University of Reading

Farmer attributes associated with farm profitability - a study of dairy farms in Great Britain

Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Agricultural Economics

School of Agriculture, Policy and Development

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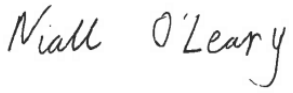
Declaration

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



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Abstract

How farmer attributes influence farm businesses performance and profitability is poorly understood. This thesis sets out to ascertain the farmer attributes that are associated with farm performance and profitability. For the first time from a farm management perspective, the management and job performance literature is reviewed comprehensively. A broad exploratory study focusing on farmer attitudes is reported along with a focused study on farmer personality attributes. Participants in both studies were dairy farmers in Great Britain. Linear models are presented in both studies. Just six and three variables were included in each model in the respective attitudes and personality studies. Models in both studies predict more than 40% of the variation in profitability.

Cumulatively, more than half the profitability variation can be predicted by the GCA, Detail Conscientious competence, Leadership competence, temperament, attitudes and beliefs of farmers.

These findings underline the major significance farm manager attributes are likely to have in driving farm profitability. The qualification ‘likely’ is used as causality has yet to be clearly established in agriculture (unlike in other sectors). The findings reported here relating to dairy farms are consistent with findings in other sectors. They thus appear to be broadly applicable and so likely to be of similar relevance to farms in sectors other than dairy. The effect sizes and the proportion of variation explained are large and may be surprising but are also similar to those found in other sectors. Strategic development and management of the highlighted farmer attributes is advised to facilitate potentially large improvements in farm profitability and financial viability. For farm management research, these may be pivotal findings offering several promising avenues for future research.

Acknowledgements

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I am indebted to Promar International for access to the financial data analysed in this thesis. Andrew Thompson the Managing Director in 2011 who commissioned the initial 'quick study' that began this thesis is, in particular, noted. Tim Harper was also a major influence and aid during the first three years of the studies.

Neil Adams, also of Promar International, and James Hanbury of Exeter Leadership Consulting, contributed to the collection of data used in the analysis presented in Chapter 4. AHDB Dairy commissioned the data collection for a study with a different focus and I am grateful to have had the opportunity to utilize the data for this thesis.

Many of my friends and family also contributed support and helpful comments on earlier drafts of this thesis. These included Alex Gordon, Charlie Gobbet, Danny Holland, Jenny Lang, Lee Murphy and Sarah Jane O'Brien.

I am glad to have produced this thesis, as part of my learning and development. Performing research that will help improve farming in general, has been a rewarding opportunity and challenge. I hope readers can share my enthusiasm for this topic. I believe it is important, engaging and only becoming more relevant.

Table of Contents

List of Tables

List of Figures

Acronyms

AIC: Akaike Information Criterion

β: Beta or standardised coefficient

CEO: Chief Executive Officer

CFP: Comparable Farm Profit

EI: Emotional Intelligence

ESC: Emotional Social Competence

ESI: Emotional Social Intelligence

FADN: Farm Accountancy Data Network

FBI: Farm Business Income

FFM: Five-Factor Model of personality

GB: Great Britain

GCA: General Cognitive Ability

GHG: Green House Gas

GMAT: Graduate Management Admission Test

Ha: Hectares

HR: Human Resources

IQ: Intelligence Quotient

KAI: Kirton's Adaption-Innovation

L: Litres

LOC: Locus of Control

MA: Management Ability

MBTI: Myers Briggs Type Indicator

MC: Management Capacity

MPE: Management Processes Effectiveness

MT: Management Thinking

NFI: Net Farm Income

NPV: Net Present Value

OPQ: Occupational Personality Questionnaire

PBRC: Profit Before Resource Costs

PCA: Principal Component Analysis

PLI: Profit Lifetime Index

ROA: Return on Assets

ROE: Return on Equity

ROI: Return on Investment

SD: Standard Deviation

SI: Social Intelligence

SME: Small and Medium-sized Enterprise

STEN: Standardised TEN

VIF: Variance Inflation Factor

1. INTRODUCTION

This introduction Chapter sets out this thesis' background, objectives and structure. The known extent that a farmer's attributes are associated with farm profitability is outlined first and some of the gaps in knowledge between agriculture and other sectors are highlighted. Some of the challenges faced by dairy farmers in Britain are then discussed followed by the potential benefits of understanding how farmer attributes are associated with farm profitability. Finally, the scope and structure of the thesis are presented.

1.1 The known

This Section is a brief overview of what is known about how farmers' attributes are associated with farm performance. Farm management research is dominated by policy, technology adoption and efficiency analysis. After reviewing these, one might assume that the farmer is a relatively minor driver of farm performance and profitability. However, this thesis contends that the farmer is not just a minor consideration but is in fact, the most important variable associated with farm performance and profitability.

In some sectors, how individuals' attributes are associated with success has been studied comprehensively. Personality and General Cognitive Ability (GCA), in particular, have been identified as major drivers of job performance (O'Boyle *et al.* 2010). Though this knowledge may not be 100% applicable to farm businesses, a convincing argument for why it would not be broadly applicable has yet to be posited.

Farmer specific studies have been relatively limited in scope and depth (Mäkinen 2013; Nuthall 2009; Solano *et al.* 2006; Trip *et al.* 2002; Rougoor *et al.* 1998; Hansson 2008). It is known, for example, that some attitudes and having an agricultural education are positively associated with farm outcomes (Mäkinen 2013; Hansson 2008; Läpple *et al.* 2013; Nuthall 2010c). The relative importance of farmer attributes, the extent farmer attributes are associated with farm outcomes, and causality in these associations have not been established.

With the exception of McGregor *et al.* (1996), studies of farmers have omitted general cognitive ability - the variable that predicts the most variation in other sectors. It is thus unsurprising that the total proportion of farm outcome variation explained by farmer attributes has been modest. At most, studies have explained just 25% of the

variation in performance of farm businesses (Mäkinen 2013). 25% is comparatively modest compared to research in other sectors where almost 50% of the variation in employee performance can be predicted by an employee's attributes (O'Boyle *et al.* 2010). In conclusion, what is known about how farmer attributes are associated with farm performance is relatively limited. Farm manager performance, and so farm performance, may be significantly increased by improving this understanding. The limited research and application of such knowledge in agriculture indicate there could be significant potential for improvement.

1.2 The unknown

At the outset of this research in 2012, there was not a consensus on which farmers' attributes and to what extent farmer attributes are associated with profitability. The 'human side' of farm management had been referred to in passing, but little studied. Trip *et al.* (2002) attributed the lack of research to the 'inherent difficulty' of measuring this 'critical input'.

> '*Owing to its complexity, managerial capacity has often been treated as a black box, represented only by a few aspects such as age and education of the manager, when authors try to explain efficiency differences in agricultural production'* (Hansson 2008).

However, what exactly makes farm management inherently more difficult to study than other sectors was not elaborated on. Managers, advisers, educators, students, and researchers have thus been left without potentially valuable insights into what farmer attributes are associated with farm profitability. Farmers, and agriculture, in general will likely benefit significantly from a clearer understanding of which farmer attributes are associated with variation in farm performance and profitability. This thesis contributes significantly to aggregating and advancing this understanding from a farm management perspective.

1.3 Dairying in Great Britain

Even in good times, the average business will want to improve and become more profitable. However, for many dairy businesses in Great Britain (GB) the past 15 years have been challenging. Between 2001 and 2011, the number of dairy producers in GB fell from 25,182 to 12,040. This drop reached an annualised peak in 2003 when 8.6% of dairy farmers left the industry and the decline slowed to 3.8% of

dairy farmers leaving in 2011 (DairyCo 2012). The recent volatility in the dairy markets has been associated with a further decline to 10,613 as of 2015, a 60% reduction since 2001 (AHDB Dairy 2016c).

Data available up until 2007 showed a strong trend towards increasing herd and farm size throughout GB. With regards litres delivered (total milk sold to processors), this mostly compensated for the lower number of holdings. Deliveries in GB dropped by just 3% from 2004/05 to 2011/12 (DairyCo 2012). These statistics are indicative of some of the challenges facing dairy farmers. Farmers are now more likely to produce more milk on larger farms. Improving manager performance is thus likely to increase the viability and slow the exodus of dairy producers. In addition to these long-standing pressures, Brexit may lead to the biggest change in UK agriculture in decades. Any knowledge and tools that can help farmers improve performance are thus likely to become even more relevant in the context of increasing uncertainty for agriculture.

1.4 The potential

Farmers manage resources that are important economically, environmentally, and culturally. Increasing managerial performance is, thus, likely to produce social, animal welfare and environmental benefits in addition to the direct economic benefits. In light of this, there is an onus not just on farmers, but also on all stakeholders, to encourage improved farm management.

It is hypothesised, but not explicitly tested, that large improvements in profitability are possible through increased understanding and management of farmer attributes associated with farm outcomes. Further to this, efforts to improve profitability and viability ignoring the farmer are likely to fail or only have a marginal impact.

> *'We can measure efficiency until the cows come home, but until we can determine causation, corrections and remedies for greater efficiency are fleeting'.* (Byma & Tauer 2010)

Improving the profitability of farm businesses first requires understanding and then active management of the human aspects of farm management. However, the research to base such efforts upon is limited. The existing research does, however, show that there is substantive scope for improvement.

Mäkinen (2013) for example found that beliefs and attitudes of farmers were associated with 25% of the variation in farm performance. The addition of GCA and

personality assessments in studies is likely to result in a much larger proportion of profitability variation being attributable to farmer attributes (O'Boyle *et al.* 2010). Psychological and social research can be relatively inexpensive and may offer significant potential to increase farm profitability. The main impediment to such research is therefore not resources, but prioritisation. A convincing argument has not been made for studying the role of farmer attributes using psychological and sociological approaches.

This thesis makes a strong argument for further research using this approach as well as for the application of existing findings. The existing evidence is reviewed systematically for the first time from a farm management perspective and contributing novel findings to the literature to facilitate such application. In addition, the association between farm performance and farmer attributes is demonstrated in two empirical studies of dairy farmers in GB. Actionable findings and insights for farmers and advisers to use and implement are also presented illustrating the importance and utility of understanding the relationship between farmer attributes and farm profitability.

1.5 Thesis aims and scope

The objective of this thesis is to identify the farmer attributes that are most associated with profitability. The study samples are dairy farm managers in GB and farm profitability is used as a proxy for farm management performance. Section 2.6 summarises the literature review's findings and the specific measures of profitability that are suitable to act as proxies of farm management performance. In light of the review findings regarding proxies of management performance and the farmer attributes that have been found to be associated with them, detailed aims and objectives are presented in the same Section (2.6).

1.6 Thesis structure

Chapter 2 is a review of the literature with systematic qualities about how farmer attributes likely determine farm performance. It is split into four broad domains - biography, psychology, attitudes/beliefs, and management practices. This was not limited to farm-based studies and summarises the evidence regarding the importance of managers in general. The review is more comprehensive than any other published with a farm management perspective. Several limitations and issues with previous research in the agriculture sector are outlined.

Two novel studies of secondary data are subsequently presented. The studies do not fully remedy the limitations outlined in the literature review. This is in part due to their secondary nature and as their design and associated data collection were performed after the literature review was completed. The analysis and interpretation have, however, been completed fully cognizant of the literature review findings. Chapter 3 presents the first of these. Associations are assessed between responses to a broad exploratory questionnaire and farm profitability. Using correlation and multiple regression analysis, a large proportion of profitability variation is predicted.

Chapter 4 focuses on personality, which has not been explicitly tested as a predictor of farm profitability before. Again, a large proportion of profitability variation could be attributed to personality measures. Chapter 5 summarises the findings of the literature review, Chapter 3 and Chapter 4. These findings and their implications are then discussed, and recommendations for future research are proposed.

2. LITERATURE REVIEW

This literature review is comprised of six Sections. The first of these is a broad introduction and overview of the farm management literature. Four domains of farmer attributes that may be associated with farm performance are introduced and then discussed in detail in Section 2.2 to Section 2.5. These are biography, psychology, attitudes, and management practices. Finally, Section 2.6 summarizes the literature review findings and their implications. In light of these findings and the broad aims and scope outlined in Section 1.5, more detailed discussion of the priority areas of research are identified for this thesis as well as related future research are presented.

2.1 Literature overview

2.1.1 Management and Leadership

In common use ‘management’ and ‘leadership’ are terms that are often used interchangeably (Boddy 2009). The term management is used for more hands-on and goal orientated roles in relatively stable organisations (Khatri & Ng 2000). Leadership is used during periods of change where followers are motivated and led through a change (Dulewicz & Higgs 2005). Of note is the emphasis on people in leadership's description.

However, managers usually have to lead and leaders usually need to manage to varying extents. Farmers tend to employ only a small number of staff, and though the industry is constantly changing due to weather and markets, structural changes are usually incremental. For that reason, farmers are more likely to be described as managers than leaders. Farm management, not farm leadership, is thus the topic of this thesis, though relevant findings from leadership research are still drawn upon.

