continues to be a debatable topic, since it considerably varies according to characteristics such as land size, socio-economic features, revenues, agro-ecological regions, soil conditions, and countries (OECD, 2015). In fact, the IFAD definition fails to specify the farm size, thus, furthering the debate of what would be the normal size. Nonetheless, Wiggins *et al.* (2010) ascertain that in developing countries small-scale farmers usually have farms of less than 2ha. They also ascertain that specifically in southern Africa, which Mozambique is part of, small-scale farmers have access to less than 1 ha. On the other hand, Zavale *et al.* (2005) state that the majority of farmers in Mozambique cultivate food crops in small areas with an average size of about 1.26 ha. This divergence in the farm size was also inclusive to this study since most small-scale farmers had farmland between 2 to 5 hectares. Thus, in this study, farm size was not considered as a criterion to define small-scale farmers but other conditions under which the activity is performed. Therefore, small-scale farmers were considered those farmers who cultivate crops in rain-fed conditions, and rear livestock in small areas, usually for subsistence, using manual or traditional techniques, low level of use of inputs and other modern techniques.

Within the small-scale category, the study was conducted at the household level. Since the forms and dynamics of a household can diverge in various aspects such as culture, socio-economic group, and prevalence of labour migration (Casimir and Tobi, 2011), it was also essential to define what constitutes a household. In their study about HIV infection among household members in Uganda, Bunnell *et al.* (2006, p.87) define a household as persons who share food and sleep at the same house or cluster of houses for at least five days per week for the preceding three months. Similar to the definition of small-scale farmers, it was essential to operationalize the concept of the household for the study site in order to fit their characteristics, since it was common to find households with more than one wife, each of them having their own house in the same compound. The extreme case was one of the first households visited, where a man had six wives. Hayase and Liaw (1997) stated that polygamy has always existed

and is a cultural and religious aspect. They gave the example of men in sub-Saharan Africa who are motivated to have more than one wife to provide them with several children because they represent wealth, free agricultural and domestic labour and opportunity to expand their communal land ownership. On the other hand, it was common to find members of the household, mainly men, who were absent for several months and in some cases years due to labour migration to South Africa or other parts of the southern region of Mozambique. Thus, for this study a household was considered as a group of people living in the same house or within the same compound, including the migrants' members.

Besides the composition of the household being necessary for the above definition, it was also crucial to determine the number of participants of the questionnaire within the household. The initial idea of the study was to interview both husband and wife within the household. However; because of the polygamy, and with participants' approval, it was defined that in these cases the husband and the first wife would be the ones participating in the study, since culturally the first wife is the one who makes certain decisions that are deemed to be taken by women because she is the oldest in the house. Household types were then categorized according to the composition (number of wives) and according to the gender of the head of the household (male or female responsible for the household). Male-headed households were considered as those in which a man was responsible for making decisions in the household, while female-headed households were those in which women were responsible for doing so. Emphasis was given to decision-making and not to other responsibilities such as financial, because in most cases where women had labour migrant husbands, women were financially responsible for their households in order to survive, since remittances were not received frequently. However, women usually consult their husbands before making many decisions, including financial, since culturally men are responsible for making such kind of decisions. The methods and tools used to collect data for the study are described next.

3.6 Data collection methods and tools

3.6.1 Research methods

Research methods involve the forms of data gathering tools, analysis, and interpretation proposed for the study (Creswell, 2014). This research used a mix of qualitative and quantitative methods to collect and analyse the data. Although the topic is more inductive, interpretative and explanatory in nature, which are characteristics of qualitative studies, the use of both qualitative and quantitative methods was crucial to improve, strengthen, validate and triangulate the data collected and findings through cross comparison. Bamkin *et al.* (2016) contend that for some studies the use of a single methodology does not satisfactorily answer the questions. Therefore, as a mean to gain a comprehensive understanding and to provide an illuminating description of small-scale farmers' cultural beliefs and their role on farmers' adaptation behaviour to drought and answer the research question, the use of both qualitative and quantitative methods was essential.

As stated by Bristowe *et al.* (2015), because quantitative and qualitative methods ask distinct questions about a phenomenon under study, their findings are often intersecting and complementary to the study. The use of qualitative methods was essential to understand the nature of participants' culture, beliefs and behavioural responses since it allowed a deep exploration of their diverse viewpoints regarding: i) why drought events are occurring in their community, ii) how the viewpoints were formed and their differences and similarities, iii) impacts of the viewpoints on participants' behavioural responses to drought, iv) the meaning they give to drought events and their drought-related experiences. Some scholars have emphasized the importance of qualitative methods in studying people who are less literate and have lower socio-economic class, since it gives those people a better opportunity to express themselves (Collins, 2002; Madriz, 2000; Muturi, 2005). Thus, this method was particularly useful for the study site where 32% of people are illiterate (UNESCO, 2015).

Quantitative methods are most helpful for addressing questions of where, when, for whom and how many times an event occurred, how much impact they have caused (magnitude of the event), and what is the relationship between specific variables involved (Shelton *et al.* 2014). Thus, in this study, quantitative methods, are useful to answer all these questions in the context of occurrence of drought events in the selected communities. The data gathering tools used for each method are described in the next sub-section.

3.6.2 Research tools

Multiple types of data gathering tools were used during this study. This was to achieve a much clearer, richer and holistic understanding of diverse individual and collective cultural beliefs and behaviours, as well as to obtain as much information as possible from participants. The tools included: individual questionnaires at household level from different age groups, individual interviews with key-informants, Focus Group Discussions (FGDs), 'mini' case studies, observations of participants and document review. In this study, 'mini' case studies are considered as single case studies of farmers who could provide in-depth understanding of a specific topic being studied. The questionnaires, FGD, and 'mini' case studies were conducted at the community level, and the interviews were conducted at the community, district, and national levels. Observation of participants and reviewing documents were a constant part of the process of data collection at all levels (Fig. 3.5).

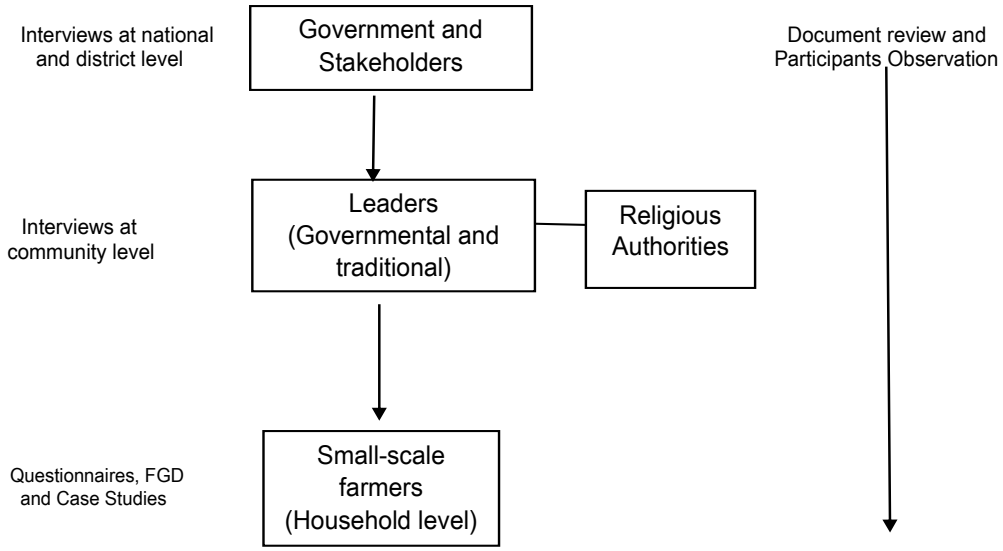

Figure 3.5: Data collection tools used in the research (source: Author's construct).

All the interviews with the local leaders, questionnaires, and FGD were conducted in the local dialect (Changana[20]) to enable respondents to feel more comfortable in talking about their points of views, beliefs and related experiences to drought events, as well as their knowledge about climate change. The interactions with participants during data collection were audio recorded to ensure the complete capture of important and useful information to the study as well as to capture the nuances of observations and descriptions made by them and avoid fragmentation of the information collected. Photos and field notes of participants' behaviours, activities, interactions and settings complemented the data collection by allowing me to capture and present a more rigorous description of the contextual situation. The implementation of the field research, which occurred from April to September 2017, comprised of three stages: a scoping exercise, a pilot study and the main study (Fig. 3.6).

[20] Changana is a dialect of the Xitsonga language, which is a southern African Bantu language spoken by the Tsonga people (Zerbian, 2007).

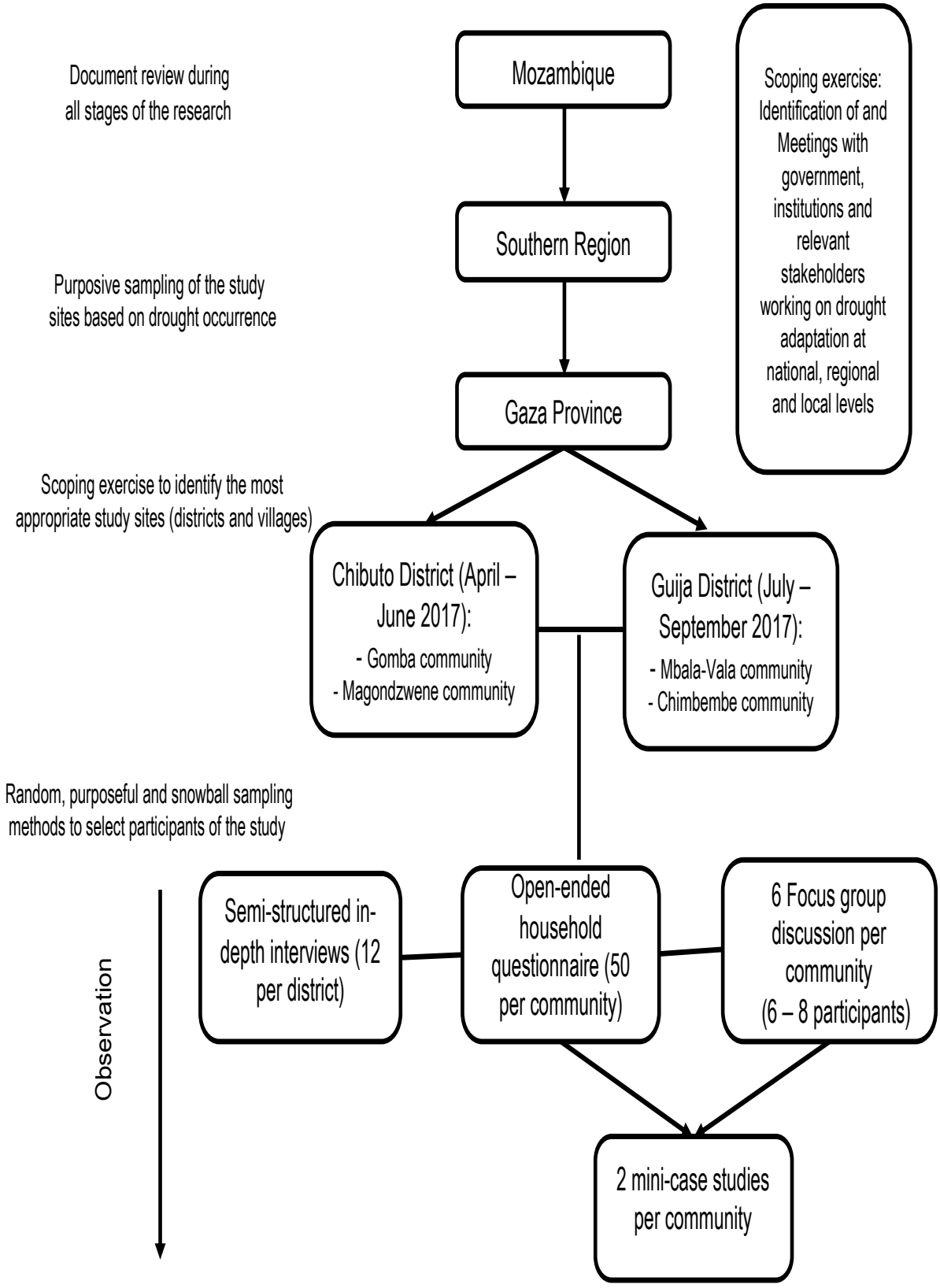

Figure 3.6: Study sampling and tools used (source: Author's construct)

3.6.2.1 The scoping exercise

The primary stage of the field research was the scoping exercise, which lasted for three weeks. The exercise was conducted at the national, local and community levels. The first two weeks of the scoping exercise occurred in April 2017 and were devoted to the exercise at the national level and to the first study location (Chibuto) at both local and community levels. The scoping exercise in the second location occurred at the end of June 2017 (in Guija). At the national and local levels, the scoping exercise involved introductory meetings with the government and NGOs, the gathering of background information of the selected districts and asking for their suggestions of the most appropriate study location within each district (administrative posts and communities). It also intended to create synergies with these actors to increase their trust and facilitate the sharing of information to yield the content of the study.

Moreover, at the local level, the scoping exercise also served as an opportunity to identify the research assistant, which also served as the translator. Although I am originally from Mozambique, I am not from the region of the selected study site. Thus, Changana is a dialect unknown to me. Additionally, because most rural people do not speak the official language of the country, which is Portuguese, I was unable to directly communicate and interact with the participants. Thus, help from a translator was needed in order to break this barrier.

At the community level, the exercise also involved introductory meetings with the local authorities (governmental and traditional[21]) and members of each community (Fig. 3.7). It also served to become more familiarized with the selected communities and institutional bodies implementing drought-related adaptation programs there. A list of the actors met during this exercise can be found in Appendix 1.

[21] Traditional authority is the leaders of the community, who is selected by the community members for being one of the descendants of the native family of the community.

Figure 3.7: Research introductory meeting in Mbala-Vala community, Guija (source: Author, July 2017)

3.6.2.2 The pilot study

The second stage of the field research consisted of two weeks' pilot study (pre-test) conducted (in Chibuto only) right after the scoping exercise. It aimed to assess the feasibility of the main study, i.e., whether or not the research methods and tools were appropriate, realistic, workable and effective for answering the research questions, and thereby making the necessary adjustments to facilitate and increase the likelihood of the study being successful. The adjustments of the tools included the adapting the wording of questions to improve ease of understanding by the research assistant/translator and thus avoid the risk of misinterpretation by him. It also included the removal of questions with similar meanings, which tended to generate similar answers.

The study also served as a trial for the research assistant and to test his ability to understand the questions, translate them to the participants and then translate participants' answers to me. Moreover, the study also reinforced the bonds created by the scoping exercise and helped to identify some problems that could arise and affect the main study. A total of two in-depth interviews, six

questionnaires at the household level and two FGDs of around eight people (one with men and another with women from 25 – 44 years old) were conducted. Participants for the study were randomly selected from a list of inhabitants provided by the leaders of the communities.

3.6.2.3 The main study

The final stage of the field research was the main study, which was conducted from May to mid-September 2017. Sixty percent of the time was spent in Chibuto and the remaining in Guija. This is because of some setbacks faced when collecting data In Chibuto, which served as lessons for the study in Guija, as further explained in the Section 3.8. After that, two weeks were spent in Maputo, the capital city of Mozambique, to conduct a few more meetings with Governmental and Non-Governmental institutional bodies. The meetings were intended to gather additional and clarifying information for the study and strengthen synergies with these institutional bodies. This period in Maputo also enabled the collection of meteorological data from the National Institute of Meteorology (INAM), as described next. The sampling of the participants and the types of data previously collected through the use of the multiple tools are also described next:

a) Rainfall and Temperature Data

Historical monthly mean rainfall and temperature data for Chibuto were obtained from INAM for the past 47 and 33 years, respectively. This was to allow the examination of changes in rainfall amount, distribution and duration (including the occurrence of dry spells and droughts) as well as changes in temperature and farming seasons. However, there were significant gaps in the data for some months within these years, and no records of temperature since 2000 and rainfall since mid-2014 (see Appendix 3). According to FAO (2012), there is a significant geographical gap in station networks around Mozambique, especially in Gaza and Tete provinces, since they are critically insufficient with

only 27 synoptic weather stations, providing coverage of only one station per 29,000km^2, thus the country has very significant amounts of missing data.

No data were obtained for Guija district since the meteorological station in the district was destroyed during independence and civil wars, making INAM obsolete from around 1975 to 2000 due to the wars. Despite the end of the wars, INAM is still very limited and poor in its capacity to adequately monitor, forecast and communicate the current weather, and analyse the trend and predict future weather scenarios (INGC, 2009). Therefore, the research appealed to some documented information of regional drought occurrence in the country from the Ministry of Land, Environment and Rural Development (MITADER, 2015) and World Meteorological Organization (WMO, n.a), which also served for Chibuto. Additionally, participants' perceptions about variabilities and changes in rainfall, temperature and farming seasons were also explored through individual questionnaires and focus group discussions and further compared with meteorological data, where applicable. Rainfall and temperature data collected from the participants was also useful to identify and explore drought events that they retained in the memory, and factors that have made those events memorable.

b) Individual interview

In each district, 12 Individual semi-structured interviews (see Appendix 4) were carried out with key-informants (Government, NGOs, some religious institutions, and community leaders) to collect diverse and richer information from these experts' sources of information. As stated by Marshall (1996) people are not equally good at observing their own and others' behaviour, or at understanding and interpreting what they have observed, thus some key-informants are 'richer,' and thereby more likely to give the researcher insights and understanding about the topic under study than others. The open-ended question format of the semi-structured interview (see Appendix 7) was helpful to guide me, avoid distraction, loss of track or focus. The key-informants were purposefully selected for the interviews.

Information collected through document reviews and during the scoping exercise was helpful to select the Governmental bodies and NGOs implementing drought-related intervention programs in the selected study sites. While the religious institutions were selected based on their popularity, i.e., the most frequented churches. Such popularity was measured based on participants' answers during the individual questionnaire.

Interviews with the Government and NGOs served to acquire more detailed information about the characteristics of the communities under study, reasons for selecting these communities for their intervention programs, activities being implemented there, factors taken in consideration for the implementation of their activities and the outcomes of these activities. Interviews with local leaders were useful to become more familiarized with the communities' culture and its complexity, the livelihoods, farming activities and issues, their perceptions, traditional beliefs about causes and responses to drought, and how they have been affected (experiences) and responded to drought over time and the effectiveness of the responses. Interviews with the most frequented local religious institutions allowed further exploration of the importance religion has in the communities' everyday lives, thoughts, actions, and activities, including beliefs about drought causes and responses.

c) Individual household questionnaire

This study took into account that a proper sample size must be used to appropriately answer the study question (Marshall, 1996). To achieve this, in each study site, 100 questionnaires (50 per community) were conducted at household level from both gender and diverse age groups (Table 3.2). The majority of participants for the questionnaire were randomly selected based on a list of inhabitants in the communities supplied by their leaders. However, in cases where the selected people, mainly men, were absent due to, for instance, labour migration issues, they were replaced by others who were purposefully selected.

Table 3.2: Socio-demographic characteristics of the participants of the study (n = 50 per community or 100 per district)

Socio-demographic Characteristics		Chibuto District (%)			Guija District (%)			Gaza Province (%)
		Gomba	Magondzwene	Total	Mbala -Vala	Chimbembe	Total	Grand Total
Gender	Male	26.0	20.0	23.0	28.0	22.0	25.0	24.0
	Female	74.0	80.0	77.0	72.0	78.0	75.0	76.0
Age group (years old)	16 – 24	0.0	6.0	3.0	12.0	0.0	6.0	4.5
	25 – 44	36.0	60.0	48.0	30.0	40.0	35.0	41.5
	Over 45	40.0	18.0	29.0	32.0	30.0	31.0	30.0
	Unknown	24.0	16.0	20.0	26.0	30.0	28.0	24.0
Education level	Illiterate	48.0	32.0	40.0	28.0	38.0	33.0	36.5
	Primary school	42.0	54.0	48.0	62.0	52.0	57.0	52.5
	Second-degree primary school	6.0	10.0	8.0	8.0	4.0	6.0	7.0
	Lower secondary school	2.0	4.0	3.0	2.0	4.0	3.0	3.0
	Unknown	2.0	0.0	1.0	0.0	2.0	1.0	1.0
Social group	None	17.0	38.0	27.8	26.5	18.0	22.2	25
	Religious	74.2	62.0	68.0	71.4	82.0	76.8	72.5
	Livestock Producers' Association	0.0	0.0	0.0	2.0	0.0	1.0	0.5
	Witchdoctors ' Association	6.4	0.0	3.1	0.0	0.0	0.0	1.5
	Xitique club*	2.1	0.0	1.0	0.0	0.0	0.0	0.5

* Xitique means savings in Tsonga. It is a sort of traditional banking system commonly practiced, in both rural and urban areas, by family members, friends, co-workers, churchgoers, and other peer groups of which people might be part. Usually, the xitique members agree on the amount of money and frequency of contribution, and one member is responsible for keeping the money. Then, on the agreed periodicity, each time a member of the group receives the total amount saved, and once everyone receives it, the cycle begins again.

The study takes into account that female and male farmers in developing countries have different levels of access to opportunities and constraints, and gender roles may thus constrain their decision making and choices regarding agricultural practices and innovations (Cardey, 2013, p. 18 - 19). Thus, as

previously explained, where it was possible, within the household, both husband and wife participated in the questionnaire. This arrangement was intended to better explore both the husband and wife's diverse beliefs, feelings, attitudes, and behaviours towards drought impacts and responses, as well as to evoke intra-household and gender similarities and differences. However, besides the absence of men, the significant number of widows aggravated the already registered prevalence of women in Gaza province, thereby affecting the gender balance goal of the study. For this reason, 76% of the participants were women.

As shown in Table 3.2., to answer the study questions, the questionnaire collected detailed information about participants' demographic structure, education level and livelihood strategies. The questionnaire also collected information regarding land tenure and assets, farming practices, roles of the members of the household and philosophy behind the assignment of the roles and how the roles influence their attitudes and behaviours towards drought impacts and responses. It also explored farming limitations, and the natural[22], the physical[23], social capital, and livelihoods network[24] (see the example of the questionnaire guide in Appendix 5). A free-listing technique was used to list participants' answers on the most relevant issues related to perceptions and observations of drought causes, climate and environmental changes, and responses, and to further quantify the relative importance that participants gave on their answers. This exploratory technique aimed to obtain a list of items within a cultural domain and to determine their prominence and relative importance (Weller, 1998) and assumed that

[22] Natural capital accounts for the stocks of natural assets, such as land, soil, water, which makes human life possible by providing goods and services that satisfy their needs (WFNC, n. a.).

[23] Physical capital refers to a factor of production that can be used to produce goods and services, such as labour, cultivation tools, inputs and machinery (Lewis, 2018).

[24] A livelihood network concerns with the "spatially extended social contacts that a household utilized to provide information, guidance, support, and material help in making a living or dealing with adversity (Chimhowu and Hulme, 2006 p. 730)."

the items which are mentioned first and more frequently by the participants tend to be more prominent in their cultural domain (Campos *et al.* 2014).

d) Focus Group Discussions

The study also used Focus Group Discussions (FGDs) to complement the information collected through individual interviews and questionnaires, and further explore participants' culture, beliefs, and related experiences, for a better understanding and to increase knowledge (see the FGD guide in Appendix 6). Indeed, Shelton *et al.* (2014) affirmed that FGDs are appropriate for exploring cultural issues within a specific community, as the group interaction provides additional related-information. A combination of random and snowball sampling strategy was used to select the FGD participants. For the snowball sampling, the help of the community' members was crucial to select other participants they considered knowledgeable in the subject, and to replace the absent members' selected randomly. In fact, snowball sampling is the most used sampling strategy in qualitative research in many social science disciplines, on some occasions, it is the main and most effective mechanism through which informants are selected. It is also employed as a complementary means to help researchers to enrich sampling clusters, and approach new or hidden (e.g., elders) participants and groups of people when other means of obtaining information have dried up or are not feasible (Warren & Levy, 1991).

In each community, six FGDs of around 6 – 8 participants (Fig. 3.8) were formed according to their gender (male and female) and age group (3 age groups per gender: 16 – 24; 25 – 44; > 45), except for Gomba in Chibuto where, due to the reduced number of elders, there were two female groups of 45 years old, each comprised of 4 participants. This small number of participants in each group helped the interaction with and collaboration of and between participants, the management of the discussion, gathering of information, to give more attention to each participant and to their responses. It also helped to make the participants feel comfortable to talk frankly about their own beliefs, experiences and

perspectives and to ensure that everyone participated in the discussion and that the research questions were answered. As Kitzinger (1995) states, small group interaction and discussion between participants allow reciprocation, exploration, and elaboration of ideas, and therefore generate data and insights that would not be easily obtained without the group discussion and reciprocation.

Figure 3.8: Focus Group Discussion: left: women from 25 – 44 years and right: men over 45 years (source: Author, May and June 2017)

Additionally, the gender and age differentiation allowed me to explore in-depth similarities and differences in perceptions, knowledge, and beliefs about environmental and climate change risks. The gender and age differentiation also allowed to compare perceptions of drought causes, impacts and solutions, and associated experiences/life stories and practices to adapt to drought between and within them, and factors driving their perceptions and beliefs and their effects on the decision-making process to respond to drought.

The group discussions also served to explore how participants' beliefs, behaviours, and practices have changed in order to adapt and respond to drought. Moreover because of some cultural issues that sometimes do not allow women to comfortably talk in front of their husbands or other men unless they are given permission, bringing people from the same gender and age group allowed them to feel less constrained to talk in front of each other, made the discussion a bit more fruitful and generated more data to the research. Moreover, the discussion explored participants' levels of scientific knowledge about climate change, causes of drought, as well as the level of implementation of and feelings/opinions about technological strategies to drought being locally implemented and the corresponding outcomes. In addition, as previously mentioned, participants' perceptions about variabilities and changes in rainfall, temperature, and farming seasons were also explored. A free-list technique was also used on the FGDs.

e) Observation

Observation is the more common method in a case study (Gillham, 2000, p. 47). It involves the emersion, systematic examination and field notes of settings and events. This includes participants' dialogue and interactions that are used to understand the phenomenon under study and the meanings participants attach to actions and events. Observation achieves this to an extent that would not be entirely possible through the insights of others gained solely during interviews (Bristowe *et al.* 2015; Shelton *et al.* 2014). Therefore, Gillham (2000, p. 45) argues that observation has three main components: "watching what people do; listening to what they say and sometimes asking them clarifying questions." Thus, observation is useful to mitigate differences between what people say and what people may actually do, which is one of the primary limitations of the interview (Patton, 1980; Shelton *et al.* 2014). Bearing this in mind, participants of the study were observed daily, and notes were taken in a field diary about their actions, conversation, behaviour, and activities, including visits to their fields. Unfortunately, it was not possible to observe the practice of traditional ceremonies or

prayers to ask for the rain since they were performed a few months before the beginning of study when drought was occurring. Thus, only verbal explanations about how and why they perform the ceremonies were obtained. However, I had the opportunity to witness food aid distribution from WFP in Magondzwene, Chibuto (fig. 3.9), which served to explore further the types and quantity of food aid, modes and frequency of distribution and participants' related-viewpoints.

Figure 3.9: WFP Food aid distribution in Magondzwene, Chibuto (source: Author, June 2017)

I also had the opportunity to visit some fields in Mbala-Vala, Guija, where the government is promoting the production of vegetables, multiplying sweet potato slips and constructing water reservoirs (see photos in Appendix 2). The production of vegetables is a national five-year program (2014 – 2019) aiming to help increase farmers' food and nutritional security, and income, and in long-term reduce the country's high level of importation of vegetables from South Africa. The multiplication of sweet potato slips intends to distribute to the population as a way to incentivise them to continue cultivating this crop after the end of the last drought occurring in the country (2014 – 2016). The water reservoirs were being constructed to reduce the impacts of the lack of water for both people and animals as a result of drought

f) Data collected through 'mini' case studies.

A case study is a conventional study designed to understand with greater clarity individual or collective issues being studied (Stake, 2008). In each community, two rich-cases (the ones from which it was possible to learn the most) were selected for further studies in order to gain more insights and in-depth understanding about some of the information given by participants related to their perceptions and beliefs about the causes, consequences and solutions to drought, as well as associated experiences. Information-rich cases are crucial to answer the research questions since they yield in-depth insights of a phenomenon under study (Patton, 2002). In order to capture significant variations in responses and ease comparisons, participants for the case studies were selected from the different categories of beliefs (traditional and religious) of causes and responses to drought, and possession of assets (e.g. cattle and family members) or financial resources that could help to respond to drought. This selection also allowed in depth exploration of these diverse beliefs and the differences and similarities in responses and levels of vulnerability between people with more and less assets or financial resources. Participants' decision-making processes and behavioural intentions to take actions and responses to adapt to drought were also explored in order to understand the correlations between assets, financial resources and responses to drought.

g) Data collected through documents review

Some official and unpublished documents, reports from the government (e.g. National Adaptation Programme of Action, National Disaster Management Law; National Climate Change Strategy), development actors (e.g., Red Cross, UNDP, World Bank, WVI), journal articles written by other researchers, online newspapers, handbooks and field reports about the areas under study were reviewed before, during and after the fieldwork. The most insightful documents for the study were further analysed. The complete list of documents can be found in Appendix 8. This analysis yielded

the background information about the study sites (overview of the history, characteristics, nature, and demography of the area), activities being implemented there and the outcome of these activities.

3.7 Ethical considerations

Ethics are invaluable to an interview process, and ethical issues go through the entire research process; thus, potential ethical issues should be considered from the very beginning of research to the end of the report (Kvale and Brinkmann, 2009). Therefore, bearing in mind about some ethical issues that the study could raise, efforts were made to ensure that the implementation of the study in the selected location was accepted and the aims and objectives known by everyone. Firstly, to ensure that it would comply with the University of Reading good practice, legal, ethical requirements and other applied guidelines in research, an ethical clearance of the study was requested from and granted by the University Research Ethics Committee. Then, I made sure that the selected participants were voluntarily participating in the study, that they were aware that they could discontinue their participation from the research at any time if they wished so and that the study was not using information in a way that could directly or indirectly affect them adversely. For this purpose, an information and consent sheet was provided to all participants of the study (see Appendix 5).

Moreover, all participants were informed that their participation was anonymous, and to further maintain their privacy and anonymity, the filled forms and results would be coded rather than named unless they agreed to be identified. Furthermore, to ensure data protection and confidentiality, the research data was stored on my personal computer, in a hard disc drive as well as on the university computer. In all these devices, the data was password-protected to only allow access to people who had permission to access and use them. The hard copy version was stored in a locked cupboard.

3.8 Research challenges and setbacks

Conducting field research can be very challenging since delays, frustrations, changes of plan, miscommunication and other unexpected things may occur for several reasons. This research was not an exception as challenges and setbacks were faced throughout the process; however, they served as a tool for reflection and improvement of the research outcomes, as explained in the following paragraphs:

Positionality and bias

Although I am not from any of the selected study locations, the fact that I am from the same country where the study was conducted could easily bring the sense of knowing the culture of the country of origin. This could possibly cause some positionality bias during the research that could influence the outcomes. Positionality is the stance that the researcher takes in relation to the context of the study, which can have implications on every stage of the research process (Coghlan and Brydon-Miller, 2014). Bias is a deliberate or unconscious attempt either to hide the research findings or to highlight them in a way that is not proportional to the research findings (Kumar, 2005). Having this in mind, I tried to control my positionality bias as an outsider of the communities by ensuring that participants' diverse points of view and explanations were carefully listened to and fully understood, and by not trying to verbally or symbolically judge their viewpoints or try to give my own viewpoints and influence participants' responses. What is more, since most participants were illiterate and had limited scientific knowledge about the causes, consequences, and responses to drought, I let the participants talk freely without commenting on their viewpoints and related experiences.

Additionally, because I have background in agricultural studies, food security and agrifood systems, and have worked for several years with small-scale farmers helping them improve their livelihoods, yields, and income, I made sure that no judgment and suggestion to the participants was made about

their choices of responses to drought events. This was intended to avoid the risk of pushing them to give answers that did not reflect their activities. Moreover, all research questions were designed in a way to avoid persuasive thoughts and responses. Furthermore, care was also taken to ensure that the written data reflected participants' viewpoints and explanations. Noble and Smith (2014, p. 2) stated that "the challenge for qualitative researchers is to present a cohesive representation of the data, which can be 'vast' and 'messy,' and needs to make sense of diverse viewpoints or complex issues." Thus, triangulation of the study data was extremely useful to understand the diversity of participants' viewpoints and make sense of them.

Extra care was also taken to ensure that the research assistant did not have the same or even worse positionality bias than me since he was originally from one of the regions where data were collected, and he was the person that was directly communicating with the participants through their local language. Therefore, before the beginning of the fieldwork, a training was provided to the research assistant about how to use open, non-leading questions as well as how to make comments on participants' answers that facilitated the participants to comfortably and freely develop their viewpoints and explanations. Additionally, an informal refresher training was given through daily wrap-up and reflective sessions throughout the fieldwork. These sessions were also crucial for constructive criticism of both my and the research assistant roles and behaviour during data collection.

On the other hand, because of the nature of the study, which involved asking several questions related to the way participants are affected by drought, their responses, institutional interventions and participants' viewpoints related to those interventions, participants may have perceived the study as some kind of procurement to find out their needs in order to bring institutional help to address them. They tended to cite everything they needed for their livelihoods and survival, and what they would like to have to provide them with a better lifestyle. Therefore, it was crucial to carefully explain to

participants that I was only a student undertaking the study for academic fulfilment, giving the example of the school assessments their children have to go through in order to pass.

Language barrier

Although the use of the translator made communication possible between me and the participants, it also raised some challenges such as the interpretation of the message to participants and to me. Indeed, van Nes *et al.* (2010) argue that during translation, challenges in the interpretation and representation of the meaning of the message communicated in the source language are very complex when there are differences in cultural context and inter-lingual translation is required. Thus, to ensure that the research assistant was correctly transmitting the information to participants, a training was given to him before the beginning of the fieldwork, during the pilot and main studies. Additionally, in cases when participants' answers did not match with the question asked, the question had to be reformulated and re-asked to participants in order to get a relevant answer. In the case of interpreting the message to me, this was only ensured during data processing, as further discussed in the next section.

Collaboration

Making synergies and collaborations with institutions was an essential part of this research in order to answer some of the research questions. However, getting information from some of the institutions was very difficult and sometimes unsuccessful since they often showed no willingness to Cooperate. Even though I explained to them the nature of the study and showed my credential, in most cases the argument given by the contacted people was that the institutional rules do not allow them to share information. So, perseverance was the key to overcome this barrier, as I had to persistently contact them or contact others that could help with the issue, although sometimes unsuccessfully.

Challenges were also faced to interview governmental extension officers in Guija district since during the time of the research they were in other parts of the district engaged in a vaccination prevention campaign against poultry flu. For instance, in Guija district as in the rest of the country, there is a reduced number of extension officers, only 6, each assisting at least 155 farmers and covering extensive areas such as one locality (GDG, 2012). Therefore, in cases where it was not possible to personally meet the officers, a phone conversation was arranged.

Finding participants for the Focus Group Discussion

I encountered some delays in the execution of the Focus Group Discussions (FGDs) due to the incomplete number of participants, mainly in male groups from 25 – 44 and over 45. The research design included the participation of 6 to 8 people for the FGD. However, because almost half of the selected participants did not come to the discussion, it had to be delayed several times. Understanding the reasons for their absence was a daily lesson. Some of the main reasons learned were the lack of incentive to participate in the discussions (e.g., money, food or drinks). Because of that they would prefer to go somewhere else where they could get their traditional alcoholic drink while at the same time fraternizing with their friends and neighbours. Drawing on these insights, and with the help of one of the community members, the FGDs were organized in more informal environments, such as one of the participants' backyards. By doing so, it not only ensured the realization of the FGDs but also created a more comfortable and relaxed environment to the participants.

Although it is argued that incentives encourage participation as it represents a sort of thanks, appreciation and compensation for participants' time given to the study (Head, 2009), I opted to not do so for two reasons. Firstly, it would compromise the ethical principles of free participation in the study, since participants could feel coerced to participate in order to get the incentive. Lastly, I feared that

providing incentives could affect participants' responses, leading them to give responses that did not reflect their beliefs, experiences and viewpoints but what they thought I wanted to hear.

Conversely, the FGDs were also delayed in other circumstances when participants were willing to participate because they had started consuming traditional alcoholic drink very early (around 10 AM); thus, they were not in an appropriate condition to participate. Knowing how to overcome these reasons was challenging but helpful for the second study site since I was able to avoid similar kinds of barriers and consequently did not face any delays. The strategy used in the second study sites was to set up the group discussions during the first week and not the last weeks to avoid delays, to adjust the timing to 9 AM before they started drinking. Additionally, a list of participants for each group discussion was made in the first week and shared with at least one of the group members who was responsible for reminding others about the discussion day and time.

Seasonality

This study was conducted a few months after the end of the most recent and prolonged drought (from 2014 – 2016) that farmers could remember having experienced, which provided a unique opportunity to gain a rich knowledge and clearer understanding of farmers' beliefs about the causes of and responses to drought. Despite these advantages, the fact that the study was not conducted during drought period also brought some limitations. As humans' memories of events are prone to errors (Schacter and Addis, 2007), there was therefore the possibility of participants' forgetting to share small details of their experiences, viewpoints and reasoning about drought that could make big contribution to the study. Additionally, the fact that the study coincided with the harvest season, a period of bonanza to farmers, may have contributed to some errors in their memory. In fact, this was reflected in farmers' behaviour towards timely harvest of part of their production. As commented by one the local authorities, because farmers had plenty of food, they forgot about past suffering caused by drought and were not

worried about harvesting and storing food surplus in case of occurrence of another drought. Therefore, conducting the study during a drought period would provide a different perspective of farmers' behaviour, real-time experiences, as well as more detailed viewpoints and reasoning of drought. It would also make possible to me to participate in or see the types of responses implemented by farmers themselves to deal with drought, including the formulation of reasoning about the causes of, the decision-making process and preparation to respond. Thus, I had to rely on farmers' explanations on the topic under study and some signs of the impacts caused by drought (e.g., water restrictions, food aid distribution and arid soils).

3.9 Data processing and analysis

In order to gain an adequate understanding of and strengthen the topic under study, different tools for data collection were used to triangulate[25] the findings through cross comparison. All the voice recorded data from the interviews, questionnaires and FGDs were first manually transcribed by me, then transcribed to Microsoft Word by myself and two people hired for this purpose. Since during the fieldwork I was using a translator from Changana to Portuguese, the use of transcribers intended to complement the notes I took and to ensure the full capture of participants' responses. To analyse the data, NVivo was used for qualitative content (FGDs) and SPSS (Statistical Package for Social Sciences) for quantitative content (questionnaires). The analysis of the data from interviews did not involve any statistical package since I found it practical to visualise, contextualise and interpret the data on printed transcripts.

[25] This methodological triangulation refers to the combined use of different data collection methods to allow the capture, interpretation of participants' diverse viewpoints and worldviews (Thurmond, 2001).

For qualitative analysis, a coding scheme (see an example on Appendix 9) was developed in order to ease the process of comparison, help classify, organize and categorize the data according to the similarities (agreement, partial agreement, silence, or dissonance) to analyse them. Coding consists of linking together, through code, one or more passage of text that fits a particular theme. This way enabled me to compare the variance across similarly-coded cases and with texts coded differently (Flick, 2007, p. 54). Indeed, constant comparison and contrasting are the most widely employed type of analysis for qualitative research because they are always present in humans' reasoning and in their observation of the world. It helps to discern conceptual similarities and differences between categories, and to discover, code and categorize the patterns, then do what is needed to begin delineating and writing a theory more or less inductively (Leech and Onwuegbuzie, 2007; Tesch, 1990, p.60). After the development of codes, the transcribed FGDs were transferred from Microsoft Word to NVivo, and themes were created to ease the comprehension of the data, compare and contrast them, and calculate the reference (number of evidence within the theme) and generate theory. New themes were generated as the data were analysed and new questions emerged.

For the quantitative analysis, codes were also assigned to participants' responses during the questionnaire. Then, the nominal[26] data were inserted into Excel, and later transferred to SPSS. The SPSS analysis involved descriptive statistics, specifically, cross tabulations (crosstabs – see Appendix 10) to discern the interrelation and interaction between the variables being analysed, compare and contrast them and calculate their percentages. However, since these digital tools only use partial data of the research (transcript-based analysis), this research also recurred to note-based analysis of the field notes from observation and informal conversation taken during the fieldwork, which allowed a more rigorous description of the context of the study.

[26] Nominal data are those labelled by the category they belong (Hinton *et al.* 2004).

This chapter described the approaches, design, methods and tools used to undertake the research, as well as the sampling procedure for the different types of tools used to collect data. Since conducting research involves unplanned and unexpected things, this study chapter also outlined the challenges and setbacks faced during the fieldwork, which served as a tool for reflection and improvement of the research outcomes. The data obtained were analysed using Nvivo and SPSS, which culminated with the elaboration of three findings chapters. The first findings chapter is discussed next.

4 Traditional prediction of drought under weather and climate uncertainty: assessing the challenges and opportunities for small-scale farmers in Gaza province, southern region of Mozambique

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Abstract

This paper explores the traditional indicators that small-scale farmers in Gaza province in southern Mozambique use to predict drought events on their rain-fed farms. It assesses the contextual situation regarding the accuracy and reliability of the traditional prediction methods under the current weather and conditions of climate uncertainty and variability, and the opportunities that their prediction methods can bring to reduce their current and future exposure and vulnerabilities to drought. Farmers use a total of 11 traditional environmental indicators to predict drought, either individually or combined, as required to increase their prediction certainty. However, the farmers perceive that current unpredictability, variability, and changes in weather and climate have negatively affected the interpretation, accuracy, and reliability of most of their prediction indicators, and thus their farming activities and their ability to predict and respond to drought. This, associated with the reduced number of elders in the community, is causing a decline in the diversity, and complexity of interpretation of indicators. Nonetheless, these difficulties have not impeded farmers from continuing to use their preferred prediction methods, as on some occasions they continue to be useful for their farming related decisions and are also the main, or sometimes only, source of forecast. Considering the role these methods play in farmers' activities, and the limited access to meteorological forecasts in most rural

areas of Mozambique, and the fact that the weather and climate is expected to continually change, this paper concludes that it is important to enhance the use of traditional prediction methods. However, the increase of the accuracy and reliability, and continued existence of the methods depends on the farmers' own abilities to enhance, preserve, and validate them by tailoring the traditional methods used to work with the new environmental, weather, and climatic conditions, or through the development of new methods.

4.1 Introduction

Over the generations, small-scale farmers whose livelihoods depend on rainfall have developed a detailed system for gathering and interpreting signs from the weather, the climate, and the environment in order to predict rain, to interpret its implications, and to make farm-related decisions (IPCC, 2007; Speranza *et al.* 2010). This intricate system has enabled them to become familiarized with and to recognize changes in their surrounding environment and climate (Hyland *et al.* 2016; Tschakert, 2007). They do so without a detailed understanding of the scientific factors that drive the changes or the use of recorded data for understanding weather patterns (Ramnath, 1988). The term 'traditional prediction' refers to environmental indicators that are locally used to read its signs and to then interpret the expected weather or climate conditions (Zuma-Netshiukhwi *et al.* 2013). This paper seeks to develop a comprehensive understanding of traditional methods used by farmers to predict drought, the dynamics of the methods under the current weather and conditions of climate uncertainty and variability, and the opportunities the methods can bring to reduce farmers' current and future exposure and vulnerabilities to drought.

In recent years there has occurred a resurgent interest in traditional prediction methods in relation to disaster risk reduction due to the increased number of natural hazards transforming into disasters

because of current climate change. Natural hazards turn into disasters when they destroy people's lives and livelihoods (WMO, 2018). On one hand, some scholars feel sceptical about the accuracy and reliability of traditional prediction methods under current weather and climate change and variability (Chinlampianga, 2011; Kempton *et al.* 1997, King *et al.* 2008). On the other hand, various scholars have acknowledged and emphasized the importance and use of local knowledge for weather and climate prediction (Chand et al. 2014; Roncoli et al. 2002; Speranza et al. 2010), decision making, climate change adaptation (Anik and Khan, 2012; Leonard *et al.* 2013; Ishaya and Abaje, 2008) and to complement scientific information (Green et al. 2010; Huntington et al. 2004; King et al. 2008). More recently, scholars have also stressed the need to go beyond that and to acknowledge the importance of validating and documenting this knowledge to enable it to continually exert its multiple use and benefits over generations to come (Chang'a et al. 2010; Kijazi *et al.* 2013; Lebel, 2013).

While these scholars praise the numerous advantages of local knowledge for weather and climate prediction, on the whole they do not see local knowledge as a valid system in its own right. Rather, they concentrate on highlighting it as a tool for documentation, and as a source of input to improve and validate science, which is considered the benchmark of all types of knowledge systems (Agrawal, 2002; Klenk *et al.* 2017; Kronik and Verner, 2010, p. 145). However, Huntington (2000) and Naess (2013) argued that this trivializes and diminishes local knowledge, resulting in the loss of its dynamism and obscuration of its contribution. What is more, to date these studies have mostly analysed the role of traditional prediction methods from one angle, i.e., the studies looked at the benefits or challenges of the methods without combining them in a context-specific perspective. As the role of the methods may differ from place to place according to socio-economic and bio-physical characteristics (Klenk *et al.* 2017), thus, such analysis may not reveal the real picture of the traditional prediction methods, thereby obstructing the broad understanding of the methods and leading to misinterpretation of their context-specific role. Drawing on this, this paper aims to assess both challenges and opportunities of farmers'

traditional prediction methods, taking as an example small-scale farmers living in remote areas in the southern province of Gaza in Mozambique.

To do so, the paper starts by first unpacking farmers' definitions of drought in order to obtain a clear understanding of what farmers are predicting. It shows how farmers' conceptualization of drought is driven by the impacts on their activities and well-being, and how such conceptualization differs from the one used by the National Institute for Disaster Management (INGC), and how the timing of occurrence of drought relative to farmers' activities influences their perception of drought risks. Second, it explores the diverse (traditional and meteorological) forecast methods used by farmers. Then, the paper focuses on traditional prediction methods to discuss the contextual situation regarding the accuracy and reliability of the methods under the current scenario of weather and climate variability. Here the paper shows through farmers' perceptions and viewpoints the links between the current changes in the weather, climate, and environment, and the methods their use to predict drought, and the consequences of that. It also shows how independently of the outcomes, farmers value their traditional forecast methods and use them as their primary forecast for farm-related decision making, even when they are provided with seasonal meteorological forecasts.

Following that, the paper discusses the contextual importance of enhancing, safeguarding, and validating traditional drought prediction methods for the less privileged groups of farmers who live in places where there is no location-specific meteorological station to timely monitor and communicate drought, or who have limited access to scientific forecasts, as is the case for most rural farmers in Mozambique. Although the paper recognizes the high importance of traditional prediction methods in such places for the timely prediction of drought, and other natural hazards, it also acknowledges the role of meteorological forecasting in farmers' decision-making and responses to drought. Thus, where it is possible to diffuse meteorological forecasts through local means, such as radio or local meetings,

combining both scientific and traditional methods would be crucial to strengthen the success of the forecast, and thus to reduce farmers' exposure and vulnerability. Nonetheless, findings suggest that a successful combination of forecast methods imply first the understanding of the nature of farmers' traditional methods as this will further facilitate the communication of scientific forecasts to farmers.

4.2 Perspectives on traditional prediction methods

Traditional prediction methods are important to farming communities around the world that lack, or have limited access to, scientific forecasts. Such communities commonly use a combination of biological, *celestial,* and climatic indicators to predict the weather and climate, including the behaviour of plants and animals; the strength and directions of winds; the colour of the sky; and the appearance of the clouds, the sun, and the stars (Chang'a et al. 2010; Green et al. 2010; Lefale 2010). However, the way communities observe, read, and interpret the indicators may vary according to their culture and the surrounding environment. For instance, while Mengistu (2011) found that farmers in Adiha, Ethiopia, interpret winds blowing in one direction close to the time of land preparation as a sign of drought, Santha *et al.* (2010) found that farmers in India consider windy periods which occur near to the agricultural season as a sign of good rains coming. Moreover, farmers in Tlaxcala, Mexico, reported that the inclined angle of the moon is an indication that rain will fall within five days (Eakin, 1999), whilst Tanzanian farmers view this as a sign of erratic rainfall to come (Chang'a et al. 2010). All of these are examples of farmers relying on single indicators. Yet, communities' abilities to combine multiple types of indicators is also considered valuable as the practice is believed to increase confidence in the accuracy of their predictions, and to reduce their vulnerability to weather and long-term climate change (Garay-Barayazarra and Puri, 2011; Huntington et al. 2004).

Nonetheless, despite their abilities, nowadays, farmers worldwide are increasingly exposed to unpredictable and more frequent, severe and lengthier drought events that are impacting their yields, production, food security, and livelihoods. This is the result of several interlinked climatic and non-climatic factors, such as extreme weather and climate variability, and soil type or management (IPCC, 2007; Mishra and Desai, 2006). As a result, farmers have been conducting their prediction activities in increasingly unpredictable and challenging conditions, which has affected the performance of some of the indicators routinely used to predict the weather and climate, and causing adverse consequences to farmers who are unprepared for an incorrect prediction. For this reason, the accuracy of farmers' traditional prediction methods has been questioned by some scholars (e.g., Ayal *et al.* 2015; Chinlampianga, 2011; Kempton *et al.* 1997, King et al. 2008; Orlove et al. 2010).

For instance, Ayal et al (2015) and Egeru (2012) argued that the accelerated weather and climate change and variability is causing a change in the usual behaviour and the disappearance of some plants and animals used to predict the weather. They gave examples of acacia trees and hartebeest, which are disappearing, and African teak trees, a yielding timber scientifically known as *Milicia excels,* changing their shading patterns, i.e., dropping off and growing new leaves in unusual periods of the year, and hornets nesting at the ground level instead of hollow trees. Adding to that, Lebel (2013) found that the traditional prediction knowledge holders in India claimed a reduction of 25 – 40% of the accuracy of a set of bio-indicators they have monitored. Egeru (2012) also reported Eastern Uganda farmers' perceptions of changes in wind direction and intensity as a result of climate change.

Because of this decline in the accuracy and reliability of some indicators, it is argued that farmers are no longer able to predict when the rain is going to start and when they will be able to start planting their crops, or if the rain will be good enough for the forthcoming agricultural season. Consequently, some farmers who prepare their land and plant their crops based on traditional prediction techniques are

forced to replant them due to an unexpected dry spell after the early rains (Egeru, 2012; Tambo and Abdoulaye, 2013). In most cases, farmers are forced to reschedule their activities (Chand *et al.* 2014; Chinlampianga, 2011) or choose to plant short-circle varieties to reduce the risks (Ishaya and Abaje, 2008; Orlove *et al.* 2010). Regardless of that, farmers still use and rely on their methods as, for them, the challenges they face do not mean, under the current circumstances, that their predictions are not always going to be reliable and accurate (Eakin, 1999). Indeed, even science has issues to accurately predict some parameters, such as the duration and coverage of drought (Roncoli *et al.* 2009), which in some places is aggravated by the fact that the forecasts are not location-specific (Kogan, 1997). As both traditional prediction and scientific forecast methods have uncertainties of their own, Eakin (1999) and Ebhuoma and Simatele (2017) suggested that it may lead farmers not to trust and have the willingness to use the scientific forecasts. While Roncoli *et al.* (2002) and Speranza *et al.* (2010) contend that it may, in fact, create an environment for farmers to be interested in and accept scientific forecasts to increase the confidence of the forecasts, thus reinforcing the need and importance of making scientific forecasting information accessible to farmers to minimise risks and agricultural losses.

Conversely, some studies have registered a decline in the use of traditional prediction methods due to an increase in modernization and cultural homogenization, a reduction in the number of elders using such techniques, and a lack, or poor documentation of them (Boven and Morohashi, 2002; Chang *et al.* 2010; Muyambo *et al.* 2017). Additionally, some researchers have registered a decline in the richness of, and some contradiction in, the interpretation of diverse traditional indicators by farmers (Manyanhaire, 2015; Mengistu; 2011; Santha *et al.* 2010). Notwithstanding this, Ziervogel (2001) argued that as the interpretation of environmental indicators is a part of personal knowledge and experience, inconsistencies are expected, even within the same community. This stresses the urgent need to safeguard traditional knowledge which, despite the current challenges faced, continues to be the primary source of farmers' forecasts for farm-related decisions, especially considering that access

to, and utilization of, scientific forecasting remains very limited in most rural areas (Chisadza *et al.,* 2013). Thus, although several factors might increase farmers' vulnerability to drought, Wongbusarakum & Loper (2011) contend that the lack of drought-related information and early warning systems are making farmers more vulnerable to its impact.

Therefore, there is growing recognition among researchers (e.g., Kalanda-Joshua *et al.* 2011; Green *et al.* 2010; Mahoo *et al.* 2015; Manyanhaire, 2015) of the importance of making forecasts as location-specific as possible, and some scholars have suggested combining traditional prediction and scientific forecast methods with the aim of increasing their accuracy and reliability, and thereby reducing farmers' vulnerability to weather and climate change. These scholars argue that traditional knowledge may provide an informal record of communities' observations of local changes in the environment and climate over time, thus offering useful insights to fill the paucity of scientific data about changing trends and patterns of local seasons and weather, and other phenological observations made over several generations. These local measurements will aid historical climate reconstructions that will be useful to analyse and understand the weather and climate trends, and so further increase the confidence and accuracy in the projection of possible future scenarios. Many studies explored this and found good agreement on some aspects and poor agreement on others such as rainfall trends. For instance, Ayal *et al.* 2015, Huntington *et al.* 2004 and Roncoli *et al.* 2002 agree that the local measurement may aid in the location-specific historical analysis of the trends in onset, duration, and distribution of seasonal rainfall or environmental changes. While Lebel, 2013; Mackinson, 2001 and Speranza *et al.* 2010 contend that because local measurement focus on timing, not the quantity of rainfall, it may fail in aiding the analysis of the quantification of trends in rainfall. Additionally, they argued that because local measurement uses different parameters and scales, it may be incompatible with science, thereby would make the analysis challenging. The following section builds on this discussion by exploring the relevance of traditional prediction methods in the context of Mozambique.

4.3 Study setting and methods

Mozambique provides a highly relevant context to explore the use and importance of traditional drought prediction methods by small-scale rain-fed farmers. Agriculture remains the primary economic activity of the country, practiced by approximately 80% of the population, of which 95% practice the activity under rain-fed conditions. The majority of these rain-fed farmers live in rural areas (Arndt et al. 2011; Uaiene, 2008), which continue to have limited, or no, access to scientific forecasts. Due to several years of independence (1964 - 1974) and civil war (1977 - 1992), Mozambique continues to have a highly reduced number of functional meteorological stations, so that most rural communities, including the study sites, do not have one. The country has only 27 synoptic weather stations, each station providing coverage for 29,000km^2; thus, there are significant amounts of missing data (FAO, 2012; INGC, 2009).

Moreover, the Mozambican National Meteorological Institute (INAM) is limited in its capacity to adequately monitor, forecast, and communicate the current weather and climate, or to analyse the past and present trends to help predict future drought situation, location, extent, or magnitude (INGC, 2009). The country also lacks a comprehensive system to adequately manage drought, (FAO, 2004; Muller, 2014). The fact that the country is one of the most vulnerable in the world to natural disasters and climate change, ranking third amongst the African countries, adds extra weight to the problem (Venton et al. 2013; World Bank, 2014). Thus, traditional methods to predict rainfall and timely make farm-related decisions are highly relevant and continue to be the most widely used methods in most rural communities. The selected study site, Gaza, is one of the provinces with significant geographical gaps in meteorological station coverage and is one of the most affected by drought, which occurs in seven out of every ten years (Kyle, 2003; Uaiene, 2008).

Within Gaza province, the specific study locations were the districts of Chibuto (Gomba and Magondzwene communities) and Guija (Mbala – Vala and Chimbembe communities), both located in the south-west. As in the rest of the country, small-scale rain-fed agriculture is the primary economic activity in Gaza, practiced in an average area of around one hectare. Women constitute the majority of farmers and inhabitants of the province (around 60%). The province also registers a low number of people who are over 45 years old (less than 20%) (MAE, 2005). For instance, in Gomba, Chibuto, where I had access to a more detailed list of the inhabitants, which included age, people over 45 years old constituted only 1.63% of them. These demographics are attributed to several reasons, such as labour migration to South Africa, or to other locations within the country, and early death of men between 15 to 49 years old due to HIV – Aids, and tuberculosis (Gawaya, 2008).

Agriculture is also characterized by the use of traditional cultivation techniques, such as hoe (100%), animal traction (38.2%), and low-level use of chemical fertilizers (1.6%) and pesticides (1.4%) (MINAG, 2012). The main cultivated crops are cassava, maize, and beans (butter and cowpea). Although there is considerable variation in level and distribution between and throughout the years, two typical seasons characterize the climate of the districts, regions and the country in general: a cool and dry 'winter' season from May to September (average temperatures of around 20^{o}C); and a warm and rainy 'summer' season from October or November to April, with December and January being the hottest months (with average temperatures exceeding 28 to 30^{o}C), and February the rainiest (Hulme *et al.* 2001).

However, rainfall is very low, varying between 400 – 600 millimetres per annum, and normally occurring on a series of isolated rain days and locations, barely exceeding 50 rain days per year. A mid-season dry spell often occurs during the rainy period, causing significant effects on crop yields. Therefore, agricultural activities start in November and are divided into four periods: early rains (November –

January); rains, which can be used for a second planting (February – April); harvest of the first planting (May – July); and harvest of the second planting (August – October) (Cunguara *et al.* 2011). Livestock rearing is also commonly undertaken in both districts, the main livestock being cattle and goats, followed by sheep, pigs, and poultry (chicken and ducks). Livestock is rarely used for commercial purposes unless there is a major financial need. Cattle ownership is prestigious, and some animals are used as traction or draught for farming activities, while others are consumed on special occasions, such as family visits. The main off-farm activities are the production and commercialization of wood, charcoal, traditional alcoholic drink, and artisanal fishing (GDG, 2012).

The study was conducted between April and September 2017, the first three months of which were spent in Chibuto and the remaining months in Guija. A total of 25 focus group discussions (FGDs) were conducted to explore participants' conceptualizations of drought, their memories of past drought events and why those events were memorable to them, the diverse traditional methods they use to predict drought, access to other sources of forecasting, and viewpoints of the reliability and accuracy of all forecast types accessed and used. Each FGD comprised six to eight participants and were organized according to participants' gender and age group (three age groups per gender: 16 – 24; 25 – 44; and over 45 years old). Participants were randomly selected based on a list of habitants of the communities supplied by the leaders. A snowball sampling was also used to replace the absent participants selected randomly. These groupings were intended to make the participants feel more comfortable with one another and therefore more likely to express their knowledge and viewpoints in front of each other. The FGDs were useful as they facilitated comparison between respondents of the amount and type of knowledge they have of traditional prediction methods.

Twelve interviews with key informants (community leaders, governmental bodies, and NGOs) were also conducted to explore the kinds of drought-related information that they provide to farmers and to

investigate the nature of drought adaptation strategies being carried out at the study sites and their outcomes. Additionally, the study made use of official documents and reports from the government and Non-Governmental Organizations (NGOs) journal articles, online newspapers, handbooks, and field reports related to the areas under study. All the interviews were audio recorded to ensure a complete transcript as possible of each discussion could be produced. Photos and field notes of participants' behaviours, activities, interactions, and settings complemented the data collection by allowing a more rigorous capture and subsequent description of the context of the study sites. NVivo was used to analyse the data, collected and organized through a coding scheme, to establish similarities and differences in group responses.

4.4 Farmers' drought perceptions and prediction methods

Before this section explores how farmers in the study site traditionally predict the occurrence of drought events, the current contextual situation, and relevance of their traditional prediction methods in terms of the accuracy and reliability, it is essential to understand what they identify or define as drought to further have a better understanding of what farmers are predicting. In this section, the paper draws on the empirical data to demonstrate how farmers conceptualize drought and compare it with the concept of drought adopted by the INGC. It then explores the diverse methods farmers use to forecast drought based or not on their definition, and how farmers perceive the links between the current changes in the weather, climate, and environment, and the methods their use to predict drought.

4.4.1 Farmers' conceptualization of drought

Results show that farmers define drought based on its negative impacts on their farming activities and livelihoods. Similar findings among Tanzanian and Spanish farmers were reported by Slegers (2008) Urquijo and De Stefano (2016), respectively. Based on the most cited definitions of drought by

participants, the information was combined to conceptualize drought as a lack of rain that makes rain-fed crop production difficult or impossible, dries up water sources and grass, causes thirst and hunger for people and livestock, and results in livestock death. Livestock, especially cattle, were always mentioned by farmers because of the crucial social and economic role these animals play in their lives. Clearly, what farmers actually consider drought is the lack of rain. However, the concept of agricultural drought, which is adopted by INGC, accounts for a shortfall in rainfall over an extended period that leads to sub-optimal availability of water and soil moisture for their adequate farming activities (Wilhite *et al.* 2014). Therefore, some farmers argued that they feel affected by drought when it happens before planting and not after, since following planting they can always get some production for household consumption, such as 'green leaves' from a plant known as cacana (*Momordica balsamina*). Slegers (2008) also noted similar perception among Tanzanian farmers who perceive drought as complete crop failure, not a reduced crop production due to rainfall deficiency; thus, they believe have never experienced a drought.

4.4.2 Farmers' methods used to predict drought

4.4.2.1 Access to meteorological forecasts

Only regarding the recent drought occurring in the country, have 62.5% of farmers in the study site begun to gain access to seasonal meteorological drought forecasts, although this is not location specific. Their main sources of information are through local authorities (57.6%), radio (32%), and family and friends (10.4%). The information provided concerns the possibility of drought occurrence during the season and advice about what to do to make timely preparations for the upcoming event to reduce its negative impacts. Such preparations include: storing seeds for planting when the rain starts; selling livestock; or finding other sources of income (e.g., production and sale of traditional mats, charcoal, or wood) to provide money for food. Most participants stated that they use the seasonal meteorological drought forecast because their personal experiences of diverse hazards, such as floods

and strong winds, meant they could confirm that the information provided was accurate. Additionally, they perceive local authorities as reliable because they are seen to be at the top of the hierarchy of the social structure, and thus respected and their advice followed. In fact, in their framework to diagnose barriers to adapt to the changing climate, Moser and Ekstrom (2010) argued that people give enormous consideration to the source of information provided. The perception, or evidence, that they have not been wrong in the past constitutes the basis on which to build trust, although this is something that can easily be undermined (Patt and Gwata, 2002; Tversky and Kahneman, 1974). Therefore, although some farmers have argued to the contrary, most consider the meteorological information useful for them to make timely preparations for the expected adversity.

4.4.2.2 Traditional prediction methods

All farmers in FGDs reported that their main sources of the seasonal drought forecast for farm-related decisions are their traditional prediction methods. A total of 11 traditional prediction methods were identified in the study sites (see Table 4.1) and grouped into four categories of indicators: celestial bodies (3); weather and climate (5); physical environmental (2); and biological (1). As shown in Table 4.1, the indicators serve to predict, near the rainy season, the imminent possibility of no rain during the following day or night. However, when these indicators become recurrent for long periods of time, then they become signs of possible drought for upcoming agricultural season.

Table 4.1 Small-scale farmers' short-term traditional drought prediction indicators (*n* = 25 FGD)

Category of the Indicator	Type of Indicator	Description of the interpretation of the indicator	Community which uses the indicator*	Number of references**
Celestial bodies	Moon appearance and position	When the moon rises clear, i.e., without a circle with rain or heavy cloud appearance inside it	Gomba, Mbala-Vala, Chimbembe	9
		When the moon rises the other way around, i.e., turned to the top with its back turned to the earth	Gomba, Magondzwene Mbala-Vala, Chimbembe	8
		When the full moon rises in a perpendicular or inclined position	Gomba, Magondzwene	4
		When the moon gives signs of rain, but it does not rain	Magondzwene	1
		When the moon is not surrounded by clouds during the night	Mbala-Vala	1
	Sun	When the sun is clearly visible, without clouds around or a circle that looks to have water on it	Mbala-Vala, Chimbembe	2
	Star quantity and appearance	When the stars are clear, without any cloud shadows around	Gomba	3
		When there are numerous numbers of stars in the sky	Gomba; Chimbembe	3
		When the stars are constantly moving from one place to another, are radiant, and brighten up the earth	Mbala-Vala, Chimbembe	3
		When the stars are not concentrated in the sky but dispersed	Magondzwene	1
Weather and climate	Air Temperature	When it is very hot throughout the year	Magondzwene	4
	Clouds	When there are no clouds, or the clouds are clear and dispersed in the sky during an extended period in a year, or during the season considered as rainy	Gomba, Magondzwene Mbala-Vala, Chimbembe	21
		When during the morning the clouds are dark, showing signs of rain but then they start clearing up through the day and become clear and it does not rain	Magondzwene Mbala-Vala	2
	Wind direction	When the wind blows in only one direction (e.g., West) without response (blowing) from the opposite direction (e.g., east)	Gomba, Magondzwene Mbala-Vala, Chimbembe	9
		When the wind blows in two opposite directions as if one direction was responding to the other (e.g., West and East directions)	Mbala-Vala, Chimbembe	5
		When it is windy because there is no rain with wind	Magondzwene	2

Category of the Indicator	Type of Indicator	Description of the interpretation of the indicator	Community which uses the indicator*	Number of references**
		When the wind blows in one direction and is not accompanied by thunder	Magondzwene	1
		When there is no wind	Gomba	1
		When the wind starts blowing and suddenly stops	Mbala-Vala	1
		When there is a whirlwind during the morning period	Chimbembe	1
	Thunder	When there is thunder but no rain	Magondzwene	1
	Lightning	When there is lightning but no rain	Magondzwene	1
		Where there is lightning coming from only one direction and not from two opposite directions	Magondzwene	1
Physical environmental	Dew	When there is no dew in the field early in the morning	Magondzwene	1
	Fog	When the fog disappears by 7am and not by 10am as happens during the rainy season	Magondzwene	1
Biological	Animal behaviour	When the animals are quiet, not running and playing a lot as usual	Gomba	1

* Gomba and Magonzwene are communities from Chibuto district, while Mbala-Vala and Chimbembe are from Guija district

** Number of FGDs which have given the response

The celestial body indicators farmers have been observing around the rainy season to predict drought include the moon's appearance and position (92% of the FGDs), the sun's appearance (8% of the FGDs) and the stars' appearance and quantity (44% of the FGDs). According to these farmers, the main signs from the moon of upcoming drought are: when it rises 'the other way around', i.e., turned to the top with its back turned to earth; when it rises in a perpendicular or inclined position; or, when it is clear, without a circle which gives the appearance of rain or heavy clouds. Similar findings were reported by Eakin (1999) in relation to the moon's appearance and backward position, but not concerning the inclined position. Also, signs of no rain soon include when the sun is clearly visible, without clouds around or a circle that looks to have water on it; or when the stars are numerous and radiant in the sky and brighten up the earth, or when the stars are dispersed in the sky.

Regarding weather and climate, despite farmers having mentioned using indicators such as very hot temperatures throughout the year, and the occurrence of thunder and lightning without rain, to predict drought, signs from wind (72% of the FGDs) and clouds (88% of the FGDs) were the most cited. According to these farmers, the main signs of forthcoming drought are: when there are no clouds; or when the clouds are clear and dispersed in the sky during the rainy season; or when they have been showing this behaviour over a long period during the year; or when during the morning the clouds are dark and showing signs of rain, but then they start to clear during the day until the sky becomes completely clear and no rain falls. The appearance of the clouds was also reported as being used in different parts of the world as a short-time predictor of rainfall, such as in India and Mexico (Eakin, 1999; Santha *et al.* 2010).

However, the farmers' interpretation of the signs of drought from the wind around the rainy season were contradictory within the communities. Even though, in both study locations, 36% of the FGDs argued that it is a sign of drought when the wind blows in one direction only (e.g., from the West), 20%

of farmers in FGDs in Guija district argued to the contrary. These farmers contended that the wind blowing in two opposite directions is a sign of drought. However, in Chibuto, 12% of the groups rejected both views with the justification that, independent of the direction, the fact that it is windy means drought will occur because there is no rain with wind. Nonetheless, even in other parts of the world, the interpretation of the wind is still quite diverse. Some examples are the similar findings from Mengistu (2011) of the interpretation of the wind blowing in one direction as a sign of drought, and the opposing findings from Santha *et al.* (2010). Nonetheless, much of this confusion related to the interpretation of the direction, presence, or absence of the wind as a sign of drought came from those under 45 years old.

The use of physical environmental indicators such as dew and fog to predict drought was only reported in Magondzwene community in Chibuto. According to farmers, signs of upcoming drought occur when there is no dew on the field early in the morning, or when the fog disappears by around 7am, rather than persisting until around 10am as is usual when the rainy season is approaching or underway. In fact, several times during the fieldwork I faced intense fog on the morning trips to the communities in Chibuto, and indeed it disappeared before 8am with the intensity of the sun. Despite animal behaviour being frequently reported as a biological indicator to predict the weather in different parts of Africa (e.g., Ayal *et al.* 2015; Chang *et al.* 2010; Speranza *et al.* 2010), it was not so common in the study sites, even though livestock rearing is commonplace. Only one group discussion of males over 45 years old in Gomba, Chibuto, mentioned this, explaining that they predict drought when their animals change their behaviour, becoming quieter and not running or playing as much as usual.

4.4.3 Perceptions of changes affecting drought indicators

Farmers have recognised diverse changes in their surrounding environment (trees, grass, fog, water levels, and soil) and in the weather and climate (wind, temperature, and rainfall) over the years. They also recognised that some of these changes have affected the accuracy and reliability of their predictions. For instance, 52% of the FGDs in both study locations noticed a significant reduction in the quantity of stars compared to the past and stated that this has affected their interpretation of the signs from this indicator. In the past, a reduced number of stars meant rainfall would come in a few hours, but now such a sign is almost meaningless.

A similar decline in the use of fog and dew as a sign of drought was also registered as farmers noticed that now fog does not last as long as it used to, and often it has already disappeared when they wake up due to intense heat, even during the winter. The intense heat during the evening also affected the formation of dew, as it is now barely seen in the morning and its absence is felt by the crops. Additionally, the intense heat throughout the year that has been verified in the country over the past decades has affected farmers' interpretation of hot temperatures which endure for extended periods in a year as a sign of drought. Farmers have explained that now summer periods are warmer and longer, and winters are much shorter and not so cold. Indeed, records show that since 1960 the temperature in the country has increased between 1°C to 1.6°C, which was accompanied by an increase in the number of hot days (INAM, 2013). Lastly, farmers have lost confidence in the use of the start of the rainfall as an indicator of drought as they have noticed that, nowadays, it starts late and is irregular, thus while in the past they would plant from September to December, now they no longer know the exact months they will plant. Some farmers even contend that they no longer plant during the summer season. In fact, records also indicate a later start of the rainfall season since the 60s (INGC, 2009), and inter-annual variability regarding rainfall beginning and cessation, which makes it challenging to determine the official start of the agricultural season (MICOA, 2013).

I witnessed some other reliability issues related to the clouds, during the fieldwork since there were some days that the sky was cloudy as described by participants as indicating rain in the past, but it did not rain. There were also some days where there were no signals from any traditional indicators, but it rained. However, on these occasions, the rain was of such light intensity that participants considered it only useful to dampen the dust on the roads and in their yards, not for planting. Similar reliability issues, but with the moon's position, were also found by Eakin (1999) when interviewing farmers in Tlaxcala, Mexico. Therefore, in cases when farmers fail to predict the occurrence of drought, they start observing visible signs that drought is already occurring through plant behaviour (52% of the FGDs); delays in rainfall beginning (12% of the FGDs) or reduction in water levels in the lake (8% of the FGDs). They explained that they can observe the occurrence of drought when the trees, crops, woods, and grasses start to dry up, they look brown as if they have been burned, and they lose their leaves. They can also notice that drought is already happening when they observe the stunted development of their crops and the dryness of the soils (Fig. 4.1) and perceive delays in rainfall beginning (not raining between September and December).

Figure 4.1: Stunted development of maize crops in Chibuto (left) and Guija (right)

Notwithstanding, farmers' difficulties with their prediction indicators have not impeded them from using their methods to make farm-related decisions since there are also occasions when the methods still appear to be useful to them. Even when they are provided with meteorological forecasts, and despite the trust they have in this source of information, farmers continue to value traditional prediction methods and always make use of them for confirmation of other sources. They ask the elders to use their knowledge, wisdom, complexity and diversity of forecast methods to traditionally predict the weather and to certify or deny the scientific forecasts given by the local authorities to the community. The elders' predictions are then what primarily influences farmers' motivations to use the scientific forecasts or not. One such example was found during this study when farmers explained that, although the last drought has ended recently, they became aware, through the local authorities and radio, of the possibility of occurrence of another drought in the upcoming season, and they believed in the information, and have been preparing for the event because the elders followed-up and positively confirmed it.

4.5 Discussion and conclusion

This paper uses a case study of small-scale rain-fed farmers in Gaza province in southern Mozambique to understand how farmers predict drought, and the contextual situation regarding the accuracy and reliability of the traditional prediction methods under the current weather and conditions of climate uncertainty and variability. The paper also assesses the opportunities that farmers' predictions may bring to their activities and daily lives. Due to their dependence on the natural environment for their livelihood activities, farmers often observe, monitor and use traditional indicators to predict the weather and climate. These methods have acted as important tools to help them analyse the implications of the prediction and make farm-related decisions, such as the type of crops to plant each season, when to start planting and precautionary measures to take to avoid losses or prevent hardship (Chand *et al.*

2014, Green *et al.* 2010). The methods have been fundamental in helping farmers to reduce their exposure and vulnerability to weather and environmental changes (Nyong *et al.* 2007; Roncoli *et al.* 2009).