2.1.2 What is good management?

Management performance is generally measured in results, not the actions themselves. However, this does not help identify what it is about the management that leads to good or bad performance. Perry (2001) quoted the following succinct summation of the difficulties of directly defining bad management:

> *' "While everyone agrees that bad management is the prime cause of failure no one agrees what 'bad management' means nor how it can be recognised*

except that after the company has collapsed—then everyone agrees how badly managed it was" (Argenti 1976, p. 3)'

Boddy (2009) defines successful management as the attainment of:

'organisational goals through planning, organising, leading and controlling on several areas such as production, marketing, financing and staffing, and taking into account the political, economic, social, natural and legal environment'.

Boyatzis (2009) surmised that a person's talent is described/profiled by their:

'values, vision, and personal philosophy; knowledge; competencies; life and career stage; interests; and style'.

Rougoor *et. al* (1998) defined 'Management Capacity' (MC) as

'having the appropriate personal characteristics and skills (including drives and motivations, abilities and capabilities and biography), to deal with the right problems and opportunities in the right moment in the right way'.

When discussing which aspects of farm management are important, there have been a number of terms used and applied which generally refer to very similar concepts and ideas but some clarification and consistency is required.

2.1.3 Ability, Capacity, Competence or Talent?

In addition to the variety of definitions outlined in the previous Section, the terminology used in the published literature is not consistent. Nuthall (2009) described his work as modelling 'Management Ability' (MA) as did Wilson *et al.* (2001). Rougoor *et al.*(1998) and Mäkinen (2013) dubbed it 'Management Capacity' (MC).

Mäkinen (2013) distinguished between the two terms as follows:

'Management ability and management capacity have been used in some contexts as synonymous terms. However, the former deals with personal characteristics, the psychological make-up, of a person while the latter deals with having both the necessary personal characteristics and the skills to deal with the decision-making system. This may include such elements as the management tools being used, the information being processed, and the various analyses being performed.'

This 'Management Capacity' definition encompasses all the farmer attributes assessed in this thesis for associations with farm performance. Hereafter, 'Management Capacity' is therefore used in preference to 'Management Ability'.

Table 2-1 Three focus areas of farm management research

A. Explaining general farmer behaviour	B. Influencing specific behaviours	C. Manager performance
Farmers ' Attitudes, Objectives, Behaviours, and Personality Traits: The Edinburgh Study of Decision-making on Farms (Willock *et al.* 1999)	Understanding farmers' decisions with regard to animal welfare: The case of changing to group housing for pregnant sows (de Lauwere, van Asseldonk, 2012)	Farmers' managerial thinking and management process effectiveness as factors of financial success on Finnish dairy farms. (Mäkinen 2013)
The Social and Intellectual Construction of Farming Styles: Testing Dutch Ideas in Australian Agriculture (Vanclay *et al.* 2006)	Factors affecting the uptake and adoption of rice research outputs in Ghana, West Africa. (McKemey *et al.* 2000)	Modelling the origins of managerial ability in agricultural production (Nuthall 2009)
Modelling farmer decision-making: concepts, progress and challenges. (Edwards-Jones 2006)	Policy Analysis Intentions of UK Farmers toward Biofuel Crop Production: Implications for Policy Targets and Land Use Change (Mattison & Norris 2007)	Decomposing variation in dairy profitability: the impact of output, inputs, prices, labour and management. (Wilson 2011a)
Entrepreneurial behaviour of Dutch dairy farmers under a milk quota system: goals, objectives and attitudes (Bergevoet *et al.* 2004)	Identifying and understanding factors influencing the uptake of new technologies on dairy farms in SW England using the theory of reasoned action (Rehman *et al.* 2007)	Evaluation of a training programme designed to improve the entrepreneurial competencies of Dutch dairy farmers. (Bergevoet *et al.* 2007)
Explaining variation in farm and farm business performance in respect to farmer behavioural segmentation analysis. (Wilson *et al.* 2013)	Environmental grants and regulations in strategic farm business decision-making: A case study of attitudinal behaviour in Scotland (Sutherland 2010)	Understanding farmers' decision-making processes and improving managerial assistance. (Ohlemér *et al.* 1998)

2.1.4 Overview of farm management research

Farmer behaviour and attributes have generally been studied for three reasons:

A. Broadly explain farmer behaviour (primary research);
B. Encourage farmers to perform a particular action/practice; and,
C. Explain farm performance variation.

The literature on farmer behaviour is extensive and has been predominantly focused on objective B, encouraging a particular action or practice (McKemey *et al.* 2000; Mattison & Norris 2007; Garforth 2010; Schroeder 2012; Jones *et al.* 2016). The literature focused on broadly understanding farmer behaviour (A) is rare and research exploring variation in Managerial Capacity (MC), is relatively more common. Please see Table 2-1 for example papers pursuing each objective.

A review of the literature assessing how farmer attributes associate with farm performance has not been published since Nuthall (2001) and several important papers have been published in the interim making this review of publications up to 2016 a timely addition.

2.1.5 Methodology

This review of farmer attributes which may be associated with farm outcomes is split into four domains. Beginning with socio-demographics of managers, how a manager's background can help predict performance is reviewed. Second, psychological traits such as IQ and personality are assessed followed by attitudes and objectives. Finally, specific management preferences and actions are considered.

Primarily with Google Scholar, relevant keywords for each domain were searched for. Abstracts were first assessed to determine if they were relevant. Relevant papers were downloaded and added to the PDF and reference database management software Mendeley (Mendeley Ltd. 2016). References to other relevant papers in the introductions and discussions were also assessed and added to the database as appropriate.

Most Sections have tables summarising the key findings and the study population characteristics of pertinent studies. Upon completion of these tables, the text was written summarising the key findings for each topic/sub-domain.

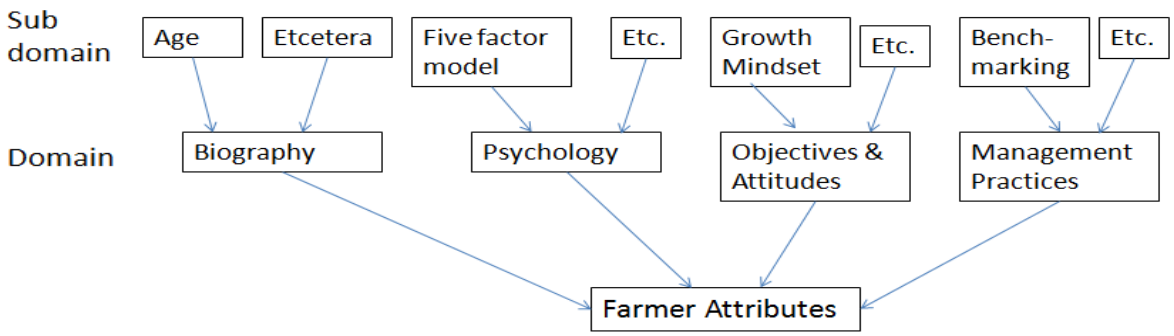

Figure 2-1 Illustration of literature review structure

At the end of each of the four domains, a table is generally presented aggregating the findings at a domain level. For example, the management practices findings are summarised in Table 2-28 bringing together the key findings of Table 2-15 to Table 2-27. At the end of the review, the key findings of these summary tables are again aggregated into a single table identifying the farmer attributes most associated with farm performance (Table 2-29). This process is illustrated in Figure 2-1.

2.1.6 Assessing farm performance

A substantial discussion focused on what are and what are not appropriate measures for assessing farm manager performance has not been found in the reviewed literature with the notable exception of Rougoor *et al.* (1998). Two key question have for example not been fully addressed in the literature. Are all the variables that have been used as proxies of farm manager performance been appropriate for the task? It likely that some measures are more appropriate than others yet this gold standard has not been clearly defined.

Secondly, farm performance can and has been measured in many different ways. If an association between one measure and a farmer attribute is found, would a similar association also be found if a different measure had been assessed? These questions create uncertainty when interpreting the literature. Summarising the key farmer attributes and how they associate with farm performance must take into account the various measures used. One often needs to compare “apples to oranges” in terms of results with different measures of farm manager performance. The remainder of this Section summarises and categorises the wide variety of mostly financial measures used in research of farm management performance to date.

Farm-level estimation of Green House Gas (GHG) intensity and other environmental measures are also increasingly available. However, their accuracy is unclear as they

are based on many assumptions and have not to date been used in this context. As outlined Section 1.5, the purpose of this thesis is to identify associations between farm financial performance - specifically profitability, and farmer attributes. As such other measures of farm performance, be they efficiency, social or environmental are generally not discussed in this thesis except when referencing other research findings.

Accounting data is collected for taxation purposes by law and so may be readily available and is relatively accurate. It is possible to assess financial and efficiency performance of businesses with accounting data and efficiency measures are often used as proxies for environmental performance. With accounting data, it is also possible to assess the resilience of businesses using for example debt to equity ratios to assess the likely ability of a business to continue in various scenarios. Accounting data thus contrasts favourably with other measures of performance for research purposes.

Herrmann (2016) outlined 3 distinct categories of measures when assessing performance in agriculture, liquidity, profitability and stability.

Focus	Liquidity	Profitability	Stability
Time horizon	Short-term →		Long - Term
Performance indicators	Liquidity ratio	Profit or Loss	Net Worth
	Current ratio	Labour income	Owner Equity Ratio %
	Net working capital	Return On Assets	Mean change of Owner Equity over time
		Return On Equity	Change in total Assets

Figure 2-2 Measures for assessing farm performance – reproduced from Herrmann (2016)

Agricultural economists measure farm profitability for many reasons. The largest such exercise in Europe is the Farm Accountancy Data Network (FADN). FADN's primary purpose is to assess the impacts of the Common Agricultural Policy and farm incomes (European Commission 2017). Net Farm Income (NFI) and Farm Business Income (FBI) are common financial measures used in agricultural economics.

NFI is gross farm income minus cash and non-cash expenses. It is a long-term measure of the ability of the farm business to survive. It includes a notional rent for land owned to make it comparable across differently tenured situations. FBI includes

a number of charges such as interest payments and inputted figures for rent that are excluded in NFI. These charges are reflective of a farmer's resource endowment and are unlikely to be affected by farm management actions in the short and medium term.

FBI is generally used for national surveys and it allows comparison across sectors. NFI is no longer widely used by researchers in the UK as it assumes all farmers are renting and imputes a rent which has been deemed to be somewhat artificial as the majority of farmers are now owner-occupiers (Scottish Government 2014). However, of the two, NFI is a more accurate measure of how well a farm is managed.

This thesis sets out to assess the extent financial performance is associated with farmer attributes. Ideally, one would not measure, or would adjust for, that which is beyond the influence of farmers. This ideal measure would, in essence, be a proxy for farm manager performance. It would be independent of a farm's resource endowment and be based on outcomes over which the farmer has direct influence. It would allow comparison of farmers in different situations and structures and not overly bias or discriminate for or against specific subgroups. FBI appears unsatisfactory in this case with NFI perhaps being more closely aligned with this ideal measure.

Different measures will capture different aspects of performance and will influence which attributes will be identified as important. An argument could be made that the manager may be more limited in their ability to change fixed costs. A margin-based measure might, therefore, be 'fairer' to the farmer. However, this would bias the measure towards farmers who are perhaps technically proficient but who may be using their assets inefficiently and against those pursuing a greater profit through volume rather than efficiency.

Research into the extent farmer attributes are associated with farm performance have also used a very wide range of other measures. These include:

- Margin over all feed (Dawson & Hubbard 1987; Beyer 2001);
- efficiency as measured by Data Envelopment Analysis and Stochastic Frontier Analysis (Trip *et al.* 2002; Hansson 2008; Wilson *et al.* 2001);
- financial ratios such as debt to total assets (Jose & Crumly 1993);
- margin/cow and margin/ hectare (Ha) (Solano *et al.* 2006);

- ROA / investment (Solano *et al.* 2006; Gloy & LaDue 2003);
- Net profit and profit ratio (profit/labour and capital employed) (Mäkinen 2013); and,
- composite or latent variables including:
    - profit increase
    - asset increase
    - productivity (Nuthall 2009)

Mäkinen (2013) used simple net profit and net profit plus labour and capital. Solano *et al.* (2006) used return on investment, margin per cow and margin per ha. Alvarez and Arias (2003) stated that there was no obvious best choice in finding a proxy for MC.

Many of these measures clearly do not meet or come close to being an ideal measure of farm management performance. Though not perfect, a somewhat artificial measure of profit such as NFI adjusted for size may be the most appropriate measure to compare farmers fairly (e.g. as a percentage of turnover).

2.2 Biography

2.2.1 Introduction

The age, experience, past learning and skill set (biography) of farmer attributes are assessed as potential associations with farm performance in this Section, 2.2. Generally, with the exception of education, biography is weakly associated with profitability.