Farmers have been using a total of 11 traditional drought prediction indicators, either individually or combined, as required to increase their prediction certainty. However, results show that the most used indicators are the moon's appearance and position (92% of the FGDs), clouds' appearance (88%), wind direction (72% of the FGDs), star quantity and appearance (44% of the FGDs) and plant behaviour (40% of the FGDs). They not only use their traditional prediction methods because of being poor and highly illiterate, as stated by Muyambo *et al.* (2017), but also because it is part of their cultural knowledge and inheritance which they believe should be passed from generation to generation. They have learned these methods from their grandparents and parents during their story-telling moments around the fire, and they also transmit them on to their descendants. Additionally, due to the very sparse or non-existent weather stations in most rural areas in the country, which makes drought monitoring and early warning a daunting task, on many occasions, farmers' traditional drought prediction methods are the main, or only, source of information for them.

Despite increased efforts by government to diffuse the regional seasonal meteorological forecasts through the local authorities or radio, farmers do not always have access to the forecasts, for which there are several reasons, e.g., non-participation in their community meetings, lack of radio ownership, or in other cases, the information is simply not transmitted to them. Even though radio constitutes the only medium through which farmers have access to information due to the lack of electrification, less than 3% of the farmers owned one. Moreover, despite the presence of NGOs in the study sites, and the existence of the INGC in the country, farmers reported they did not receive drought forecasts from them, but only information related to predictions of cyclones, floods, strong winds, and storms. They

explained that the Red Cross and INGC have even formed a committee of those specially trained to disseminate these kinds of forecasts through the use of flags, where, for instance, a blue flag means to prepare for the occurrence of heavy winds within 24 or 48 hours, a red flag means the wind will come within a few hours or is already blowing, or a yellow flag indicates heavy winds and rainfall within 24 hours. These are the same colours used by the National Meteorological Institute (INAM) as part of their cyclone alert system. Nonetheless, lessons could be taken from these mechanisms of communications to incorporate in early warning systems for drought.

Nevertheless, results show that farmers are aware of, and acknowledge, the current unpredictability, variability, and changes in weather and climate negatively affect the reading, interpretation, accuracy, and reliability of most of their prediction indicators, and thus their farming activities. Thus, like other findings (Chinlampianga, 2011; Kempton *et al.* 1997; King *et al.* 2008; Tambo and Abdoulaye, 2013), farmers now face some difficulties in their ability to predict when the rain will start, so they can start to plant their crops, or if the rain will be good enough for their agricultural season, as they did in the past. As a result of the difficulties with the predictions, on some occasions, farmers do not obtain the expected yields as unexpected dry spells occur during plant development. What is more, because of their difficulties in predicting drought, farmers explained that nowadays every raindrop represents an opportunity to plant their crops that cannot be missed, as they cannot be sure that rain will come again at another time in the year. This is the reason farmers have started planting during the winter season (April - August), not a traditional practice in their communities since by doing so they can guarantee their harvest and their families' subsistence.

Adding to that, although farmers have not recognised that some other changes in their indicators affect their prediction methods, the fact that only one FGD of over 45 years old people mentioned the use of some traditional prediction indicators, such as animal behaviour and dew, suggests a decline in the

use of these methods when compared to other indicators, which were mentioned by people from different age groups. However, it is not clear whether or not this reduction in the use of such indicators, and in their interpretations, were caused by the reduction of their accuracy or availability as, for instance, farmers continue to own livestock, although in much-reduced quantities when compared to the past. On the other hand, even though the few existing elders continue to transmit their prediction knowledge to their descendants, similar to findings from Kalanda-Joshua *et al.* (2011), a decrease was also registered in the diversity and complexity of traditional prediction methods among younger people. According to Chang'a *et al.* (2010), traditionally it has been the elderly who have the local knowledge and who subsequently pass this knowledge on to the next generations. Thus, results showed that while people older than 45 years old would give more diverse and detailed information about their reading and interpretation of signs from the celestial bodies, weather and climate, younger people's (from 16 – 24 years old) knowledge of those signs was shown to be much reduced. This latter group mostly gave examples of biological and physical environmental indicators, which were not predictions but visible signs that drought was already occurring, such as when the crops and grasses start drying up, or when water levels in the lake reduce.

The reduced number of elders and reduced knowledge and recognition of local prediction methods is threatening not only the richness and complexity but also the endurance of those methods and farmers' ability to make a timely response to drought. Ensor and Berger (2009) argued that the fact that education has become more available to younger people means that they learn what is taught at school, and their unique community knowledge is not transmitted to them. In addition, it is argued that as the younger generation spend less time in direct contact with the environment and, as agriculture is no longer their only livelihood activity, they gain a little experience in reading and interpreting drought indicators through long-term observation of their environment and climate (Speranza *et al.* 2010). In fact, most of the younger participants in the study, mainly males, had more than one livelihood activity,

and they often referred to off-farm activities as their main ones, as their wives were responsible for the on-farm activities. This responsibility was also verified among women with husbands who had migrated away for work.

Notwithstanding, as the natural climate variability associated with climate change is expected to lead to never before experienced extreme weather and climate events (IPCC, 2012), and specifically with the expected stronger influence of future El Niño events, and the increase in frequency of extreme drought in Mozambique by 2060 (INAM, n. a), farmers will increasingly require timely drought forecasts for their farming related decisions. Since the climatic projections and early-warning systems to provide better information to vulnerable people in the country are still non-satisfactory (Governo de Mocambique, 2017), farmers will continue to rely on their traditional prediction as their main, or some cases only, methods to predict drought. The fact that farmers have themselves made their own judgement about the accuracy and reliability of certain methods they use, made them more aware of the risks they may face and which type of methods they can partially or entirely rely on, such as the moon's appearance and position. Nevertheless, as the moon is only visible for part of the month this may force the farmers to revert to the use of the others available indicators, which were reported to have become less reliable. Tailored and robust traditional prediction methods would be of great benefit to farmers and for scientific research into drought adaptation.

The future of traditional prediction methods and the potential increase in their accuracy and reliability depends on the farmers' own abilities to enhance, preserve, and validate the methods by tailoring them to fit the new environmental, weather, and climatic conditions, or by the development of new methods based on that. This is because most of the traditional prediction methods they use were created by continually observing the indicators in different environmental, weather, and climatic conditions as registered today; as they have changed over years, so have the indicators (Ayal *et al.* 2015; Egeru,

2012; Speranza *et al.* 2010). Thus, the indicators should not be interpreted in the same way as they were in the past. Since farmers have a long history of adaptation to the changing environment through adjustments to their farming practices (Adger *et al.* 2013; Lebel, 2013; Nyong *et al.* 2007), their traditional prediction methods should also be part of the process to endure. Indeed, Speranza *et al.* (2010) contend that with the gradual changes that are occurring, local knowledge may not remain static as local communities may progressively identify new indicators. However, the paper acknowledges that it will take time for people to identify and share the new indicators that work under the changing conditions.

The paper emphasizes that the adjustments in the farmers' prediction methods must be accompanied by the transmission of this knowledge to the younger generations to safeguard the continued existence of their local knowledge, as they are, and will continue to be, their main source of forecast information, as well as a powerful tool for their farm-related decisions and adaptation to drought. Indeed, some studies suggest that one potential way of doing so is through its integration into the educational curricula (Slaughter, 1997; Speranza *et al.* 2010). Mozambique has already started to integrate local languages in some rural schools in the northern and central part of the country as part of a bilingual educational system which aims to improve the performance of rural children at school. They have struggled to learn in Portuguese which is the official language of the country. So, the inclusion of traditional prediction methods could follow the same pathway. By doing so, it will ensure not only the oral transmission of their knowledge to the younger generations, but also its documentation, preservation, and use by other people, either in similar conditions or who will have access to it.

Additionally, there are also off-school opportunities for the elders to transmit the local knowledge to the younger generation. However, as the younger generation is more interested in the scientific forecasts (Ayal et al. 2015), to ensure that the taught knowledge will be put into practice, the teaching should be

accompanied by efforts to revitalize their interest in their traditional prediction methods as well as increase awareness of the importance of the methods. Thus, there is a need for communities to find locally appropriate mechanisms in order to achieve the above revitalization. For example, as the younger generation enjoys socializing with friends after school, perhaps gathering them together as a group for collective learning can, to some extent, be attractive to them and create a 'positive competitive and cooperative learning environment' during and after the sessions that will contribute to maximizing their learning. This strategy may result in them frequently observing their environment and climate in order to read and interpret signs and exhibit their skills to each other. The strategy might also provide opportunities to transmit the knowledge to more people, including those who do not have elders in their families.

On the other hand, despite not location-specific, the paper also recognizes the role of meteorological forecasting in farmers' decision-making and adaptation to drought, and believes that the short-term meteorological forecasting in poor countries such as Mozambique will improve with time with the creation of more observation sites and better tools to predict and monitor the weather. Since farmers showed trust and acceptance of meteorological forecasts and taking into consideration the non-satisfactory early warning systems that predominate in most rural communities in Mozambique, combining both scientific and traditional methods would also be crucial to strengthen the success of the forecast, and thus to reduce farmers' vulnerability. One potential way of combining these methods could be through Participatory Scenario Planning (PSP) for seasonal climate forecasts and decision-making, which has been increasingly researched and implemented in parts of the world such as sub-Saharan Africa. During PSP both traditional and scientific climate forecasts are shared and interpreted by community members and the relevant governmental and development bodies. Such an approach can also constitute a powerful way to revitalize the value of the traditional prediction methods among the community members as well as among the governmental and development bodies.

PSP would enhance the governmental and development actors' awareness of the methods and the unique roles the methods have played, currently play, and will continue to play in helping farmers to make timely predictions of drought, and other natural hazards, and reduce their vulnerability to these events, in spite of the current difficulties faced. As supported by Kalanda-Joshua et al. (2011), the awareness and understanding of the nature of traditional prediction methods will further facilitate the communication of scientific forecasts in a way that is meaningful and relevant to farmers' decision-making. This may facilitate the interpretation of the forecasts and the successful combination of both forecast methods, as well as the development of context-specific and feasible strategies for timely responses to drought. This may represent a win-win opportunity for the farmers, the government and their development partners, as by reducing farmers' vulnerability to drought it may also reduce their dependence on food aid.

5 Explaining the uncertainty: Understanding small-scale farmers' cultural beliefs and reasoning of drought causes in Gaza Province, Southern Mozambique

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Abstract

This paper explores small-scale farmers' cultural beliefs about the causes of drought events and the reasoning behind their beliefs. Cultural beliefs vary across countries, regions, communities, and social groups; this paper takes the case of farmers from Gaza province in southern Mozambique as its focus. Findings show that the farmers have a limited knowledge and understanding of the scientific explanation about drought. Thus, farmers' beliefs about the causes of drought are strongly based on traditional (the power of spirits) and religious philosophies that attribute drought to supernatural forces, such as ancestors or God, and as a punishment for (some unknown) wrongdoings. Farmers have a distinct and under-explored repertoire of possible wrongdoings to justify the punishments driven by those cultural beliefs. Some of their reasoning is static, while some is mutable, and is based on their observation and perception of the negative, unexpected, or harmful recent or current events which happen in their surrounding environment, and which they believe could be avoided or prevented. Farmers' beliefs about drought causes, and their underlying reasoning for those beliefs, are what will primarily influence their perception of their own capacity to adapt, their motivation to respond, and their behavioral responses. Yet, their social groups exert a great influence on their choices of response. The paper concludes that more context-specific investigations into the socio-psychological nature of

farmers' beliefs are required prior to interventions in order to better help farmers to respond to future drought risks.

5.1 Introduction

In recent decades, the increasing threats posed by climate change and variability, and the increasing occurrence of natural disasters, especially droughts, have raised an urgent need for small-scale farmers in rain-fed areas to adapt to the negative impacts of the threats on food production, availability and security (IPCC, 2007). This need for adaptation is particularly high for small-scale farmers in sub-Saharan Africa (SSA) due to their high dependence on rain-fed agriculture as their main economic activity (Wilhite *et al.* 2014). This is because SSA is seen as the center of occurrence for global drought and desertification problems (Benson *et al.* 1998). Additionally, due to climate change, drought episodes in SSA are projected to increase by 2030 – 2040, which is expected to adversely affect crop production and reduce yields by 40 – 80% (World Bank, 2013). Adaptation refers to a process of conscious change in individuals' systems of behaviour and characteristics in order to respond to actual or expected climatic stimuli (Brooks, 2003, p. 8; IPCC, 2001).

In different parts of the world, governmental bodies and their development partners have been designing, planning and implementing adaptation strategies to help farmers reduce their exposure and vulnerability to climatic stimuli, and to enhance their adaptive capacity and resilience. However, most of their planned adaptation strategies have focused on technical aspects, socio-economic factors and resource constraints (Adger *et al.* 2007, 2009; IPCC, 2007). However, changes in individuals' systems of behaviour and characteristics is a complex, heterogeneous, and continuous process that requires more than simple adjustments to the above factors (Smit and Wandel, 2006). There are several other factors and conditions that may also influence behavioural change, some more hidden than others and

often forgotten, such as cultural factors, which are essentially endogenous to society (Adger *et al.* 2009). In fact, some authors argue that the success or failure of adaptation activities are determined more by cultural factors, such as local knowledge, perception, values, beliefs and religion, than any other factor (Adger *et al.* 2007, 2009; Artur and Hilhorst, 2012).

Cultural factors shape societal relationships with the surrounding environment, the way people identify, perceive, understand and experience risks, how they behave in relation to those risks and how they decide to respond (Ariff and Beng, 2006; Farmer *et al.* 2012; IFRC, 2014, p. 40). For example, Kahan *et al.* (2015), through their ''Cultural Cognition Thesis'', argue that the heavy reliance of individuals on cultural meanings when framing perceptions of risk can lead them to perceive and attribute risks in ways that correspond with their cultural values and beliefs. This reliance precedes fact in risk perception, and risks may therefore be dismissed if they do not fit cultural values and beliefs. At times, this selective viewpoint can represent a key factor in risk by making it meaningless, and thereby hindering people's ability to make decisions and to act. This results in farmers exposing themselves to even greater risk (Kahan *et al.* 2011; Persson *et al.* 2015; Slovic, 2000).

Moreover, cultural beliefs have been increasingly recognized as crucial in adaptation to, and reduction of, the risk of disaster due to their influence on people's attitudes and behaviours towards natural hazards, on their exposure, and on their vulnerability, although this is an area that remains under-researched (e.g., IFRC, 2014, p. 14; Schipper, 2010). Murphy *et al.* (2016) and Schipper (2015, p. 146) define cultural beliefs as the underlying philosophies and ideologies that influence individuals' and communities' worldviews. Many studies exist on people's perceptions of climate change and risks, on traditional ecological knowledge, and on beliefs about the causes of natural disasters. However, emphasis is mostly given to religious beliefs that attribute the causes of natural disasters to God (e.g., IFRC, 2014, p.11; Jarawura, 2014), and to the description of diverse rainmaking ceremonies (e.g.,

Babane and Chauke 2015; Başgöz, 2007). These studies give little explanation about people's underlying reasoning for those beliefs which make God cause natural hazards. Additionally, limited attention is given to the traditional beliefs (the power of ancestors' spirits) people hold that help them to explain the occurrence of natural disasters, and to sometimes live with their risks. Limited attention is also given to how people's beliefs are formed, why they are followed, and the influence they exert on people's perceptions of nature, their worldviews, and their daily lives.

Therefore, this paper aims to reduce this gap in the research and to gain an understanding of farmers' cultural beliefs and reasoning about the underlying causes of drought. The paper also aims to facilitate the understanding of how the reasoning is formed, why the beliefs are followed and how they influence farmers' behaviour and choices of response to drought. It is expected that the insights gained will influence the design and implementation of intervention strategies that are more culturally sensitive and successful in helping farmers to respond to future drought risks. Since cultural beliefs are place specific, and vary across countries, regions, communities, and social groups, this paper takes, as an example, the specific case of small-scale farmers in Gaza province, Southern Mozambique. Although, in the last 20 years, several drought events have occurred in the province that have impacted farming activities and led to problems such as famine and malnutrition (Devereux, 2007; Rovere et al. 2014), the most recent drought (from 2014 – 2016) was more prolonged than farmers could remember having experienced before. Therefore, this particular event provided a unique opportunity to gain a richer knowledge and clearer understanding of the farmers' beliefs about the causes of drought. For the purposes of this study, drought is defined as an extended period (months or years), in which precipitation is less than the annual average, resulting in scarcity of water for environmental functions and human activities (Rouault and Richard, 2005; Udmale et al. 2014).

The following section provides a discussion on the role of cultural beliefs in helping farmers explain the occurrence of drought events and why cultural beliefs matter in the adaptation context. The paper then describes the study site and the methods used for data collection. It subsequently explores the diverse traditional and religious beliefs that farmers in the study sites hold and which relate to the occurrence of drought and the reasonings behind those beliefs. It also explores the dynamics of their beliefs and the factors which drive them. Lastly, the paper reflects on how farmers' beliefs and reasoning are formed, why they are followed and how they influence farmers' decision-making process, motivation to act, and responses to drought.

5.2 Why cultural beliefs matter in an adaptation context

Religion and tradition have shaped African societies' cultures over millennia, affecting all aspects of daily life, from economic activities to the food people eat, the way they live, dress, educate their children, treat disease, and bury their deceased kin. Whatever happens, it is possible to find an explanation that is religiously or traditionally grounded (Christian, 2014; Mbiti, 2015, p. 8). Cultural beliefs have also historically played a crucial role in helping farmers explain the occurrence of drought and to cope with its impact.

Most African societies continue to closely associate the changes in their environments with supernatural forces, including ancestors, spirits, and God (Dei, 1994; Schipper, 2010). On the one hand, they believe that almost everything in the natural environment is infused with spiritual meanings that give power and significance to their actions, and with which they establish contact through ancestor worship. They venerate their ancestors because they believe they are constantly observing their living kin and, through their power are guiding their activities and behaviour while protecting them against

adversity, including natural disasters and illness, and believed misfortunes to be caused by evil spirits (Christian, 2014; Dei, 1994).

On the other hand, African societies also view weather as a phenomenon controlled by God who is seen as the creator of the universe, the omniscient, and at the apex of everything, overseeing, regulating, sustaining, and upholding all activity in the universe to allow its continuity (Golo & Yaro, 2013; Mawere, 2011, p. 40). Religion is one of the world's oldest and most enduring social institutions, directly influencing more than two thirds of the global population (Haluza-DeLay, 2014). According to Mbiti (2015, p. 8), religion constitutes the richest part of African heritage. Schipper (2010, p. 378) defines religion as "all forms of belief systems shared among individuals and groups based on spirituality, mysticism, and faith in divinity, enshrined in formal institutions, in organized religions, and expressed in devolved form through superstitions, mythology and folktales".

Although African societies see both ancestors and God as protectors, they also believe that they will be punished by them for any deviation from social norms and moral codes, for inappropriate behaviour (Dei, 1994; Fountain et al. 2004; Johnson, 2005), or for a sin committed against them or the environment (Ngara and Mangizvo, 2013). Thus, they use these beliefs to explain the occurrence of natural disasters, such as drought. Although historically different religions fully expect recompense or punishment from God for behaving in a good or bad way in this life, or after death in heaven or hell, the expectation of payback is, to some extent, integral to human nature and mind independent of religious beliefs (Johnson, 2016, p. 3-4). Hence, it is argued that as societies fear punishment, it is this fear that acts as a mechanism for them to reinforce the importance of respecting their culture, behaving according to their cultural norms or moral codes, and thus ensuring its maintenance (Johnson, 2005).

As a result of human dislike of uncertainty and unknowns (IFRC, 2014, p. 41), and because in their cultural beliefs adversity and disasters do not happen without a cause (Christian, 2014), people find diverse ranges of reasoning to justify punishment from supernatural forces. For instance, some people blame human beings for practicing black magic (IFRC, 2014, p.11; Lewis and Russell, 2016; Orlove et al. 2010), while others specifically blame younger generations for behaving inappropriately and committing adultery (Boillat and Berkes, 2013; Jarawura, 2014). Therefore, younger generations are accused of ruining religion by not upholding values, or by being less religious than previous generations. This is because the victims of natural disasters often do not perceive the events as 'natural', thus they tend to assign primary responsibility to human actions or inactions (Kumagai et al. 2006).

While some people exclusively hold a single type of belief, others may hold both traditional and religious beliefs concurrently in the hope that if one fails, they can still count on the other (Murphy et al. 2016; Pew Forum, 2010; Roncoli et al. 2002). Additionally, Murphy et al. (2016) found that some church leaders, such as in the Bolero community in Malawi, encourage churchgoers to pursue both traditional and religious beliefs as they recognize the importance of respecting traditional beliefs and preserving their culture. However, they also noted that such encouragement was given because the church leaders have shared leadership roles by also being the community headmen.

On the other hand, besides the co-existence of two types of beliefs, people may also shift their beliefs. For instance, in SSA and in the South-Pacific, a shift has been noted from traditional to religious beliefs with increased numbers of Christians (IFRC, 2014, p. 11; Murphy et al. 2016). Although people may now rely more on religion to provide them with direction, purpose and meanings to their lives, they may also question their faith and abandon it because of feeling betrayed or abandoned by God in circumstances they believe required his divine intervention, such as during the occurrence of natural

disasters. This disappointment with a capricious God may lead people to feel isolated and have a sense of estrangement from their community or social group (Wilson and Moran, 1998). Such shifts show that societies' beliefs are not static, rather they may vary according to circumstances. However, the effects of these shifting beliefs on adaptation are still not well understood (Murphy et al. 2016).

Societies' widespread beliefs that droughts are caused by uncontrollable and compelling supernatural forces (Roncoli et al. 2009; Slegers, 2008), may lead them to implement responses which ask for forgiveness, make peace with these supernatural forces, and ask for rain through the performance of traditional ceremonies or prayers. These kinds of responses may stop societies from taking the most appropriate measures and may in fact increase their vulnerability to drought risks (IFRC, 2014, p. 37). It is also argued that their beliefs may block the uptake of scientific information or technological responses if they are not transmitted in a way that is acceptable to the intended beneficiaries (Kahan et al. 2007, p. 497). Indeed, not attempting to understand the nature and importance of cultural beliefs and include them in current polices and technological adaptation strategies has been highlighted as one of the causes of the lower than expected, or maladaptive outcomes, of adaptation strategies (Adger et al. 2013; Kuehne, 2014; Schipper and Dekens, 2009). One example of failure was given by IFRC (2014, p. 121) concerning some current policies and programs operating in the Pacific.

People are more likely to take part in, and remain committed to, adaptation actions with which they identify and are directly connected to, which correspond to their needs, and which preserve and promote their culture. Thus, involving communities in the identification of their vulnerabilities, needs, priorities, and their existing and effective strategies used to respond to environmental, weather, and climatic stressors, is crucial to encourage their participation as it empowers them to take action and to lead others (Lebel, 2013; Shaw et al. 2008; Sheil et al. 2006). Moreover, as adaptation requires joint efforts to mediate collective risks, communities' shared or normative beliefs about the causes of a

stressor can act as a starting point for collective action against it, can promote their cohesion, and can also increase their social resilience (Adger, 2003; Jones, 2011; Leck et al. 2011). People share the belief that working together is efficacious to the achievement of their aims (Bandura, 1998). Thus, cultural beliefs have been increasingly recognized as both a facilitator and an inhibitor of adaptation to environmental and climate change, and thus are a crucial part of any context of Disaster Risk Reduction (DRR). The following section builds on these ideas by exploring the role of cultural beliefs in the context of small-scale, rain-fed farming in Gaza Province in Southern Mozambique.

5.3 Methodology

5.3.1 Study site

Mozambique is one of the most vulnerable countries in the world to natural disasters and climate change (INGC, 2009), and drought constitutes the most common and devastating natural hazard. The southern region of the country is especially susceptible to regular drought, and in Gaza province drought occurs in seven out of every ten years (Kyle, 2003; Uaiene, 2008). The study was conducted in two districts extremely vulnerable to drought, Chibuto and Guija, in the southern province of Gaza (Fig. 5.1). Both districts are in the south-western part of the province, in the watershed of the Limpopo river basin, which is one of the main rivers in the country. Small-scale, rain-fed subsistence farming is the main economic activity in both districts, and the main cultivated crops are maize and beans (butter and cowpea). However, annual rainfall is low and irregular, varying between 400 – 600 millimeters, which makes rain-fed agriculture very challenging, and sometimes leads to food insecurity problems. The rainfall period is usually from October to April with a mid-season dry spell often occurring during this period and falling during critical periods of crop growth (Brito et al. 2009). Chibuto has a tropical arid climate, and annual mean temperature of above 25^{o}C, while Guija's climate is tropical dry to semi-

arid, with annual mean temperatures of between 25 - 26ºC. These climatic conditions, when combined with poverty make farmers extremely vulnerable to drought.

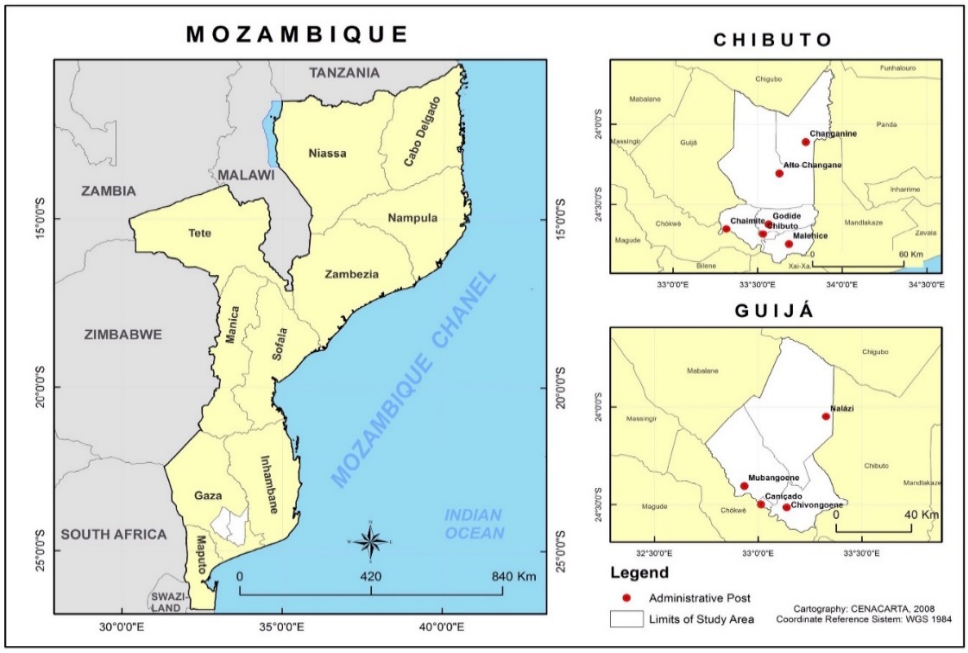

Figure 5.1: Location of the study sites in Gaza Province, southern Mozambique

Illiteracy levels remain very high in Chibuto (54%) and Guija (70%) districts, mostly among women who also constitute the majority of the population there (MAE 2005). This is a result of poor state investment in rural education after the end of independence war (1964 - 1974) and civil war (1977 - 1992) in Mozambique (UNESCO, 2015). Although Portuguese is the official language of the country, it is spoken by only 37% of the population in Chibuto and 24% in Guija (MAE, 2005). The most commonly spoken language is Xitsonga, which is a southern African Bantu language spoken by the Tsonga people. Within Xitsonga, the most spoken dialect is Changana (Shangaan, Shangani). Most inhabitants are religious, i.e., practice or believe in a religion. Although Christianity and Islam are the most widespread religions in SSA, a recent change of religion has occurred in most parts of the region, including in Mozambique. This change of Christianity and Islam religions was marked by the rapid increase of diverse Pentecostal Charismatic Churches, such as Assembly of God, Apostolic faith, and the Zionist movement (Meyer, 2004). In the study site, the Zion church is the most frequented, followed by the Catholic Church (MAE,

2005). However, especially in the rural areas, ancestral spirit worship continues to play an important role, and is reflected in diverse ways such as through the annual performance of various types of traditional ceremonies.

5.3.2 Methods

This study used a mixture of qualitative and quantitative methods to collect and analyse the data. Although the approach is mostly inductive, interpretive and explanatory in nature, which are key characteristics of qualitative studies, the use of both qualitative and quantitative methods was crucial to triangulate and validate the data and the findings through cross-comparison. The study was conducted between April and September 2017. During data collection, open-ended questionnaires and Focus Group Discussions (FGDs) were used to gain a clear, rich, and holistic understanding of diverse individual and collective cultural beliefs about drought causes. Open-ended questions allow participants to have more freedom to express their viewpoints because they do not provide a defined set of alternative answers. Since the majority of the participants only spoke Changana, the data was collected by me, with help from a translator from Changana to Portuguese. To ensure the complete capture of participants' responses, the interactions with them were audio recorded, and first manually transcribed by me, then transcribed to Microsoft Word by myself and 2 transcribers.

One hundred questionnaires were delivered at household level for each district (50 per community), totalling 200 (see Table 5.1). The questionnaires included both genders (male and female), and three age groups (16 – 24; 25 – 44 and over 45 years old). Of the participants, around 4.5% belonged to first age group, 41.5% to the second, and 30% to the last. The remaining 24% did not know their ages and did not have any type of identification, which is a result of years of Portuguese colonialism, followed by independence and civil wars. However, judging by their facial features and ages of their descendants

they could be grouped as 45 years old or over. The majority of the participants were women (76%), which reflected the general scenario of the inhabitants of the province due to reasons such as male labour migration to South Africa, or to other parts of the country. The questionnaire collected detailed information on participants' demographic structure, education level, livelihood strategies and networks, assets, the natural, the physical and social capital. The questionnaire also collected information on participants' perceptions of the causes, impacts and responses to drought, and the insights obtained were explored further during the FGDs.

Table 5.1 Socio-demographic characteristics of the participants of the questionnaire (*n* = 50 per community or 100 per district)

Socio-demographic Characteristics		**Chibuto District (%)**			**Guija District (%)**			**Gaza Province (%)**
		Gomba	**Magondzwene**	**Total**	**Mbala -Vala**	**Chimbembe**	**Total**	**Grand Total**
Gender	Male	26.0	20.0	23.0	28.0	22.0	25.0	24.0
	Female	74.0	80.0	77.0	72.0	78.0	75.0	76.0
Age group (years old)	16 – 24	0.0	6.0	3.0	12.0	0.0	6.0	4.5
	25 – 44	36.0	60.0	48.0	30.0	40.0	35.0	41.5
	Over 45	40.0	18.0	29.0	32.0	30.0	31.0	30.0
	Unknown	24.0	16.0	20.0	26.0	30.0	28.0	24.0
Education level	Illiterate	48.0	32.0	40.0	28.0	38.0	33.0	36.5
	Primary school	42.0	54.0	48.0	62.0	52.0	57.0	52.5
	Second-degree primary school	6.0	10.0	8.0	8.0	4.0	6.0	7.0
	Lower secondary school	2.0	4.0	3.0	2.0	4.0	3.0	3.0
	Unknown	2.0	0.0	1.0	0.0	2.0	1.0	1.0

A total of 25 FGDs (13 in Chibuto and 12 in Guija) of around six to eight participants were formed according to their gender and age groups mentioned above (three age groups per gender – see Table 5.2). The group discussions explored participants' beliefs, behaviours and practices, and how these

have changed over time as a consequence of the unpredictability of weather and climate. The rationale for putting together people from the same gender and age group was to make them feel less constrained to talk in front of each other, to make the discussion more fruitful and, consequently, to generate more data. Additionally, gender and age differentiation between the FGDs allowed exploration of in-depth similarities and differences in people's beliefs, as these are some of the attributes that are generally deemed to shape individual's beliefs and their interpretation of, as well as their attitudes and responses to risks (Gaillard, 2007; Leck et al. 2011).

Table 5.2 Number of participants of the FGDs per gender and age group (*n*= 25 FGDs)

District	**Community**	**Number of participants per group**					
		Female Group (years old)			**Male Group (years old)**		
		16 -24	**25 - 44**	**Over 45**	**16 -24**	**25 - 44**	**Over 45**
Chibuto	Gomba	8	8	2 X 4*	8	6	7
	Magonzwene	8	8	8	7	6	6
Guija	Mbala-Vala	7	7	8	8	6	7
	Chimbembe	7	6	8	8	7	9

* Two FGDs of four participants were formed

A free-listing technique was used in both the questionnaires and the FGDs to list participants' beliefs about drought causes, their perceptions and observations of climate changes, and to quantify the relative importance that participants gave to their answers. Free-listing is a technique that is exploratory in nature, aiming to obtain a list of items within a cultural domain and to determine their prominence and relative importance (Weller, 1998). The technique assumes that the items mentioned first and most frequently by the participants are the most significant (Campos et al. 2014). The study also used a narrative-type inquiry to explore in depth the life histories of participants' experiences of drought events and their explanations about their beliefs of its causes. This type of inquiry is useful to collect

information related to events, happenings, human activities, meanings of key events in people's lives at individual and collective levels, and the cultural context in which they live. It uses narrative analytic procedures to generate stories that are explanatory (Flick and Gibbs, 2007, p. 56).

A coding scheme was developed for both the questionnaires and the FGDs to ease the process of comparison, to help classify, organize, and categorize the data according to the similarities (agreement, partial agreement, silence, or dissonance) and to analyse them. After the development of codes, themes were created to analyse the qualitative data (FGDs) using NVivo. The themes facilitated the comprehension, comparison and contrasting of the data, as well as the calculation of the reference (number of evidences within the theme), and the generation of theory. The quantitative data was analysed using SPSS (Statistical Package for Social Sciences), and involved descriptive statistics, specifically, cross tabulations to discern the interrelation and interaction between the variables being analysed, compare and contrast them and calculate their percentages.

5.4 Results

In this section, the paper explores farmers' beliefs about drought and the reasoning behind their beliefs about the occurrence of drought. This is followed by examination of the dynamics of farmers' beliefs and the factors that drive them.

5.4.1 Farmers beliefs and reasoning of drought causes

During FGDs and in the individual questionnaires, farmers were asked about their beliefs of the causes of drought events in their communities. Responses showed that participants have a limited knowledge and understanding of the scientific explanation for drought and climate change, and they mostly began

to hear about it during the last drought (2014 – 2016) via the radio and announcements by local authorities at their general community meetings. Most of the participants are illiterate (36.5%), 79.5% of them being women, or have only attended primary school (52.5%), which is why many are unfamiliar with the scientific explanations for drought. On the one hand, these illiterate participants related climate change to changes in their socio-cultural environment by giving examples of the current behaviour of young people, which is dissimilar to the past. Participants asserted that nowadays young people are disrespectful to adults and have children when they are around 12 years old. On the other hand, participants related drought to the El Niño phenomenon, a warming of the sea surface temperature, which causes drought in Southern Africa and other parts of the world. However, because participants only heard about El Niño during the last drought, they struggled to pronounce the name and referred to El Niño as aluminum (due to the similar pronounciation in Portuguese), an ice stone or an animal which is in the ocean blocking the rain, asserting that it will rain when the animal dies.

The young people (16 – 24-year old), who have more access to education up to lower secondary school, were the ones who tended to talk about drought-related scientific information as part of their own knowledge. For example, young people mostly mentioned about the impacts of their activities on the changes in weather and climate, such as cutting down trees and burning them to clean fields, grow crops or produce charcoal. Despite such explanations, these young participants claimed that there was nothing they could do since they depend on their activities for their livelihoods and survival. Tambo (2010) also correlated low levels of education to farmers' weak understanding of scientific information about drought events. Conversely, the majority of farmers (63.5%) hold a variety of cultural beliefs about the causes of drought that range from traditional to religious, which can sometimes be exclusive, or a mixture of both types of beliefs as a result of their uncertainty of the causes. There were also some farmers who were unsure (9%), or claimed not to know what could be the possible causes of drought

(23.5%). Some farmers also showed shifting beliefs, voluntarily or involuntarily, as a result of perceived social group pressure.

5.4.1.1 Religious beliefs

In both study sites, 51% of the individual farmers who were surveyed stated that drought is caused by God, while this was mentioned by five out of twenty five FGDs (Chibuto only) (see Table 5.3). Most participants are religious (72.5%) and they attend different types of churches, with the Catholic (17%) and Zion (32%) churches being the most attended ones in Chibuto and Guija, respectively (Fig. 5.2). Women constitute the majority of religious members of the community, representing 80% of them as well as the majority of participants (75.5%) who have given religious-related answers. The latter also tended to be people who were over 25 years old (97%).

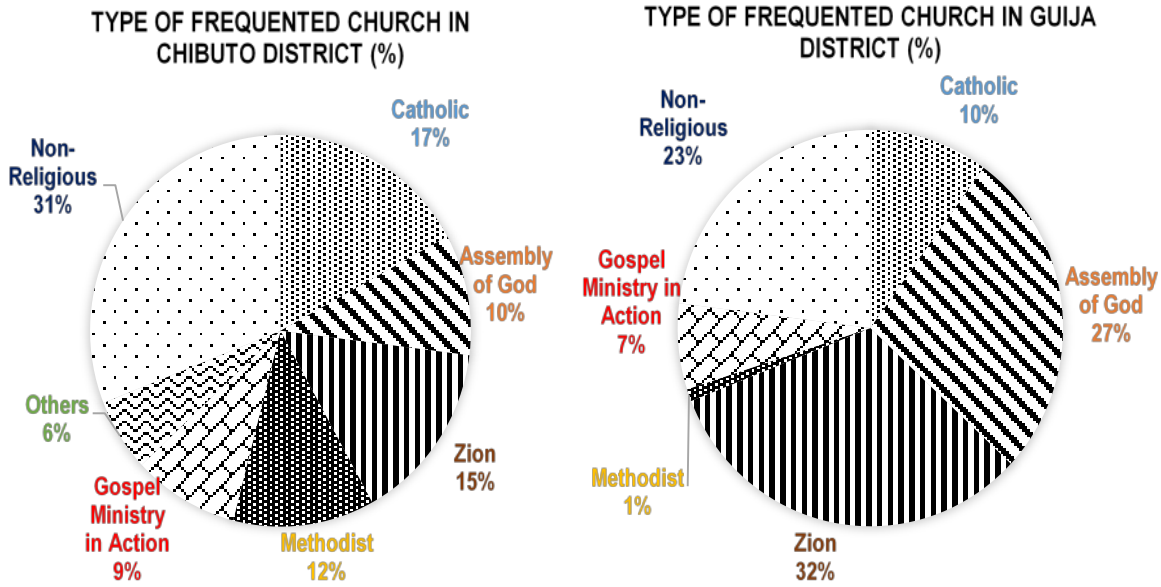

Figure 5.2: Most frequented churches in Chibuto (left) and Guija (right) districts (n = 100 participants per district - source: author's compilation).

Table 5.3: Religious-related responses given during the fieldwork (*n* = 200 questionnaires; *n* = 25 FGDs)

Religious-related explanations of drought	Study site	Number of References*
We do not know how to explain it, we just know it is god	Chibuto, Guija	Questionnaire (32)
The rain belongs to god and he is the only one who has the power to stop the rain, not a human being. Therefore, we pray for him asking for the rain, although our requests are not always met	Chibuto, Guija	Questionnaire (27)
God controls nature, including the rain. He created nature and put human beings on it	Chibuto	FGD (1)
	Chibuto, Guija	Questionnaire (22)
God forgot about us, that's why he is not sending rain, but we do not know what we have done to make him forget about us	Chibuto	FGD (1)
	Chibuto, Guija	Questionnaire (17)
God controls the rain and decides when it should rain, even when we make traditional ceremonies it will not result if god doesn't want to send rain at that moment	Chibuto, Guija	Questionnaire (17)
God is punishing us for doing unnecessary abortions, since it is considered a sin. Also, for doing it without the elders' consent	Chibuto	FGD (2)
God is punishing us for being ungrateful, i.e., we do not thank him for the good harvest we have when he sends the rain. What is more, to make things worse, instead of thanking him we thank our ancestors for the good harvest	Chibuto	FGD (1)
We do not know why god it is not sending rain, since it is not raining in other areas as well	Chibuto	FGD (1)
The rain comes from the sky	Guija	Questionnaire (2)
God regulates the rain, he is now giving rain to other zones and then will give it to us	Chibuto	Questionnaire (2)
God is not sending rain because he gave up on us	Chibuto	Questionnaire (2)
God is not sending rain because of the war in the country	Chibuto	Questionnaire (1)

*Number of FGDs which have given the response

The most predominant argument in both the individual questionnaires and the FGDs was that *God created nature and also controls it. Since the rain comes from the sky, God is the only one who has the power to stop it and to decide when it should or should not rain. This is why we pray to Him and ask for the rain and for other needs.* This explanation resonates with the traditional way participants refer to God in their Changana dialect, "Xikwembo", which means "father of everything in the realm of existence" (Mawere 2011, p. 40). The sovereignty of God was even recognised by almost half of 27.5% non-religious people. Yet, when asked why then they think God, with his omnipotence, is stopping the

rain, their justifications were vague. Individually, the majority of them did not know the underlying reasons, they just knew that it was God because of his omnipotence. Others argued in vague terms that God simply forgot about them, or gave up on them for some unknown reason or for sins they believed they might have unsconsciously committed. Similar responses were given by the FGD.

However, two individual farmers and one FGD from Chibuto seemed to have a different answer to the others, which was found after analysing what was going on in the country. A 48 year old female farmer who attends the Methodist church concluded that: "*since it is not possible to rain everywhere at the same time, God was being fair to everyone by giving, at times of drought, rain to other zones, before giving rain to our zone*". Consistent with findings from Robinson (2009, p. 62), the other farmer, a 65 year old non-religious man, believed that: "*God was causing drought because of the war in the country*." This belief was related to the recent political instability in the country caused by a conflict between the main opposition party (RENAMO) and the ruling party (FRELIMO), that lasted from October 2014 to the end of 2016. This resulted in RENAMO armed militia attacking national roads and rail traffic in the centre of the country, killing a large, undisclosed number of civilians. Conversely, a group of over-45 years old women recognized that everyone was guilty of causing the punishment for being ungrateful, of not thanking God for the good harvest that they have when he sends rain, and thanking their ancestors instead.

5.4.1.2 Traditional beliefs

For generations, oral traditions have played a crucial role in societies as the primary vehicle of history, transmission of knowledge and for the teaching of important aspects of local culture (e.g., social norms, customs, beliefs, and moral values) (Sumner, 2013, p. 9). Although drought as a punishment from ancestors was less prevalent in terms of individual beliefs (12.5%), when compared to group beliefs (100%), participants believed their ancestors were punishing them with drought for not following and

respecting their customs as in the past. A decline in individuals' traditional beliefs has been registered across sub-Saharan Africa (Pew Forum 2010), but as such beliefs are condemned by Christian and Muslim groups, people are very hesitant to discuss them (Orlove et al. 2010). Participants provided a variety of justifications about why they have not been following and respecting tradition (see Table 5.4 for complete explanations), which were categorized into four groups: failure to undertake rituals correctly; unnecessary abortion; unburied dead bodies; and witchcraft. It was noted that individuals' traditional drought beliefs were mostly verified among those female non-religious participants who had little (primary school) or no education, and were over 25 years old.

Table 5.4: Traditional-related responses given during the fieldwork (n = 200 questionnaires; n = 25 FGD)

Category of traditional beliefs		Explanation	Study site	Number of references
Rituals	Traditional rain ceremony	Not making traditional ceremonies regularly as we used to do in the past. Now we just do it when we feel delay in the start of the raining season, therefore we are punished by our ancestors	Chibuto and Guija	FGD (5) Questionnaire (3)
		When the traditional ceremony is not performed by people who are part of the traditional (native) family of the community	Guija	FGD (2) Questionnaire (4)
		Not making traditional ceremonies regularly to eliminate crop pests, since this ceremony also serves to ask for the rain and always have positive results	Chibuto	FGD (1) Questionnaire (1)
		When people performing the ceremony do not follow the norms of the community and do not do everything requested by the ancestors	Guija	FGD (1)
		The family of the native ancestors are not taking care of them, are not doing what they want such as the performance of traditional ceremony, therefore they are furious and are punishing us by not sending the rain	Guija	FGD (1)
	Coupling Rituals	When a man sleeps with a widow, and on the following day, they do not undergo the required ritual	Guija	FGD (1)
	Burying rituals	When someone dies from tuberculosis and is not buried according to the tradition to release their souls	Guija	FGD (5)
		When someone who had dreadlocks is buried without them first being cut	Guija	FGD (3)
		When a woman dies while pregnant and is not buried according to the tradition, i.e., a slight tear must be made in the belly to remove air and the person must be buried in the lower part of the lake and not in the cemetery	Guija	FGD (1)
		When a woman dies before having a child and is not buried according to the tradition, i.e., when burying her, her chest region must not be covered by sand, but a plastic basin must be placed there to release her soul. Moreover, a sharp stick must be stuck in the ground outside her house	Guija	FGD (1)
Unnecessary abortion		Unnecessary abortion without the elders' consent	Chibuto and Guija	FGD (23) Questionnaire (19)
Unburied dead bodies		When the bones, mainly the teeth, of dead bodies get exposed they shock the lightning, stopping the rain from falling. Therefore, in order to avoid that, they must be buried again	Chibuto and Guija	FGD (4)

Category of traditional beliefs	Explanation	Study site	Number of references
Witchcraft	When the witchdoctors invoke spirits that are not from the area when doing their activities	Guija	FGD (2)
			Questionnaire (2)
	Indian food traders in the town are stopping the rain to impede us from producing food, and so buy from them	Chibuto	FGD (1)
	Road workers stop the rain to allow them to do and finish their works without interruption	Guija	FGD (1)
	I know a lady here in the community who stops the rain, but I prefer to not to talk about it	Chibuto	Questionnaire (1)
	Fishermen who wants salty fish for selling, so the fish quickly dry up	Chibuto	Questionnaire (1)
	Commercial farmers with access to irrigation are blocking the rain, so they can be the only ones producing	Chibuto	Questionnaire (1)

Rituals

Rituals are the primary mechanism through which communities maintain beliefs among their members (Sanderson, 2008), and participants in southern Mozambique showed that their communities were no exception to this as they linked drought to non-frequent realization of certain rituals. Some FGDs (10 out of 25), and a few individuals who took the questionnaire (4%), linked drought to traditional ceremonies. Most of these individual participants were over 45 years old female and male. The common belief in both study sites was that the present-day non-realization of traditional ceremonies, which were performed regularly in the past, was the underlying reason for punishment by their ancestors. Currently, such ceremonies are only performed when they perceive long delays to the start of the rainy season.

As part of participants' tradition, diverse types of traditional ceremonies have been performed throughout the year in their communities. Some are specific ceremonies to ask for rain, called 'Mbelelo', whereas others are for diverse motives, but are also used as an opportunity to ask their ancestors for rain. One such ceremony is called 'Pfupfanhe', which is intended to chase away crop pests. Additionally, participants from Guija believed that traditional ceremonies are fruitless, and that drought persists when they are not performed correctly, especially when they are not performed by people who are part of the native family of the community, of which their leader is part. The value of traditional rain-making ceremonies has also been recognized by other communities in other parts of the world where the rain has been inadequate, such as Iranian settled agriculturalists, and South African and Nigerian tribes (Başgöz, 2007; Haruna, 1997; Semenya, 2013).

In addition to explanations related to traditional ceremonies, participants from Guija district strongly believed that drought was related to people not following the correct rituals when burying people who had died from tuberculosis (5FGDs), or who had dreadlocks (3FGDs) in order to release their souls

and avoid misfortune. Mozambique has a significant incidence of tuberculosis (37%) which is mostly related to Human Immunodeficiency Virus (HIV), and there are higher mortality rates in rural areas due to factors such as lack of diagnosis and poor access to healthcare (Wikman-Jorgensen et al. 2015). Participants explained that, before burying a person who died from tuberculosis, the ritual must start in their homes. If the person was living alone, the ritual includes burning, inside the house, the grass that forms the core of its ceiling together with a traditional plant, eggshells, salt, and a bit of the house rubbish. The smoke created serves to partially release the soul of the deceased person. In other cases, a simple ritual of housecleaning is followed, and a traditional tea must be served to all household members. After that, when burying the person, the sand grave must be levelled off instead of being given the usual oval shape which allows the rain to run off, as the former shape facilitates the release of the soul. Additionally, the person must be buried in the lower part of the lake, not in the cemetery as usual. Although family backyards, burial places, or cemeteries are the most common places to bury corpses in Africa (Mbiti, 2015, p.114), other less common burial places, such as the rivers, running streams, and the river or sea, have also been used in other parts of the world, such as in Iraq and India. This is a result of the belief that running water has a sacred power of purification of humans' souls, thus, acting as an effective mechanism to cleanse humans of their sins, and reduce the punishment in the other world (Oestigaard, 2005, p. 13).

Participants from Guija also explained that when someone who has dreadlocks dies, their dreadlocks must be cut off before they are buried. This belief, which was even shared by younger participants, was reinforced during the last drought when a member of the native family of the community, and who had dreadlocks, died. Before his death, he asked his family to cut off his dreadlocks, but they did not do so. Since there was no rain in the community for a long period, after this the inhabitants started to speculate and to believe that this was the reason behind the lack of rain. Thus, feeling pressure from the community, his family decided to exhume him and cut off his dreadlocks. According to the

participants, after that it did not take long for the rain to start. Mbiti (2015, p. 120) explains that most Africans believe that when someone makes demands before they die that can be fulfilled, they must be met, otherwise their spirit will not stay quiet and rest in peace. In fact, in Mozambique, it is common to see people requesting to be buried in their hometown or city, and their families achieving the 'impossible' in order to attend to their request against the fear of bringing misfortune into their lives. Sometimes, even after attending to the deceased's request, if misfortune occurs, they revert to witchcraft in the belief that something went wrong during the process. As the witchdoctors are believed to communicate with dead people, they are given the mission to discover what went wrong so that it can be corrected.

Witchcraft

Witchcraft is considered an integral part of traditional African societies, a way of life, and is believed by around 80 to 90% of people (Weese, 2016). Although, these societies often credit witches for causing malevolent events, such as diseases, natural disasters and death (Lewis and Russell 2016), in the study sites such attribution was not so popular in relation to the causes of drought. Only 1.5% of male individual farmers (over 45 years old) and two male FGDs (16 – 24 and 25 – 44 years old) stated that witchcraft was related to drought occurrence in their communities. In Guija, the general belief was that witchdoctors are responsible for drought as they invoke spirits that are not from the area when carrying out their activities to treat clients when they should only invoke the spirits of their ancestors.

In Chibuto, it was believed that some people who benefit from drought, by being able to uninterruptedly do their work, are responsible for drought through witchcraft, such as the Indian food traders in the town and commercial farmers who have access to irrigation. Their perception was that Indian food traders were stopping the rain to allow them to sell more of their products because the farmers could not produce their own food and would be forced to buy from them. Participants from 16 -24 years old

male FDG gave examples of how they confirmed their theory during the last drought when the traders came to their community to sell their products and the inhabitants were forced to buy from the traders because they had no production surplus. Similar reasoning was also applied by an over 45 years old male participant when explaining that *commercial farmers who have access to irrigation could stop the rain to ensure they were the only ones producing in the area, and therefore ensuring a market for their harvest.*

5.4.1.3 Co-existence of and shifts in beliefs

Some female participants who completed the questionnaire (2.5%), and two of the male FGDs from Chibuto and all over 25 years old, believed that drought was a concurrent punishment from both ancestors and God due to unnecessary abortions by young people. From one perspective, participants see abortion as a sin through God's eyes, and one that must never be committed. From another perspective, abortion is also seen as a wrong and unacceptable action according to participants' cultural values, and that this kind of behaviour is sanctioned by their ancestors. Therefore, to avoid sanctions, young women who become pregnant secretly, or who have unwanted pregnancies, must ask for the elders' consent prior to having an abortion. Elders are the carriers and guardians of oral traditions and are respected for their wisdom and perceived proximity to the ancestors (Dei, 1994).

The elders are then the ones who organize a ritual, with the foetus corpse present, to inform the ancestors of the abortion, and to prepare the corpse for burial in the lower part of the lake in accordance with their tradition, where they also bury people who die from Tuberculosis. Additionally, the woman's genitals are 'purified' with a traditional medication that has a burning sensation, thus also serving as a punishment for her actions. However, in cases where the person who performed the abortion is unknown, all women of reproductive age must have their genitals 'purified', as happened during the

last drought in Magondzwene community in Chibuto. According to some female groups (16 – 24 and over 45 years old), after this general abortion ceremony it started to rain in the community.

The co-existence of traditional and religious beliefs was also noticed among participants of a 25-44 years old female FGD in Chibuto who believed that drought was occurring due to the non-frequent realization of diverse types of traditional ceremonies. They explained that, even though the traditional ceremony to ask for rain is directed towards their ancestors, God is the one who ultimately controls the rain, and because their ancestors are in heaven then they will directly transmit their rain request to God to help it to be fulfilled. Thus, their ancestors serve as the medium through which their needs are transmitted to God.

In addition, similar to findings from IFRC (2014, p.11), in both districts a shift in beliefs from traditional to religious was also noticed among some of the participants, mostly over 25 years old women, who answered the questionnaire. They reported that some churches, such as Zion, Gospel Ministry in Action, Assembly of God, and Old Apostolic, made them choose between the two types of beliefs. According to participants the church leaders argued that when someone starts attending the church then they must forget about the worship of ancestors and only follow God and his words. It is not possible to follow two pathways simultaneously, otherwise they will walk in the darkness and become lost. However, such claims, which oppose findings from Murphy et al. (2016) in Bolero in Malawi where the church leaders encourage churchgoers to pursue both traditional and religious beliefs, were denied by the church leaders. Meanwhile, others have argued that they have voluntarily changed their beliefs based on their perception and understanding of the disadvantages or problems which arise when following tradition. This position is exemplified by an over 45 years old woman from Guija when answering the questionnaire:

"I no longer follow tradition because I go to the church, and also because the last time I participated in a traditional ceremony to chase away crop pests in 2005, I returned home with my feet aching, and it did not get better since then. I think it was God who punished me because of all the yelling and insulting we normally do during the ceremony in order to chase away the pests. God does not like or want to see people yelling and insulting."

Conversely, there were also over 45 years old female and male participants from both districts who reported having abandoned religion as they had lost hope and trust in God, as exemplified by a 68 years old woman from Guija who answered the questionnaire: *"I stopped going to church after the death of my sons since I felt that I did not deserve such pain for being religious, going frequently to church and following God's words."* Notwithstanding, some participants explained that abandoning Christianity allowed them to participate again in traditional rainmaking ceremonies, which was forbidden by the churches they followed. Moreover, participants explained that, despite their disappointment, they are considering returning to the church one day, as they fear not having a blessed funeral or not going to heaven when they die.

5.5 Discussion and Conclusion

This study has explored small-scale farmers' cultural beliefs about the occurrence of drought, which constitutes one of the major stressors to their rain-fed agricultural activities, and the reasoning behind their beliefs. The results show that farmers mostly rely on traditional and religious beliefs to explain the occurrence of drought. Farmers have limited knowledge and understanding of the scientific explanation for drought due to low levels, or a lack, of education. Thus, in this study, younger people, who have more access to education (second-degree primary school and lower secondary school) and more contact with the external "world", were the ones who tended to mention this. The study also found that

due to their uncertainty in their beliefs, farmers may simultaneously have different types of beliefs. Farmers' beliefs are also dynamic, since farmers may voluntarily shift beliefs based on their perception, understanding and judgment of their veracity and outcomes, or involuntarily through pressure from their social groups. However, in general, people who were religious tended to show less devotion to ancestors' worship and had doubts that human beings could have the power to stop the rain, crediting such powers instead to God. People who were illiterate or had lower levels of education showed the opposite.

As found in other studies, independently of the type of beliefs held, farmers generally see drought as a punishment from God or their ancestors for some unknown wrongdoing or shameful behaviour. To justify the motives for punishment they find a variety of reasons that are driven by their context specific cultural beliefs. Nevertheless, these reasons remain underexplored in the literature and ignored in the adaptation context. The diversity of traditional reasons outweighs the religious reasons, and most participants did not have an explanation for their beliefs about God's punishment through drought; they just knew it was God because of His ability to control rain and to decide when it should or should not fall.

Although the traditional reasons provided by participants from Chibuto and Guija belonged to the same categories presented in Table 2, participants from Guija presented more explanations as they follow more rituals than Chibuto (e.g., coupling and burying rituals). Nonetheless, participants gave a total of 18 explanations in the questionnaire and FGDs for their ancestors' infliction of punishment through drought, and the most predominant explanations were that the punishment was a result of unnecessary abortion by young people, and the failure to regularly perform traditional rain ceremonies, as had been done in the past. Yet, women presented more variety in their reasoning than men, as they showed

themselves to be more observant and aware of happenings in their communities, and they placed greater emphasis on the importance of showing respect for their tradition.

While these most predominant reasons were static since they have been transmitted through the generations from ancestors to their descendants, the least predominant, but not least important, reasons were non-static, mutable, or circumstantial. The reasons were based on individual or group value-laden perceptions of what might be the negative, unexpected, wrong, or harmful things that have recently happened, or are currently happening, in their environment at local level (e.g., burying someone who had dreadlocks), or in some cases nationwide (e.g., war in the country). When people believe that the events could be avoided or prevented, they use them to attribute the blame for punishment through drought. They may attribute the blame to someone inside their community when they perceive that drought is not witchcraft-related, as they all depend on the rain for their activities and livelihoods. Otherwise, they may blame an outsider perceived as having suspicious and uncommon behaviours, and somehow benefiting from the lack of rain by not 'directly' depending on it for their activities.

The example given by younger people regarding the Indian food traders brings to attention how, in moments of distress, certain kinds of interventions can be misinterpreted, considered suspicious, not well received, and may create an opportunity to attribute blame for a negative event. This is especially the case if that distress comes from unknown or untrusted sources, even though the primary intention was to help farmers to survive. Trust plays an important role for farmers in ensuring a successful interaction and outcome of the intervention. For instance, during the same periods that the food traders intervened, the sale of improved seed at a subsidized price by the Government, a trusted body that often provides aid, was viewed as assistance. Farmers asserted that such assistance made it possible

to cultivate after the end of drought, as they had consumed their saved seed after depleting food surpluses.

On the other hand, other examples given by farmers of 'effective' strategies for stopping drought, such as traditional ceremonies for abortion and exhumation of the person who had dreadlocks, showed how such 'perceived effectiveness' served to reinforce their traditional beliefs about the causes of drought and to create new reasoning to justify the beliefs. Although these static and non-static beliefs and reasoning may serve to justify the occurrence of drought and help farmers live with its impacts, they may not reflect the real causal factors, and thus may lead farmers to underestimate their ability to control the environmental problems, which they see as within the domain of supernatural forces. Indeed, some studies about drought perceptions have related peoples' lack of appropriate adaptation to their perceived low capacity for control over environmental problems (Jones, 2011; Slegers, 2008). Generally, people are more motivated to engage in behaviours they consider feasible (Bandura 1997). At the same time, the importance of showing respect for their culture, or to be part of the community or social group (e.g., friends and religious groups) or perhaps fear of having some kind of reprisal from them, may lead farmers to have different answers about what constitutes their drought beliefs when individually and when in groups. Individually, farmers might be honest as they feel more comfortable and free to talk about their real beliefs, while in groups they might feel somehow 'pressured' to talk about what constitutes general thoughts, comments, or the beliefs of the community or their social groups (subjective norm). This normative behaviour is considered to be one of the social barriers to adaptation (Jones, 2011).

Nevertheless, independently of farmers' underlying beliefs, it is important to bear in mind that they hold some kind of cultural belief about how the natural environment works, and this guides their understanding of the causes and risks of drought, and it influences their behavior and motivation to

respond. However, as individuals continually check their own behavioural intentions against the actual or perceived intentions of significant others (Lalani et al. 2016), it is their perception of the social pressure they believe they are under to think and behave in accordance with those intentions which will dictate their choice of response. They may respond to drought, either individually or collectively, in a way that their significant others believe is most appropriate for the correction of the perceived wrongdoings for which the majority perceive they are responsible and accountable. Some examples are the performance of traditional rain ceremonies when the perceived punishment is related to their ancestors, or prayers to God when it is related to religious beliefs. Such responses may constitute maladaptive strategies and lead farmers to greater vulnerability to drought events.

Murphy et al. (2016) contend that, globally, vulnerability tends to be higher in places where religion is predominant, which is the case in sub-Saharan Africa where Christianity is very important in daily life. In fact, findings have shown that, independent of age group, the majority of farmers are committed to religion and it plays a huge role in their personal lives and livelihood activities. According to farmers, churches not only represent God's house and a formal place in which to worship Him and ask for their needs, but they are also places where they make friends and gain a spiritual family, and learn to respect and live in harmony with each other. Churches are also places where they receive blessings for their lives and activities, and find emotional, physical, and financial support when needed, such as in the case of natural hazards, personal problems, funerals, and sickness in their family. Additionally, some churches such as Assembly of God and Zion are seen as places where diseases can be healed without the need to go to the hospital through the power of prayers. Some members stated that the hope of being cured from their long-term diseases was what drove them to start attending church. Thus, Kirkpatrick (2005, p. 5) contends that religion can be a powerful force in promoting mental health and improving social behaviour and states of being.

Nonetheless, the majority of those claiming religious beliefs were over 25 years old female, even among married participants, i.e., 29 out of 48 (60%) of the male participants responded as being religious, while 117 out of 152 (77%) women did so. Evidence from other studies has shown that, due to a combination of factors, women are more vulnerable to drought and other hazards than men (IFRC, 2014, p. 21; Shackleton et al. 2015; Shahid and Behrawan, 2008). In reality, women not only constitute the majority of religious, but also the majority of the population, illiterate people and farmers in Gaza province, and this scenario extends to the rest of the country. Women are also culturally responsible for deciding which crops to plant and when, according to the season, and are responsible for saving seeds for planting. On some occasions, to ease their decisions about crop choices, some women commented that they look at what others are doing in order to do the same, arguing that if the production fails everyone will fail together. This once again stresses the great influence of significant others on the farmers' agricultural choices, but specifically it stresses the important role women have concerning these choices, which may influence the adoption of seed varieties or crops that are drought resistant or tolerant.

Thus, all of the above explanations emphasise the importance of giving more focus to the influence of farmers' beliefs, reasonings, perceived capacity to adapt, and their social groups, on their decision-making processes, motivations to act, and responses to drought. As previously explained, caution should be taken when approaching farmers in order to avoid negative interactions and the outcomes of current or future intervention. On the other hand, as people's vast experiences and perceptions of the risks and impacts of drought on their agricultural activities, food security, and overall well-being is deemed to influence their behaviour (van der Linden, 2015), it seems clear that farmers' behavioural change will require more than their experience and perception of the risks. As farmers' responses are based more on the belief that drought is caused by supernatural forces, rather than their personal experience of drought and knowledge of its impacts, as stated by Deane (2009) and Leck et al. (2011),

behavioural change will first require a clear knowledge of the causes of drought. Although this may not change farmers' worldviews about the natural environment, it may change the reasoning behind their beliefs for drought occurrence. However, extensive work will be required to achieve this.

Even though social groups, shifting beliefs, and trust in the Government may constitute opportunities for the transmission of scientific information to farmers, it is not the intention of this paper to suggest the kind of activities that should be undertaken to change farmers' beliefs, reasoning, or behavioural responses to drought. The expectation is that the insights gained into the socio-psychological factors that influence farmers' behavioural adaptation decisions in Gaza Province, Mozambique, will be useful to better understand farmers facing similar environmental and socio-psychological conditions elsewhere. However, sight should not be lost on the fact that cultural beliefs and reasoning are place-specific, thus each case should be considered independent and unique. Therefore, further context-specific investigations into the socio-psychological nature of farmers' beliefs will be required prior to intervention for more successful outcomes in helping farmers to respond to future drought risks.

6 Managing the impacts of drought: the role of cultural beliefs in small-scale farmers' responses to drought in Gaza Province, Southern Mozambique

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Abstract

Drought has had a harsh impact on farmers' agricultural activity, livestock production, and well-being, so that even droughts dating back to 1947 remain memorable. These memories, experiences, and knowledge of the impact of drought frame their awareness of the need to respond to it, and farmers implement an array of responses at collective level to tackle its causes, and at individual level to reduce its impact. Farmers' collective responses, comprised of prayers or traditional rainmaking ceremonies, are framed by their enduring cultural beliefs of the causes and appropriate responses to address them. Each farmer's individual choice of response (e.g., dependence on help, activities which generate income or secure immediate food needs) is a reflection of the interconnection of the socio-cultural, economic, and institutional environment in which they live. On the other hand, some of the variables within the social and institutional factors contribute to the reinforcement and endurance of farmers' beliefs. Although farmers' responses, which are reactive coping strategies, serve to help them, in the short-term, to deal with the causes and impacts of drought, maintain their livelihoods, and survive and recover from hardship, such strategies are not yet helping farmers' adaptation to drought become a reality. Thus, the paper concludes that farmers' adaptation requires a set of changes at all levels, as the factors that determine their choices of responses are interrelated.

6.1 Introduction

"In the past, we enjoyed regular, moderate and long-lasting rainfall that was adequate for our agricultural activities giving us abundance in food production, which we traditionally called Ziva Mussoco, but it has completely changed over the past two decades, and now rainfall is scarce and harmful to our food production and lives." (FGD, 31.05.2017)

Drought has become one of the most common and devastating natural hazards in many parts of the world (Sheffield *et al.* 2014), and has been typically characterized as an agricultural and food security problem in developing countries, including Mozambique, since agriculture remains the primary economic activity for most rural communities (Bryan *et al.* 2009; Wilhite *et al.* 2014). According to Wilhite et al. (2014), drought occurs when precipitation is lower than normal over the length of a season or more, resulting in insufficient availability of water for human activities and the environment. Small-scale farmers predominantly depend on rain-fed agriculture and have therefore had to continuously use diverse strategies to adjust their activities in response to drought over many years. These strategies are commonly based on farmers' local knowledge, experience, and cultural practices (Tompkins *et al.* 2010). However, adapting to current erratic, intense, prolonged, and frequent drought events has become increasingly challenging, and small-scale farmers face the impacts (IPCC, 2007; Mishra and Desai, 2006).

The impacts of drought can vary according to the use of different kinds of agricultural systems (e.g. rain-fed or irrigated), different types of crops and livestock, and different sizes of farm, to name just a few factors (Musolino *et al.* 2018). Small-scale rain-fed farmers are particularly vulnerable to the negative impacts of drought since it causes reduced crop productivity (yield quantity and quality) or even crop failure (FAO, 2004; Sheffield *et al.* 2014; Singh and Chudasama, 2017). These impacts can lead to reduction of food availability and income, as well as increases in food prices, unemployment,

migration, food insecurity, and triggering disaster relief programs (FAO, 2004). These complex and potentially severe impacts emphasize the vital and urgent need for adaptation of the agricultural sector to reduce farmers' vulnerability and enhance their resilience and adaptive capacity to drought (Bryan *et al.* 2009). However, it is imperative to understand the non-climatic (e.g., socio-economic, cognitive, and cultural) factors that have contributed to farmers' vulnerability to drought to better address them and help farmers to enhance their adaptive capacity to such events. This paper aims to further this understanding by assessing the role of cultural beliefs on small-scale farmers' responses and vulnerability to drought.

Several studies on vulnerability to drought relate the issue to farmers' low level of adaptive capacity, which is a result of widespread poverty, high reliance on rain-fed agriculture and natural resources, limited financial and technological resources, and insufficient safety nets and educational progress (Below *et al.* 2012; Bingen *et al.* 2003; Deressa *et al.* 2009). While these factors are strong determinants of financial capacity to adapt, they are not final determinants of farmers' motivation to take adaptation measures (Ajzen, 1991; Grothmann and Patt, 2005; Persson *et al.* 2015). The factors determining farmers' motivation to act can sometimes be hidden and unconscious (Adger, 2007). However, studies show that in general people perceive and believe themselves as having minimal control over environmental problems (Grothmann and Patt; 2005), they believe that environmental problems fall within supernatural domains, such as god, ancestors, or witchcraft, against which they are powerless. The people's low perception of adaptive capacity often leads them to 'technological' inaction against environmental problems (Jones, 2011; Slegers, 2008), rather they act according to their understanding of the natural environment which is place specific, based on their local knowledge, and rooted in culture (Adger *et al.* 2009).

Culture shapes, and is shaped by, societies' relationships with their physical and social environment and supernatural forces (Halloran, 2004; IFRC, 2014, p.18). Culture represents a society's identity and personality, the common way to think, communicate, give meaning to symbols, and behave. Such commonalities constitute a society's tools, made to cope with their world and with one another, the basis of their activities, lifestyle, and interactions (Billington, 2000, p.159; Hall *et al.* 2003). Although culture encompasses knowledge, practices, beliefs, attitudes, values, norms and behaviours, it is cultural beliefs which are the focus of this study. These beliefs have gained increasing attention for their influence on the way people perceive, understand, identify, experience, and prioritize risks, their motivation to act, choices of response, and means of implementation, and the resultant impacts (Hofstede *et al.* 2010, p.4; Hulme 2009; IFRC, 2014, p. 40). Therefore, cultural beliefs, a society's underlying spiritual philosophy, ideology, and worldview (Murphy *et al.* 2016), are considered a crucial component in any context of Disaster Risk Reduction (DRR) and adaptation (Adger *et al.* 2009; Jain *et al.* 2015; Vincent, 2007; Wheeler *et al.* 2013). This illustrates the need to have a comprehensive understanding of the place-specific nature of farmers' cultural beliefs, the process of their decision-making responses, and how those beliefs can facilitate, or limit, responses to drought and ease the adaptation process.

Despite this, cultural beliefs remain neglected in research and are rarely taken into account in the design and implementation of DRR and adaptation, which has been linked to the maladaptive outcomes of the strategies (Adger *et al.* 2009; IFRC, p. 121; Ayeni *et al.* 2014; Narayan, 2005, p. 6). This paper tries to address this gap in the literature by exploring the diverse responses to drought undertaken by small-scale rain-fed farmers in Gaza Province, Mozambique. The country is one of the world's most vulnerable to natural disasters (e.g., droughts, floods, and cyclones) and according to Artur and Hilhorst [29], the scientific explanation about the occurrence of drought is not well-known or understood by many farmers in Mozambique. Thus, the farmers find alternative explanations for the

increased occurrence of drought and other natural disasters, which are commonly based on their cultural beliefs regarding the power of supernatural forces (God, ancestors, and witchcraft) over these disasters. Mozambique is therefore ideally suited to exploring and understanding cultural beliefs about the causes of drought, as well as the role of those beliefs in framing farmers' responses to drought.

To do so, the paper first shows how farmers have been adversely affected by drought and why the impacts are memorable and strong enough to trigger the need for responses to tackle its causes and reduce its impacts. Then it explores the diverse individual and collective responses farmers implement, including institutional intervention, and the dynamics and effectiveness of the responses. Third, the paper assesses how farmers' responses are formed, the role of cultural beliefs and other socio-cultural, economic, and institutional factors in the formulation of responses, and the interconnection between these factors and the outcomes. A key purpose of the assessment is to show how, despite the role of their enduring cultural beliefs in collectively tackling the causes of drought, farmers' choices of individual responses to reduce the impacts of drought and their level of vulnerability are a reflection of the interconnection of the socio-cultural, economic, and institutional environment in which they live.

6.2 Determinants of adaptation to drought

Adaptation is one of the policy strategies that are crucial to reduce farmers' vulnerability and increase their capacity to adjust to the adverse impacts of drought, to protect their livelihoods and ensure food security (Adger *et al.* 2007; Bryan *et al.* 2009; Jones *et al.* 2010). Adaptation is a palpable modification in human systems of behaviour and characteristics which allows reaction to, or anticipation of, responses to climatic stimuli (Adger *et al.* 2013; Brooks, 2003, p. 8; IPCC, 2012, p. 556). Adaptive action, at institutional and local levels, to reduce or cope with the impacts and to effectively adapt to the conditions, can take many forms. However, based on timing relative to stimulus, institutional

adaptation strategies are generally portrayed as planned, based on predictions of possible future conditions, while adaptation at the local level is often described as reactive, based on memories of past events and current impacts (Adger *et al.* 2005; Jones *et al.* 2010).

Nonetheless, most African countries have limited economic resources to invest in potential measures to enhance adaptation, such as improving agricultural technologies (e.g., development and promotion of drought-tolerant crops varieties and improved water management techniques), markets, information systems, infrastructures, etc. (Cooper *et al.* 2008; Grothmann and Patt, 2005). Thus, most drought adaptation strategies implemented by government and their development partners take the form of relief responses, the most common being food aid distribution to compensate for production shortfall (FAO, 2004). Hence, it is argued that food aid distribution to drought-affected people has become a structural feature in most African countries (Nunn and Qian, 2010), aiming to meet their immediate basic food needs, but struggling to do so, while at the same time building their capacity to adapt to future droughts (FAO, 2004; Tschirley *et al.* 1996). Other common forms of institutional responses are drought rehabilitation (free, or subsidized, seed distribution), and drought mitigation (construction of water reservoirs and food storage programs) (FAO, 2004). Thus, Wilhite (2005, p. 4) contends that government responses to drought are in fact reactive, mostly they respond to crises (crises management) in a poorly coordinated and untimely way. Additionally, Wilhite *et al.* (2014) posit that such relief responses have been shown to increase vulnerability to future drought episodes by reducing self-reliance and increasing dependence on government and its partners.