2.2.2 Age, experience and parental factors

Farmer age is not discernibly associated with farm performance in agriculture based on the reviewed literature. The effect sizes in the literature are tiny and only statistically significant intermittently (Nuthall 2009; Langton 2013; Solano *et al.* 2006; Bergevoet *et al.* 2004; Tauer & Mishra 2006). The trend is slightly negative with older farmers performing slightly worse. The effect is stronger where technical efficiency is the dependent variable (Hansson 2008; Wilson *et al.* 1998; Byma & Tauer 2010). This is consistent with observations in other sectors relating to job performance. One

meta-analysis reported no consistent effect even after taking into account the potential for curve linear / inverse U relationships (McEvoy & Cascio 1989).

Experience has been a recurring candidate predictor of farm performance in studies. Studies measuring years of experience have reported marginal positive associations (Table 2-3). The assertion that experience is a major aspect of predicting farm management performance has been stated regularly in the literature but lacks supporting evidence.

Nuthall (2009) went as far as to conclude that an 'Experience' factor was the most important predictor of MA. However, the appropriateness of this factor label is questionable. The four most prominent loadings on the 'Experience' factor were objectives, not measures of experience. The loadings on the factor which did relate to experience were also comparatively small. The loadings are reproduced in Table 2-2.

The narrative that should probably have been drawn from this is that certain objectives align with Nuthall's dependent variable, labelled MA. MA was a latent variable in a large and complex model. It loaded on several variables including, but not limited to, Locus of Control (LOC), self-rated ability, self-rated intelligence and three measures of financial performance.

Table 2-2 Nuthall's (2009) 'Experience factor' loadings

Variable	Standardised loading
Objective Risk remover	+0.656
Objective Way of Life	-0.541
Objective Reluctant Farmer (leave)	+0.470
Objective Balanced	-0.20
Education level and grades	-0.098
Learn from mistakes	+0.045
Had good luck, few problems	-0.021
Years of management experience (p= 0.17)	0.018

A subsequent analysis using the same data set (Nuthall 2010c) revealed that MA was quite distinct from financial performance. In Section 2.1.6 it is argued that financial performance is the most appropriate measure of MC. Nuthall's 2009 study therefore likely had both an erroneous factor label and a nebulous dependent variable which may have been a valid measure of farm management performance. As such, it failed to provide clear evidence to support its main conclusion - experience is a major predictor of how well a farm manager can be expected to perform. Despite this, several books were subsequently published aimed at students and farmers stating the importance of experience in farm management (Nuthall 2010b; Nuthall 2010a).

Outside of agriculture, Ericsson (2006) stated that the traditional view of experience was that novices gain in proficiency rapidly during initial training followed by smaller incremental improvements. After an initial burst of improvement and satisfactory performance was reached, the focus of the person would shift.

Actions would become automatic in many cases and so improvement would become minimal. This is consistent with the findings for farm performance with only small correlations and effects have been found in most studies measuring years of experience. Once a farmer becomes good enough to be viable, the incentive to improve reduces.

Some people, however, would continue to focus and achieve significant improvements in performance, avoiding arrested development (Ericsson 2006). Chess expertise, for example, was attributed to recognising and being familiar with most chessboard configurations and the appropriate move. Non-experts assess more configurations as novel and need to work through the consequences of potential moves to decide the most appropriate move.

> *'Once an acceptable level has been reached, they need only to maintain a stable performance, and often do so with minimal effort for years and even decades. For reasons such as these, the length of experience has been frequently found to be a weak correlate of job performance beyond the first two years'* (Ericsson 2006).

Ericsson asserted that expert performance is much more likely to occur when a trainer and advisor guides a learner by providing appropriate focus and structure. Breaking down task performance to its elements and achieving constant small

Table 2-3 Age and Experience

Source	Age	Experience	Nature and size of sample
Barnes (2006)	Not assessed	Years In farming,> 10, increased technical efficiency marginally.	61 Dairy farmers in Scotland
Byma and Tauer (2010)	Slight reduction in technical efficiency	Not assessed	3,375 Dairy farmers in New York
Cavazotte *et al.* (2012)	Not assessed	Large 0.46 effect on management performance (goal achievement & evaluation)	134 Middle-level managers of a Brazilian energy firm
Dhungana *et al.* (2004)	Negative effect on efficiency.	Not assessed	76 Nepalese rice farmers
Hansson (2008)	Efficiency negatively associated with age	Mixed but slightly positive association with experience	507 Swedish dairy farmers
Micheels (2014)		Experienced farmers were more satisfied with results and more 'learning orientated'.	285 beef farmers in Illinois
Nuthall (2009)	Non-significant	'Experience' to 'true ability' (β= 0.97) ($p<0.001$). See Table 2-2.	943 farmers in New Zealand
Nuthall (2010c)	Not significant	Most non-significant except 'quick learner' (β = 0.13)	657 farmers in New Zealand
Ondersteijn *et al.* (2003)	Age did not predict margin or volume.	Not assessed	114 dairy specialists in the Netherlands
Peiperl and Trevelyan (1997)	Negative effect on MBA grades	Working experience negative association with grades.	362 MBA graduates
Solano *et al.* (2006)	No effect on outcomes	Not assessed	2,081 Costa Rican dairy farmers
Tauer and Mishra (2006)	Negative effect	Not assessed	749 dairy farmers in the United States.
Wilson *et al.* (1998)	Not assessed	Less efficient, (0.02, SE= 0.007)	140 Potato growers
Wilson *et al.* (2001)	Not assessed	Experienced farmers greater efficiency	73 Wheat farmers from England
Wilson (2011a)	Non-significant	Not assessed	228 dairy enterprises in England

incremental improvements in these elements are projected to accumulate to large overall improvements. He has described this as 'Deliberate Practice' (Ericsson 2006).

A meta-analysis has shown that deliberate practice can explain up to 26% of the variation in games and 21% in musical performances (Macnamara *et al.* 2014). There is, however, a key difference between these activities and farm management. The predictability of a task significantly moderates the impact of deliberate practice and seven studies of professional performance found little to no effect. The domains studied included computer programming, military aircraft piloting, soccer refereeing, and insurance selling. Given the large variety of tasks and responsibilities entailed in farm management and the relative unpredictability, encouraging farmers to perform deliberate practice on a particular aspect of management may not yield large benefits to farm performance (Macnamara *et al.* 2014).

However, improving the provision of coaches, mentors or advisors to farmers may be beneficial and warrants investigation. Accurately assessing farmers' development needs is also likely to significantly influence outcomes (Aguinis & Kraiger 2009). This will likely require regular visits by this third party to create a rapport and implement (Akobundu *et al.* 2004).

In summary, based on the extant literature, age and experience are generally not associated with farm performance (Table 2-3). Simple measures such as age or years of experience have so far not been found to be associated with variation in farm performance. However, research into experience quality and programs to assess and guide farmer development may be worthwhile.

2.2.3 Education

Education's purpose is to improve knowledge and skills (Aguinis & Kraiger 2009) and various measures of educational attainment have been included in studies of farm performance variation. The results are generally positive ranging from small to moderate in size (Table 2-4). This range appears to be associated with the measure of education used with some measures tending to be more strongly associated with outcomes than others.

First, university-level education failed to predict the efficiency of wheat farmers in the east of England (Wilson *et al.* 2001), dairy farmers in Scotland (Barnes 2006) and dairy farmers in Sweden (Hansson 2008).

Table 2-4 Education

Source	Measure	Effect size	Sample
Akobundu *et al.* (2004)	Secondary / university	Non-significant negative effect	205 beef farmers in Virginia USA
Byma and Tauer (2010)	Years of education	-1.97 to - 2.11 coefficient to output orientated technical inefficiency	3,375 dairies inNew York
Dhungana *et al.* (2004)	Years of schooling	Significant link to economic and technical efficiency ($\beta = 1.4$).$p<0.05$	76 rice farmers in Nepal.
Edwards-Jones *et al.* (1998)		Correlated to behaviours: Production 0.25 and Environmental 0.18	>250 Farmers in Eastern Scotland
Hansson (2008)	Agricultural education	Long-term economic efficiency (0.045)	507 dairy farmers in Sweden
Kilpatrick (2001)	Agricultural education	Implemented more changes within 3 years, more training and more profitable	2,500 farmers in Australia
Läpple *et al.* (2013)	Agricultural education	€348 greater margin per ha for non-discussion group participants	311 dairy farmers in Ireland
Mishra and Morehart (2001)	Completed college	+$49,998 return on operators labour and management, marginal significance $P<0.10$	596 dairy farmers in the US
Ondersteijn *et al.* (2003)	BSc/MSc.	Significantly higher technical and nutrient efficiency	114 farmers in the Netherlands
Rougoor *et al.* (1998)	Multiple	Some positive results, some insignificant	Multiple study populations
Solano *et al.* (2006)	5 levels of education	Correlated to management practices, no association with efficiency or profitability	88 dairy farmers in Costa Rica
Tauer and Mishra, (2006)	Beyond high school	Insignificant effect	749 dairy farmers in the USA
Vanhuyse (2016)	University education	Small to non-significant relationships	431 farmers England & Wales
Wilson *et al.* (2001)	Further education	Non-significant positive effect on technical efficiency	Potato farmers in England
Wilson, (2011b)	Degree level education	Non-significant link to NFI per cow	228 dairy farmers in England

As the proportion of farmers with university degrees in most samples has been small, this consistent finding may be due to limited statistical power. As university level qualifications become more common among farm managers, this may be worth reassessing but it is unlikely to be a large effect. Measuring years of formal education, generally small, and non-significant effects, have been found. One exception was a study of Nepalese rice farmers which found a strong link to years of formal education (Table 2-4).

Some researchers have looked specifically at whether a manager has an agricultural education or not. Hansson (2008) reported that three efficiency measures are positively associated with an agricultural education. In a study focused on discussion group participation, Läpple *et al.* (2013) reported a model where discussion group participants who had an agricultural education earned €232 more gross margin per Ha than other discussion group participants. However, this was not a statistically significant variable in the model.

For non-discussion group participants, those who had an agricultural education achieved €348 more margin per Ha in the presented model. This indicates that agricultural education moderates the benefit of discussion group participation. The benefit of agricultural education can be partially recouped by non-agriculture graduates by participating in discussion groups. Based on the summary results reported in the paper, a weighted average of participants and non-participants was calculated for this review. This weighted average benefit for agricultural education is €314 or 12% greater margin per Ha across, approximately the same effect size as the effect observed for discussion group participation - the focus of that study.

In summary, specifically assessing if farmers have an agricultural education has revealed moderate effect sizes in the two reviewed studies. The effect sizes range from a 4.5% higher economic efficiency (Hansson 2008) to 12% greater gross margin per Ha (Läpple *et al.* 2013). It is thus advisable that future research use this binary variable when studying variation in farm performance in preference to the other reviewed measures.

2.2.4 Knowledge, skills and competencies

In this Section, the literature regarding specific knowledge, skills and competencies is examined. Rougoor *et al.* (1998) reviewed a number of articles about the relationships between particular knowledge sets/skills with outcomes and concluded that:

> *'sometimes a positive effect is found on production, sometimes no effect could be determined.'*

Table 2-5 Knowledge, skills and competencies

Source	Skill / competency	Effect size	Sample
Bergevoet *et al.* (2007)	Entrepreneurial course	Increased number of cows and yield compared to control group.	169 dairy farmers in the Netherlands
Jackson-Smith *et al.* (2004)	Financial	Calculating the cost of production was weakly positive. Other financial measures were not.	84 dairy farmers from Wisconsin
Langton (2013)	Computers and IT skills	Slight positive effect associated with using a computer.	402 dairy farmers in England
	Environmental Maintenance	Slight positive effect to being satisfied with current knowledge	
Kaplan *et al.* (2012)	Execution skills	Execution skills and 'resoluteness' seen as positive	316 CEO candidates for large companies
	Familiarity with business	No effect from bringing in outside managers for large companies	
Nuthall (2010c)	Self-rated ability in 5 domains.	β of 0.49- 0.51 to financial performance, 0.12- 0.16 to productivity.	657 farmers in New Zealand

Research published in the interim has indicated a nuanced picture (Table 2-5). The literature on whether any one specific skill set relates to financial performance is relatively consistent in that no large effects have been reported. For example, Jackson-Smith *et al.* (2004) found no benefit to financial training being provided to

farmers. However, matching skills and training to needs has also been found to be important in other sectors (Aguinis & Kraiger 2009). The amount and appropriateness of knowledge is therefore important and would undermine attempts to find a link between a specific skill and performance in an observational study, e.g. Jackson-Smith *et al.* (2004).

Nuthall (2010c) stated that general job knowledge predicts job performance in other sectors and this is mostly driven by GCA. He also found that being a quick learner relates to profitability (Nuthall 2010c) and this is also likely GCA dependent. Please see Section 2.3.2 for a discussion of GCA.