Indeed, due to poverty, reliance on institutional aid is one of the most common reactive and short-term responses to shock implemented by poor farmers (Mavhura, 2015; Ogalleh *et al.* 2012). Other common responses include livelihood diversification, modification of crop management practices, sale of assets, such as livestock, and local or international mass labor migration (Cooper *et al.* 2008; Ogalleh *et al.*

2012; Singh and Chudasama, 2017; Thomas *et al.* 2007), as well as consumption of alternative foods, reduction in the number of daily meals to fewer or to one (Carter *et al.* 2007; Opiyo *et al.* 2015; Trærup and Mertz, 2011; Webb and Reardon, 1992). Such short-term responses, which may over time be turned into long-term strategies, are not necessarily adaptation, but are coping strategies (Jones *et al.* 2010), i.e., short-term measures used to lessen the impacts of unexpected stressors (Ogalleh *et al.* 2012), often driven by farmers' limited capacity and initiative to adapt due to poverty and livelihood shocks.

These 'reactive' responses, at both institutional and local level, are not helping farmers to reduce their vulnerability and adapt to drought since they still lack the necessary means to do so. Some studies have found that limited access to resources, credit, markets, technologies, and extension services are some of the constraints faced by poor farmers to take measures to adapt to drought (Brooks *et al.* 2005; Deressa *et al.* 2009; Maddison, 2007). Other factors that may constrain or facilitate adaptive measures, which receive less attention, are the normative and cultural factors that have influenced people's motivational behaviour to take adaptive actions (Frank *et al.* 2011; Jones and Boyd, 2011; Shackleton *et al.* 2015). These factors frame how societies function, their beliefs about and attitude towards risks, values about the prioritization of risks, and the actions people are expected to take in response to risks. Such factors, thereby, can be a supportive system influencing actions, or they can act as a perceived pressure on people to respond accordingly (Hofstede *et al.* 2010, p.28; IFRC, 2014, p. 14; Jones, 2011). Therefore, understanding these normative and cultural factors is essential to understand adaptation activities carried out at community level, the reasons behind the choice of activities, and the success and/or failure of the chosen strategies (Adger *et al.* 2013).

Several theories exist to explain the complexity of human behaviour and what motivates performance of a certain behaviour. One such theory, widely used in socio-psychological and agricultural studies, is

the Theory of Planned Behaviour (TPB), which addresses behaviours over which humans lack complete volitional control (Ajzen, 1991). According to the theory, the performance of a behaviour is a joint function of intentions and perceived behavioural control, as both are critical determinants of people's motivation to undertake a certain behaviour. Usually, people start to weigh the potential harm of a stressor and assess their own capability to prevent losses when they reach a certain risk threshold (Gocsik *et al.* 2014; Grothmann and Patt, 2005). Thus, generally, people are more likely to engage in behaviours they believe are achievable, or that will achieve the desired end – perceived self-efficacy (Ajzen, 1991; Bandura, 1997). This perceived self-efficacy can influence people's choice of response and the level of preparedness and effort they would take to perform the behaviour in question based on the perceived level of difficulty (Bandura, 1997; Gocsik *et al.* 2014; Grothmann and Patt, 2005). People's perceived behavioural control, together with their attitude (positive or negative) towards the behaviour and subjective norms (perceived social pressure to behave in accordance), leads to the formation of intentions (Ajzen, 1991).

However, because many societies worldwide spiritualize their universe, they attribute drought events to supernatural forces, such as God, spirits, and ancestors (Dei, 1994; Schipper, 2010), about whom people feel a sense of disempowerment and inaction (Slegers, 2008). Since farmers believe that supernatural forces only act for a reason (Christian, 2014), they hold themselves responsible and accountable for the supernatural forces' actions (Douglas and Wildavsky, 1983, p. 7), and their choice of response will be driven by the desire to correct the perceived wrongdoing in order to gain forgiveness and stop drought from occurring (IFRC, 2014, p. 37). Despite a considerable decline, one of the most common cultural responses to please the supernatural forces and induce them to end drought is the performance of rain-making ceremonies (Başgöz, 2007; Christian, 2014; Semenya, 2013). This may not be the most appropriate response, and may increase people's exposure and vulnerability, but it bonds communities together, helps them explain the occurrence of drought and find comfort to

overcome its impacts, and thus it facilitates recovery (IFRC, 2014, p. 40). Such beliefs about the causes of drought may also affect the uptake of the related scientific information and may create discrepancies between peoples' beliefs about appropriate responses and those institutional adaptation strategies that are considered logical and effective (Adger *et al.* 2013; Persson *et al.* 2015).

Therefore, Ajzen (1991) asserts that behaviour is a function of salient information, or beliefs, relevant to the behaviour and, as a consequence, salient beliefs are considered the prevalent determinants of intentions and actions. Hence, cultural beliefs have received increasing attention for vigorously framing people's interpretations of the causes of the risks, attitude towards risks, and the means of addressing them, thus also influencing adaptation to environmental and climate change (Brennan *et al.* 2009; Leck *et al.* 2011). However, cultural factors are often missed in adaptation and DRR contexts, which has reduced the effectiveness of the strategies for not connecting with communities' viewpoints, concerns, and priorities (Adger *et al.* 2013; IFRC, p. 121; Kuehne, 2014). Drawing on these insights, the next section explores how cultural beliefs shape the formulation of responses to drought, taking the case of small-scale farmers in Gaza province, southern Mozambique.

6.3 Research setting and Methodology

6.3.1 Research setting

Mozambique is one of the poorest countries in the world, agriculture is the primary economic activity of around 80% of the population, and 95% of them practice under rain-fed conditions (DFRI, 2012). However, drought, the most common and major hazard in the country, has occurred more frequently and severely over the past few decades (INGC, 2009). From 1980 - 2016, at least ten major drought events occurred, 70% of them lasting more than a year, affecting more than 19 million people (MITADER, 2015). Therefore, drought represents the single most important limiting factor in agricultural

development, with the risk of crop failure up to 75% in the interior of Gaza province (MASA, 2011), the focus of this study. Currently, only 10% of the 46% of the existing arable land is being exploited (FAO, 2017b), in an average farm size of 1.4 ha (MINAG, 2012), and with stagnant yields of between 30 to 60 percent of their potential (IFAD, 2011). As a result, drought is also seen as an impediment to the achievement of food security, poverty reduction, and long-term development of the country, and thereby as a contributing factor to small-scale rain-fed farmers' vulnerability (Artur and Hilhorst, 2012).

On the other hand, inequity in agricultural development and economic growth have affected the geographical distribution of resources and services in Mozambique; thus, poverty levels remain high in the country (54.7%), mostly in rural areas where around 70% of the population live (Irish aid, 2018). Moreover, Gaza was the only province in the southern region to register an increase in the poverty rate in the 2000s, while it stabilized or declined in the rest of the region (World Bank, 2016). Around 46.1% of the Mozambican population of 28 829 476 live on less than US$1.90 a day (World Bank, 2018a), below the poverty line. Mozambique has Gross Domestic Product (GDP) per capita of 500.77, and a low Human Development Index (HDI) of 0.437, which positions it at 180 out of 189 countries and territories (UNDP, 2018, p. 25). High poverty rates associated with poor access to financial services and limited access to markets, credit facilities, or employment opportunities have restricted small-scale farmers' ability to invest in diversification or improved techniques and to respond to drought and other natural disasters (Artur and Hilhorst, 2012; Cunguara et al. 2011). Thus, Hesselbein (2010) argues that the above reasons were the main contributors to the failure of the Green Revolution strategy in the country. Farmers' limited ability to respond to drought has continued their need for assistance in the aftermath of disasters, with at least 300,000 people requiring food assistance per year (DRFI, 2012).

Therefore, from 2006 - 2016, the government implemented a plan to reduce the risks from natural disasters and the vulnerability of the population. This incorporated prevention, vulnerability reduction,

reconstruction, and development of drought-prone areas. The Government argued that one of the country's main weaknesses is the culture of dependence on aid, a result of civil war (1977 – 1992) and disasters, which has become almost a way of life (Governo de Moçambique, 2006). Thus, in the fight against extreme poverty, the Government acknowledged the urgent need for change through the reconstruction of rural people's self-esteem, self-assurance, and dignity, and by the reduction of their dependence on rain-fed agriculture as their primary economic activity (Foley, 2007). Failing to achieve several expected outcomes, mainly the reduction of people's vulnerability to drought, which remains very high and is unsustainable, the plan was updated in 2017 for a further 13 years. The lack of an early warning system and of a guide to activities to make a timely response and mitigate the impact of drought were some of the factors believed to have contributed to the failure of the plan. In the updated plan, the Government recognized the importance of improving public understanding of DRR and adaptation to climate change, and involving the public and a better-trained team on DRR and adaptation activities for better outcomes (Governo de Moçambique, 2017).

6.3.2 Methods

To have a more comprehensive understanding of drought situations, impacts, and responses in the study site, fieldwork was conducted between April and September 2017, in an arid (Chibuto) and semi-arid (Guija) district in the south-west part of Gaza province. A total of 200 open-ended questionnaires and 25 Focus Group Discussions (FGD) were carried out, where participants' experiences with drought, individual and collective responses (rooted, or not, in their culture) and their viewpoints or beliefs of the most appropriate (local and institutional) responses to drought were explored. The majority of participants were randomly selected based on a list of inhabitants supplied by the local leaders. In cases where the selected people were absent, purposive and snowball sampling were used to replace participants of the questionnaire and FGDs, respectively. Snowball sampling was crucial to select other people that the participants considered knowledgeable in the subject. Women constitute

the majority of the population in the study site and province, subsequently more women (76%) participated in answering the questionnaires than men (24%) (See Table 1 for socio-demographic characteristics). Women constitute the majority of the population in the study site and province, subsequently more women (76%) participated in answering the questionnaires than men (24%)

The FGD were more balanced in terms of gender (male and female) and age group (16 – 24; 25 – 44; and over 45 years old). The same number of FGD, comprised of six to eight participants, were formed for each gender and age group, except for Chibuto where it was formed two female groups of 45 years old, each comprised of 4 participants. In addition, a total of 17 interviews with key-informants (community leaders, governmental bodies, NGOs and Church leaders) were conducted to gain familiarization with the study site and to have a better understanding of the interventions being implemented in response to drought. The interviews also served to explore the interaction between farmers and these institutional bodies, the influence of the institutional bodies on farmers' perceptions of the causes and behavioural responses to drought, and consequent vulnerability levels. Field notes and recordings, informal conversations, revision of official documents, reports, journal articles, handbooks, and online newspapers complemented the background information of the study site. The qualitative data were analyzed through conducting a thematic analysis using NVivo software. This involved reading, thoroughly, through the interview and FGD transcripts and identifying themes in the participants' responses. SPSS (Statistical Package for Social Sciences) was used to analyze the quantitative data, which consisted of descriptive statistics, particularly, cross tabulations (crosstabs) to determine the interconnections and interaction between variables, compare them and calculate their percentages. Vensim was used to design the causal loop diagram which shows the interconnection among the diverse factors affecting farmers' responses to drought.

6.4 Understanding the need for, and choices of, response to drought

Before delving into farmers' responses to drought and factors that drive them, the paper explored the reasons why farmers feel the need to respond to drought. This section shows how farmers' activities, lives, and livestock have been affected by drought, and the drought events farmers remember. The paper then explores farmers' (individual and group) responses made to reduce the impacts of drought they keep alive in their memories, including institutional interventions, and the dynamics and effectiveness of those responses.

6.4.1 Impacts of drought on farmers

Since impressionable events tend to be easily recalled from people's memories (Ferrier and Haque, 2003), results show that harsh impacts on farmers' agricultural activity (crop production and yield), livestock production, livelihoods, and health are as a result of droughts dating back to 1947 which remain memorable to them (Table 6.1). Such classic events were even shared by younger people as their grandparents and parents recalled them countless times during their traditional storytelling moments about the past suffering caused, thus the events have become collective memories within the community. These memories are what make farmers compare past and current duration, intensity, and impact of drought events, the type and level of difficulties of responses and, thereby, the need to adjust their responses to reduce the impact and consequent suffering.

Table 6.1: Farmers memories of drought events (*n* = 25 FGD)

Year	Memory	Study site	Age group (years old)	Number of references*
1947	It killed many people and cattle. We used to take the bones of the dead cattle to sell and have money to buy food.	Guija	Over 45	1
1952	We did not have any food to eat; we survived eating cassava and hunting.	Guija	Over 45	1
1970	It killed many people and cattle. We survived eating wild fruits, roots, and tubers. We had to cut trees to feed the cattle.	Guija	25 – 44; over 45	2
1980**	There was no food and drinking water. We used to eat only bread with cacana (*Momordica balsamina*).	Guija	25 – 44; over 45	4
1982**	We faced hunger and were forced to go to Songuene (more than 30km distance) to get food.	Guija	Over 45	1
1983**	There was no food, even in the markets or food shops. We survived eating wild fruits, roots, tubers, and animals from the bush we had never eaten before. We used to take the bones of the dead cattle or mafurra (*Trichilia emetica*) lump to sell and have money to buy food.	Chibuto and Guija	25 – 44; over 45	10
1992**	Many people and cattle died due to the lack of food and drinking water.	Guija	25 – 44; over 45	2
1993	There was no food and our parents were forced to go to distant places to buy coconuts to re-sell it to have money to buy food. We also survived thanks to food aid from Calamity Organisation.	Chibuto	25 – 44	1
1995**	There was no food and water for people and cattle; we queued for days in some food shops to buy food. We also survived thanks to food aid from Calamity.	Chibuto and Guija	25 – 44; over 45	2
1997	There was no food; we survived thanks to food aid from the National Disaster Management Institute (INGC).	Guija	Over 45	2
2004**	There was no drinking water for people and cattle; we had to walk long distances to get water.	Guija	25 – 44; over 45	1
2005**	There was no drinking water for people, and animals and many cattle died because of that. We were forced to consume salty water from the lake and eat wild fruits. We were also forced to find other sources of income to survive, such as produce and selling traditional mats, or seasonal work at rice companies.	Guija	16 – 24; 25 – 44	4
2007**	We starved to the point of not being able to walk. We survived eating cassava and helping each other.	Guija	16 - 24	1
2008	Same impacts as in 2005 and we had to remove the grass that serves as the roof of our houses to feed the cattle.	Guija	16 - 24	3

Year	Memory	Study site	Age group (years old)	Number of references*
2012 – 2017***	We had no food and drinking water. We were forced to sell our animals for derisory prices to get money to buy food or exchange the animals for food. We sold wood, charcoal, traditional mats and baskets, and did some seasonal jobs to get money to buy food. We were also forced to buy water from people bringing it from other areas. We only managed to have one meal a day, instead of the usual three that consisted of maize flour porridge with some meat from the animals we had to sacrifice since they were fragile. We used to drink hot water and tie capulana (a traditional type of sarong) very tight around our waist to reduce the feeling of hunger. Because of the bad nutrition, some people started losing weight and getting a swollen belly.	Chibuto and Guija	All	25

*Number of FGDs which have given the response.

** Matching with the general records of drought years in the country (Source: MITADER, 2015 and WMO, n.a.).

***Farmers expressed different views on the duration of the event, but shared similar memories of the impacts; 4% of farmers believed it started in 2012; 8% in 2013; 60% in 2014; 24% in 2015 and 4% in 2016, while 92% believed that it ceased at the end of 2016 and the remaining 8% believed it ceased at the beginning of 2017. As farmers have different levels of sensibility and vulnerability to drought, they felt the impact of the event on their food availability and overall livelihood in different periods.

According to the farmers, while in the past droughts were shorter in duration (less than a year) and less intense (moderate), nowadays droughts are more prolonged (up to 3 years) and extreme, making the soils arid and compact, thus not ideal for planting under rain-fed conditions. Additionally, the arid and compacted soils make it even harder to use animal traction for ploughing, forcing farmers to plough with a hoe, thereby reducing the cultivated area and increasing the workload for women who are already responsible for most of the agricultural-related activities within the household but are forced to help to manually prepare the land. This is because men are usually responsible for using animal traction for ploughing, while women are mainly responsible for the rest of the agricultural activities as well as the household chores (e.g., child-care, food preparation and collection of water). Even within the female-headed households, women often have someone ploughing their lands in exchange of labour in the person's land during weeding periods, or in some cases they hire ploughing services. The compacted soils also make the infiltration of water very difficult, in most cases the soil becomes saturated, resulting in reduced plant growth and yield, often forcing farmers to temporarily move to high land areas during intense rain periods (February), or even permanently if they manage to do so at all.

On the other hand, despite a combination of factors which may have contributed to the described reduction in crop yields of more than 50% in the last two decades, such as poor seed quality and low soil fertility, the majority of farmers (97%) believed that drought was the primary cause of the reduction. The reduced yield and the current prolonged drought periods mean most farmers and their families face food shortages, food insecurity, and hunger at some point since they struggle to afford the expensive foods in the market. This is exemplified by an over 45 years old male group in Chibuto who compared a drought in 1983 with one in 2014 – 2016, as seen in Table 6.1:

"In the past, during periods of drought we had money to buy food, but there was no food in the shops. We used to queue for days outside the food shops to buy some food to feed our families, but not always we managed to get what we queued for. While now there is enough food in the shops during drought, but everything is costly that we can barely afford them".

Also seen from comments in Table 6.1, food insecurity and hunger make people weak and thin and swells their bellies, in extreme cases it causes death. It also stops children from attending school, as they feel weak and unmotivated, or in some cases they have to help their parents with activities to generate income. Drought also affects farmers' livestock by significantly reducing the availability of food (grass and leaves from trees) and drinking water, often causing their death. Drought also limits the availability of drinking water for people, with male farmers from a 16-24 and an over 45 years old FGDs in Guija exemplifying that:

"*During the last drought, the water in the reservoirs was not enough to supply the usual daily quantity to people and animals. Therefore, water was provided on alternate days to people and animals. We were only allowed to have 75 litres of water per week, independent of the size of our families; thus, not being enough for us, neither for the animals, which although we gave them sap from a local tree, they did not resist.*"

Therefore, all the described reasons made farmers increasingly aware of the current magnitude of drought events and their impacts, consider it as the limiting factor to their agricultural activity and well-being, and acknowledge the importance of responding to drought to minimize its impacts. The diverse strategies used by farmers (individually or in groups) to deal with the causes and impact of drought are described in the next section.

6.4.2 Farmers' responses to drought events

Results show that the majority of farmers (63.5%) believe that drought is caused either by God (51%) or by their ancestors (12.5%) as a punishment for some (unknown) wrongdoings. The majority of these farmers were over 25 years old women. Therefore, based on their knowledge and understanding, and their cultural belief of appropriate responses, i.e., to address the perceived causes of drought (God or their ancestors) as they have done for endless years, farmers implement a range of responses at collective and individual levels that are culturally based. The collective responses (implemented as a group for a common purpose) try to tackle the perceived causes of drought. While the individual responses (conducted by one person, although for a shared group purpose) attempt to address its impacts.

6.4.2.1 Responses to tackle the causes of drought

Although only 12.5% of the participants continue to believe that their ancestors cause drought, a more significant portion of old people (31%) still participate in traditional ceremonies to ask their ancestors for rain; driven by their common needs and recognition of the importance of respecting, following, and preserving such traditions for a prosperous life. Tradition also dictates the performance of diverse types of traditional ceremonies which include the request for rain. An example is the usual rain-making ceremony called Mbelelo, which is performed before the rainy season begins, or even after if rain is delayed. The ceremony takes place in a sacred venue under the direction of the community elders, the secretary, and the witchdoctors; the community leader stays at home to inform, from there, their ancestors' spirits about the ceremony. However, a portion of everything to be consumed at the ceremony has also to be left at the leader's house for presentation to the spirits. The essential food items comprise of traditional alcoholic drink, usually made from canhu (a wild fruit), a goat, and two black chickens.

The presence of the elders is crucial to the ceremony as the carriers and guardians of the traditions, and for their closeness to the ancestors, thus they are the right people to transmit the request. While the witchdoctors are believed to have supernatural power to communicate with dead people, they serve as the communication channel between the elders and the ancestors. In case of fruitless results, witchdoctors are also responsible for discovering and reporting the reasons for failure which need to be corrected with another ceremony. In fact, 48% of the participants, individually, shared the perception that nowadays the traditional ceremonies do not provide a significant result. This perception was even shared by the local authorities, as exemplified by one of the community leaders:

"In the past, an animal, such as a snake or a turtle, always appeared during the ceremony. These animals were symbols of our tradition, and confirmation that the ceremony was successful, our requests were heard and accepted, and thereby the production would be good. Additionally, right after the ceremony, it would start to rain heavily, even before the attendants were able to leave the venue, soaking them all. However, nowadays these animals do not appear anymore, and the ceremonies have been fruitless since it does not rain right away. I believed this is happening because our ancestors and God are extremely mad at us to respond or accept our requests".

On the other hand, although prayers at the church to ask God for rain have always been a practice in the study site, over the last decade churchgoers started to believe that it was not enough to produce the expected results, but that it was essential to complement the individual church prayer with a joint prayer including all the existing churches. Thus, a joint churches' prayer started to take place at the community meeting centre a day after the performance of the traditional rain making ceremony to strengthen the request and increase the possibility of it being rapidly fulfilled. The prayer is attended by 69% of

participants, both religious and non-religious since everyone believes that God is the only power with control over the rain. However, similar to the traditional ceremony, 42.5% of participants perceived that the joint churches' prayers often fail to provide expected results.

While trying to 'fix' the failure of both these collective responses to provide an immediate positive outcome, even if that occurred, would require at least three months before farmers could harvest any crops, thus, in order to survive, farmers feel the need to individually find other types of responses to obtain food for their household consumption, as explained in the following section.

6.4.2.2 Responses to reduce the impacts of drought

Although 91% of farmers have strategically shifted planting months from September – December to other months due to rainfall unpredictability, including planting during the winter season (from April to August), not a usual practice in the past. This has become essential to secure the opportunity to plant their crops, and may be unique to that particular year, however they continue to be affected by drought, which have last much longer than their stored food. Therefore, farmers have to individually implement several activities to reduce drought impacts and ensure their household food security and survival. A total of 11 activities were identified and grouped into three categories (Fig. 6.1): dependence on help; income generation activities; and secure immediate food needs. Most of their responses are short-term coping strategies, as they are only implemented during that period of unexpected stress to lessen the impact (Barrett *et al.* 2001; Ogalleh *et al.* 2012).

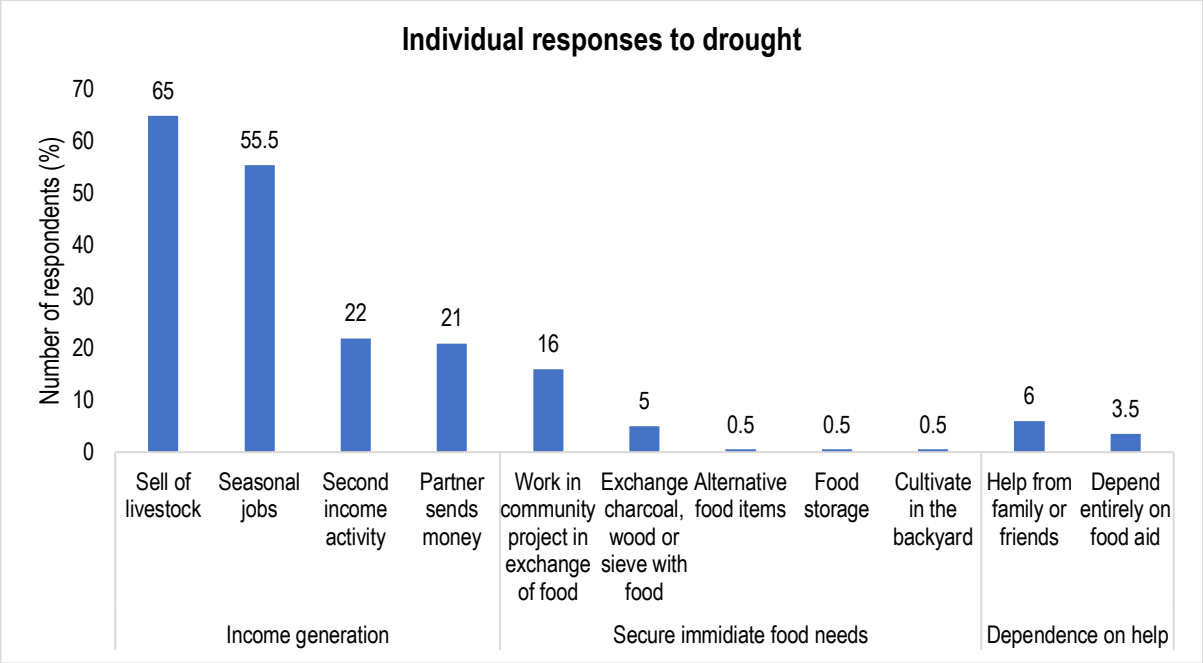

Figure 6.1: Farmers' individual responses to drought

Dependence on help

Although most farmers individually implement actions to reduce the impacts of drought, they all rely on help from the government and their partners through food aid (e.g., World Food Program - WFP). Even though the process of selection which prioritizes beneficiaries, the quantity and type of aid distributed, and the frequency and duration of distribution is still not satisfactory to farmers, they feel that such kind of intervention is vital to them since it provides them with food for their survival and helps to reduce suffering, as exemplified during the FGDs in Guija:

"Although help comes a bit late, it serves to minimize the impacts of drought. Perhaps if we did not have such help, we would have moved to other zones such as Chockwe, which was not as heavily affected by drought" (25 – 44 years old female group).

"The kind of help given is appropriate for that moment when we are suffering from hunger for being unable to produce any crops. However, we need other kinds of help, such as cattle to increase our production and thereby have more animals to sell during drought periods, waterholes for our consumption, and reservoirs to irrigate vegetables, and for cattle's consumption during and after drought periods" (over 45 years old male group).

The prioritized beneficiaries were usually the ones unable to self-implement responses to drought, such as: the poorest farmers, who had no financial means or assets to sell; elders, due to their physical inability to take jobs; and widows, orphans and single mothers because of their sole responsibility to take care of family members. Thus, they were entirely dependent on food aid or help from their families and friends living in other areas not affected, or not as severely affected, by drought.

Income generation activities

Farmers' most common income generation activities are selling livestock (65%) and finding seasonal jobs (55.5%). Contrary to findings from Trærup and Mertz (2011), where livestock represented security against shocks, and although livestock, mainly cattle, constitute farmers' main asset and its sale is the most implemented individual strategy to respond to drought, it is not necessarily the primary option for obtaining money to buy food, rather it is a last resort. This is because cattle have social and cultural value to male farmers, representing prestige, selling them means losing the prestige at the end of the drought. Even when farmers run out of surplus food and savings, they still prefer to find other solutions to obtain food. Manjengwa et al. (2012) and McCabe (2004) have reported similar findings regarding the socio-cultural value of cattle to farmers but opposing in relation to reluctance in selling the animals in times of stress as the animals are used as buffer. On the other hand, studies by Ainslie (2005) and Nyima (2014) associate farmers' reluctance in selling cattle with the unfair market prices.

According to one local authority in Guija, during the last drought it was crucial to make a vigorous campaign to promote the timely sale of livestock to gain fair payment and help farmers buy food. However, the authorities found some resistance among most farmers. For example, one of the biggest livestock producers, with whom I had the opportunity to visit during the fieldwork, despite having lost almost 100 out of 350 cattle, continued to refuse to sell his cattle since the goal was to multiply. This view and resistance were shared by several farmers, with some adding that they did not want to start from zero once the drought ended, or create a habit of selling their animals.

Due to farmers' reluctance to sell their cattle, they tended to be sold for derisory prices, when the animals were fragile and thin, and almost dying; therefore, the money obtained from the transaction was insufficient to secure food for farmers' families. Moreover, due to this perceived prestige, the decision to sell cattle is exclusive to men, while women are allowed to decide (alone or with their husbands) to sell or consume small animals such as goats and poultry. Manjengwa et al. (2012) also found among rural Zimbabwean farmers that small animals are mainly considered to belong to women.

On the other hand, the most common seasonal jobs taken during drought periods are selling locally produced items (e.g., charcoal, wood, traditional mats and sieves, and dried fish) (30%); fishing or helping to pull fish nets (13%); finding odd jobs locally, in the nearest town, city, or in South Africa (e.g., bricklaying or weeding on irrigated farms) (8.5%). Most of the seasonal jobs implemented within the community are performed by women and some by older people, while men (mostly under 45 years old) tend to look for seasonal jobs outside the community.

Secure immediate food needs

Farmers also take measures to secure their immediate food needs. The most common practices include exchanging locally produced charcoal, wood, and traditional sieves for basic food items (5%), and working in community projects in exchange for food (16%). The former practices are mostly implemented by female farmers when they do not manage to access buyers for the locally-produced items, which is aggravated by farmers' difficulties to access markets, which are far away, and along poor roads. The latter, called Food for Work Program, was recently introduced in the country (during the last drought) as part of the state and its partners' portfolio of food aid, but with the aim of reducing people's perception that it is the government's responsibility to provide food aid during emergencies and, in the long-term, to increase people's self-sufficiency while helping them meet their immediate basic food needs. For instance, in exchange for food provided by the WFP (40 - 60kg of maize grain, 9kg of peas, and 4 litres of oil), the beneficiaries have to work together to improve or build infrastructures in the community, such as cleaning or building schools, roads, and meeting centres.

The rural roads the beneficiaries build are basically dirt roads, which they build by removing grass and stumps using local instruments such as machete, axe and saw. The schools and community centers are essentially mud huts with grass rooves, which are the same materials most community members use to build their houses themselves. In other cases, the community centers only comprise of an open space with some trunks strategically placed to serve as seats. A rotary system is used to select the first beneficiaries, prioritizing those most in need, such as elders, widows, and orphans. This system was not very well understood nor received by the other beneficiaries who found it hard to see others eating while they were starving.

Although consuming alternative food items (e.g., wild fruits and tubers, aquatic roots, and wild animals) and storing any food surplus are strategies that were widely implemented by participants in the past, now alternative food items are scarce in their communities, even during the rainy season, and the current long periods of drought have made it challenging to store the limited food surplus for the duration of the drought. It is also a challenge to have sufficient water to cultivate crops in the backyard, a common practice in Chibuto district, as water is primarily used for consumption. The limited amount of food surplus for the extended drought period is what made farmers stop selling or exchanging any food surplus for non-food items. Additionally, the long periods of drought meant farmers learnt not to squander food, to consume it wisely in reduced quantities and less frequently (i.e., reducing meals from three to one a day) to be sufficient to feed their large families (the average size being 11).

This section has shown the diverse individual and collective activities farmers implement to respond to drought. However, for a better understanding of why they implement these responses, the next section explores the underlying decision-making process about responses and the factors influencing farmers' choices of responses to drought.

6.5 Unveiling the factors influencing farmers' behavioural responses and choices of responses and vulnerability

This section explores factors influencing farmers' individual and collective responses to drought. Section 6.5.1 draws on the empirical data to develop a comprehensive understanding of farmers' decision-making processes to deal with the causes and impacts of drought and to assess the role of cultural beliefs in the process. Section 6.5.2 unveils the diverse factors influencing farmers' choices of response; it examines

factors involved and the outcome of their interconnection in farmers' response choice and vulnerability levels.

6.5.1 The process of response formulation

Results show that farmers' knowledge, experience, and memories of the impacts of drought frame their awareness of the need to respond, and that they implement an array of responses at collective and individual levels. Responses at individual level are implemented at different stages (Fig. 6.2).

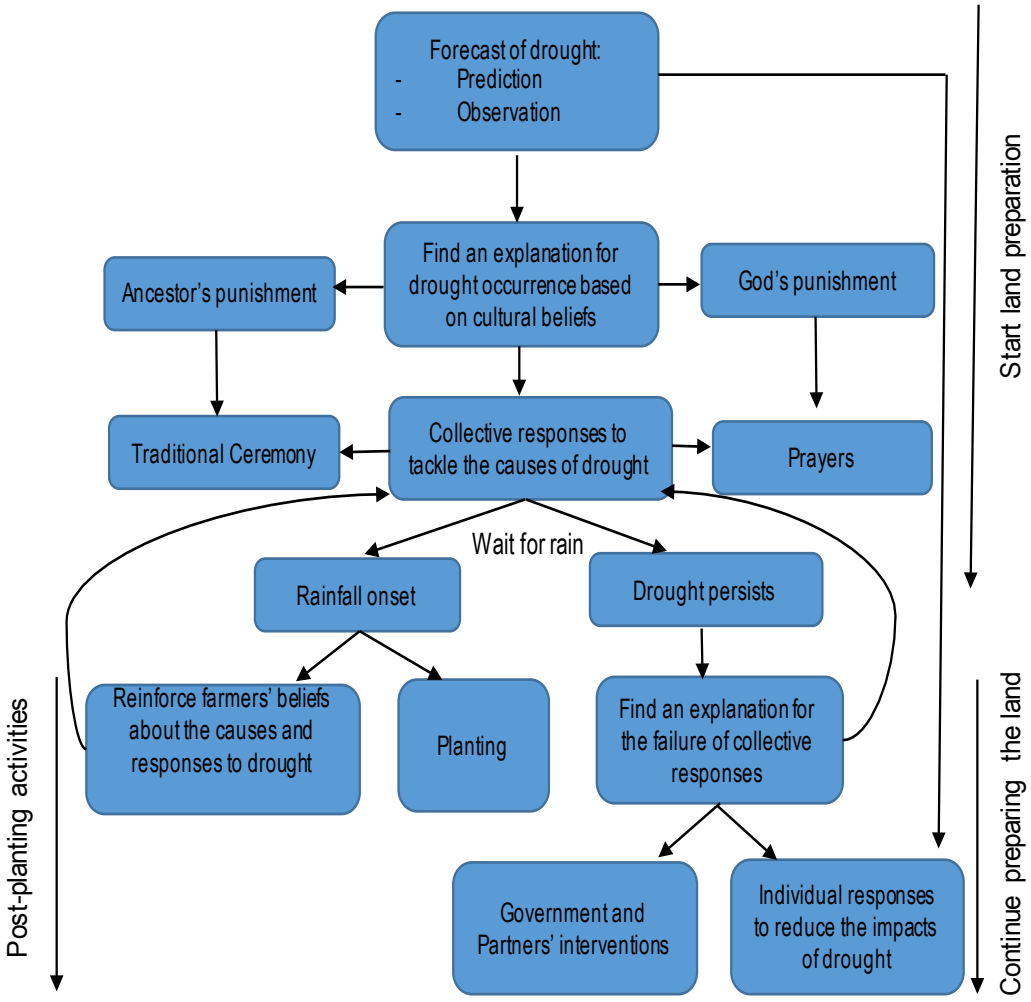

Figure 6.2: Farmers' decision-making process in response to drought

First, there are those farmers who are neither directly nor indirectly involved in collective responses; thus, after predicting drought, they immediately focus on their individual responses. Those who do not get directly involved are usually the ones who do not participate in the ceremonies, rather they follow the tradition of contributing money or goods for the realization of the ceremony, or get another household member (usually the eldest) to participate. Those who do not directly participate in the ceremony (mostly under 45 years old men) generally have another income generation activity outside the community or become labour migrants during times of stress.

Last, there are those farmers whose responses are framed by their understanding of drought as being a punishment from God or their ancestors for their wrongdoing, and by their enduring cultural belief of the most appropriate responses to address the perceived causes of drought. Thus, after drought is predicted, those farmers tend to first collectively address the perceived causes (Fig. 6.2), firstly by trying to find explanations for the punishment, driven by their perceptions of a recent or current moral wrong, or of peculiar or adverse events occurring in their local environment, or even nationwide. Then, through the performance of traditional ceremonies or prayer, farmers ask their ancestors or god for forgiveness for the wrongdoing and to bless them with the rain and hence successful production.

Even though around 45% of farmers perceived a significant reduction in the effectiveness of these collective responses to drought, 63.5% continue to believe that they are the most appropriate responses. When the collective responses are fruitful, they serve to reinforce their cultural beliefs about the causes (ancestors or God's punishment), the underlying reasons (explanation found for the punishment), and the most appropriate response to drought (traditional ceremony or prayers). On the other hand, when these responses are fruitless, farmers do not necessarily abandon their beliefs about the causes of drought, but rather they hold themselves accountable for the failure of their responses, and seek a potential explanation

in order to correct them. While trying to 'fix' such failures, and as the months of no production continue, along with the reduced food surplus from their low yield, farmers start to implement individual responses to drought to obtain food for household consumption.