Nuthall (2010c) also assessed farmers' self-rated ability in five specific areas: animals, plants and soils, labour, financial, marketing and strategic planning. He found a very strong relationship to financial performance (β= 0.51). This self-assessment could form the basis of a needs assessment to guide student and farmer training and development. Aguinis and Kraiger (2009) discuss the large benefit associated with performing a needs assessment to guide training provision (Section 2.5.7 Training and advisory services').

2.2.5 Biography summary

In summarising Section 2.2 two findings stand out as being relevant. First, three studies support the benefits of an agricultural education (Hansson, 2008; Kilpatrick, 2001; Läpple *et al.* 2013). Agricultural education is moderately predictive of farm performance with effect sizes ranging from 4.5 to 12% having been observed.

Secondly, farmers' self-rated ability on five measures was highly predictive of financial performance in one study (Nuthall 2010c). A standard deviation change in self-rated ability predicted more than half a standard deviation change in profitability (β = 0.51) - a very large effect.

2.3 Psychology

In this Section, farmer attributes in the domain of psychology are considered. Psychology and psychometric tests are employed in many industries to guide in the hiring and training of staff but are not currently widely used in small businesses such as farms but may have the potential for greater application in these businesses.

Intelligence and 'emotional intelligence' are discussed in Section 2.3.1 and 2.3.2 respectively. The Five Factor Model of personality is reviewed in 2.3.3 and in Sections 2.3.4 - 2.3.7; the literature on optimism, LOC, intuition and the Myers-Brigs-Type Indicator is considered. Finally, in Section 2.3.8, the Sections 2.3's findings and their relative importance are summarised.

2.3.1 General Cognitive Ability

GCA, IQ, 'g', or intelligence, is generally described as consisting of two components: fluid and crystallised intelligence (Nuthall 2001). Fluid (non-verbal) intelligence is thought to be largely genetic and relate to the capacity to solve problems in novel situations (inference, induction, memory span, intellectual speed). Crystallised (verbal) intelligence relates to learned and cultural intelligence and familiarity with the situation at hand (numerical, verbal and social ability).

GCA is one of the best predictors of job performance in most contexts including management. In a review, Hunter and Hunter (1984) reported that a manager's GCA has a β to job performance of 0.5. This equates to 25% of the variation in performance being predicted by the GCA of the manager.

A meta-analysis of predictors of employee performance by O'Boyle *et al.* (2010) included Emotional Social Intelligence (ESI), GCA and the Five Factor Model (FFM) of personality. When assessing all these predictors in the same model, GCA was by far the biggest predictor of performance. It predicted between 31 - 34% of the variation. The FFM component 'Conscientiousness' predicted between 9.9 and 12.8% and ESI between 6 and 13.2% of job performance (Table 2-6).

Contradicting this somewhat, Dulewicz and Higgs (2000) found that a pseudo IQ measure was much less predictive of advancement within an organisation for general managers than ESI. 'Intellectual intelligence' (pseudo IQ) predicted 27% of management performance, 'management intelligence' 16% and emotional competence (ESI analogue) 36%. Management intelligence was defined, in this

case, as engaging communication, managing resources, empowering, developing and achieving.

Table 2-6 Relative importance of psychometric variables

	EI stream 1		EI stream 2		EI stream 3	
	Raw relative weights	Relative weights as a % of R^2	Raw relative weights	Relative weights as a % of R^2	Raw relative weights	Relative weights as a % of R^2
Cognitive ability	.313	73.5	.331	69.7	.339	69.0
Neuroticism	.005	1.3	.005	1.1	.008	1.5
Extraversion	.006	1.3	.004	.9	.005	1.0
Openness	.016	3.7	.019	4.0	.021	4.3
Agreeableness	.004	.9	.004	.8	.004	.8
Conscientiousness	.055	12.8	.047	9.9	.050	10.2
Emotional intelligence	.027	6.4	.065	13.6	.065	13.2
	$R^2 = .427$		$R^2 = .474$		$R^2 = .491$	

Reproduced from (O'Boyle *et al.* 2010).

This small study's use of a pseudo measure of IQ that is clearly distinct from a traditional GCA measure undermines the validity of the assertion the IQ is less important than ESI. The study also likely suffered from restriction bias in that being managers, most participants were likely to have higher than average IQ as a prerequisite for attaining their position. This is a general critique of studies linking IQ to manager performance (Mcclelland 1973). One study in agriculture also used an even more tenuous pseudo intelligence measure based primarily on education and concluded that intelligence was not a major aspect of management ability (Nuthall 2009).

In agriculture, only one study has used a real GCA measure in relation to farm performance. It found that low GCA farmers in Scotland had a £20,000 lower gross margin than high and medium GCA farmers (McGregor *et al.* 1996). This represents approximately 25% of the median total gross margin, a large difference. McGregor *et al* . (1996) did not report a correlation, but a Cohen's d value of 0.29 was calculated for this review. Based on this imperfect secondary analysis, this indicates at least a

Table 2-7 General Cognitive Ability

Source	Size of relationship	Type of GCA test	Sample
Austin *et al.* (1998)	Openness predicted by intelligence (0.26). GCA correlated to computer use Correlation not specified.	Crystallised and (Fluid)	252 farmers in East Scotland
Austin *et al.* (2001)	Production orientated behaviour (0.14) mediated by openness.	National Adult Reading Test & Raven's test	207 farmers in East Scotland
Cavazotte (2012)	0.53 indirect effect on management performance	Selected Graduate Management Admission Test (GMAT) questions	Brazilian energy firm 134 managers
Dulewiz and Higgs (2000)	R^2 0.27 to manager advancement.	Pseudo intelligence, 'intelligence competencies'	58 MBA graduates.
Hunter and Hunter (1984)	R^2 for job performance, Manager 0.28, Salesperson 0.38	GCA & General psychomotor ability	Meta-analysis of multiple datasets
Edwards-Jones *et al.* (1998)	Not predictive of behaviour profiles.	National Adult Reading Test and Raven's test	252 farmers in East Scotland
Krause *et al.* (2006)	GCA - performance correlation 0.53. Adj R^2 =0.28 from multiple regression.		91 police officers in Germany
McGregor *et al.* (1996)	Low GCA farmers make £20,000 less gross margin. R = 0.14, Cohen's D 0.29.	Nart (Crystallised) and Raven's (Fluid) tests	220 farmers in Eastern Scotland
O'Boyle *et al.* (2010)	69%-73% of explained variance. R^2 0.31 - 0.33	Not discussed as was not the focus of study	Meta-analysis general employees

small to medium effect is present in agriculture. Given the strong effects observed in other sectors, it is reasonable to assume that a correlation analysis of the data would have shown a larger effect size.

In summary, GCA of managers is an important aspect of predicting farm performance (Table 2-7). However, within farming, a reliable estimate of the size of the effect is not currently available. Studies of managers and employees in other industries indicate accurate measurement is important and the use of pseudo-intelligence measures is not effective. The much greater role intelligence plays in job performance in non-managers as outlined by O'Boyle *et al.* (2010) indicates a restriction bias whereby people with low intelligence usually do not become managers in most sectors. Given the family ownership prevalent in agriculture, GCA is likely to be more variable, and so, more important in predicting variation in farm profitability.

2.3.2 Emotional Social Intelligence

Salovey and Mayer (1997) defined Emotional Intelligence (EI) as a set of interrelated abilities that can be classified into four dimensions. The ability to:

- perceive accurately, appraise, and express emotion;
- access and/or generate feelings when they facilitate thought;
- understand emotion and emotional knowledge; and,
- regulate emotions to promote emotional and intellectual growth.

The term Social Intelligence (SI) refers to awareness and management of emotion in others. Collectively EI and SI are referred to as ESI and is purported to be an important predictor of success in many contexts by many researchers. It was initially popularised by Goleman (1996) and his book 'Emotional intelligence: Why it can matter more than IQ'. However, the evidence base to support these assertions is not as strong as its popularity might imply.

In one of the few quantitative studies that support ESI's importance in predicting financial performance, Boyatzis (2006) assessed the competencies and financial performance of outstanding leaders relative to average leaders in a large international firm. 13 of 14 measures found to predict gross margin were ESI measures. Using a form of analysis called tipping point analysis, he reported a 10% difference in gross margin between those who surpassed a high threshold of competencies.

For self-regulation, in particular, the difference was 20%. The sample restriction was, however, extreme. The high-performance group was drawn from the top 4% within the firm based on nominations and an average control group, which helps explain the very large effect sizes. This extreme comparison, unusual statistical methods and small sample size (n=64), make it difficult to infer implications for the general (non-star performer) population.

Table 2-8 Emotional Social Intelligence

Source	Size of association	Sample
Boyatzis (2006)	Facilitates learning Rho 0.5 with gross margin - similar to Growth Mindset. See Section 2.4.2.	32 top senior consultants (4%) compared to 32 average performers
Cavazotte *et al.* (2012)	Correlation of 0.43 to ratings and achievement. When IQ, experience, gender and FFM are accounted for; non-significant.	134 mid-level managers of a Brazilian energy firm
Dulewicz and Higgs (2000)	R^2 0.36 regression to advancement within an organisation after 7 years	58 graduates of a general management course
Law *et al.* (2004)	β : Job performance (0.42), Life satisfaction (0.16) and powerlessness (0.17)	Two studies. 732 and 2,560 high school students and cigarette factory staff
Kaplan *et al.* (2012)	Interpersonal and listening skills did not predict the performance of CEOs. Used ghSmart interview results, not an ESI tool.	316 CEO candidates
O'Boyle *et al.* (2010)	0.24 - 0.30 correlation Job performance	43 studies relating to job performance
Sunindijo *et al.* (2007)	Sharing & Communication: 0.32, Proactive 0.29	22 project managers, 12 engineers

This unusual design appears to have been designed to overcome a difficulty of finding a significant effect with a random sample as evidenced by the fact that this review found no such findings in the literature, especially when other variables such as GCA are accounted for.

GCA, by a long distance, is thus the number one psychometric predictor of general job performance (O'Boyle *et al.* 2010). Having accounted for IQ / GCA and personality measures, EI can predict 6.4% to 13.6% of the explained variation in general job performance compared to IQ (69% to 73.5%). The raw R^2 of 0.03- 0.07, are, however, modest compared to 0.30 - 0.33 for GCA and are comparable in effect size to the conscientious component of the Five Factor Model of personality.

In summary, theoretically at least, there is a case that ESI may be important for managers. The few studies in other sectors (Table 2-8) report moderate correlations. However, only small incremental improvements to models have been reported when other variables are accounted for.

2.3.3 Five-Factor Model

The Five-Factor Model (FFM) / Big 5 is the predominant personality model in psychology and has surpassed other theories and such as the Myers Briggs Type Indicator in research contexts. The main components within the FFM are agreeableness, conscientiousness, neuroticism (emotional stability), extraversion, and openness (McCrae & Costa 1985). Of these, conscientious and emotional stability have been found to be predictors of capability in a wide range of sectors. The remaining three can be important to a lesser extent depending on the context. Openness and agreeableness are advantageous during training for example (Poropat 2009).

The FFM has strongly influenced two studies in agriculture. Willock *et al.* (1999 a & b) employed a 60 question instrument to assess personality traits of Scottish farmers. 'Business orientated behaviour' was modelled using a structural equation model with some factors derived from FFM included as independent variables.

However, the results are not directly comparable to other FFM studies due to the significant adaptation of FFM in the study. Nuthall (2006) also adapted FFM theory to create 25 questions to assess 700 New Zealand farmers' 'management style'. Following factor analysis, six 'style factors' were identified, two of which aligned somewhat with two of the FFM factors while four factors did not.

Two variables predicted financial performance and are related to conscientiousness. 'Thoughtful creator' was positively associated with profitability and 'concern for correctness' was negatively associated with profitability with an effect size of about 0.1 each (Nuthall 2010c).

Another study of farmers used a lesser known but similar personality instrument called the BIP-6F (Herrmann 2016). He reported positive correlations of career 'Commitment' (r 0.37-0.40) and 'Discipline' (r 0.20 - 0.40) to changes in owner equity. Another variable labelled 'Control' focused particularly on details and had large correlations ranging from 0.33 - 0.66 to changes in owner equity. The Control measure consisted of just three statements, 'I check that my orders and targets are implemented correctly', 'I know the production costs for my animal or plant products pretty precisely' and 'I'd rather check too often than not often enough'.

The effect sizes for conscientiousness in studies outside of agriculture report coefficients ranging from 0.19 to 0.32 (Table 2-9). Use of established conscientiousness, neuroticism and agreeableness instruments would aid comparability in future studies but published papers in agriculture have so far employed their own heavily adapted instruments impeding comparability. However, specific personality measures which are likely to be more predictive of performance than gross measures of the FFM have been identified.

Table 2-9 Five-Factor Model

Source	Dependent variable	Conscient-iousness	Openness	Extraversion	Agreeableness	Neuroticism	Sample
Austin *et al.* (2001)	Production behaviour	0.29	0.16	N/A	N/A	N/A	202 farmers in eastern Scotland
Barrick *et al.* (2001)	Managerial performance	0.21	0.10	0.10	0.10	-0.09	Meta-analysis
Cavazotte *et al.* (2012)	Management performance	0.32	NS	NS	NS	-.22	314 Brazilian energy firm managers
Joseph and Newman (2010)	Job performance	.22	N/A	N/A	N/A	N/A	Meta-analysis
O'Boyle *et al.* (2010)	Job performance of non-managers	0.256 to 0.299	-0.22 to -0.27	NS	NS	NS	Meta-analysis having accounted for IQ and ESI
Zhao *et al.* (2010)	Entrepreneurial performance	0.19	0.21	0.05	-0.06	-0.9	Meta-analysis

N/A: Not applicable. NS: Non-significant.

2.3.4 Optimism and cynicism

Hmieleski *et al.* (2009) reported that among entrepreneurs, optimism was negatively correlated with the success of new ventures in the USA. Surprisingly, this was exacerbated by experience, which strengthened the negative effect of optimism. A study in Laos found entrepreneurial optimism to be positively predictive of new firm success (Chen *et al.* 2013).

Table 2-10 Optimism, pessimism and cynicism

Source	Effect sizes	Sample
Green Jr *et al.* (2004)	Organisational optimism to performance (β= 0.45 - 0.53) Individual optimism correlated to organisational performance (0.31) & individual performance (0.45)	133 manufacturing employees from multiple factories in the USA
Hennessy *et al.* (2016)	Pessimistic farmers that underestimate future production were less profitable.	679 sheep and cattle farmers in Ireland
Hmieleski *et al.* (2009)	β (-0.17 to -0.25) for optimism predicting entrepreneur revenue and employment growth.	201 entrepreneurs
Medlin and Green Jr (2009)	Workplace optimism predicts individual staff member's performance β (0.77)	426 people in Southern USA
Peterson *et al.* (2003)	Management teams' optimism correlated to income growth (0.53).	17 top management teams of US firms
Stavrova and Ehlebracht (2016)	Cynicism had a β -.10 having accounted for FFM, age, gender & education.	General German population (15,968)

These contradictory findings are likely to be due to cultural differences indicating that entrepreneurs in the USA may be overoptimistic and may benefit from more pragmatism. In Laos, however, more optimism may be beneficial.

Cynicism, the distrust of others and their motivations, has been shown to be independent of the FFM and, to predict lower incomes of people in safe and stable countries (Stavrova & Ehlebracht, 2015). In a general German population, optimists increased their annual income by €2,000 over nine years while cynics did not. A

standard deviation in cynicism resulted in an approximate 8% change in income. Extreme levels of cynicism predicted up to 25% lower income. The negative effects of cynicism are not present in extremely corrupt countries. The likely mechanism of this disparity is that cynics are more likely to forgo fortuitous opportunities for cooperation in less corrupt countries because they distrust potential partners too much. Distrust, however, is more warranted in countries that are more corrupt.

Farmers are the main decision-makers in their business so how optimistic or pessimistic and cynical they are may affect farm performance. Langton (2013), found that dairy farmers with greater confidence in the future (optimism) were more efficient. Similarly, Hennessy *et al.* (2016) reported that less profitable farmers were more likely to be pessimistic and underestimate future production levels.

In summary, the few studies reviewed show mixed effects, mostly in samples quite distinct from farm management (Table 2-10). Further research would thus be required to determine if these measures are associated with farm management performance. If an effect is found, it will likely not be a linear relationship with success but, instead, a case of appropriateness contingent on the context as evidenced by the Laotian (Chen *et al.* 2013) and American studies (Hmieleski *et al.* 2009). Given these challenges, this topic may not be an efficient predictor of farm performance.

2.3.5 Locus of Control

LOC measures respondents' perception that they can influence outcomes (Rotter 1966) and is similar to the Perceived Behavioural Control construct of the Theory of Planned Behaviour (Ajzen 1991). An internal LOC indicates a person believes that they can influence outcomes. Conversely, an external LOC indicates a person believes outcomes are generally outside of their control and due to external forces or parties. In agriculture, LOC is the only psychometric measure that has been used in multiple studies, albeit in significantly adapted forms.

In a review of the use of LOC in agricultural management research, Nuthall (2010c) found a generally positive relationship with farm business outcomes and an internal LOC. Using a 19 item instrument, he found that 10% of the variation in farm profitability could be predicted by LOC. Hansson (2008) used a four-point qualitatively derived LOC scale. A weak link to efficiency assessments of Swedish dairy farmers was found. A study in Finland used a six-item measure. They reported

removing LOC from their final model as LOC did not load on variables in a manner consistent with the theoretical framework they employed (Mäkinen 2013).

Table 2-11 Locus of Control

Source	Effect sizes	Sample
Hansson (2008)	0.018 regression to long-term input economic input efficiency - 4 point scale for LOC	507 Finnish Dairy farmers
Herrmann (2016)	No effect on change in owner equity over three years.	136 farmers in eastern Germany
Kaine *et al.* (2003)	30% of cautious internal 'Analysers' suffered financial hardship, internal 'prospectors' 41% and external 'Defenders' 49%.	783 mixed enterprise farmers in NSW Australia
Mäkinen (2013)	Found to affect implementation stage of farm management - effect size not reported.	Dairy farmers in Finland
Miller and Toulouse (1986)	LOC has a β of 0.21 to growth in sales ($p<0.05$) and 0.19 to return on investment ($p<0.10$).	97 diverse firms in Quebec
Nuthall (2010c)	β of 0.2 for LOC to productivity and 0.19 to financial performance. 19 item instrument.	943 farmers in New Zealand
Rauch and Frese (2007)	Business success correlation 0.13, to business creation 0.19.	Meta-analysis entrepreneurship

In summary, for a psychometric measure, LOC has been assessed in agriculture more extensively than any other. The results have been disappointing, ranging from negligible to moderate (Table 2-11). Given the relatively detailed assessments of the measure to date compared to several other measures with strong prospects of predicting farm profitability identified in this review, further study of LOC in agriculture should be a relatively low priority. If it is to be assessed, careful consideration should be given to how it should be measured.

2.3.6 Intuition

Intuition or tacit knowledge can be defined as

'affectively charged judgments that arise through rapid, non-conscious, and holistic associations' (Dane & Pratt, 2007)

The intuitive nature of farming is often stressed and Nuthall (2009) stated that:

'most decisions on a farm are made intuitively, in contrast to the use of a formal analysis, improving farmers' inherent ability will have a significant payoff'

and:

'what appears to others (as) intuition is actually a display of well trained cognitive ability to handle ill-structured problems'.

Mäkinen (2013) stated that intuitive decision-making could be a missing piece of the puzzle for understanding the influence of farm managers on farm financial performance. Lifecycle was also highlighted as a potential mediating factor in the effectiveness of intuitive versus analytical decision-making. Generally, experienced farmers can rely on intuition. However, novice farmers are probably better served by following a more analytical approach at least until they become proficient enough to achieve similar results intuitively.

Like Optimism and cynicism (Section 2.3.4), much of intuition - performance research has taken a contingency view where certain contexts lend themselves to intuitive thinking while others are more suited to an analytical approach (Khatri & Ng, 2000). Weather and markets can have significant destabilising effects in agriculture, but agriculture does not tend to revolutionise as much as say the computer industry does. Government supports also provide a degree of certainty to agriculture not present in other sectors. The stability of farm businesses relative to other sectors has not been ascertained to date. Extrapolating contingency-based research to farming is thus difficult without further research.

Beyond agriculture, a link has been found between performance and intuition-based decision-making. Khatri and Ng (2000) studied financial performance of banks, utilities and computer companies. Banks and utilities that were more analytical performed better than banks that were more intuitive and, intuitively managed computer companies performed better than analytical ones.

The effect within computer companies was quite large with a correlation of 0.4 to financial performance in a relatively unstable industry. This study's 'intuitive

synthesis' model was composed of judgement, gut feeling and relying on experience. Stability was assessed by measuring the intensity of competition, the role of government regulation and importance of technological change.

A subsequent study of small and medium business owner/managers found a positive relationship between intuitive decision-making and firm performance (Sadler-Smith 2004). The same study found that analytical decision-making was not positively correlated to success but, like Khatari and Ng (2000), it had a negative effect in unstable environments.

If analytic managers were more prevalent in stable environments and intuitive managers in unstable environments was also assessed. No significant difference was found. This indicates that preferences for intuition or analysis are not selected strategies, but an attribute of the manager. In summary, further study of manager intuition and how it influences farm performance is warranted given the moderate to large effect sizes found in other contexts (Table 2-12).

Table 2-12 Intuition and analytical

Source	Effect sizes	Sample
Khatri and Ng (2000)	Correlation of 0.4 for intuition to performance in low-stability environment	IT managers
Ritchie *et al.* (2007)	β 0.28 with financial performance, correlation 0.17	144 non-profit executives
Sadler-Smith (2004)	Correlation = 0.43 to financial performance 2 years later. Marginally significant in a model	141 SMEs in England
Young and Walters (2002)	Found no relationship to performance using a 'sensing' - 'intuition' dichotomous scale (MBTI).	60 dairy farmers in the USA

2.3.7 Myers Briggs-type Indicator

The Myers Briggs-Type Indicator (MBTI) classifies people into 16 'types' based on their score on four 'cognitive style' continuums. Despite models such as the FFM being consistently found to be more robust and theoretically sound (Nuthall 2001), the MBTI is one of the most widely known and used, psychometric tests in non-research contexts. It has, however, been applied in agricultural research. Jose & Crumly (1993) found that 'thinking' farmers, as opposed to 'feeling' farmers, had

greater assets and extroverted farmers had higher debt than introverts. Young & Walters (2002) found statistically significant relationships between practice implementation rates and dairy herd performance measures. They reported a link between MBTI measures and implementation of measures such as milking three times a day and herd performance indicators. MBTI measures, however, did not directly predict financial performance.

2.3.8 Psychology summary

The central message of this Section, 2.3, is that GCA and Conscientiousness are large and statistically robust predictors of job performance (Table 2-13). Moderately important topics include neuroticism and ESI. Promising areas that should be investigated further include intuition, optimism and cynicism. LOC and the MBTI should not be used in future research to predict farm performance.

Table 2-13 Psychology concepts in descending order of importance

	Correlations	Model β	Source Table
GCA		0.25 to 0.33	Table 2-7
Conscientiousness		0.05 to 0.46	Table 2-6
Emotional Social Intelligence	0.13 to 0.50	0.03 to 0.06	Table 2-8
Intuitive - analytical	0.17 to 0.46	0.28	Table 2-12
Emotional stability		0.01 to 0.26	Table 2-8
Openness		0.01 to 0.13	Table 2-6
Optimism - cynicism	0.53	-0.25 to +0.77	Table 2-10
LOC		0.018 to 0.19	Table 2-11

2.4 Attitudes, beliefs, objectives and values

In this Section, the attitudes, beliefs, objectives and values of farmers are explored as potential predictors of farm performance. First, the terms are defined and

contrasted. The results from past research relating to agriculture are then summarised in Section 2.4.1. In Section 2.4.2 the research in other contexts relating to Growth Mindset is assessed followed by a summary of what is known about how attitudes, beliefs, objectives and values of farmers influence or are likely to influence farm performance in Section 2.4.3

Attitudes, beliefs, objectives and values can be defined and contrasted as follows. An attitude is an expression of favour or disfavour toward a person, place, practice or event that may be relatively transient or amenable to change. A belief, or conviction, is a psychological state where someone holds a specific premise to be true or not. As they are both closely related concepts, attitudes and beliefs shall be henceforth referred to together as attitudes.

Values relate to what a person holds to be an idealised state of existence.

> *'Values refer to the goodness or badness of results, the situation, things, etc. ... Values express the farmer's needs and motives; goals and objectives express the means to follow those values.'* (Ohlemér *et al.* 1998)

Gasson (1973) discussed farmer behaviour through the prism of goals and values, postulating that farmers could be classified into one of four value-based categories:

Instrumental (e.g. means to an end, making money);

Expressive (e.g. self-respect, creativity, challenges);

Social (e.g. tradition, prestige, family); and,

Intrinsic (e.g. independence, enjoyment, lifestyle).

Gasson's value scheme has been used by several researchers to predict outcomes, e.g. Bergevoet *et al.* (2004) and Hansson (2008). As values are related to objectives, and objectives are more discrete, objectives and values shall be considered together, henceforth referred to as objectives.

2.4.1 Attitudes and objectives

The design, effort expended, and decision-making on farm are likely to be influenced by the reasons the farmer is farming. Objectives, and associated attitudes have thus been studied as potential predictors of much about a farm business, not just performance.