However, as the earnings from individual responses are insufficient to feed their large families, a great number of farmers face food insecurity, turning the situation into an emergency. Therefore, the government and their partners are required to intervene to help reduce farmers' food insecurity through food aid. This cycle of actions, which has become characteristic in the country, results in farmers perceiving it to be the government's responsibility to provide them with food aid and to compensate them for their losses, even though they could manage to obtain food for themselves.

6.5.2 Factors influencing farmers' responses and vulnerability levels

While we have seen above that farmers' collective responses are influenced by their enduring cultural beliefs about the causes and appropriate responses to drought, their choice of individual response and their level of vulnerability are a reflection of the interconnection between the socio-cultural, economic, and institutional environment in which they live (Fig. 6.3). Indeed, Artur and Hilhorst (2012) contend that individuals' responses to stressors are rooted in their social, historical, cultural, and institutional environments.

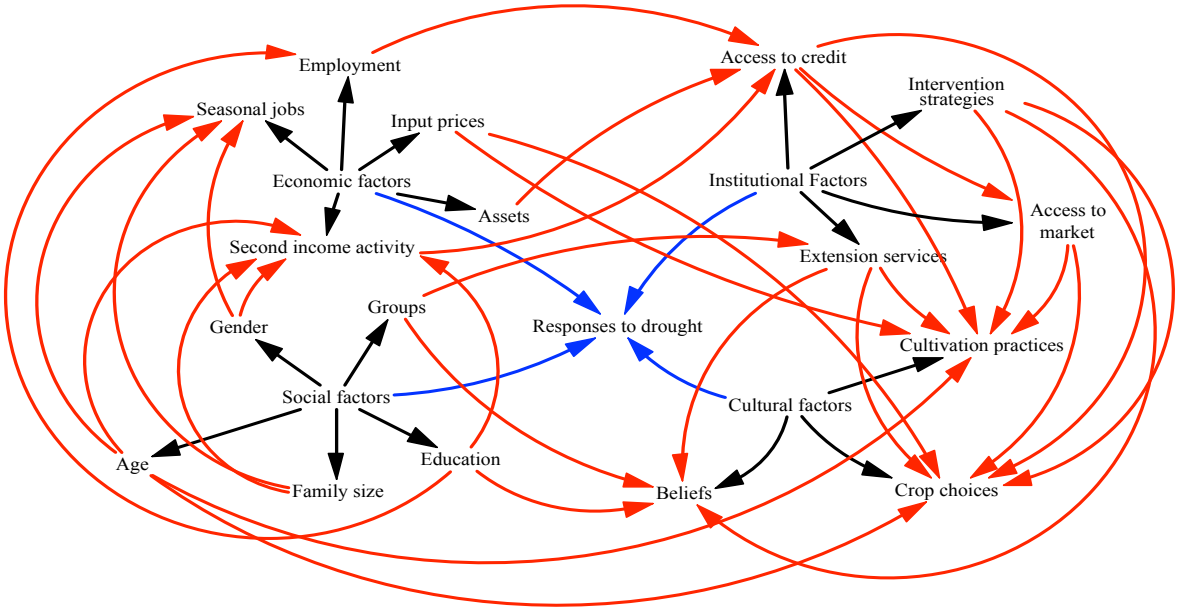

Figure 6.3: Causal loop showing how socio-cultural, economic, and institutional factors are interconnected, affecting farmers' responses. The blue arrows indicate the factors influencing farmers' responses, the black arrows indicate the variables within each factor, and the red arrows demonstrate the relationship between the variables.

How the interconnection among the above factors affects responses is explained below. Within each factor, the paper unpacks the main variables influencing farmers' responses and analyses how some influence farmers' cultivation practices, the choice of crops to grow, and their income generation activities.

Influence on cultivation practices

While the modification of agricultural practice is seen as one of the strategies for responding to drought (Singh *et al.* 2016), farmers did not change their traditional cultivation techniques (e.g., manual and continuous cultivation without fallow) to include improved techniques suitable to dry conditions, such as conservation agriculture. This is because their techniques constitute the only practices they know and can

afford. They have been implemented for generations and acknowledged as providing 'good production' for household consumption when the rainy season is good. In fact, these farmers' traditional practices and the local seed varieties used are deemed to be one of the main contributors to their low yields (less than 1ton/ha) (IPNI, 2011). This is barely enough for farmers to feed their families until the next harvest and to have surplus to sell to help them reduce their financial ability to respond to stressors.

On the other hand, as shown in the causal loop, the lack of access to extension services (both governmental and institutional) also contributes to reduce farmers' production, to limit their knowledge, and to prevent their use of improved cultivation techniques (Cunguara and Darnhofer, 2011; MASA, 2011; Meijer *et al.* 2015), and this includes scientific knowledge about the causes and responses to drought. Mozambique has abysmal coverage and quality of public extension, with one extension agent assisting 230 producers (MASA, 2014). In the study site, only those farmers organized into groups or associations, or with access to irrigation, or those producing vegetables were assisted by an extension agent. Despite a strategy to compensate for the reduced number of extension agents in the country and to cover a higher number of farmers at once, most farmers in the study site, and nationwide, are individual rain-fed maize producers who may be in more need of assistance than those who belong to associations. The latter tend to be those who benefit from diverse development projects.

The favoured farmers also tended to be the 4% who had collateral (e.g., a herd of cattle) to benefit from the District Development Fund (FDD) credit, a Government loan initiative created in 2006 to stimulate economic activities and crop production, and thereby generate jobs and income and reduce poverty and food insecurity. These farmers who benefited for the credit were all over 40 years old men, and none of them invested in crop production but in other income generation activities such as grocery shops, bakery and hardware. However, according to the majority, the investment did not provide the expected outcome

since it did not provide profits, which made impossible to them to even pay back the credit. Ordinary farmers possessed very few animals, often restricted to a pair of cattle, and fewer than five small-ruminants (e.g., goats, pigs, or sheep) and poultry (e.g., chickens or ducks). The FDD is the only credit available to farmers since most of the banks in the main district town and nationwide only give credit to people employed in non-farming activities, which are considered less risky for not being dependent on the rain. The lack of financial means limits farmers' access to market and their ability to invest in better cultivation techniques and inputs that would facilitate not only their practices, but which would also increase their yields and incomes, and their consequent ability to respond to drought. This limit is more prominent on women who are more restricted in their choices of income generation activities that would provide collateral to them (e.g., jobs or more profitable and secure activities within their communities) to access the credit or financial means to access the market, and in particular, on those married women who are also restricted in their decision about the implementation of certain income generation activities (e.g., sell of livestock) and how to invest the credit given to their husbands. As women are mostly responsible for agricultural activities and for feeding their families, while men are often responsible for providing cash income (Doss, 1999, p. 2), perhaps women would be more likely to invest at least part of the credit in the production of subsistence crop for their household consumption.

Influence on crop choices

Concerning the role of institutional factors, although Mozambique Natural disaster management law (article 8) requires the Government to promote the cultivation of crops resistant to drought to mitigate its impacts (Boletim da Republica, 2014), the choice of crops being promoted in the study site by the government and their partners are ambiguous. Despite cassava and sweet potato being tolerant to drought and having multiple uses for human consumption (i.e., tubers/roots and leaves), only 3% of farmers produce these

crops in tiny areas, such as in their backyards; this does not provide them with sufficient harvest to feed their families during prolonged drought periods.

Besides not being a widespread and common practice in their community, farmers argued that their sandy soils are not appropriate to cultivate cassava and sweet potato. Moreover, these crops find it hard to resist prolonged drought periods, and when they do cassava is bitter and not suitable for eating. Despite farmers' aversion to the production of cassava and sweet potato, the focus continues to be on the production of these crops by institutions working in the area on a drought adaptation program. Little focus is placed on the promotion of maize varieties which are tolerant or resistant to drought even though maize constitute farmers main cultivated staple crop. In fact, Caswell *et al.* (2001) contend that the perception that a technology does not perform well under their environmental conditions may stop farmers from adopting the technology. Thus, whether the government and its partners are trying to address farmers' needs, or their agenda is to increase the current low production of cassava and sweet potato in the southern region of the country is questionable. Nonetheless, it raises the importance of taking into account people's needs and priorities for the success of the strategy.

On the other hand, as demonstrated in the diagram, the lack of extension assistance to farmers to guide the production of these crops after distribution, or to introduce other crops into the community, weigh on farmers' reluctance to cultivate crops that are not common in their communities, but to continue to cultivate their habitual crops, or what others are cultivating. This constraint is particularly evident on women who constitute the majority of farmers and are also mostly responsible for agricultural activities within the household, including the choices of crops to plant, and often in accordance with their peer groups' choices to ensure that they are doing the right and same things. Additionally, as previously mentioned, difficult access to markets which are at least 40km away, and the often-poor road infrastructure, limits farmers'

awareness of the production of cassava and sweet potato in their district, or the commercialization of maize varieties tolerant or resistant to drought (e.g., open-pollinated varieties ZM 309 and ZM 523). Awareness, which Rogers (2010) considers the first stage in the adoption process, would be the starting point to induce farmers' own initiative to invest in these crops, although this may be partially constrained by farmers' limited financial ability and high input prices. Moreover, knowing that others are cultivating these crops may lead to another stage of adoption, which is interest.

Influence on choices of income generation activities

Even though farmers implement responses individually, as shown in the diagram, they tend to choose income generation activities that are commonly practiced in their community, or that are being implemented by their social group (e.g., the sale of charcoal and wood, migration, or the sale of livestock as a last resort). In most cases, farmers' preferences to continue to follow traditional activities prevents them from investing in other economic activities in their community, even ones which may be more profitable, secure, and an alternative to agriculture, such as fishing, which is only practiced in times of stress. Moreover, the types of income generation activities farmers implement are a consequence of the limited employment opportunities in most rural areas and their low education level, which makes it difficult for them to obtain employment in the cities. Therefore, farmers tend to engage in not so profitable odd jobs locally, in the nearest town or city, (e.g., weeding on irrigated farms or housekeeping), and men in particular, adventurously try to find odd jobs not only at the regional level but also in South Africa (e.g., bricklaying, barbershops and mining). Farmers' limited access to credit also restricts their financial ability to diversify their sources of incomes.

Additionally, although farmers who own more assets tend to be less vulnerable because their assets can be used as a buffer (Trærup and Mertz, 2011), findings show that farmers' culturally- and socially-based reluctance to sell their livestock, their main asset, makes them as vulnerable as those farmers with fewer

assets, even after taking the ultimate decision to sell their animals because they are sold for derisory prices. However, as they are not allowed to make a decision about the sale of the animals, women are even more vulnerable. They are usually the ones responsible for the care of the children and the animals while their husbands are absent earning an income in the main town, city, or in South Africa. Moreover, women's dependence on their husbands' income, which is not sent regularly, adds to their vulnerability.

As a result, women tend to take seasonal jobs (e.g., selling wood and charcoal, helping to pull fishing nets, and housekeeping in the nearest town or city) to compensate for the shortage both in their husbands' income and of food, although the remuneration is often not enough to meet the needs of their large families. Although large families represent added, and free, agricultural labour (Hayase and Liaw, 1997), in times of drought they may represent a burden to farmers as there are more people to feed. This is especially harder on those female-headed households (separated, widows or orphans) even though they implement similar activities to generate income and secure food as the female-managed households (husbands are labour migrants or live with another wife). This is because besides not having a husband to support them (even if it involves irregular remittances), which results in their sole responsibility to take care of their family members; female-headed households tend to have less assets, including animals (often restricted to a pair of goats and less than 5 chickens and ducks) that could be used as a buffer or food for their family members. Thus, more diversified strategies are needed to rationalize food consumption since the majority of the family members are still young and unable to take care of themselves. Additionally, elders also tend to be highly vulnerable due to their physical inability to take jobs. Thus, these vulnerable groups rely on food aid or help from family, friends, and neighbours.

6.6 Conclusions

Drought represents a limiting factor for farmers' agricultural activities, food security, and well-being; thus, they have implemented a set of responses to drought at individual and collective levels. Farmers' collective responses are primarily guided by their enduring cultural beliefs about the causes of, and appropriate responses to, drought. Meanwhile, individual responses to address the impacts of drought are not only driven by their cultural practices, but also by the poorly developed socio-economic and institutional environment in which they live. On the other hand, some of the variables within the social environment (e.g., low level of education and social groups) and institutional factors (e.g., lack of extension services and intervention strategies) contribute to the reinforcement and endurance of farmers' beliefs. Therefore, findings suggest that all these interrelated cultural, socio-economic, and institutional factors that frame farmers' choices of response are reactive coping strategies to help them, in the short-term, to deal with the causes and impacts of drought, to maintain their livelihoods, and to survive and recover from the hardship.

Since adaptation requires proactive and long-term strategies to enhance the adaptive capacity, the paper concludes that this will require a set of changes at all levels. The government needs to create a socio-economic and institutional environment that enables the development of farmers' cognitive and financial capacity to adapt to drought, and to enhance the performance of their agricultural activities, thereby contributing to reducing farmers' continuing reliance on food aid in the aftermath of drought. The changes will also help to strength farmers' systems to deal with the impacts as they deal with the causes of drought. Additionally, results suggest a crucial need for policymakers and development actors to understand the cultural beliefs, practices, needs, and priorities of the farmers they intend to help. In this way, the likelihood of farmers supporting and engaging with the proposed strategies can be increased, and factors constituting limits to those strategies can be transformed into facilitators, thus enhancing the overall outcomes of the strategies.

7 Conclusion

7.1 Introduction

This study explored the role of cultural factors, with emphasis on cultural beliefs, on small-scale farmers' behavioural adaptation to drought. To assess this interaction, the study used the example of small-scale farmers in the Southern Gaza province of Mozambique, who have limited access to education and scientific information about the causes of drought, but benefit from some drought intervention measures being implemented in the country by the Government and their partners. Drawing on that, firstly, this Chapter presents the key findings of the study, which addresses the objectives of the study. This intends to make the discussion of the key findings fruitful and avoid repetition since the same objectives of the study are addressed in different Chapters, with results of the analyses of one Chapter building and supporting the analysis of the others. This is followed by the empirical, theoretical and policy implications of the study. The last Section presents the key considerations for future studies.

7.2 Key findings of the study

The key findings of the study are unveiled and discussed in Chapters 4, 5 and 6. Chapter 4 sought to understand how and when farmers identify drought since people first need to detect the existence of a problem in order to decide to act (Moser and Ekstrom, 2010; Risbey *et al.* 1999). This understanding was a crucial entry point to learn when farmers start deciding to respond to drought, and what types of decisions are made at this identification stage, during and in the aftermath of drought. Building from the insights gained, in Chapter 5 the study sought to comprehend the nature of farmers' beliefs about the causes and appropriate responses to drought. By doing so, it facilitated an understanding of the influence of their beliefs on their perceptions of nature, worldviews and responses to drought. Moreover, these insights allowed, in

Chapter 6, the comprehension of how farmers' responses are formulated, and factors influencing them, including institutional, as well as why and how their decisions to respond are made. A summary of the findings is presented next.

7.2.1 Impacts of droughts on farmers

Farmers perceive, are affected by and respond to drought in different ways. The first objective of the study intended to elucidate these diversities, which were explored in Chapters 4 and 6. In Chapter 4, besides exploring farmers' perceptions of drought for farm-related decisions, the Chapter also explored the challenges farmers are currently facing with their prediction methods under the current weather, climate and environmental change, and some consequences of the challenges. Chapter 6 explored further the consequences of the challenges, as well as farmers' perceptions of drought acuteness and risks.

Farmers have been historically and adversely affected by drought due to dependence on rainfall for their agricultural activities as well as living in areas highly prone to drought (occurring seven out of ten years). Drought has caused harsh impacts on farmers' agricultural activities (crop production and yield), livestock production, livelihoods, and health. Although drought may occur before or during planting, in Sub-Section 4.4.1, findings have shown that farmers feel affected by drought when it happens before planting since it makes them unable to plant, while following planting they can always get some production for household consumption, such as 'green leaves' from a plant known as cacana (*Momordica balsamina*). Adding to that, as revealed in Sub-Section 6.4.1, drought before planting makes the soils arid and compact, thereby harder to use animal traction for ploughing, forcing farmers to plough with a hoe. As a result, farmers have to reduce the cultivated area and women are forced to help men (husband or the person hired or negotiated to do the job) with the manual ploughing, thereby increasing women's workload since they are also

responsible for most of the agricultural-related activities within the household as well as the household chores (e.g., child-care, food preparation and collection of water). Furthermore, findings have shown that the arid and compacted soils cause a reduction in plant growth and yield, and often force farmers to temporarily move to areas in high lands, or with less compacted and higher infiltration soils, during intense rain periods (February), or even permanently if farmers manage to do so at all as the soils become saturated and flooded. The reduced yields make farmers and their families, at some point, face problems of food insecurity and hunger, resulting in their weakness, swollen bellies, and weight loss or in extreme cases, death. Food insecurity and hunger also affect children's education since they stop attending school, as they feel weak and unmotivated, or in some cases, they have to help their parents with activities to generate income.

Drought also affects farmers' livestock, especially cattle, which were always mentioned by all farmers. As explored in Sub-Section 6.4.2.2, cattle play a crucial social and cultural role in farmers' lives, representing prestige. Thus, losing the animals means losing the prestige at the end of the drought. Because of all the harsh impacts on farmers, drought is seen as an impediment to the achievement of food security, poverty reduction, and long-term development of the country, and thereby as a contributing factor to small-scale rain-fed farmers' vulnerability (Artur and Hilhorst, 2012).

Farmers' perceptions of changes in weather and climate are mostly accurate

The harsh impacts of drought have made drought events over the years, including the year of occurrence, memorable to farmers. Findings in Sub-Section 4.4.1 and 6.4.1 have demonstrated that the memorable impacts of drought are what guided farmers' conceptualization of drought, the perception of the risks and need of responses. In Sub-Section 6.4.1, findings have shown that farmers have memories of impressionable drought events that date back from 1947. These memories are even earlier than the

meteorological data obtained from Chibuto (1967 – 2014) and the general regional records of drought in the country (1980 – 2016). Farmers' memories showed to be mostly accurate as many drought years remembered matched with the general country records, as seen in Table 6.1. The memorable droughts contribute to farmers perceiving an increase in the duration (from less than 1 to up to 3 years) and intensity (from moderate[27] to extreme[28]) of drought events over the years. Indeed, as presented in Sub-Section 6.3.1, the INGC (2009) accounts for an increase in the frequency and intensity of drought over the past few decades, but no mention is made in relation to the duration. The increased duration and intensity of drought made the events more impactful to farmers since the events affect not only food availability as the events last longer than their stored food but also access, as the events induce a dramatic rise in food prices that farmers struggle to afford.

Findings in Sub-Section 4.4.3 have shown that farmers noticed an unpredictability in rainfall compared to the past. They noticed that nowadays the rainfall starts late and is irregular, thus making it challenging for them to know the exact planting months, which in the past were from September to December. Adding to that, as discussed in Section 4.5, the rainfall unpredictability has induced farmers to start planting during winter periods (April - August), a practice that was uncommon to the farmers but essential to guarantee some harvest and the subsistence of their families. The country records also indicate a later start of the rainfall season since the 60s (INGC, 2009), and inter-annual variability regarding the onset and cessation of rainfall (MICOA, 2013). Moreover, in Sub-Section 4.4.3, findings have shown farmers' perception of an increase in the temperature in both summer and winter season, and increase in the duration of summer

[27] The past moderate drought caused some damages to farmers' activities such as reduction of production and yields.

[28] The current extreme drought causes major and widespread damages to farmers' activities and lives such as a significant yield reduction, inability to plant, complete crop failure and water restrictions.

periods, which is also evidenced by the country records that accounts for an increase in temperature between 1°C to 1.6°C and the number of hot days since 1960 (INAM, 2013). The warmer and extended summer periods aggravate the impacts of drought by causing a reduction of crop and soil moisture, accelerating the dryness of the grass and leaves from trees that serve to feed farmers' livestock. The warmer and extended summer periods also affect the availability, reading and interpretation of some of the traditional indicators used to predict drought (e.g., dew and hot temperature throughout the year).

Farmers rely on traditional methods to predict drought

Timely forecast of drought can be a powerful tool to reduce drought-related impacts on farmers' activities and lives (Wilhite, 2000). As explored in Sub-Section 4.4.2.2, farmers use diverse traditional methods to predict drought, and the methods constitute their primary, and sometimes the only source of drought forecast for farm-related decisions. The methods constitute part of farmers' cultural knowledge and inheritance that have been transmitted over generations. They comprise of reading and interpretation of signs from celestial bodies (moon, sun and stars), weather and climate (air temperature, clouds, wind, thunder and lightning), physical environmental (dew and fog) and biological (animal behaviour) indicators that are used either individually or combined, as required to increase farmers' prediction certainty. As discussed in Section 4.5, despite increased efforts by the government to diffuse the regional seasonal meteorological forecasts, access to this kind of forecast continues to be very limited in most rural areas of Mozambique. The lack of electrification, radio ownership and non-participation in the community meetings are some of the factors that restrict farmers' access to seasonal drought forecast. Additionally, the country lacks a drought early warning system to allow farmers to make a timely response and mitigate the impacts (Governo de Moçambique, 2017). Thus, these factors contribute to farmers' reliance on their own methods to predict drought.

In fact, in Sub-Section 4.4.3, results have revealed that farmers continue to rely on their preferred traditional prediction methods even though the current rainfall unpredictability, the warmer temperature, and some environmental changes have made it challenging for farmers to predict the occurrence of drought through the use of traditional indicators as they did in the past. Although there are occasions when farmers fail to predict drought and suffer the primary consequences on their crops production and yields, there are also occasions when the methods are useful for farming-related decisions such as when farmers predict drought through observing the moon's appearance and position, which according to farmers they continue to be reliable and accurate indicators to them. Additionally, although farmers' trust the source of meteorological forecasts and have personally experienced the veracity of the information through other natural hazards such as floods and strong winds, farmers primarily rely on their traditional prediction methods as the confirmatory forecast. The elders with their knowledge, wisdom, complexity, and diversity of forecast methods used are responsible for the confirmation and consequent farmers' motivation to use or not the meteorological forecasts.

Farmers are grappling with drought to survive

Findings in Sub-Section 6.4.2.2 have shown that farmers implement an array of reactive strategies to, in the short-term, reduce the impacts of drought and survive. The strategies are implemented individually, although for a shared group purpose, and they represent farmers' cultural practices and a reflection of the interconnections between the socio-cultural, economic, and institutional environments in which farmers live. As farmers are restricted in their financial ability to respond to drought, their responses involve activities to generate income, secure immediate food needs, and reliance on help from the government and their partners, friends and family.

The generation of income is subject to farmers' ownership of assets and willingness to sell the assets, as well as find job opportunities in times of stress or sell of locally produced items such as charcoal, woods and traditional mats. Farmers' main assets are cattle, but, due to the socio-cultural value of these animals, farmers are reluctant to sell them. In most cases, cattle are sold as a last resort and for derisory prices since the animals are fragile and thin, and almost dying. Therefore, the money obtained from the transaction is often insufficient to secure food for farmers' families until the next harvest. Additionally, the remuneration farmers get from selling their locally produced items, which is mostly performed by women, is often insufficient to meet their needs, which is also aggravated by the fact that farmers not always manage to sell the items, thus being forced to take other measures in order to secure their food needs. On the other hand, as discussed in Section 6.5, job opportunities are very scarce in rural areas of Mozambique, and very hard to get in the main cities due to farmers' limited education level. Most farmers are illiterate (36.5%), mainly women who constitute 79.5% of them, or have only attended primary school (52.5%). Nonetheless, driven by their need to obtain some income to feed their families, in times of stress some (female and male) farmers tend to engage in not so profitable odd jobs locally, in the nearest town or city, (e.g., weeding on irrigated farms or housekeeping), while others, mostly under 45 years old men, adventurously become non-skilled labour (e.g., bricklayers, barbers and miners) migrants to South Africa, or to other locations within Mozambique.

Activities to secure immediate food needs are aimed at providing farmers with direct access to food without having first to generate income. While in the past this strategy was more diversified in terms of availability of alternative food items and food surplus, now those items are scarce, even during the rainy season. As discussed in Sub-Section 6.4.2.2, this scarcity of alternative food items and food surplus not only limits farmers' choices of strategies to secure immediate food needs, but also forces farmers to diversify their strategies to rationalise food consumption to ensure they can feed their large families of average size of

11. Farmers also exchange their locally-produced items with inequitable quantities of food products and work in community projects in exchange of food.

Although both income generation and securing immediate food needs help farmers to obtain some food, findings in Sub-Section 6.5.1 have shown that these activities are often not sufficient to feed their families. Farmers therefore, at some point, face food insecurity, which turns into emergency; thus, having to rely on help from the government and their partners through food aid. There are also farmers who rely on help from their friends and family as they are restricted in their ability to self-implement responses to drought.

Women, elders and orphans are the groups most vulnerable to drought

Rain-fed farmers' dependence on the rain for their agricultural activities, which is their main and sometimes only source of income, makes rain-fed farmers' vulnerable to drought. However, as previously mentioned, the socio-cultural, economic and institutional factors have a significant contribution to the level of farmers' vulnerability. For instance, as discussed in the Sub-Section 6.5.2, farmers' reluctance in selling their assets such as cattle to serve as a buffer in the aftermath of drought contributes to making them as vulnerable as other farmers who do not have any assets, even after taking the ultimate decision to sell their animals, as the animals are sold for derisory prices. Additionally, farmers' reluctance to cultivate crops that are resistant or tolerant to drought (cassava and sweet potato), but are not their preferred traditional crops (maize, butter bean and cowpea) also significantly increases their vulnerability since such behaviour dwindles the opportunity to ensure some production to feed their families, or perhaps to sell the surplus and have some income to buy their preferred food.

While such vulnerability may be a result of cultural norms and practices, Sub-Section 6.4.2.2 has revealed the existence of other groups of farmers who are even more vulnerable because they are restricted in their

material or physical abilities to choose how to respond to drought, which are the poorer farmers, women, elders, and orphans. Although the elders have knowledge and wisdom to use complex and diversified traditional methods to forecast drought, in the aftermath of drought they may be the less able to respond due to their physical inability to take jobs to generate income to ensure their food security. The poorer farmers are vulnerable for not having financial means or assets to sell. Widows, single mothers and orphans are also vulnerable because of their sole responsibility to take care of other family members. Although these latter group of female-headed households tend to implement activities to generate income and secure immediate food needs that are common practices in their communities, they usually have less assets, including animals (often restricted to a pair of goats and less than 5 chickens and ducks) that could be used as a buffer or food for their family members. Indeed, FAO (2011, P. 24) points to the existence of systematic gender inequalities in livestock holding in many developing countries since male-headed households usually have larger livestock holdings than female-headed households. Thus, these vulnerable groups of people tend to rely on food aid or help from family, friends, and neighbours.

On the other hand, there are also those female-managed households (women with labour migrant husbands) who are vulnerable because of their responsibility to take care of the children. Although the husbands' income may contribute to diversifying household livelihood strategies (Chimhowu *et al.* 2004), their income is not sent regularly. Additionally, the remuneration these women earn from taking seasonal jobs (e.g. selling wood and charcoal, helping to pull fishing nets, and housekeeping in the nearest town or city) is often not enough to meet the needs of their families. Moreover, these women are responsible for livestock rearing but, for cultural reasons, they do not have the power to decide over the sale or consumption of big and more profitable animals such as cattle. Such a decision is exclusive to men as women are only allowed to decide (alone or with their husbands) to consume or sell small animals such as goats and poultry, which are not so profitable.

Moreover, as discussed in Sub-Section 6.5.2, farmers with large families, of which the majority are young and unable to take care of themselves, tend to be vulnerable, as it means more people to feed and more diversified strategies to obtain food and rationalise food consumption. The fact that farmers have limited access to employment opportunities also contributes to their vulnerability as it constitutes a barrier to enhancing their financial capacity to respond to drought through, for example, investing in improved techniques and inputs that are suitable to dry conditions, and in other income generation activities. Additionally, the lack of access to credit adds an extra burden on farmers' financial capacity to respond to drought, especially on women as credit is mostly given to men. What is more, although the beneficiaries of the credit are mostly married men, their wives often do not have much opinion regarding how to invest the credit given to their husbands since it is not invested in agricultural activities, which constitute their wives' main activities and the main source of subsistence crops for their household consumption. In fact, the credit is invested in other non-agricultural activities undertaken by men such as to open grocery shops, bakeries and hardware shops, which did not provide profits to them, making even impossible to pay back the credit. Indeed, Francis and Hoddinott (1993) argue that when people's time away from agricultural activities increases, they are less willing to invest in agriculture, and instead prefer to invest in small businesses. Furthermore, farmers' lack of access to extension services limits their cognitive abilities to respond to drought through the use of improved techniques, as farmers have limited knowledge of improved techniques to respond to drought and to increase their production. Farmers also lack guidance and incentive to implement new techniques and produce unfamiliar crops.

All the above reasons make the implementation of long-term strategies to adapt to drought more difficult. Farmers thus tend to implement short-term strategies to reduce the impacts of drought and survive. Adding

to that, farmers implement responses to tackle the perceived causes of drought, which are driven by their cultural beliefs. The perceived causes and related responses are described in the next section.

7.2.2 The role of cultural beliefs about drought in shaping farmers' perception of the causes and responses

Most farmers in Mozambique continue to have limited knowledge and understanding of climate change and the scientific explanation for drought (Artur and Hilhorst, 2012). As discussed in Sub-section 5.4.1, farmers mostly began to hear about climate change and the scientific explanation about drought during the recent drought (2014 – 2016) via radio and announcements by local authorities at their general community meetings. The low literacy levels are some of the main reasons many farmers are unfamiliar with climate change and scientific explanations about drought. Young people (16 – 24-year olds), for having more access to education up to lower secondary school, are slightly more familiar with climate change, and scientific explanation about drought. Therefore, the majority of farmers rely on their cultural beliefs to explain the increased occurrence of drought and other natural disasters, to address the perceived causes of drought and cope with the impact. Chapter 5 explored farmers' cultural beliefs of the causes and provided an overview of the related responses to drought, which was explored in more details in Chapter 6.

Drought is a punishment from ancestors and/or God

Religion and tradition have played significant roles in shaping African societies' culture, daily lives, and actions (Christian, 2014). Sub-Section 5.4.1.1 indicated that 72.5% of farmers are religious (54.7% of this share are over 25 years old women), thus the majority of farmers (51%) associate drought to punishment from God for (some unknown) wrongdoings. This is because God is seen as the creator and controller of

nature, as well as the regulator of rain since the rain comes from the sky. Such sovereignty, which was even recognised by almost half of the 27.5% of non-religious people, was the more prominent explanation to farmers uncertainties in relation to the wrongdoings. Conversely, Sub-Section 5.4.1.2 indicated that 12.5% of farmers, mostly over 25 years old female non-religious and with little (primary school) or no education, continue to believe in the power of their ancestors to punish them with drought for not following and respecting their traditions as in the past. These farmers have a repertoire of static, and non-static, mutable, or circumstantial reasoning to explain how they have failed to follow and respect their tradition.

The static reasoning is the one transmitted through the generations from farmers' ancestors to their descendants and so on (e.g., non-frequent realization of traditional ceremonies and unnecessary abortion). The non-static, mutable, or circumstantial, reasoning is based on farmers' observations and value-laden perceptions of the negative, unexpected, or harmful recent or current events which happen nationwide, and which they believe could be avoided or prevented (e.g., war in the country and burying someone who has dreadlocks). Drawing on that, as discussed in Section 5.5, farmers may attribute the blame to someone inside their community when they perceive that drought is not witchcraft-related, as they all depend on the rain for their activities. Otherwise, they may blame an outsider perceived as having suspicious and uncommon behaviours, and somehow benefiting from the lack of rain by not 'directly' depending on rain for their activities.

Besides the dynamism of the reasoning for the punishment, in corroboration with findings from Murphy *et al.* (2016), results in Sub-Section 5.4.1.3 have also demonstrated a circumstantial dynamism of farmers' beliefs. Farmers may shift their beliefs involuntarily to please the social groups and ease their integration and acceptance into the group (subjective norm) or voluntarily when, for diverse reasons, they are confronted with the loss of hope and trust in the supernatural forces they worship, or when they perceive

disadvantages or problems which arise from following a particular belief. For instance, some farmers explained that they have involuntarily stopped following tradition because some church leaders made them choose between tradition and religion. On the other hand, although less common, farmers may also choose to abandon one belief and not follow any. Farmers may also hold two types of beliefs as they believe in both God and ancestors concurrently punishing them for a behaviour seen by both of these supernatural forces as wrongful.

Farmers' cultural beliefs shape responses to tackle the perceived causes of drought

Results in Sub-Section 6.4.2.1 have shown that farmers implement responses to tackle the perceived causes of drought, which are driven by their enduring cultural beliefs. The responses comprise the realization of diverse types traditional ceremonies and religious prayers to ask for rain, which constitute farmers' cultural practices implemented over generations. Thus, the majority of farmers participate in these traditional and religious responses as they recognize the importance of preserving their tradition, even though currently these responses are not regularly performed before the rainy season begins but only when farmers perceive long delays to the start of the rainy season. However, as adaptation requires adjustments in social processes (Tompkins et al. 2010), farmers have also adjusted their religious responses in order to enhance the likelihood of a positive outcome as farmers have perceived that nowadays both religious and traditional responses do not provide expected results. Besides the performance of individual church prayers, in the last decade, farmers have added a joint church prayers aiming to reinforce both the individual church prayer and traditional ceremony. Farmers believe that the realization of the joint church prayer right after the traditional ceremony will strengthen their rainfall request to the supernatural forces and increase the likelihood of the request being fulfilled. As discussed in Sub-Section 6.5.1, in most occasions, farmers' implement these collective responses to tackle the causes of drought before the implementation of responses to deal with the impacts of drought. Those who do not

follow this pathway often tend to be under 45 years old men who have another income generation activity outside the community or become labour migrants during times of stress. Although these collective responses do not necessarily help farmers to adapt to drought, they serve as a psychological support system to deal with the causes, recover from the hardship and survive.

Even though the majority of farmers have perceived a significant decline in the frequency of realization and effectiveness of these collective responses, farmers continue to believe that the traditional ceremonies and prayers are the most appropriate responses to tackle the causes of drought. The reduced effectiveness does not necessarily lead farmers to doubt the power of their ancestors and God in making rain, but to hold themselves accountable. Thus, farmers tend to instinctively seek for a potential explanation in order to correct the failure. When farmers do so, and the responses are fruitful, it serves to reinforce farmers' cultural beliefs about the causes (ancestors or God's punishment), the underlying reasons (explanation found for the punishment), and the most appropriate response to drought (traditional ceremony or prayers). All of these collective responses bind farmers together in solidarity in times of drought as they are driven by their common need of rainfall for their agricultural activities. Thus, the majority of farmers participate in at least one of the collective responses or have one of the family members participating or contribute with money or goods for the realization of the ceremonies. Besides these farmers' collective responses, as discussed in Sub-Section 6.5.2, there are also responses implemented by some institutions in the country in behalf of farmers, which have impacts on farmers' adaptation to drought. These institutional responses and the corresponding outcomes are summarised next.

7.2.3 The nature of Institutional responses to drought

Institutions such as Government and NGOs play a crucial role in agricultural sector development and transfer of technology. However, concerns are growing that in developing countries Government and NGOs have prioritised the well-resourced farmers (Farrington and Lewis, 2014, p. 4). Besides this limit to the development of poor farmers' agricultural activities, and although not receiving adequate attention and acknowledgment yet (Jones and Boyd, 2011), institutional top-down approaches to transfer technologies are increasingly regarded as also constituting limits to farmers' adaptation to the changing weather, climate and environment (Adger *et al.* 2013; IFRC 2014, p. 121). Thus, Chapters 4 and 6 explored how these institutions affect farmers' timely preparation and responses to drought through the supply of seasonal drought forecasts and interventions strategies, respectively. Additionally, these Chapters discuss the relevance of taking farmers' cultural practices to predict and respond to drought into account for better outcomes. Furthermore, Chapter 6 discusses the importance of first understanding and taking into consideration farmers' cultural beliefs since they influence farmers' motivation to act, choices of response, and means of implementation, as well as the resultant impacts.

Institutional interventions take a top-down approach

Findings in Chapter 6 have revealed that Governmental and NGOs' drought adaptation actions in Mozambique take two forms: proactive and reactive responses. The proactive responses are those implemented through drought adaptation programs intended to promote the use of improved techniques such as the cultivation of crops resistant or tolerant to drought, specifically cassava and sweet potato. Indeed, as discussed in Sub-Section 6.5.2, the potential to resist or tolerate drought and the multiplicity of uses of the selected crops for human consumption (tubers/roots and leaves) are the main factors these institutions take into account to select these crops being promoted by them, rather than the varieties of

crops that are habitually cultivated by farmers or that are better suited to farmers' soil conditions. This top-down approach, which is inherent to the agricultural sector of Mozambique, which is a reflection of the culture of centralised authority, (Cunguara and Hanlon, 2012), has resulted in an extremely low rate (3%) of implementation of the strategies. Farmers continue to prioritise the cultivation of their habitual crops (maize and beans), including the reduced numbers of farmers who are cultivating cassava and sweet potato, since these farmers are doing so in small areas such as in their backyards, which do not provide them with sufficient harvest to feed their families during prolonged drought periods. Thus, the proactive strategies are as yet failing to help farmers to reduce the impacts of drought. Nonetheless, the approach to the implementation of proactive responses brings attention to the importance of accounting for people's needs and priorities for the success of the strategy. As Brennan *et al.* 2009 findings' suggest, the extent to which communities' endorsed and engaged with external efforts and the resulting outcomes depended on the compatibility of the efforts with their culture.

Besides not taking farmers' needs and priorities into account, the types of interventions and approaches to the implementation of the interventions also make clear that the Government and NGOs are still not considering farmers' cultural beliefs of the causes and appropriate responses to drought. These institutions are not yet including farmers' cultural beliefs or cultural dimensions of adaptation in their program design and implementation since they focus more on overcoming the technological and economic limits to farmers' adaptation, as explained in the next paragraph. Adding to that, these institutions do not take part in the responses farmers implement to tackle their perceived causes of drought. This approach has resulted in reduced institutional knowledge of farmers' culture, needs and priorities, as well as knowledge of the hidden causes of farmers' vulnerability to drought and means of addressing them. This has therefore reduced the institutional connectivity with farmers and the rate of success of the programs, as the above example of the cultivation of cassava and sweet potato. The fact that no extension assistance is given to farmers by

both the Government and NGOs adds weight to these institutions' reduced knowledge of and connectivity with farmers and the outcome of the programs. Therefore, Kruger *et al.* (2015) argue that culture is the missing dimension for the success of the Disaster Risk Reduction (DRR). In fact, in Sub-Section 4.4.2.1, the findings have revealed that these institutions are also failing to provide farmers with an explanation for the occurrence of drought, as the information provided inherently focuses on the forecast of drought and some advice to make timely preparation for the event to reduce its negative impacts such as store seeds for planting when the rain starts; sell livestock; or find other sources of income to provide money for food.

The reactive responses are in the form of food aid and free or subsidized seed distribution, a short-term structural and 'cultural' feature in the country to compensate for production shortfall, and ensure production after the end of a drought. As explored in Sub-Sections 6.4.2.2 and 6.5.1, although these reactive strategies are effective for ensuring farmers' immediate food needs, and reducing their momentary suffering and recovery, these strategies led to a culture of dependence and a sense that the government and their partners are responsible for providing farmers with such help in times of stress; thus, reducing farmers' efforts to secure food for themselves. These institutions have acknowledged the drawback of these reactive strategies and have introduced the Food for Aid program to reduce farmers' mind-set of dependence in times of stress, while at the same time increasing their self-sufficiency and helping them meet their immediate basic food needs. However, the program still not sustainable. Not all farmers can ensure their immediate food needs through the program, as priority is given to the most vulnerable ones. This creates a sense of discontentment with the institutions and envy towards the prioritised beneficiaries who are seen as having something to eat while others are starving. On the other hand, considering the large number of family members' farmers have, the quantity of food provided does not necessarily ensure their self-sufficiency, but the momentary relief that is brought with the food aid, which is what this program also represents.

Poor and individual farmers have less access to opportunities

The majority of farmers in Mozambique are poor and subsistent and practice their agricultural activities individually. However, those farmers have benefited less from agricultural development and economic growth in the country. Such inequity in the distribution of resources and services has contributed to farmers' low yields and incomes and stagnant poverty situation (Irish aid, 2018). In fact, this situation seems to be far from improving in the country as more conditions have been created to make access to agricultural opportunities to individual farmers even more challenging. Results in Sub-Section 6.5.2 have shown that farmers who are organised in associations have more access to opportunities such as extension services, credit, and intervention programs. This strategy to allocate resources and opportunities, which is intended to cover at once a bigger and more significant number of farmers, results in neglect of assistance to the average (individual) farmer in the country, who perhaps might be most in need of assistance to change their poverty and vulnerability conditions and contribute to the Green Revolution that continues to be the country's dream.

Moreover, considering the fact that most farmers are illiterate, especially women who also constitute the majority of farmers, the lack of assistance from extension services contributes to hampering farmers' knowledge and implementation of improved drought adaptation strategies, as well as scientific knowledge of the causes of drought. Apart from drought periods, the lack of extension assistance also limits farmers' knowledge of the improved cultivation techniques to help them increase their yields and income as well as to improve their livelihoods. Thus, most farmers continue to implement their enduring traditional cultivation techniques, which they perceive as providing 'good production' for household consumption when the rainy season is good since they associated the reduction of crop yields of more than 50% in the last two decades with drought rather than with their cultivation techniques and inputs used. What is more, the individual rural

farmers' limited access to intervention programs aggravates the impacts of the limited access to extension services.

Furthermore, credit is mostly given to farmers who have collateral (e.g., a herd of cattle) or have a non-farming activity as the latter is considered less risky than farming. However, the majority of farmers do not fulfil such requirements since farming is often their only or main activity and they possess very few animals such as a pair of cattle, fewer than five goats, pigs, sheep poultry, chickens and/or ducks, and are thus, not entitled to the credit. What is more, as previously mentioned, the quantity and types of animals are even lower on female-headed households. This restriction adds a load on farmers' lack of financial means to access the market and their ability to invest in better cultivation techniques and inputs that would facilitate not only their practices but also increase their yields and incomes, as well as their consequent ability to respond to drought. Access to market would also be beneficial to farmers as it would raise their awareness regarding the existence of crops resistant or tolerant to drought as well as cultivation of these crops by other farmers in their region, and thereby triggering their interest. The fact that markets are located around 40kms away from farmers' communities and along poor dirt roads that considerably increases travel timing and difficulties also limits farmers' awareness and access to new technologies and inputs.

7.3 Key contributions of the study

This study has provided valuable insights into drought impacts, traditional drought prediction, and cultural and institutional dimensions of adaptation that can have significant empirical, theoretical and policy implications. These contributions – which are empirical, theoretical and policy-based – are discussed next.

7.3.1 Empirical

One of the reasons for this study was to address the gap in research regarding the cultural dimensions of adaptation, which according to some authors (e.g., Adger *et al.* 2009; IFRC, 2014, p. 121; IPCC, 2007) represent some of the hidden factors affecting adaptation and continue to be neglected in both research, as well as the design and implementation of modern adaptation strategies. This study provided additional evidence and contributed to reducing the gap in research by specifically focusing on developing a comprehensive understanding of farmers' cultural (religious and non-religious) beliefs about the causes of drought and the role of these beliefs in framing farmers' responses to drought. This contribution was also crucial to enrich the research in Mozambique related to both culture and cultural dimensions of adaptation, which is still limited.

The geographical location and the physical, environmental, economic and socio-cultural conditions of Mozambique provided an outstanding case study. The fact that Mozambique is one of the most vulnerable countries in the world to natural disasters and climate change, and the study was conducted in a region highly prone to drought, provided a rich and distinct case to explore the impacts of drought on farming activities. Moreover, the fact that most inhabitants are illiterate and culture continues to be an integral part of the inhabitants' lives has provided valuable insights regarding their cultural beliefs of the causes and appropriate responses to drought. Such insights can help to develop the understanding of how the beliefs are formed, why they are followed, and why the inhabitants have responded to drought in the way they do, as well as when they decide to respond. Furthermore, this improved understanding of the timing and process of response formulation can serve as a tool to analyse the implications on farmers' ability to respond to drought in a timely manner, and assess whether their responses are adaptation, coping or maladaptation strategies.

The context-specific, rich and distinct environment of the study also provided valuable insights on a range of interrelated (cultural and non-cultural) factors and conditions at different scales that affect farmers' adaptation to drought. As such, the analysis of the interrelation between the factors provided a clearer understanding of the differences in types of responses to drought influenced by cultural and non-cultural (e.g. socio-economic and institutional) factors, and how the non-cultural factors also contribute to reinforcing the cultural factors. The study also provided some insights into differences in responses within the household and between different types of households, as well as factors driving the differences.

Some of the insights provided can be useful to undertand cultural dimensions of adaptation and adapted to other communities in Gaza province that are subjected to similar environmental risks, and under diverse socio-economic and cultural conditions that characterise the province and the country in general. This is particularly relevant for those communities that are recondite, isolated or located in the interior parts of the province with limited or no access to resources, infrastructure (e.g., roads, electricity), information and opportunities. Since the cosmological interpretation of natural disasters is widespread in Mozambique (Artur and Hilhorst, 2012), and all regions of the country are somehow affected by natural disasters; thus, the insights provided can also be useful and adapted to other regions of the country and help to further produce more general findings to understand and address cultural considerations across the country as well as in other countries. Such understanding and considerations might be crucial to design and implement policies and adaptation strategies that are inclusive of farmers' culture and preferences concerning strategies and are more suitable to their needs and conditions. This will positively reflect on the level of engagement, endorsement and status that farmers will attribute to the implementation of the policies and adaptation strategies as well as on level of success of the policies and strategies to in long-term help

farmers to reduce their vulnerability and to enhance their adaptive capacity and resilience to future drought events, as further discussed in Section 7.3.3.

However, we should not fail to take into account the fact that culture is distinct to a society and the contextual conditions may differ from place to place (Hofstede *et al.* 2010, p.6). Indeed, this study has shown the context-specific dynamism of cultural beliefs and reasoning regarding the causes of drought, and has described the contextual environment in which farmers' live, which implicates their responses. Thus, as argued by IFRC (2014, p. 79), it is important to consider each case distinctly, i.e. to understand the context-specific culture of the people under consideration in order to understand the contextual adaptation process and discern strategies.

7.3.2 Theoretical

Results from this study contribute to enrich the literature related to cultural dimensions of adaptation and to advance the understanding of: the context-specific role of traditional prediction methods, elements shaping perception of drought, cultural dimensions of risk perception, and forms and drivers of farmers' responses to drought.

The context-specific role of traditional forecast methods

Taking into account that farmers need to first have a prediction of drought in order to start preparing to respond to it; thus, through Chapter 4, the study contributes to a better understanding of context-specific traditional prediction methods and the role of the methods especially for those rural, rain-fed, and poor farmers who continue to have limited access to meteorological forecasts, and thus, these methods constitute the main and sometimes only source of forecast. As put forward in Section 4.1, most studies

have independently analysed the benefits or challenges of traditional prediction methods, without combining the benefits and challenges in a context-specific perspective, as the role of the methods may differ from place to place according to socio-economic and bio-physical characteristics (Klenk et al. 2017). Thus, through farmers' viewpoints, the study explored and provided insights on the challenges of the prediction methods under the current weather and climate scenario, which have led to the reduction of diversity and complexity of indicators used as well as the reduction of the accuracy and reliability of the predictions. Adding to that, the study has demonstrated how despite these challenges, farmers continue to rely on their methods as the primary, confirmatory and sometimes the only source of forecast. Moreover, the study has identified some non-climatic factors that are threatening the richness, complexity, and endurance of the methods, and went further to suggest some possible context-specific actions to tackle the threat, enhance and tailor the prediction methods, and thereby enable the methods to continually exert their multiple uses and benefits over generations to come. By exploring the benefits and challenges of traditional prediction methods, the study emphasised the importance of these methods to farmers themselves rather than to improve and validate science, as highlighted by some authors (e.g., Green et al. 2010; Huntington et al. 2004; King et al. 2008).

Elements shaping perception of drought

Drawing on Taylor's (1988) elements that shape perceptions that show the links between experience and perception of drought, in Chapter 4, the study added to Slegers (2008) and Urquijo and De Stefano's (2016) studies on the links between experience, memory and definition of drought. The study did so by showing how the memorable negative impacts of past drought events on farmers' activities, livelihoods and livestock shaped their conceptualization of drought. Then, the study combined the most cited definitions provided by the farmers to generate the concept of drought as a lack of rain that makes rain-fed crop production difficult or impossible, dries up water sources and grass, causes thirst and hunger for people and livestock,

and results in livestock death. This definition not only makes clear the importance of livestock to farmers but also that what farmers actually consider drought is the lack of rain, which opposes the general scientific definition of drought (e.g., Rouault and Richards, 2005, Udmale et al. 2014; Wilhite et al. 2014) that accounts for a reduction of the annual average precipitation over the length of a season or more, resulting in scarcity of water for human activities and the environment. Additionally, the study provided evidence regarding how the timing of drought occurrence in relation to the planting period influenced farmers' perceptions of drought risks and the extent to which they feel affected by drought. All these insights also reinforce Patt and Schröter (2008) conception that drought can have diverse meanings depending on the environment, drought characteristics and impacts.

Cultural dimensions of risk perception

Through Chapter 5, this study enabled a broad understanding of the under-researched and often neglected cultural dimensions of risk perception by exploring the nature of cultural beliefs farmers have about the occurrence of drought, and the reasoning behind the beliefs. The fact that the study was conducted a few months after the end of the most recent and prolonged drought (from 2014 – 2016) that farmers could remember provided a unique opportunity to gain a richer knowledge and clearer understanding of their beliefs and reasoning. By doing so, the study has shown not only the types of beliefs, and reasoning farmers have, but also the dynamism of their beliefs and reasonings, as well as the factors driving the beliefs, reasoning, and dynamism. Nonetheless, the study has contributed to understanding that farmers' relate drought to supernatural forces' (God, ancestors and spirits) punishment and their reasoning are value-laden, and based on their inherited knowledge from their ancestors or circumstantial perceptions of things happening nationwide, which are believed to be morally wrong, avoidable or preventable. In a nutshell, this shows that farmers attribute the changes in weather and climate to humans' non-conformity to morality (e.g. unnecessary abortion) and norms (e.g. not performing rituals).

By correlating nature with supernatural forces and culture, farmers are "blind" to the role of their livelihood activities in the changes in the environment, weather and climate, as well as their role in contributing to reducing the changes. As such, this correlation allows farmers to continue to implement their activities in the way they do, and to shift their concerns to a different realm, which is towards unravelling humans' immoral and non-normative behaviour in order to correct them. The study has unpacked the types of responses implemented by farmers, which made clear that none of the responses were transformational but momentary to ensure their peace of mind, forgiveness from the supernatural forces and their food needs and survival. Concerning the unravelling of the humans' immoral and non-normative behaviour, since all actions require a subject to perform them, the study has raised awareness regarding when farmers attribute the blame to someone inside their community for the actions, or an outsider. This, in turn, also raises awareness to those trying to help farmers in times of stress about the importance of knowing when and how to approach them to avoid blaming and unsuccessful outcomes. All in all, these results reinforced findings from Osbahr *et al.* (2011) and Pidgeon *et al.* (2003, p. 15) regarding the mental, mutable, and value-laden constructive nature of perceptions, which may not reflect the actual evidence correctly and may attribute the cause of changes to incorrect subjective factors that socio-culturally shape their interpretation of the event.

Forms and drivers of farmers' responses to drought

Through Chapter 6, the study made possible the identification of an array of responses implemented by farmers, which are culturally-based and address different concerns regarding the occurrence of drought. Then, it allowed the categorisation of the identified types of responses and the discernment of factors driving the responses. The study ascertained two types of responses:

- *Responses to tackle the causes of drought*: are those implemented as a group for the common purpose of addressing the perceived causes of drought (God or their ancestors) based on their enduring cultural beliefs of appropriate responses through the performance of traditional ceremonies or prayers to ask for the rain;
- *Responses to deal with the impacts of drought*: are those implemented by farmers individually, although the purpose of reducing the impacts of drought is shared with their social groups. These responses are shaped by farmers' cultural practices and the poorly developed socio-economic and institutional environment in which farmers live.

The categorisation of these different types of responses does not only facilitate the understanding of the role of cultural beliefs in adaptation, but also the role of non-cultural factors in shaping adaptation, including the institutional role, which also has not yet received adequate attention and acknowledgement by researchers. This understanding resulted in the design of a causal loop of the interaction between the cultural and non-cultural factors, which not only facilitates the comprehension of the complexity of the interaction between the factors driving farmers' adaptation to drought, but also makes it clear that the factors act as a system. As such, they should be analysed in tandem, although some factors may exert more influence than others. By doing so, the systematic analysis also facilitates the understanding of how the non-cultural factors influence, reinforce and are influenced by farmers' culture, which allows the identification of entry points for what could be done or adjusted to enhance farmers' adaptive capacity and resilience to drought. For instance, the study gave the example of the role of the limited access to market on farmers' choices of their habitual crops and cultivation practice. As such, the study has shown how access to credit would provide farmers with financial means to change their traditional cultivation practices by investing in better cultivation techniques and inputs, as well as means to increase farmers' financial

ability to respond to drought. The next section discusses some of the potential entry points to help enhance farmers' adaptive capacity and resilience to drought.

7.3.3 Policy

Although the focus of this study was on the role of cultural beliefs in shaping behavioural adaptation, this study also looked at the institutional role in shaping such behaviour. The results provided useful insights concerning the Governmental and Non-Governmental role on farmers' adaptation and the potential adjustments needed in terms of policy in Mozambique in order to change the current scenario and facilitate farmers' adaptation. In this manner, this study has identified the following implications:

For Natural Disaster Management Policy

The increasing threat posed by natural disasters in Mozambique has made the management and reduction of these disasters' risks a priority in the country political agenda (Governo de Mocambique, 2007). The country has no specific drought policy yet but has a Natural Disaster Management Policy, which is the dominant legal framework of responses to climate variability and change, considered as one of the biggest threats to the development of the agricultural sector, which is considered the base for poverty reduction and development of the country. Therefore, the implementation of appropriate strategies to reduce and mitigate climate change risks and enhance farmers' adaptation is seen as fundamental in order to reduce the threats and poverty in Mozambique (Governo de Mocambique, 2017). The Government has designed a National Adaptation Programme of Action (NAPA), which has identified four intervention priorities: strengthening early warning systems; strengthening the capacity of farmers to deal with climate change; reduction of the impacts of climate change along the coastal zone; and water resources management. This study contributes to the first two priorities.

Regarding the strengthening of the early warning systems, the Government planned to develop a system to disseminate locally-relevant early warning information through communication mechanisms available at the community level. The Government intended to do so through the translation of meteorological forecasts and data into actionable information at the local level as well as to identify and evaluate the local systems for the prediction of extreme events (Governo de Mocambique, 2007). However, as discussed in Section 4.5, more work needs to be done to disseminate drought early warning information, which is very relevant at the community level for farming-related activities, as the system in place disseminates warning information regarding floods, cyclones, storms, and strong winds. In fact, lessons could be taken from the existing mechanisms to incorporate into drought early warning system. What is more, the insights provided in Sub-Sections 4.4.2.2 and 4.4.3 regarding the traditional prediction methods used by farmers, the challenges and role of these methods to farmers, mainly to those rural farmers who have limited access to meteorological forecast, may then be useful for the design of strategies to better communicate the scientific forecast to farmers and facilitate the uptake of the forecast by farmers. For instance, the indicators farmers use to predict drought could be used as a visual aid mechanism to communicate the scientific forecast to farmers in a way that is familiar to them. On the other hand, the challenge farmers' face with some of the indicators can represent a leverage point to communicate the scientific forecast as a confirmatory forecast to clarify farmers' doubtful traditional predictions.

Nevertheless, as previously mentioned, it is important to take into account that farmers often rely on their traditional prediction methods as the primary and confirmatory forecast. Thus, this study emphasises the need to make efforts to first acknowledge and enhance the use of farmers' prediction methods, then to combine the use of these methods with the scientific forecast to strengthen the success of the forecast and allow timely planning and preparation to respond to drought. This will contribute to reducing farmers'

vulnerability to drought. In fact, there is a need for changing the mind-set of viewing communities as mere beneficiaries of projects and programs to partners. A participatory approach to drought forecasting, interpretation of the forecast and planning of appropriate responses can be an empowering and successful adaptation strategy. Such an approach can help to develop the governmental and development bodies' awareness of the traditional prediction methods and the unique and enduring roles the methods play in helping farmers to make timely predictions of drought, and other natural hazards, and reduce their vulnerability to these events, in spite of the current difficulties faced. This will further facilitate the communication of scientific forecasts in a way that is meaningful and relevant to farmers' decision-making, and thereby increasing the likelihood of successful combination of both traditional and scientific forecast methods, as well as the development of context-specific and feasible strategies for timely responses to drought. PSP would also constitute a powerful way to revitalize the value of the traditional prediction methods among the community members, especially among the younger generation which is seen as having more interest in scientific forecast.

Moreover, this study has previously discussed about how the lack of access to electricity, the restricted number of farmers who own a radio and participate in the community meetings limits the coverage of the transmission of the regional early warning information and advice to farmers regarding appropriate responses to drought through the media or the local authorities. Thus, alternative forms to transmit information to farmers are required to enable farmers to make timely preparations to respond to drought. For instance, social groups such as churches play an important role in explaining the causes of, responses to and recovery from drought, as well as in bonding the groups together for a common purpose. Thus, the means for communication and bonding the groups can represent a valuable tool to disseminate information, especially among women who constitute the majority of religious people and farmers.

Regarding the strengthening of farmers' capacity to deal with climate change, the country planned to develop and apply a community-based innovative approach to adaptation to complement scientific knowledge on the implementation of related policies, plans, and programs. The country also planned to establish alternative forms of subsistence to agriculture to increase farmers' financial capacity to deal with changes. The Government acknowledged that a proactive approach to natural disaster response depends on the in-depth knowledge of the environment in which we live. Such an approach aimed to avoid a weak involvement of the communities, which could constitute a barrier to the success of the plan to reduce natural disasters' risks (Governo de Mocambique, 2007). In fact, in theory, involving communities in the implementation process seems an ideal and important pre-condition for successful policy implementation (Honig, 2006, p. 2). Nonetheless, in practice, it is also essential to involve communities in the designing process in order to design plans that are feasible and culturally-friendly. Communities know their environment and the temporal changing occurring on it better than anyone else. Communities have their own knowledge, beliefs, and perspectives to explain and respond to the changes, which are place-specific, based on their social and cultural conditions and experiences. These knowledges, beliefs and perspectives shape communities' ability and motivation to act, therefore, they should be taken into account and incorporated in the design of the policy, to increase the likelihood of success of the policy's implementation.

Attention also needs to be given to the role of cultural beliefs in framing the timing and order of farmers' responses to tackle the causes and impacts of drought, as this may also have influence on the implementation of policies through programs and plans. As previously explained, this is because most farmers first implement responses driven by their cultural beliefs in order to deal with the perceived causes of drought, then to deal with the impacts of drought. Thus, such timing and order may reflect on the position farmers will (conscious or unconsciously) attribute to the implementation of policies. Therefore, results reinforced findings from IFRC (2014, p. 79) to emphasize the crucial need of changing the current top-

down to bottom-up approach to first understand communities' culture and make the necessary context-specific adjustments to the plans and programs in order to fit their culture, needs, and priorities. For instance, a participatory community risk assessment and management could represent successful ways to increase knowledge of a community, get closer to them and assess their vulnerability and capacity to risks. Such a bottom-up approach will allow the design of projects that will address the community's conditions, needs, priorities and culturally sensitive ways to reduce their vulnerability and increase their capacity to adapt to drought. This approach may increase communities' support and engagement with the projects, and the likelihood of their success. In this account, results of the study do not demonstrate culture as a barrier in the first instance, but the approach to which the programs are designed and implemented as what dictates whether or not culture will constitute a barrier or help.

Conversely, farmers' social capital can serve as a tool to boost the implementation of policies that are inclusive of farmers' culture and correspond to their needs, priorities, and preferences concerning strategies. However, special attention should be given to socio-cultural gender differences. On the one hand, women are more religious, and place greater emphasis on the importance of respecting and following religion and tradition for a prosperous life. Women often look after their peer groups when making decisions, and are more observant and aware of things happenings in their communities. Thus, as previously explained, women's social groups can be used a tool to disseminate, encourage and enhance the implementation of drought-related adaptation programs at community level. Therefore, women may represent the main drivers of the success of the strategies being implemented in their communities. On the other hand, women's cultural restrictions on decisions regarding the implementation of certain activities to respond to drought may constitute a constraint to the success of the strategies.

Moreover, since the country is as yet failing to establish alternative forms of subsistence to farmers, this study has identified in Sub-Section 6.4.2.2 some of the alternative forms of subsistence that farmers' use in times of stress, which represent their cultural practices, and are based on the available resources in their communities. Some examples are the sale of locally produced items such as charcoal, traditional mats and sieves. Such practices may have the potential to be implemented in stress-free periods, be more profitable and secure than agriculture. Therefore, there is a need to help farmers to boost the implementation of the existing alternative cultural practices to agriculture throughout the year and provide them with the bridging system they lack to transform their livelihoods locally. For this end, the provision of both public and private extension assistance will be fundamental. In fact, the presence of extension agents is also crucial to guide the implementation of proposed drought-adaptation activities and to transmit related knowledge to farmers. This would increase the likelihood of farmers' engagement with the strategies during the program timeframe and continuity after the end of the program. Additionally, as discussed in Section 4.5, younger people, mainly males, usually have more than one livelihood activity, the off-farm activities being their main ones, as their wives are responsible for the on-farm activities. Thus, younger people may constitute great allies in the establishment and implementation of alternative forms of subsistence in their communities. However, women can also constitute great allies in the implementation of these alternative forms since during times of stress they tend to implement income generation activities within their communities. Such seasonal activities can with time become permanent, i.e., be implemented throughout the year.

On the other hand, in Section 4.5, this study also gave an example of how schools and gathering the younger generation together as a group for collective learning in their communities could be important vehicles to transmit and revitalize the local knowledge to them to safeguard the continued existence of their knowledge, including to those who do not have elders in their houses. These vehicles can also be suitable for various purposes such as to increase awareness of climate change, natural hazards and

appropriate responses to these phenomena among the younger generation. Since young people are considered "the driving force that can shape the future of a country" (World Bank, 2017), they would then constitute a powerful tool for long-term changes in the agricultural sector and country. This should then be accompanied with more access to education for rural people.

For Agricultural Policy

Throughout the years, Mozambique has developed several policies, as well as plans and tools to reinforce and implement the policies in order to boost a sustainable development of the agricultural sector. Such development intended not only to help reduce farmers' poverty and enhance the development of the country, as previous mentioned, but also to reduce farmers' food insecurity. Some examples are the National Agricultural Program (PROAGRI), Strategy for Green Revolution, Strategy and Action Plan for Food Security and Nutrition, Poverty Reduction Plan (PARP), National Agriculture Investment Plan (PNISA) and Strategic Plan for the Development of the Agricultural Sector (PEDSA). These strategies aimed to transform the predominant small-scale subsistence farmers into commercial farmers who cultivate diversified crops for their household consumption, to supply the national and international market (Governo de Moçambique, 2011). Such transformation would be possible through the improvement of small-scale subsistence farmers' access to agricultural and financial services, as well as through capacity building to improve the efficiency and efficacy of the agricultural sector (Governo de Moçambique, 2014). However, in practice, more focus was given on the growth of small-scale farmers cultivating cash crops such as tobacco, cotton, and sugarcane and to commercial farmers (Rosario, 2012). Such inequality in the distribution of agricultural resources has resulted in the increased vulnerability of small-scale subsistence farmers and the persistently high poverty levels (Irish aid, 2018).

As previously discussed, results from this study, in Sub-Section 6.5.2, also reinforced these findings from Rosario (2012) and Irish aid (2018) by demonstrating how small-scale subsistence farmers continue to have limited access to agricultural services (e.g., extension assistance and market), credit and education, and how such limitations are hindering farmers' financial and cognitive capacity to invest in and use improved techniques to increase their yields, ensure their food security and respond to drought. Once again, there is a crucial need to re-evaluate the way policies, plans, and programs are implemented in order to avoid worsening small-scale subsistent farmers' situation. Additionally, considering that less than 10% of farmers in the country sell food surplus (Governo de Mocambique, 2011), findings suggest a need to give more attention to and promote crops that are commonly cultivated by farmers, as previously mentioned, such crops constitute farmers' priorities in terms of food needs and preferences. On the one hand, farmers' priority crops may constitute the basis of their agricultural development, food security, and poverty reduction. On the other hand, farmers' priority crops may constitute a limit to the engagement and implementation of other subsistent crops or crops resistant or tolerant to drought being promoted in the country. Both positive and negative sides of farmers' priority crops will also have implications on natural disaster management policy.

Moreover, findings in Sub-Section 6.5.2 reinforced other recent studies from Rosario (2012) and Orre and Forquilha (2012) concerning the fact that the District Development Fund (FDD) is not producing significant results in terms of the development of economic activities and crop production, job and income generation and reduction of food insecurity at the local level. This is because the FDD credit is not only being allocated to male farmers or people with collateral, as previously mentioned, but also with the capacity to produce under irrigation conditions. Therefore, these findings urge the need for reform regarding the criteria to allocate resources in order to fit the conditions of the average farmers, empower these farmers and fulfil the aims of the FDD. In this stance, reform is also needed concerning credit from financial institutions to

agricultural sector in order to benefit poor, and rain-fed farmers who are seen as less likely to provide a return of investment. If the necessary conditions are not created, farmers will probably continue to struggle to have the financial power to invest in their activities and move from subsistence to commercial farmers, thereby reducing poverty levels through agriculture may not be possible. Once again, special attention should be given to gender inequality in resource distribution, as men tend to benefit more than women but women constitute the majority of farmers in the country. Women are also mostly responsible for agricultural activities within the household, including the choices of crops to plant and when, according to the season, or sometimes in accordance with their peer groups, as these tasks are culturally viewed as women's responsibility. Thus, women can be important and powerful advocates of the adaption of improved crop varieties and techniques, and the key players of agricultural development.

All in all, this study has shown how culture is the basis of farmers' agricultural activities. Culture is present in the way farmers get informed about the seasonal forecast for their activities and prepare for the season, their choice of crops and the way they cultivate the crops as well as the type of agriculture farmers practice. Culture is also present in the way farmers perceive, experience, and decide to respond to stressors affecting their agricultural activities. On this account, culture should not be dissociated from agricultural policy, plans and programs but constitute their foundation. Such perspective about culture will allow the design of policy, plans, and programs that are not only feasible at the institutional level but more importantly at the community level, which is where the majority of farmers are.

7.4 Considerations for future studies

Mozambique provided a highly relevant context to conduct this study since the majority of farmers are illiterate, have limited access to, and understanding of scientific explanation for drought, as well as other natural disasters and climate change. Thus, these conditions contribute to farmers' reliance on alternative explanations for these events, which are based on their cultural beliefs of the power of supernatural forces (God, ancestors, and witchcraft) in causing these disasters. This study has provided valuable insights regarding farmers' value-laden explanation for the occurrence of drought events. However, this study was conducted away from a drought period, which brought some limitations to the study in terms of observation of the process of formulation of explanation for the occurrence of drought and responses. Therefore, conducting a study during the drought period would be beneficial as it would allow the collection of data on farmers' real time experiences, as well as to observe and experience the process of finding an explanation for the occurrence of drought (reasoning), the planning and implementation of diverse types of responses and the corresponding outcomes. It would also enhance the understanding of the role of culture and social capital throughout the process.

Even though 63.5% of the participants in this study were literate, 52.5% of them only attended primary school. Thus, further studies should consider involving rural and traditional farmers who have higher literacy levels and access to information. This would enable a better understanding of the extent to which education level and access to information influence farmers' beliefs about the causes and responses to stressors and culture. Additionally, further studies with traditional farmers that are financially well-off would allow a comparative analysis of the typology, types, and timing of responses they implement based on their financial conditions. The analysis of farmers in better socio-economic conditions would also enable correlation of these conditions with farmers' level of attachment to culture in adaptation processes and daily lives.

Additionally, this study was conducted in the sourthern province of Gaza and involved communities located approximately 40km away from a tarred road. Such distance has influenced the communities' level of access to opportunities and reliance on their cultural knowledge and practices. Further studies with communities located further away from a tarred road and in other parts of the country would provide a better perspective regarding the interconnections between the relative geographical location, level of isolation, infrastructure (e.g. roads, power supply), access to opportunities and culture. It would also enable consideration of different perspectives regarding the types of reasoning these communities have about the occurrence of drought, as well as their related responses, and further draw comparisons with communities located closer to a tarred road.

Although this study has made inroads into the role of the institutional environment in framing responses to drought, more context-specific studies would provide a broader understanding of how the institutional environment affects farmers' motivation and capacity to self-implement responses or to implement the proposed strategies, and the overall adaptation. This study has shown how the institutional top-down approach to interventions has negatively affected the rate of implementation of the proposed drought adapation strategies. While results may be insightful to other countries in similar conditions, studies of countries where an institutional bottom-up approach is taken would not only allow correlation of the type of approach used to the outcome regarding the rate of the implementation of the strategies but also to put forward recommendations. What is more, this study has demonstrated how, at some point, during drought period farmers rely on help from the Government and their partners through food aid. Additional studies to Wilhite (2000) and Wilhite *et al.* (2014) are needed to evaluate the extent to which such reactive institutional responses reduce farmers' adaptive capacity by reducing their self-relience and increasing their dependence on institutional help. Moreover, greater consideration needs to be given to the extent to which

the governmental and non-governmental institutions take farmers' culture into account when designing and implementing their strategies, and how their approaches affect farmers' culture and beliefs.

Furthermore, although not extensively explored, this study has shown how farmers have limited understanding of climate change or scientific explanation about drought. Thus, this creates room for further research regarding strategies to communicate better and enhance farmers' understanding of the phenomena and explanation about drought. More studies are needed on understanding the past, present and future context-specific role of traditional prediction methods to farmers themselves rather than to improve science. Also, further studies are required regarding potential mechanisms to help to enhance the use and reliability of traditional forecasts by farmers with limited access to meteorological forecasts.

Lastly, while gender balance was a constraint of this study, addressing this constraint would provide a better picture in terms of gender differences in decision-making, access to resources, choices and implementation of responses, as well as factors driving the differences.

7.5 Conclusion

Farmers have implemented an array of responses to drought to deal with the causes and impacts of drought. Cultural beliefs have historically played an important role to farmers in explaining the perceived causes of drought and guiding collective responses to tackle them. Such enduring collective responses bind farmers together in solidarity in times of drought as they are driven by their common need of rainfall for their agricultural activities, thus acting as a psychological support system to farmers to deal with the causes, recover from the hardship and survive. Farmers' cultural beliefs also indirectly influence responses to deal with the impacts of drought by determining the timing and order of implementation of these types

of responses, which often lag behind the responses to tackle the causes of drought. As such, this study emphasises the crucial need of understanding farmers' culture and beliefs, their influence on farmers' perception of risks and behaviour, and further incorporating them in the design and implementation of DRR strategies to increase the likelihood of successful outcomes of the strategies. Such an approach will dictate whether or not culture will constitute a barrier or a catalyst to DRR strategies.