Attitudes and objectives relating specifically to profit have been described in numerous ways. These include 'Managerial Thinking', 'Business Orientation', 'Entrepreneurial Orientation', 'Profiteer', 'Profit Maximiser' etc. Entrepreneurial Orientation, Strategic Thinking, and instrumental values have been found to be predictive of financial performance (Mäkinen 2013). In that study, these measures loaded on a construct called Managerial Thinking that was highly predictive of operating margin (β =0.59). The most important of these, Entrepreneurial Orientation, was derived from the responses to the following:

> *'A farmer today can be regarded as a business manager.*
>
> *A farm should be managed like any other business.*
>
> *My managerial skills are good.*
>
> *I follow business principles in managing my farm.'* (Mäkinen 2013)

Strategic Thinking also loaded heavily on Management Thinking and the questions it was derived from were:

> *'I have a vision how to develop the farm in the long run.*
>
> *I have plans for investments on machinery and buildings.*
>
> *I can describe my business plan easily with few sentences.*
>
> *As an entrepreneur, I have clear goals that guide the way of farming.*
>
> *It is difficult to set goals for a period of a couple of years. (reversed)'* (Mäkinen 2013)

The beliefs and objectives identified in this Section appear advantageous for profitable farming Table 2-14. Viewing farming as both a lucrative business and way of life is particularly predictive of financial performance (Mäkinen 2013). Encouraging farmers to embrace these aspirations and associated concepts may increase farm profitability.

Other motivators and attitudes are also predictive of profitability. Herrmann (2016) recently reported that farms run by those who prioritised their own leisure and enjoyment had smaller increases in owner equity over three years than those that did not with Pearson coefficients ranging from 0.25 to 0.49 - a large effect.

Table 2-14 Attitudes and objectives

Source	Effect size	Sample
Barnes (2006)	Multifunctional attitude associated with technical efficiency (β 0.02).	61 dairy farmers in Scotland
Ferguson & Hansson (2013)	Expansion predicted by business values (2.38) and belief in future profits (2.19). Exit planned predicted by belief in future profits (0.59). Odds ratios.	282 dairy farmers in Sweden
Hansson (2008)	'Idea of Profitability' 0.09 and 'Expected profitability' 0.03 to long-term economic efficiency (Regression coefficients).	507 dairy farmers in Sweden
Herrmann (2016)	Farmers that prioritised their career and were committed to increased owner equity over three years. r=0.39.	51 mixed farms in E Germany
Mäkinen (2013)	Management thinking (MT) composed of 5 factors, 28 questions predicted operating margin (β 0.59). The factors loadings on MT included entrepreneurial orientation (0.58), strategic thinking (0.55) and intrinsic values (0.44).	117 dairy farmers in Finland
Manevska-tasevska & Hansson (2011)	Interest in farming negatively associated with technical efficiency (-0.05 to -0.04). Profit maximisation 0.14 to 0.21, increasing production 0.14 to 0.1 and standard of living objectives 0.09 to 0.14.	300 grape growers in FYR Macedonia
Nuthall (2010c)	Self-rated ability model β 0.49 - 0.51 to financial performance, objective of risk reduction (β 0.13) and profiteer (-0.07).	657 farmers in New Zealand
Rauch & Frese (2007)	Entrepreneur success correlated to: Need for achievement 0.3, Innovativeness 0.27, Proactive 0.27, Generalized self-efficacy 0.25, Stress tolerance 0.2, LOC 0.13, Risk taking 0.1.	Meta-analysis of entrepreneurship
Rosenberg & Cowen (1990)	Attitude towards employee motivation predicts milk yield (β 0.433). Somatic cell counts (-0.23).	87 dairy farmers in California
Thomas & Thigpen (1996)	Opposition to regulations and environmental rules associated with higher gross income. Past participation associated with opposition.	1,063 arable farmers in Texas
Vandermersch & Mathijs (2004)	Prioritising reducing inputs and costs: higher gross margin (model partial R2 = 0.12). Focus on pedigree and yields negative (partial R2 0.05). Model R2 0.21.	79 farmers in Flanders
Wilson *et al.* (2001)	Maintaining the environment (0.019) and maximising profits (0.017) in the top 2 of priorities. Placing both in the top two would predict approximately 4% greater efficiency.	73 wheat farmers in E England
Wilson *et al.* (2012)	High performing farmers characterised by attention to detail, focus on margins and cost control as being important.	24 farmers in England
Willock *et al.* (1999)	Achievement in farming objective predicts business orientated behaviour (Cor 0.45). Quality of life objective correlates to business orientated behaviour (0.287).	252 farmers in E Scotland

Nuthall (2010c) reported that those who have risk reduction as an objective were more profitable. Having the view that farming delivers more than just food but also environmental and social outputs was associated with greater technical efficiency (Barnes 2006) and a need for achievement was found to be important for entrepreneurs' business success (Rauch & Frese 2007).

2.4.2 Growth and fixed mindsets

Someone who generally believes that people can change and develop, especially with concerted effort, is said to have a 'Growth Mindset'. The converse to this is a person that believes that people do not really change over time - a 'fixed mindset'. Growth Mindset is associated with employee appraisal accuracy, manager engagement in employee coaching (Heslin & Vandewalle 2011) and employee performance (Dahling *et al.* 2015). Botatzis (2006) found that the related behaviour of 'facilitates learning' was associated with success among senior managers of a large international consultancy firm.

Growth Mindset can be encouraged and interventions have been successful in creating durable changes in mindset (Heslin & Vandewalle 2008). In a study of farm technical performance, Rosenburg and Cowen (1990) reported that dairy managers that viewed staff as ambitious, reliable and independent (as opposed to the lazy and inherently disliking work) tended to produce better quality milk with a lower somatic cell count. The same study found providing feedback to employees also had a positive impact on somatic cell count. In summary, farmers' views on how fixed or malleable theirs and staff's attributes are is probably associated with outcomes on farm. However, no research published to date has directly linked a 'Growth Mindset' to higher profitability on farm or elsewhere.

2.4.3 Attitudes, beliefs, objectives and values summary

The largest association between attitudes and objectives with farm performance was for MT (Table 2-14). Having an 'entrepreneurial orientation' was the most important aspect of MT. This is followed by having a strategic view of how the farm will develop. The objective of risk reduction, having a and self-rated ability have also been identified as predictors of farm profitability. Growth Mindset may also be of importance but has not yet been tested as a predictor of farm profitability.

2.5 Management practices

2.5.1 Planning

Table 2-15 Planning and decision-making

Source	Effect size	Sample
Boyd (1991)	Effect size of at least 0.11 for strategic planning.	Meta-analysis
Farm Business Survey (2010)	Bottom 25% less likely to plan. 20% difference between high and low profitability groups.	1,900 farms in England
Gloy and LadDue (2003)	Payback, cash flow, or Net Present Value during expansion predicts +6% Return on Assets (ROA) and profitability analysis +4%.	76 dairy farmers in New York
Langton (2013)	Not having a business plan negatively related to economic efficiency -0.02.	402 dairy farms in England
Mäkinen (Mäkinen 2013)	Strategic thinking associated with financial performance.	117 dairy farms in Finland
Manevska-tasevska and Hansson (2011)	Production planning not significant. Monitoring of accounting data during year 0.01- 0.02. The inclusion of family in decision-making 0.09 - 0.11.	300 grape growers in FYR Macedonia
Perry (2001)	Weak relationship between five planning measures and staying in business.	304 small companies
Peterson *et al.* (2003)	Flexibility correlated to income growth (0.48).	17 CEOs of large corporations
Solano *et al.* (2006)	Sharing decisions with outsiders such as advisors was linked to successful management styles.	88 dairy farmers in Costa Rica
Trip *et al.* (2002)	Goal forming and planning does not predict efficiency.	26 horticulturists in the Netherlands

Formal planning and who participates is discussed in this Section. Only negligible or small effects have been found in the literature (Table 2-15). As planning activity may be initiated because of financial distress, confounding is likely to some extent. A firm may only formally plan to satisfy banks for example.

For formal planning, the effects observed have been generally small. Formal planning, therefore, does not appear to be a requirement for profitable farming but appears to be beneficial in some forms at least. For example, Gloy and LaDue (2003) found that when large investments are being planned - calculating cash flow, payback period or net present value predicted higher returns on investment. Mäkinen (2013) also found that attitudes relating to planning important such as 'Strategic Thinking' were positively associated with financial performance.

Perry (2001) reported that Small and Medium size Enterprises (SMEs) that went bankrupt had done less planning prior to their bankruptcy than those that did not. He found that most businesses either performed a lot of planning or do almost no formal planning with few in between. Those who did more formal planning tended to have more employees. Though not tested, it was hypothesised that there may be a threshold number of employees, they suggested in the range of 5 to 15, beyond which planning has value and that planning was generally not worthwhile for businesses with fewer employees than this threshold. In summary, planning appears to be of minor importance in predicting farm profitability.

2.5.2 Decision-making and implementation

Having reviewed the literature regarding planning and farm profitability in the previous Section 2.5.1, how farmers make decisions and implement them is now discussed as a potential predictor of farm performance. Three models of how farmers make decisions were found in the literature (Ohlemér *et al.* 1998; Rougoor *et al.* 1998; Trip *et al.* 2002).

Trip *et al.* (2002) attempted to assess the quality of decision-making using a four-step model. These steps were: goal formation; planning; monitoring (including data recording); and evaluation. Of these, only the latter two were marginally predictive of technical efficiency. Only data recording was statistically significant. The small sample of size of 26 farmers was a particular weakness of this study.

Rougoor *et al.* (1998) proposed a three-stage process: planning; implementation; and control. Mäkinen (2013) assessed Management Processes Effectiveness (MPE) which encapsulated three steps of Rougoor *et al.* (1998) plus a measure of how analytical the process was. They found that MPE was positively associated with MT discussed in Section 2.4.1, but the direct effect on farm performance was negative having accounted for MT. The model is reproduced in Figure 2-3.

So far, these theoretical models have failed to translate into actionable findings but decision-making may still be a predictor of profitability. A study of grape growers in FYR Macedonia reported a 0.09-0.11 coefficient to technical efficiency with the inclusion of all adult family members in decision-making (Manevska-tasevska & Hansson 2011). The inclusion of more people in decision-making appears to be generally positive in agriculture but the effects are still rather modest (Solano *et al.* 2006).

In summary, decision-making processes and quality have been found not to be clearly associated with farm performance when assessed.

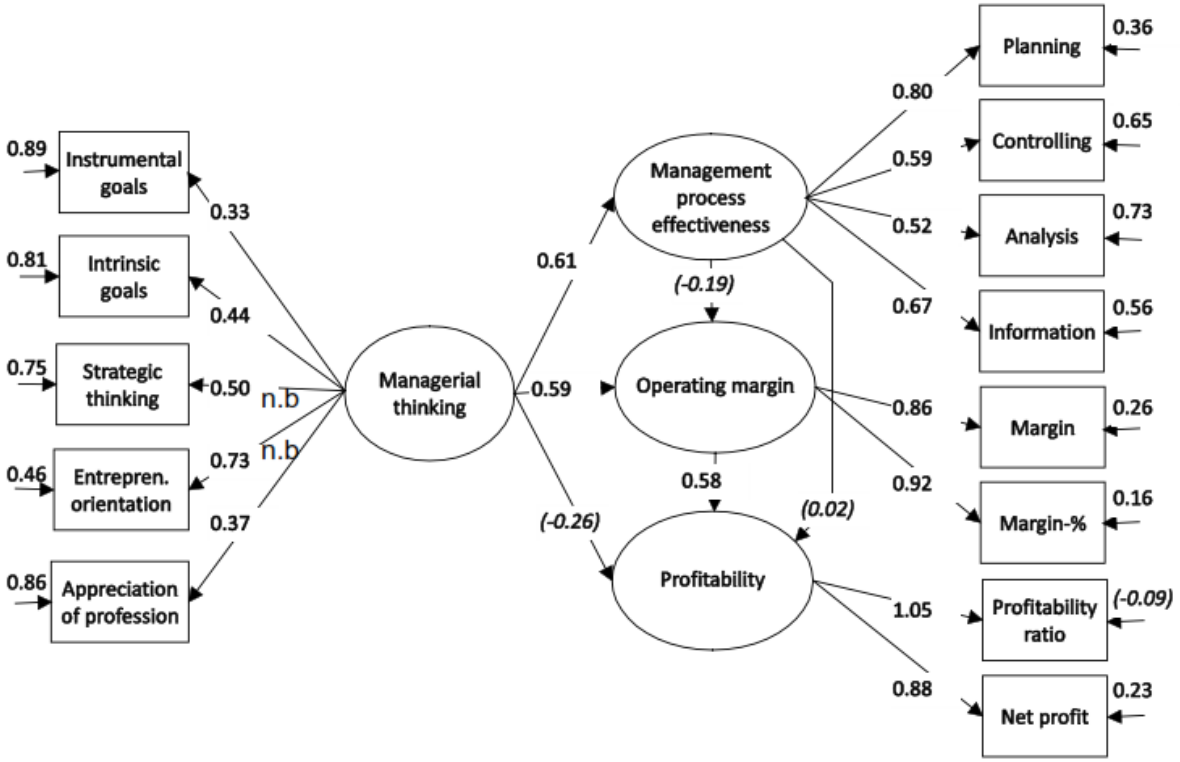

Figure 2-3 Structural equation model of MC (values in the parentheses are non-significant - those not in brackets are statistically significant). Reproduced from Mäkinen (2013)

2.5.3 Setting targets and goals

In Section 2.4.1 , the link between objectives and farm performance was discussed. A potential manifestation of strong objectives is to set intermediate goals. Goal Theory states that setting specific challenging goals should lead to higher performance than other types of goals (Baum & Locke, 2004).

Greenbank (2001) discussed objective setting in micro businesses in the UK and stated that micro businesses are more likely to compromise financial targets for non-financial ones such as flexibility. The setting of specific challenging goals as suggested by goal theory would thus be undermined. In larger non farming

businesses, the setting of targets and goals has been linked to major increases in performance of individual employees (Medlin & Green, 2009). The one agricultural study to deal with setting specific targets and goals did not find a link to technical efficiency but it had a sample size of just 26 (Trip *et al.* 2002).

In summary, setting short and medium-term goals and targets has been shown to be an effective predictor of outcomes in other industries (Table 2-16). Further study is required in agriculture but encouraging farmers to set intermediate goals is likely to be beneficial.

Table 2-16 Goal setting

Source	Effect size	Sample
Dhungana *et al.* (2004)	Growth rate targets (staff and sales) correlated to growth (0.27)	335 architecture firm CEOs and associates in North America
Medlin and Green Jr (2009)	Individual self-rated employee performance predicted by goal setting β 0.34	426 employees in the southern USA in diverse industries: 20% managers and 34% supervisors.
Trip *et al.* (2002)	Did not predict technical efficiency	26 horticulturists in the Netherlands

2.5.4 Monitoring, record-keeping and information sources

Monitoring production and the outcomes of decisions is an aspect of business-orientated behaviour and a manifestation of an entrepreneurial orientation discussed in Section 2.4.1 (Garforth & Rehman, 2006; Mäkinen, 2013; Willock *et al.* 1999a). Few studies have directly linked the act of monitoring to farm performance but it has been discussed as part of the decision-making process. Where it has been linked to performance, it was positively linked to technical efficiency and amount of milk quota (Bergevoet *et al.* 2004; Manevska-tasevska & Hansson, 2011).

Manevska-tasevska and Hansson (2011) found that monitoring the results of decisions was associated with input orientated Technical Efficiency (0.127 coefficient) and, to a much lesser extent, monitoring accounting information (0.023).

The monitoring results was widely prevalent (90%) with only 10% reporting not doing so indicating the scope for improvement was limited in the sample.

Table 2-17 Monitoring and evaluation

Source	Effect size	Sample
Bergevoet *et al.* (2004)	'I sufficiently monitor production processes'. (0.038) coefficient to milk quota	256 dairy farmers in the Netherlands.
Gloy and LaDue (2003)	Trend analysis and formal review meetings not significant	353 dairy farmers in the USA
Gloy *et al.*(2002)	Use of accounting service ROA (0.02). Large effect as average ROA was 0.052.	107 dairy farmers in New York
Hansson and Öhlmér, (2008)	Those who analysed grain quality and did not feed straw were slightly more efficient.	169 dairy farmers in Sweden
Langton (2013)	Cash flow preparation slightly negative effect	402 dairy farms in England
Manevska-tasevska and Hansson (2011)	Technical Efficiency predicted by monitoring of results of decisions (Y/N) (0.127) and accounting information (regularity) (0.023)	300 grape growers in FYR Macedonia
Rougoor *et al.* (1999)	Monitoring somatic cell count and calving interval positively associated with gross margin	38 dairy farms in the Netherlands
Trip *et al.* (2002)	Evaluating outcomes marginally predictive of efficiency. 0.034 β.	26 horticulturists in the Netherlands

Table 2-18 Record-keeping

Source	Effect size	Sample
Braun (2012)	Time on financial records positively associated with NFI, $35 per hour.	20 dairy farmers in New York
Manevska-tasevska and Hansson, (2011)	Book-keeping & budgeting were both not significant	300 grape growers in FYR Macedonia
Trip *et al.* (2002)	Recording data predicts efficiency (0.02)	26 horticulturists in the Netherlands
Rosenberg and Cowen (1990)	Record use had a small association with average days open and milk production	87 dairy farms in California

The act of record-keeping as a predictor of outcomes has a negligible to small effect on outcomes based on the four studies reviewed here (Table 2-18). Of the four, the two studies with reasonable sample sizes found little to no effect. Record-keeping is probably too broad a practice to measure meaningfully and the keeping of specific optional records may better predict outcomes.

Table 2-19 Information sources

Source	Effect size	Sample
Barnes (2006)	Information sources not a significant predictor of technical efficiency	61 dairy farmers in Scotland
Hansson (2008)	Paying attention to information sources (0.062) to long-term technical efficiency.	507 dairy farmers in Sweden
Mäkinen (2013)	Information sources, actively looking for new info; precision agriculture did not improve predictions.	117 dairy farmers in Finland
Manevska-tasevska and Hansson, (2011)	Information sources not a significant predictor of technical efficiency.	300 grape growers in FYR Macedonia
Mishra and Morehart, (2001)	Extension service predicted financial performance (+$9,962).	596 dairy farmers in the USA
Ondersteijn *et al.* (2003)	Number of information sources was not a significant predictor of outcomes.	114 dairy farms in the Netherlands
Solano *et al.* (2006)	Information preferences predicted margin per cow marginally significant (p=0.13) & Yield (p=0.06)	88 dairy farmers in Costa Rica
Wilson *et al.* (1998)	Coop membership did predict efficiency.	140 potato farmers in the UK
Wilson *et al.* (2001)	Seeking advice from more of 16 possible sources associated with more efficiency.	70+ wheat farmers in England
Wilson (2011a)	Independent technical advice not statistically significant effect on performance	228 dairy farms in England

Number and variety of information sources have been considered as potential predictors of farm performance. However, of the ten papers summarised in Table 2-19, only four found a significant relationship between information sources and outcomes. One of these was not assessing the amount or which information sources but, rather, if the farmer pays attention to information sources (Hansson 2008). The

number of information sources a farmer uses tends to predict outcomes when it is included in studies. In general, the more sources the better. The link is, however, small and intermittent, especially when other farmer attributes are accounted for.

2.5.5 Benchmarking

Benchmarking, or monitoring of results in comparison to other similar businesses, is purported to be very useful for farmers (Andersons 2015). However, substantive quantitative evidence to support this claim has not been found in this review of the literature (Table 2-20). For example, benchmarking and preparing budgets were not found to be large predictors of efficiency by Langton (2013).

Table 2-20 Benchmarking

Source	Effect size	Sample
Langton (2013)	Positive but non-significant with economic efficiency	402 dairy farms in England
Wilson (2011a)	The top half of performers regularly benchmarked more than lower performing quartiles (P=0.015).	228 dairy farmers in England

However, Wilson (2011a) did report that the most profitable dairy farmers were more likely to 'benchmark regularly'. How benchmarking is done and how its outputs are subsequently acted upon may well be important predictors of farm performance but to date, this has not been assessed robustly.

2.5.6 Staff management

The study of human resource management in agriculture is relatively new with the topic being virtually absent from farm economics research before 1990 (Bitsch 2009). Braun (2012) reported that farmers spending time on Human Resources (HR) was positively associated with financial performance. Rosenberg and Cowen (1990) found a lower somatic cell count and calving interval when feedback was given to staff.

Assessing a number of HR functions on dairy farms, Stup *et al.* (2006) found that use of standard operating procedures negatively predicted milk quality. This is likely to be

endogenous with farms with poor quality milk trying to fix an issue by implementing standard operating procedures.

As yet, the large effects of management observed in other sectors (Peterson *et al.* 2003) have not been replicated in agriculture (Table 2-21), perhaps due to the greater proportion of work carried out by farmers themselves relative to staff.

Table 2-21 Staff management

Source	Effect size	Sample
Braun (2012)	Spending more time on HR management had a positive impact on financial performance.	20 dairy farmers in New York state
Neff (2011)	Role clarity and family functionality have complex association with firm performance.	110 executives of family-run businesses
Peterson *et al.* (2003)	Cohesiveness 0.45 and Flexibility 0.48 correlation to income growth.	17 leadership teams of large corporations
Rosenberg and Cowen (1990)	Providing feedback associated with: • higher yields; and, • lower cell count and calving interval.	64+dairy farmers in the USA
Stup *et al.* (2006)	Feeding Standard Operating Procedures predicted higher somatic cell count.	42 dairies in Pennsylvania

2.5.7 Training and advisory services

Three main options are available to farmers to improve with external help: training, discussion groups and advisers. The efficacy of training was summarised by Aguinis and Kraiger (2009). They noted that training effectiveness could be substantially improved by performing trainee needs assessments and using error-management training techniques. Error management training encourages learners to explore and make mistakes and learn from them. Aguinis and Kraiger (2009) also found that delivery via technology can be just as effective as face-to-face training on average, a pertinent finding for rural businesses like farms.

Two studies have indicated that training is effective on-farm specifically. Stup *et al.* (2006) found that staff training predicted the return on equity and Kilpatrick (2001) found that those who attended training days tended to be more profitable. Bloom *et*

al. (2013) reported a 17% increase in productivity for Indian factories that received 5 months intensive consultancy. They hypothesised factories had not used consultancy before, in part due to a general lack of knowledge of what consultancy was available and how beneficial it is. However, Storey (2004) concluded that SME managers did not discernibly benefit from training.

Table 2-22 Staff training

Source	Effect size	Sample
Aguinis and Kraiger (2009)	Global review of training effectiveness; • 4.6% of financial performance explained by training (Guerrero and Barraud Didier 2004) • (Cohen's D 0.62. Arthur *et al.* 2003) • D effect of 0.39. (Collins and Holton, 2004) • Training effectiveness improved by performing a needs assessment by an experienced subject matter expert. • Error management training more effective than other methods D= 0.44. • Technology delivered training is just as effective as face to face learning	Review
Crook *et al.* (2011)	Firm-specific human capital relates to operational performance, r 0.26, 0.1 to firm performance.	Meta-analysis 68 studies, n=12,163
Kilpatrick (2001)	Farmers who made changes and attended non-field day training had on average of $83,651 operating surplus. Those that did not make changes and did not provide training had a surplus on average of only $31,580.	2,500 farmers in Australia
Micheels (2014)	Farmers who are 'Learning orientated' are more satisfied with results. Most experienced farmers are 'Learning-oriented'.	285 beef farmers Illinois
Stup *et al.* (2006)	Providers of training to staff had 10% greater ROE. ROA, somatic cell count and rolling herd average were not affected.	42 dairies in Pennsylvania

Table 2-23 Extension, discussion groups and consultancy

Source	Measure	Effect size	Sample
Akobundu *et al.* (2004)	Extension participation and number of visits.	Participation alone non-significant. However, additional visits predicted $+1,700 - $+3,300 NFI.	205 minority beef farmers in Virginia, USA
Barnes (2006)	Membership of cooperatives	No effect on technical efficiency.	61 farmers in Scotland
Bloom *et al.* (2013)	Lean management	17% increase in productivity with intensive consultancy intervention.	Indian textile factories
Davis *et al.* (2010)	Use Field Farm Schools	Yield and income up 100% among some groups. No benefit to others.	1,126 households in East Africa
Hansson (2008)	Discussion groups	Positive for economic output efficiency.	507 dairy farms in Sweden
Läpple *et al.* (2013)	Discussion groups	€310 /12% increase in Margin/ Ha.	309 Irish dairy farmers
Läpple and Hennessy (2015)	Discussion groups with incentives	Joiners after incentive introduced did not benefit significantly.	309 dairy farmers in Ireland
Langton (2013)	Discussion groups	0.01 yes, -0.01 no, to economic efficiency.	402 dairy farmers in England
	Paying for technical advice	Marginal effect on when advice is paid for ($p<0.10$).	
Maffioli and Mullally (2014)	Impact of extension	Positive but modest benefits. Increased calf production.	691 Uruguayan beef farmers
Manevska-tasevska and Hansson (2011)	Attending seminars	No predictive of technical efficiency.	300 grape growers in FYR Macedonia
Mishra and Morehart (2001)	Extension service use	+$9,962 $p<0.05$.	596 dairy farmers in the US
Storey (2004)	Management training & skills	Returns to small business managers to undertaking training are small.	Review article

A study of beef farmers found an intensity or ‘dose effect’ for advisory services that may explain the disparity. Benefits only became discernible after a number of repeated visits. They recommended prioritizing increasing existing users' engagement rather than recruiting additional users (Akobundu *et al.* 2004). This effect could explain the negative findings of Storey (2004) and the positive findings of Bloom *et al.* (2013) where intensive assistance was provided in the latter and a clear benefit was observed.