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Appendices

Appendix 1: List of actors met during the scoping exercise

Level	Place	Type of actor	Name of actor
National	Maputo	Governmental	Ministry of Agriculture and Food security (MASA)
			National Institute for Disaster Management (INGC)
			National Meteorological Institute (INAM)
		Non-Governmental	United Nations Development Programme (UNDP)
Regional	Xai-Xai	Governmental	Provincial Directorate of Agriculture
Local	Chibuto	Governmental	District Service for Economical Activities (SDAE)
			District Service for Planning and Infrastructure (SDPI)
			Maniquenique Meteorological Station (Chibuto)
		Non-Governmental	Red Cross
	Guija	Governmental	District Service for Economical Activities (SDAE)
		Non-Governmental	Red Cross
			World Vision International (WVI)
			Save the Children
Community	Chibuto and Guija	Governmental	Chief of Administrative Post
			Secretary of the Locality
			Leader of the Community
			Community members

Appendix 2: Sites visited in Mbala-Vala, Guija where the Government is implementing some drought-related intervention programs

Small-scale production of lettuce and onion in Mbala-Vala, Guija (source: Author, July 2017)

Multiplication of sweet potato slips in Mbala-Vala, Guija (source: Author, July 2017)

Water reservoir under construction (left) and the source of water to the reservoir (right) in Mbala-Vala, Guija (source: Author, July 2017)

Water points supplied by the reservoir for human (left) and animal (right) consumption in Mbala-Vala, Guija (source: Author, July 2017)

Appendix 3: Mean Monthly Temperature and Rainfall data from Chibuto district

Mean Monthly Temperature data from Chibuto district

Instituto Nacional de Meteorologia

Postal Code 256 - MAPUTO

Teleg.: OBSERTOR - Telefs.: 21490064-21490148-21492530 - Fax: 21491150 - Telex: SMMMP 6-259

Nº136-17/DOR — Maputo, 01 de Setembro de 2017

MAPUTO

Met Station: Chibuto — Period: 1967 - 2014

Element: Mean Monthly Temperature (°C)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1967	23.2	22.9	22.4	21.1	18.4	16.2	14.3	16.2	22.7	24.3	25.7	26.5
1968	27.7	26.3	25.2	23.9	23.5	17.5	20.2	21.5	23.1	24.9	24.1	28.2
1969	28.1	28.1	26.2	24.3	21.6	19.9	19.9	20.8	21.6	24.5	25.9	26.0
1970	27.6	25.9	25.0	23.3	22.7	21.0	20.5	22.1	25.0	23.1	26.7	28.8
1971	26.4	24.9	26.3	25.5	21.4	19.6	19.6	20.8	23.6	23.4	23.6	25.5
1972	27.6	24.7	25.3	24.4	20.7	18.5	19.5	20.2	23.2	24.5	24.5	28.3
1973	28.2	27.0	25.5	24.0	21.8	20.5	20.2	22.0	23.4	24.0	25.7	25.2
1974	28.3	--	--	--	--	--	--	21.0	--	--	--	--
1975	--	--	--	--	--	--	--	--	--	--	27.0	25.4
1976	25.0	25.8	24.1	21.4	17.4	16.6	20.2	19.0	23.5	24.0	25.4	28.5
1977	--	--	--	--	--	--	--	22.4	26.1	26.4	26.7	27.1
1978	26.3	26.4	--	--	--	--	--	--	--	--	--	--
1979	--	--	--	--	--	--	18.9	21.0	22.5	25.7	25.8	27.7
1980	--	27.8	--	25.4	24.2	20.3	20.6	20.9	23.3	23.6	25.2	26.0
1981	26.3	26.5	26.8	--	--	--	21.4	--	24.8	24.7	--	--
1982	--	--	--	24.0	23.3	20.3	--	--	--	23.3	--	--
1983	--	--	--	--	--	20.5	--	--	18.0	--	--	--
1984	27.2	24.4	--	23.1	24.5	21.4	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--
1991	28.0	--	26.5	23.5	22.3	21.4	--	21.3	24.3	24.9	25.9	25.6
1992	27.4	--	--	26.2	24.3	22.3	--	20.8	24.4	25.2	26.0	28.2
1993	--	--	25.2	--	22.8	21.0	19.6	21.0	22.1	22.4	24.3	26.4
1994	25.9	25.4	25.9	25.0	--	--	20.1	21.3	22.8	24.0	25.7	25.8
1995	25.8	26.0	26.1	25.2	22.7	19.0	20.1	21.3	22.8	24.0	25.7	25.8
1996	25.9	24.9	24.3	23.6	22.0	19.5	19.3	21.8	23.2	23.6	--	25.2
1997	25.8	25.2	25.6	23.7	21.3	19.6	19.4	20.4	22.0	22.8	23.6	24.0
1998	25.3	--	--	--	--	--	--	--	--	--	--	--
1999	--	--	--	--	--	--	--	--	--	--	24.4	26.0
2000	--	--	24.8	--	--	22.7	22.2	24.2	25.3	24.4	25.0	--
--	--	--	--	--	--	--	--	--	--	--	--	--
2007	--	--	--	--	--	--	--	--	--	--	--	--
2008	--	--	--	--	--	--	--	--	--	--	--	--
2009	--	--	--	--	--	--	--	--	--	--	--	--
2010	--	--	--	--	--	--	--	--	--	--	--	--
2011	--	--	--	--	--	--	--	--	--	--	--	--
2012	--	--	--	--	--	--	--	--	--	--	--	--
2013	--	--	--	--	--	--	--	--	--	--	--	--
2014	--	--	--	--	--	--	--	--	--	--	--	--

Mean Monthly Rainfall data from Chibuto district

Instituto Nacional de Meteorologia

Postal Code 256 - MAPUTO

Teleg.: OBSERTOR - Telefs.: 21490064-21490148-21492530 - Fax: 21491150 - Telex: SMMMP 6-259

Nº136-17/DOR — Maputo, 01 de Setembro de 2017

MAPUTO

Met Station: Chibuto — Period: 1967 - 2014

Element: Mean Monthly Rainfall (mm)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1967	182.3	615.5	135.1	117.8	95.9	55.4	91.8	5.1	7.8	128.9	34.2	27.5
1968	128.7	172.7	29.4	68.9	14.6	66.4	25.2	--	10.5	2.3	65.4	87.2
1969	84.0	74.6	261.1	160.3	38.5	29.1	28.0	8.0	8.7	120.8	21.2	60.0
1970	24.2	136.1	53.6	45.7	24.5	26.6	17.2	0.0	0.0	85.5	28.3	40.3
1971	164.1	114.3	161.9	24.5	26.0	71.8	18.4	0.0	8.9	54.9	30.4	100.9
1972	278.8	366.4	144.0	17.2	227.8	7.5	2.9	0.0	0.0	16.5	17.7	112.1
1973	23.3	277.2	65.8	119.4	30.1	28.8	31.4	13.6	68.7	11.9	49.0	103.4
1974	136.6	188.8	66.5	92.4	94.9	27.5	20.0	1.6	--	--	--	--
1975	--	--	--	--	--	--	--	--	--	--	47.2	102.1
1976	160.0	83.1	56.5	109.6	109.4	51.3	24.6	31.6	13.5	33.5	22.8	136.7
1977	174.4	--	--	--	--	--	10.0	76.2	171.0	1.6	78.0	65.0
1978	460.4	359.5	--	--	--	--	--	--	--	--	--	--
1979	--	--	--	--	--	--	52.6	28.9	4.5	41.5	45.3	106.0
1980	--	95.0	72.0	43.4	6.0	26.5	21.8	8.5	101.0	36.8	50.3	50.3
1981	114.0	277.0	123.0	20.0	--	--	0.0	24.3	165.0	70.3	132.4	--
1982	--	--	--	26.0	71.5	33.0	0.0	--	--	48.6	0.0	0.0
1983	--	--	--	--	112.5	18.2	9.9	20.9	0.8	0.7	--	--
1984	192.4	15.6	--	0.0	0.0	3.7	148.1	21.4	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--
1991	52.6	202.4	98.7	20.6	14.0	27.9	--	4.3	25.5	8.4	20.4	47.1
1992	117.6	--	--	0.0	0.0	167.1	--	24.4	3.3	11.4	88.0	189.3
1993	--	--	244.6	--	--	--	45.6	57.5	0.0	21.7	143.8	80.9
1994	134.7	31.6	43.5	0.0	38.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	85.0	7.3	32.4	0.0	51.2	--	64.8
1996	267.7	44.3	76.6	136.9	46.0	0.0	16.8	44.4	3.2	1.1	54.6	23.6
1997	267.8	99.7	185.6	13.0	54.9	0.0	41.4	23.4	25.2			
1998	286.7	23.7	4.4	0.0	0.0	--	--	--	--	--	--	--
1999	--	--	--	--	--	--	--	--	--	--	109.4	0.0
--	--	--	--	--	--	--	--	--	--	--	--	--
2007	--	--	--	--	--	--	--	--	--	39.8	164.6	--
2008	--	--	--	16.7	5.5	23.7	12.5	0.0	25.4	11.2	55.0	140.4
2009	108.3	110.9	61.5	22.1	47.8	20.6	9.2	115.5	3.7	4.9	112.7	25.8
2010	126.4	134.5	142.7	111.9	39.2	22.0	67.0	20.5	10.6	2.5	221.1	--
2011	--	--	4.0	12.0	58.4	--	83.3	--	--	--	--	--
2012	--	--	--	--	--	--	--	--	--	--	--	--
2013	--	--	--	--	--	--	--	--	--	--	--	--
2014	163.5	--	--	--	4.6	2.7	--	--	--	--	--	--

Appendix 4: List of key-informants Interviewed

Location	Type of Key-informant	Name/Position of the Key-informant
Maputo	Governmental	Ministry of Agriculture and Food security (MASA)
		INGC
	Non-Governmental Organizations	UNDP
Chibuto	Governmental	SDAE Director
		SDAE Extension Agent
		Chief of the Administrative Post of Chaimite
		Secretary of Tlhatlhene locality
		Leader of Gomba Community
		Secretary of the Gomba community
		Leader of the Magondzwene Community
	Non-Governmental Organizations	Red Cross
	Religious bodies	Leader of the Catholic Church
		Leader of the Methodist United Church
		Leader of the Zion Church
		Leader of the Assembly of God Church
		Leader of the Old Apostolic Church
Guija	Governmental	SDAE Director
		SDAE Extension Agent
		Chief of the Mbala-Vala locality
		Chief of the Administrative Post of Chivonguene
		Leader of the Mbala-Vala Community
		Leader of the Chimbembe Community
	Non-Governmental Organizations	Red Cross
		World Vision International
		Save the Children/COSACA
	Religious bodies	Catholic Church
		Zion Church
		Assembly of God Church

Appendix 5: Information Sheet and Consent Form

Research Ethics Committee

University of Reading

Reference number:

Information Sheet and Consent Form - Questionnaire

Dear Participants of the research,

My name is Daniela Salite, I am a second year PhD student of Livelihoods (International and Rural Development) at the University of Reading in the United Kingdom. As part of my thesis, I am conducting a research into "The role of cultural beliefs in shaping small-scale farmers' behavioural decisions to adapt to drought risks in Gaza Province – Southern Mozambique". We have chosen Gaza province as the research location due to its high risk of drought events, occuring 7 out of 10 years and because the scientific explanations of changes in climate and weather are not largely known by most rural communities in the Province. The aim of the research is to assess how cultural factors, particularly beliefs, have influenced small-scale farmers' behavioural adaptation to drought. The results of this study might be helpful to design and implement the most suitable, integrative, proactive, effective, cultural sensitive and long-term drought adaptation strategies towards reducing the vulnerability and enhance the overall adaptive capacity and resilience of the small-scale farmers to future drought risks.

To undertake this research, we are currently contacting small-scale farmers (both men and women) at household level, living in dry land areas of the province, belonging to a traditional community, with experience of drought events, and preferably benefiting from interventions from stakeholders working in adaptation to drought or having other characteristics that may be relevant and useful for the purpose of the study. Based on that, you were randomly

selected from a list of small-scale farmers in the community created with the help of key-informant people such as community leaders, lead-farmers and extension agents, therefore we would like to invite you to participate in a questionnaire where we will ask questions related to your household demographic structure, livelihood strategies, assets, natural, physical and social capital, farming responsibilities of the members of the household, practices and limitations.

The questionnaire will take approximately 1 hour of your time. You are encouraged to freely express your opinions and please be assured that your views are valued and that there are no right or wrong answers to the questions asked. We will not collect any names or personal details as part of the questionnaire. Your identity will not be revealed to anyone other than the researchers conducting this questionnaire. Moreover, to reinforce the confidentiality of your identity, the questionnaire will be coded with a reference number rather than name and the results of the research will the published anonymously. The answers will be audio recorded if you agree, and the anonymised transcripts of the audio recordings will be used by the researcher working on the project. Once transcribed the original recording and all data I collect will be stored securely electronically on a password-protected computer and hard drive or in hard copy version in a locked cupboard. Your anonymity will not be compromised as only the reference number above will be used to identify the transcript.

Participation in the research is entirely voluntary and you are free to withdraw your participation from the questionnaire at any time you feel uncomfortable or unwilling to participate, and you do not have to specify a reason. Any in-part or total contribution can be withdrawn up until the point at which the data is aggregated before 31/12/2017. After this date, it will not be possible to withdraw your contribution from the results of the research. If you wish to withdraw, please contact Daniela Salite (details below), quoting the reference at the top of this page. The reference will only be used to identify your questionnaire transcript and will not reveal any other information about you. Moreover, if at any stage you wish to receive further information about this research project, please to not hesitate to contact Daniela before September 2018. The findings will be written up into my thesis and published in academic journals. This will not affect your anonymity. The data will be destroyed at the end of the research

project, following write-up of the research findings for publication. Data destruction will occur no later than September 2019 and will be carried out in line with the University of Reading's guidelines.

By participating in this questionnaire, you are acknowledging that you understand the terms and conditions of participation in this research and that you consent to these terms.

Thank you very much for taking time to take part in this questionnaire!

Student Contact Details

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Guide for the Individual questionnaire

Questionnaire

Questionnaire No. _____ Date _____

Reference Number_____

Position_____

Location/Villa_____

Section 1: Demography

1. Are you the head of the household?

   Yes_____ No_____

   If your answer was No, what is your relationship with the head of the household? _____

2. How many members compose your household (including you)?

Name	Relationship with the head of the household's head	Gender	Age	Level of Education	Marital Status

Section 2: Assets, Natural and Physical Capital

3. What is your main source(s) of income? Rank them

4. Do you have or had access to farming credit in the past years? If yes, when and what did you use it for? Were you able to pay the credit back? Explain in details.

5. Do you own any assets that are useful to secure your necessities and farming activities? Rank them

6. Do you own or rent land?

a) How much land to you own/rent?

b) How much land do you use for: Agriculture _____ Grazing_____ Other_____?

c) Is the land you cultivate irrigated, rain-fed or a mix?

If it is a mix, how much is irrigated and rain-fed? And which crops are irrigated and rain-fed

7. How long have you been living and farming in this area?

8. What are the main crops you cultivate?

Year	Type of crop	Area cultivated (ha)	Yield Obtained (kgs/ha)	Season	Purpose of the production	
					Household consumption	Sell

9. What kind of livestock do you own?

Type of livestock	Quantity	Purpose of the production	
		Household consumption	Sell

10. Where do you get your farming inputs from (e.g. seeds, fertilizer, chemicals)?

Type of input	Input variety (e.g. seed variety)	Source (e.g. self-production, market, government, NGO's)

11. Do you own or rent any farming equipment? Describe them and what do you use them for

Section 3: Social Capital

12. Are you a member of any social group (e.g. farmers' association/cooperative, church group, etc.)? if yes, give details (e.g. name of the group, number of members, year of formation, purpose of the group, etc.).
13. Does the group have any kind of external help (e.g. from government or other institutions)? Give details

14. Does anyone in the group had access to any kind of training related to farming activities? Give details

15. Do you have access to any type of information about farming-related activities (e.g. proper planting season, market) and drought risks?

a) If yes, what is your source of information (e.g. community radio, extension agents)?
b) Do you use this information? Why?

16. What are other benefits of being part of the group? Why?

Section 4: Farming Responsibilities, Practices and Limitations

17. What are the farming and other responsibilities of each person within your household (e.g. yours and your partner responsibilities)? Why? Are those responsibilities the same in the other household within the community?

18. Who determined/assigned those responsibilities? Do you agree with those responsibilities? Why?

19. Who makes farming decisions (including responses to drought) within the household?

a) What type of decisions and Why?

b) Do you agree with the decisions taken? Why?

20. When do you start planting now? Compare it with the past

21. Is the land area you cultivate now the same that you cultivated in the past? If yes, how much it has changed and why? If no, why did you change your land?

22. Compare the yield you obtain now with the past (for each crop cultivated)? What do you think are the reasons behind the decline or increase in yields?

Type of crop	Past yield (kgs/ha)	Current yield (kgs/ha)

23. Is the type of livestock you produce now the same you produced in the past? If you answer was No, what have changed and why?

24. Are the farming practices you use now the same you used in the past? If you answer was No, what have changed and why? If is Yes, why do you still use the same practices?

25. Do you think this area is good for farming activities? If your answer was no, why do you still leave in this area? If Yes, explain why

26. What are the main constrains for your farming activities (rank them)?

a) Crop Production:

b) Livestock Production:

27. Do you experience drought in your farming activities? If yes, does it happens every year or occasionally?

28. What do you think are the causes of drought?

29. In a typical year, for how long do you experience drought in your farming activities? Explain

30. Do you think drought is limiting your farming activities? Explain

31. In which stage of crop production you experience drought?

32. What have you been doing to respond to drought (now and in the past)? Why?

Appendix 6: Guide for the Focus Group Discussion

Focus Group Discussion

Date _____

Reference Number _____

Location/Villa_____

Section 1: Perception and Impacts of Drought

1. What drought means to you?

2. How do you identify drought (parameters)? When do you perceive droughts (start, during, end)?

3. What is your source of information about drought and its risks?

4. How has drought affected your farming activities (now and in the past)?

5. How do you describe rainfall and temperature (intensity, duration and frequency) now compared to the past (e.g. increasing, decreasing, no difference, etc.)?

6. Do you identify any other changes in climate or environment now compared to the past?

a) If your answer was yes, what are the other changes you have identified?

7. What are the past drought events that you remember? And why do you remember them?

8. Do these memories about drought events influence the way you perceive the existence, acuteness and risks of drought events? If your answer was yes, how those memories influenced your perceptions of drought? If your answer was No, what are the factors influencing your perceptions of drought (rank them) and how they influence your perceptions?

9. Do these memories of drought events help you to prepare in advance (proactively) to respond to drought events or you prefer to respond to drought (reactively) when it's occurring? If yes, how does it help you and how do you prepare?

10. What do you think are the causes and solutions of drought? Why?

11. Where do you get the information about the causes and solutions of drought from (e.g. ancestors, religion, own perspective, immediate surrounding, social media, extension agents, etc.)?

12. Is the information about drought causes and solutions the same as in the past? If no, what has changed?

Section 2: Decision-making and Responses to Drought

13. What is considered appropriate response(s) to drought in the community? Do you agree with that? Why?

14. How long have the community been implementing those responses?

15. Who makes decisions related to appropriate responses and when to respond to drought in the community? Why?

16. Do you have to respond to drought in the way your community considers appropriate? If yes, why and what could happen if you didn't respond in "appropriate way(s)? If no, are there any restrictions in the other ways that you could respond to drought?

17. What do you do to reduce/change the way that drought has affected you (e.g. traditional ceremonies, conservation agriculture, plant crop varieties that are tolerant to drought, other sources of income, etc.)?

18. Do you think the responses you are implementing are helping you to reduce the impacts of drought events now and in the future? Why?

19. Do you need help in case of drought events? If your answer was yes, what kind of help do you need? If was no, why you don't need help?

20. Do you receive any help to reduce/change the impacts of drought (e.g. government, NGO's and other)? If your answer was yes, from who do you get help? What kind of help do you get from them (describe it)?

a) Did they explain to you the causes, impacts and solutions of drought? Do you agree with the explanation given? Why?

b) Do you think that the kind of help they are giving you are appropriate (are they helping you to reduce the impacts of drought or not)? Why?

Appendix 7: Guide for Individual semi-structured interview

Interview with Key-Informant People (Government)

Date _____

Reference Number _____

Department_____

Position_____

Location/Village_____

Section 1: Community Information

1. How many people (in average) live in this community?

2. How is the community organized?

3. What are the main economic activities in the community? Rank them

Section 2: Perceptions of climate, weather and environmental changes

4. Are you aware of any changes in rainfall (e.g. duration, intensity and frequency), temperature, climate or environment in the last 5 and 10 years in the area?

5. Are you aware any changes in farming seasons and practices in the last 5 and 10 years? Do you know the reasons behind that? Do you think drought has changed farming seasons and practices in the area? How?

Section 3: Perceptions of farming limitations and drought events in the area

6. What are the main constrains for farming activities in the area?

7. Has drought occurred in the area? What do you describe as drought?

8. Is there any governmental meteorological station in the area?

a) If your answer was yes, do you provide information to farmers about drought forecast, causes and risks?

b) If your answer was no, where do you get information about drought forecast, causes and risks from?

9. Do you think drought represent a risk for farming activities in the area? Why?

10. Do you remember about any specific drought event in the area? Why?

Section 4: Perceptions of drought impacts on farmers and their responses

11. Which category of farmers are affected by drought in the area? Why?

12. What are the impacts that drought has caused to those farmers?

13. How farmers have responded to drought impacts? Are they responding individually or collectively?

14. Do you think farmers' normal responses are appropriate? Why?

15. Do you think drought has changed farming seasons and practices in the area? How?

16. Do you know what farmers think about drought (causes, consequences and solution? Do you have any idea about why they think so and their sources of information?

17. Do you think farmers' beliefs about drought are influencing their responses and the way they are affected by drought?

Section 4: Activities Developed in the Area

18. What is the government doing in the area? Give details

19. What categories of farmers are benefiting from your interventions? What are the approaches you used to select the beneficiaries? Why?

a) What are drought policies/regulations in the country? How they benefit farmers?

20. Are there any other institutions (e.g. NGOs, private companies) working in the area on drought adaptation? Do you have any type of collaboration with them?

Section 5: Program design, implementation strategies and outcomes

21. Did you take farmers beliefs and practices into consideration for the implementation of your strategies? Why?

22. Are the outcomes of the strategies you are implementing satisfactory? Why?

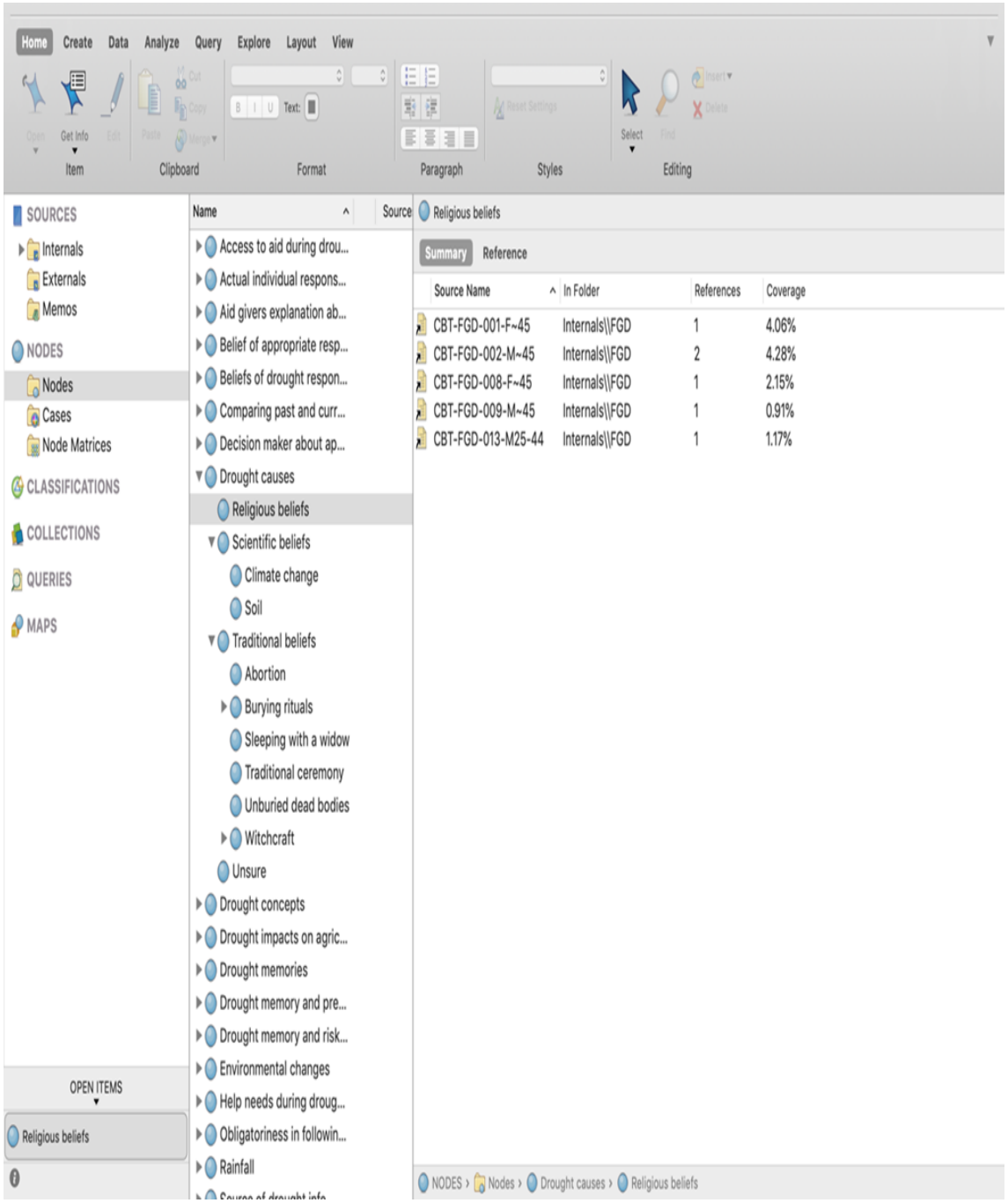
23. Are farmers adopting and implementing the strategies you are promoting? Why?

Appendix 8: List of documents reviewed and analysed for the study

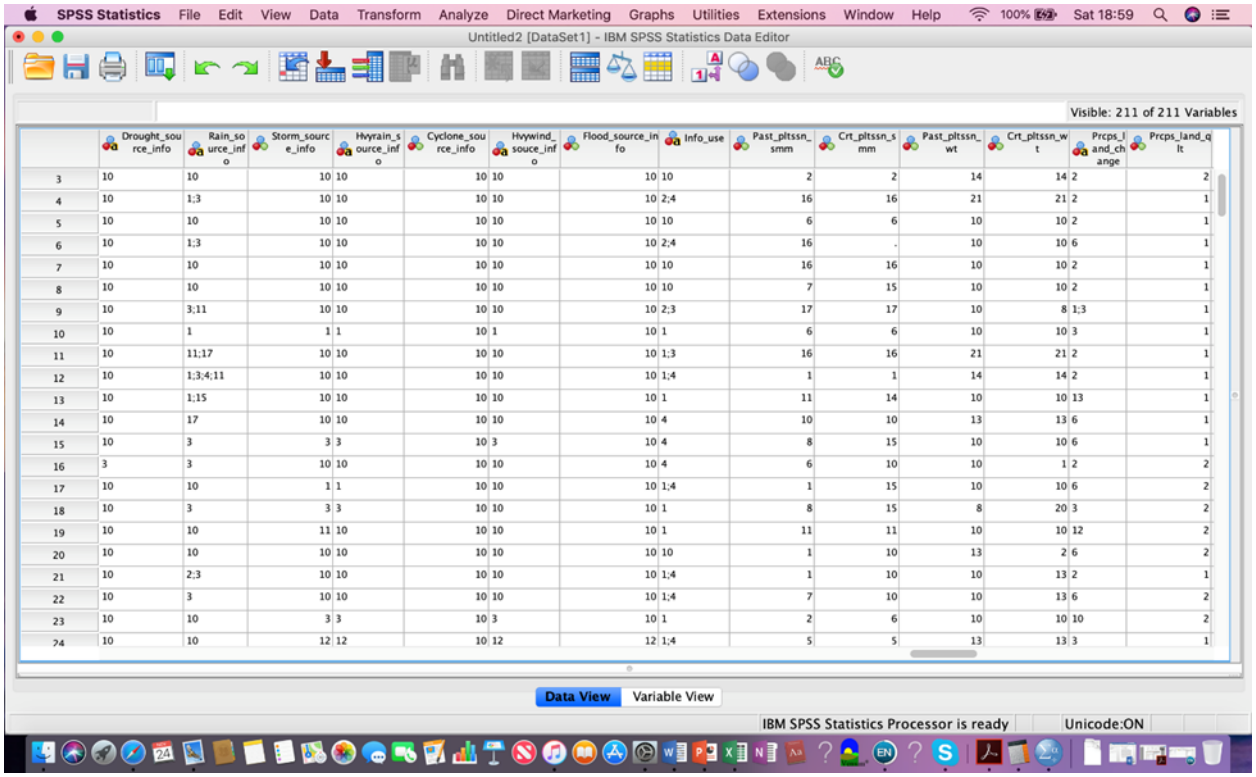
Type of document	Author and title of the Document
Governmental	**1.** Boletim da Republica, Pub. L. No. 15/2014, I Serie - Numero 50 Stat. 6 (2014). **2.** Governo de Chibuto. (2005). Perfil do distrito de Chibuto. Provincia de Gaza **3.** Governod e Guija. (2005). Perfil do distrito de Guija. Provincia de Gaza **4.** Governo de Guija. (2012). Plano Estrategico de Desenvolvimento - Distrito de Guija. Mozambique. **5.** Governo de Mocambique. (2007). National Adaptation Programme of Action (NAPA). **6.** Governo de Mocambique. (2014). National Agriculture Investment Plan 2014–2018 (Comprehensive Africa Agriculture Development Programme). **7.** Governo-de-Moçambique. (2006). Plano Director para a Prevenção e Mitigação das Calamidades Naturais. **8.** Governo de Mocambique. (2017). Plano director para a reducao do risco de desastres 2017-2030. Maputo, Mocambique. **9.** Governo de Mocambique. (2011). Plano Estrategico para o Desenvolvimento do Sector Agrario – PEDSA. **10.** IIAM. (n.a.). Melhoramento de cereais em Mocambique. **11.** INAM. (n.a.). Atlas de precipitação – Moçambique. Maputo, Mozambique **12.** INAM. (2013). Plano Estratégico de Meteorologia 2013 – 2016. **13.** INE. (2017). Resultados preliminares IV RGPH 2017. **14.** INGC. (2009). Study on the Impact of Climate Change on Disaster Risk in Mozambique: Synthesis Report. **15.** INGC. (2012). Responding to climate change in `Mozambique. Phase II: Synthesis Report. **16.** MAE (2005). Perfil do Distrito de Guija. **17.** MASA. (2014). National Agriculture Investment Plan 2014–2018. **18.** MASA. (2011). Plano estratégico de desenvolvimento do sector agrário (PEDSA), 2011 – 2020. **19.** MASA. (2015). Programa Nacional De Hortícolas (2015-2019). **20.** MICOA. (2013). Estratégia Nacional de Mudanças Climáticas (2013 - 2025). **21.** MINAG. (2012). Resultados do Inquérito Agrário Integrado (IAI) 2012 – Fase II. **22.** MITADER. (2015). Intended Nationally Determined Contribution (INDC) of Mozambique to the United Nations Framework Convention on Climate Change. Maputo, Mozambique
Non-Governmental	**1.** AGRICAB. Use case and capacity building requirements. **2.** DRFI. (2012). Mozambique: Disaster Risk Financing and Insurance Country Note **3.** FAO. (2004). Drought Impact Mitigation and Prevention in the Limpopo River Basin: A Situation Analysis. **4.** FAO. (2009). Aid Architecture in the Agricultural Sector Mozambique. Review of existing information and contribution for dialogue. **5.** FAO. (2012). Mozambique. **6.** FAO. (2017). Mozambique at a glance. **7.** GFDRR. (2011). Climate Risk and Adaptation Country Profile: Vulnerability, Risk Reduction, and Adaptation to Climate Change – Mozambique. **8.** International Federation of Red Cross and Red Crescent Societies. (2016). Emergency Plan of Action (EPoA). Mozambique Food Security

Type of document	Author and title of the Document
	9. Irish-Aid. (2018). Mozambique Country Climate Risk Assessment Report. **10.** Save the Children. (2016). The COSACA Consortium. **11.** UNDP. (2012). Coping with Drought and Climate Change (CwDCC) in Mozambique. **12.** UNDP. (2014). Terminal Evaluation Report PIMS 3786 "Coping with Drought in Mozambique" **13.** UNDP. (2016). Over 1.5 million Mozambicans face food insecurity caused by severe drought. **14.** UNDP. (2018). Human Development Indices and Indicators: 2018 Statistical Updates. **15.** World Bank. (2005). Impacts of Extension Services in Rural Mozambique. **16.** World Bank. (2014). Mozambique. **17.** World Bank. (2016). Mozambique. **18.** World Bank. (2016). Picking up the Pace of Poverty Reduction in Mozambique. **19.** World-Bank. (2018). Mozambique.
Article/Reports	**1.** Arnall, A. h. (2012). Understanding adaptive capacity at local level in Mozambique. **2.** Artur, L., & Hilhorst, D. (2012). Everyday realities of climate change adaptation in Mozambique. **3.** Brito, R., Famba, S., Munguambe, P., Ibraimo, N., & Julaia, C. (2009). Profile of the Limpopo basin in Mozambique. **4.** Cunguara, B., & Darnhofer, I. (2011). Assessing the impact of improved agricultural technologies on household income in rural Mozambique. **5.** Cunguara, B., & Hanlon, J. (2012). Whose Wealth Is It Anyway? Mozambique's Outstanding Economic Growth with Worsening Rural Poverty: Economic Growth and Worsening Rural Poverty in Mozambique. **6.** Cunguara, B., Langyintuo, A., & Darnhofer, I. (2011). The role of nonfarm income in coping with the effects of drought in southern Mozambique. **7.** FewsNet. (2014). Southern Africa Special Report: 2014/15 El Niño Event. **8.** Foley, C. (2007). Mozambique: A case study in the role of the affected state in humanitarian action: Humanitarian Policy Group (HPG). **9.** Kirch, L. H., B. E.; Luther, S.; Mucke, P.; Prütz, R.; Radtke, K.; Bochum, R. and Schrader, C. (2017). World Risk Report: Analysis and prospects 2017. **10.** Lalani, B., Dorward, P., Holloway, G., & Wauters, E. (2016). Smallholder farmers' motivations for using Conservation Agriculture and the roles of yield, labour and soil fertility in decision making. **11.** do Rosário, D. M. (2012). From Negligence to Populism: An Analysis of Mozambique's Agricultural Political Economy. **12.** Schmuck, H. (2013). The Economics of Early Response and Resilience: Lessons from Mozambique. **13.** Tschirley, D., Donovan, C., & Weber, M. T. (1996). Food aid and food markets: lessons from Mozambique. **14.** Uaiene, R. N. (2008). Determinants of agricultural technical efficiency and technology adoption in Mozambique.

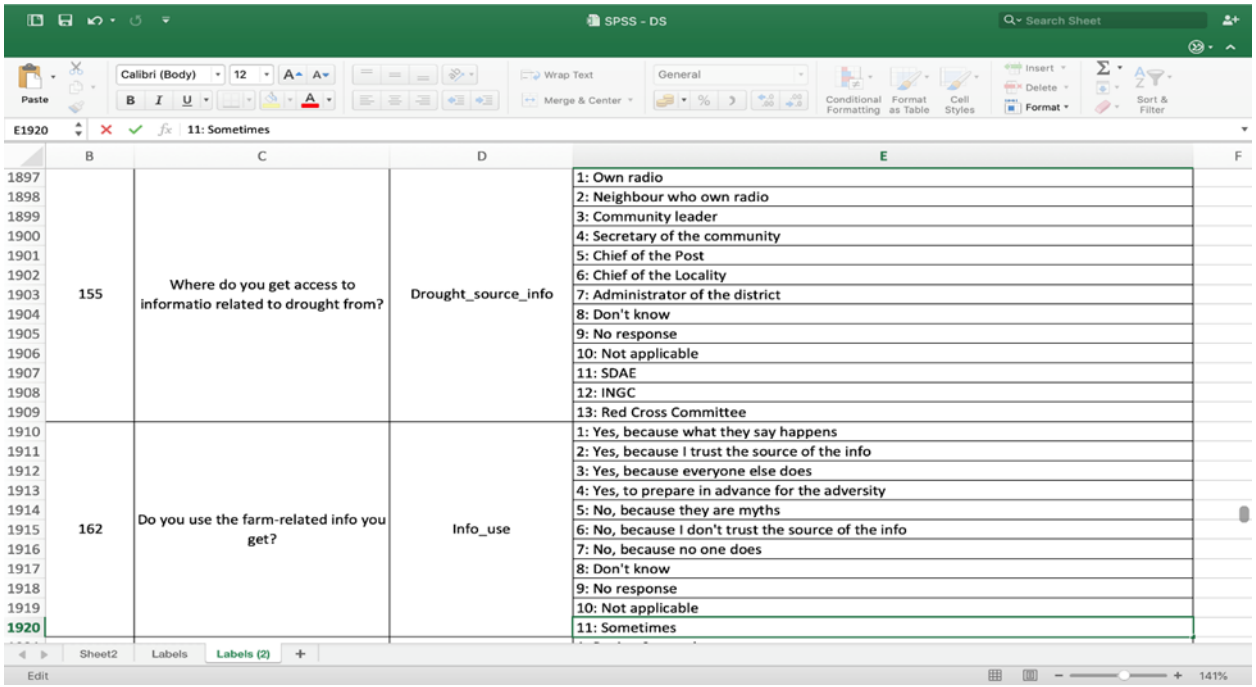
Appendix 9: Example of coding scheme used for qualitative analysis



Appendix 10: Example of coding scheme used for quantitative analysisExample of coded data on SPSS



Example of codes' labels



	B	C	D	E
1897	155	Where do you get access to informatio related to drought from?	Drought_source_info	1: Own radio
1898				2: Neighbour who own radio
1899				3: Community leader
1900				4: Secretary of the community
1901				5: Chief of the Post
1902				6: Chief of the Locality
1903				7: Administrator of the district
1904				8: Don't know
1905				9: No response
1906				10: Not applicable
1907				11: SDAE
1908				12: INGC
1909				13: Red Cross Committee
1910	162	Do you use the farm-related info you get?	Info_use	1: Yes, because what they say happens
1911				2: Yes, because I trust the source of the info
1912				3: Yes, because everyone else does
1913				4: Yes, to prepare in advance for the adversity
1914				5: No, because they are myths
1915				6: No, because I don't trust the source of the info
1916				7: No, because no one does
1917				8: Don't know
1918				9: No response
1919				10: Not applicable
1920				11: Sometimes