Langton (2013) reported that English farmers who attended discussion groups on business management issues had lower costs and greater financial efficiency. Discussion groups have been found to be particularly helpful for Irish dairy farmers without an agricultural education. Having attempted to account for self-selection bias, participation in discussion groups predicted a €310 /12% greater margin per Ha for dairy farmers in Ireland (Läpple *et al.* 2013). However, when an incentive program was subsequently introduced, those who joined then did not significantly benefit compared to a control group (Läpple & Hennessy 2015). However, the later joiners had three years of participation while the earlier joiners had had up to eight years of participation. The effect depth and duration of interaction may again have been important as in Akobundu *et al.* (2004).

In summary, farmers benefit from training (Table 2-22) and advisory services (Table 2-23). However, the evidence is limited. The literature in agriculture does not show the scale of effect seen in other sectors. This implies training and advisory services may be less effective in agriculture. Adopting best practice such as error management training techniques and needs assessments may thus improve efficacy. This thesis' findings could also inform efforts to improve existing available services.

2.5.8 Proactive and innovative management

Changing and experimenting with farm operations in a proactive rather than reactionary way is likely to be a positive management approach. In other sectors, a link has been found between innovative and proactive management (Table 2-24). In farming, one study observed that those that make changes are likely to have much larger operating surpluses (Kilpatrick 2001). Given the large effect sizes observed in other sectors (Rauch & Frese 2007; Richard *et al.* 2004) and one promising study in agriculture (Kilpatrick 2001), this is a promising area further research.

Table 2-24 Proactive and innovative management

Source	Effect	Sample
Kaplan *et al.* (2012)	Proactive CEOs of buyout firms were more successful (β 0.19).	84 CEOs
Kilpatrick (2001)	Farmers who made changes and attended non-field day training made $83,651 operating surplus. Those who did neither had an average surplus of $31,580	2,500 farmers in Australia
Läpple and Hennessy (2015)	Farmers who showed initiative and joined discussion group before incentives benefited significantly compared to those who waited until an incentive was introduced.	309 dairy farmers in Ireland
McGregor *et al.* (1996)	KAI risk/ innovativeness scale. High scorers gross margin £79,000, low £86,000 and average £56,000.	242 farmers in Scotland
Rauch and Frese (2007)	Proactive and innovativeness correlated to the success of entrepreneurs (0.27).	Meta-analysis
Richard *et al.* (2004)	Innovativeness correlated to ROE (0.18).	535 banks in the USA

2.5.9 Risk and specialisation

In Section 2.4.2, farmers' attitudes and objectives relating to risk were discussed. The most relevant finding for farmers was that the goal of reducing risk was positively associated with greater profitability (Nuthall 2010c). In this Section, risk-taking and risk management is assessed. The one study in farming reviewed is from a developing country and had mixed findings. There is, thus, insufficient evidence to make any conclusions about risk-taking, *per se,* on-farm performance (Table 2-25).

However, for risk management practices, two studies found a positive relationship with farm performance (Table 2-26). Fixing all, or some of the sale price for farm outputs and doing the same for inputs reduces the effects of volatility (Mishra & Morehart 2001).

One form of risk management that is negatively associated with whole farm performance is diversification outside of agriculture. This is likely to be partially endogenous as less profitable farmers may be more inclined to consider these options.

How specialised or diversified a farm is has been assessed in a number of studies of efficiency and financial success. Specialisation of farm enterprise has generally been linked to greater efficiencies and profitability, particularly in dairy enterprises (Ford & Shonkwiler 1994; Solano *et al.* 2006).

Ford and Shonkwiler (1994) inferred that mixed farms should focus on the dairy enterprise and not the arable / crops enterprises for example. Langton (2013) found that while having multiple farm enterprises predicted higher efficiency, diversification out of agriculture predicted lower efficiency. Stein (1997) found that in non-agricultural firms, managers were likely to be more efficient at allocating resources in smaller and more focused enterprises than larger diverse firms.

Table 2-25 Risk-taking

Source	Measure	Effect size	Sample
Dhungana *et al.* (2004)	Risk attitude	Positive link to technical efficiency, negative to cost and price efficiency	76 rice farmers in Nepal
Nuthall (2010c)	Risk reduction objective	0.11 to financial performance for risk reduction objective	657 farmers in New Zealand
Rauch and Frese (2007)	Risk-taking	Correlation to entrepreneur success (0.1)	Meta-analysis entrepreneurship
Richard *et al.* (2004)	5 questions	Risk-taking to ROE (0.06 ns)	535 banks
Peterson *et al.* (2003)	Qualitative assessment	Risk-taking of large corporations and income growth correlation 0.44, p<0.10	17 top management teams
Walls and Dyer (2011)	Relative risk-taking	Moderate risk-taking increased ROA to 9.4% from average risk taking 6.6%.	55 petro exploration firms
Zhao *et al.* (2010)	Risk Propensity	A positive relationship with intentions (0.3) found but not with performance after FFM accounted for.	Meta-analysis of entrepreneurs

Purdy *et al.* (1997) also suggested that risk aversion might inhibit specialisation even when businesses are profitable. As specialisation is associated with higher profitability, avoiding specialisation because of risk aversion is likely to be less profitable for businesses that are currently profitable.

Table 2-26 Risk management

Source	Effect size	Sample
Farm Business Survey Team (2010)	25% more of the top quartile of performers practice some form of risk management strategy compared to the bottom quartile.	1900 farm businesses in England
Mishra and Morehart (2001)	Production contracts +$23,971 ($p<0.05$). Forward pricing +$46,564 ($p<0.10$) .	596 farms in USA

In summary, attitudes to risk, risk-taking, risk management and specialisation are all associated with farm profitability to some extent. Further research is required to quantify and clarify the role of risk taking and risk management in particular.

2.5.10 Time management

The time farmers allocate to different tasks has also been assessed as a potential explanatory variable for farm performance in a few studies (Table 2-27). Gloy *et al.* (2002) suggested that more efficient farmers were more likely to outsource their record-keeping and that those that did their own accounting were not effectively allocating their managerial resources.

In a small bachelor thesis study of 20 dairy farmers in New York state, Braun (2012) found that time spent on five 'key management areas' had a positive effect on NFI. These were milking cow comfort, nutrition, dry cow comfort, financial records and human resource management. Time spent on milk quality, milk yield, disease prevention and financial management predicted lower NFI. Presumably, the latter is taken for granted by better farmers and working on the former distinguishes the best performers. Crop production and reproduction were not significantly predictive of NFI.

There have been no studies of reasonable sample size focused on this topic so no conclusions can be drawn now except to say Braun's (2012) study indicates it could be a potentially fruitful avenue of research.

Table 2-27 Effects of time allocation and other practices

Source	Practice	Effect size	Sample
Braun (2012)	• HR • Nutrition • Financial management	NFI • Positive • Very positive • Negative, sign of distressed business	20 dairy farmers in New York state
Gloy *et al.* (2002)	Outsourcing book-keeping	Use of accounting service associated with ROA (0.02).	107 dairy farmers in New York state
Hansson and Öhlmér (2008)	Feed testing	Marginal positive effects on two out six efficiency measures	507 Swedish dairy farmers

2.5.11 Management practices summary

This Section summarises practices predictive of farm performance that have been identified in Section 2.5. The findings are also summarised in the following list of practices which farmers and advisors are advised to consider:

- Proactive and innovative;
- Actively manage risk, e.g. lock prices ahead of time;
- Set challenging, but attainable, targets and goals;
- Training needs assessment;
- Monitor the outcomes of decisions;
- When making investments, calculate payback, NPV and cash flow; and,
- Pay attention to more information sources.

Some other practices have been found not to be associated with profitability. This includes benchmarking regularly, the specific process used to make decisions and keeping records. There is not sufficient research to have full certainty in the measures just recommended (Table 2-28). However, as a starting point, it should be useful for farmers and their advisors. Many papers have since 1998 investigated the role of management practices, perhaps in part based on the conclusion of Rougoor *et al.* (1998) that it was underexposed. This topic has, however, been found to be not discernibly associated with farm performance. This is particularly true in comparison

to the strong associations of psychology and attitudes to farm performance outlined in this review.

Table 2-28 Management practices summary

Section	Effect size	Source Table
2.5.1 and 2.5.2 Planning and Decision-making	Mostly small non-significant effects with exception of: • Use of NPV, Payback and cash flow during expansion predict ROA (6.35%). • The inclusion of family in decision-making predicts efficiency (0.09-0.11).	Table 2-15
2.5.3 Setting targets and goals	Predictive of performance in non-agricultural industries (0.26 - 0.34). No quality studies in agriculture so far.	Table 2-15 and Table 2-16
2.5.4 Monitoring	Monitoring results of decisions (0.127).	Table 2-17
2.5.4 Keeping records	Keeping records small relationship (0.02 - 0.05). Many studies with small or non-significant results.	Table 2-18 and Table 2-19
2.5.5 Benchmarking	Little predictive power, observed to be more common among successful farmers	Table 2-20
2.5.6 Staff management	Large effects in other sectors, small effects in agriculture	Table 2-21
2.5.7 Training and advisory services	Large effects in both agriculture and other industries.	Table 2-22 & Table 2-23
2.5.8 Proactive and innovative management	Large predictive power outside of agriculture (0.18 - 0.27). No measurement of predictive power in agriculture but one observation that proactive farmers are more profitable	Table 2-24
2.5.9 Risk and specialisation	High-risk propensity appears to slightly beneficial, some conflicting results. Some types of risk management appear beneficial. An exception is diversification out of agriculture.	Section 2.4.3 Table 2-26
2.5.10 Time management	Further study required before conclusions can be drawn.	Table 2-27

2.6 Literature review findings summary and interpretation

This Section summarises the findings of the literature review. First, the most promising findings are presented. Second, the areas that have consistently reported small or non-significant associations to performance are listed which may guide future research away from these apparently unproductive avenues of research. Third and fourth, issues relating to the validity of research findings and the statements and assertions that can be made are discussed in relation to causation and endogeneity. The promising areas that have not been studied in detail yet are outlined followed by outlining an idealised program of research to complete the understanding of the role of farmer attributes have in predicting farm performance. Finally, the two studies presented in Chapters 3 and 4 are discussed in relation to this idealised approach are then discussed.

2.6.1 Attributes associated with performance

The review findings are summarised by domain in Table 2-28 and the five most important topics are presented in Table 2-29 in descending order of importance. No study has yet assessed all five of these important variables in one study so the relative importance of each topic yet cannot yet be discerned. Conscientiousness has also not been assessed in farmers as a predictor of performance. This raises some doubt about this finding in a farm management context.

Table 2-28 Overview of four domains importance

Domain	Importance	Source	Comment
Biography	3rd	Section 2.2.5	Education and self-rated ability moderately important.
Psychology	1st	Table 2-13	Intelligence is the largest predictor of performance
Objectives and attitudes	2nd	Table 2-14	Profit objective and business approach very positive
Management practices	4th	Table 2-28	Provision of training a moderate predictor of performance

In addition to the five most predictive variables identified in Table 2-29, one might also consider assessing emotional stability, innovativeness, pro-activeness, emotional social intelligence and prioritising risk management in candidate selection. However, these variables have not yet been tested in agriculture, or if they have, the effect sizes were relatively small compared to those presented in Table 2-29.

Table 2-29 Farmer attributes most predictive of performance

Variable	β	% variation	Source
GCA	0.64	R^2 0.31	(O'Boyle *et al.* 2010; McGregor *et al.* 1996)
Management thinking	0.59		(Mäkinen 2013)
Agricultural education:		+ 12% margin /ha	(Hansson 2008; Läpple *et al.* 2013; Kilpatrick 2001)
Discussion groups (without incentive)		+ 12% margin /ha	(Läpple *et al.* 2013)
Conscientiousness	0.30	R^2 0.06	(O'Boyle *et al.* 2010)

2.6.2 Attributes not associated with performance

The following topics have been found not to be associated with farm performance when assessed statistically:

- Age;
- Decision-making processes (contrary to the conclusion of Rougoor et al, 1998);
- Monitoring and record-keeping;
- LOC, Myers Briggs Type Indicator; and,
- Learning styles.

Assessing what is not discernibly associated with farm performance will facilitate prioritisation of efforts to understand what is associated with farm performance and how that might be improved.

2.6.3 Correlation, regression and causation

This review reported findings from predominantly observational cross-sectional studies. Very few involved either intervention or longitudinal approaches. Exceptions include the impact of education (Aguinis and Kraiger, 2009) and increasing participant's Growth Mindset (Heslin and Vandewalle, 2008). In agriculture, only one project took a longitudinal approach in the reviewed literature (Läpple *et al.* 2013; Läpple and Hennessy, 2015). Investigating discussion group participation and benefits, the authors attempted to control for self-selection. Initially, they attributed a large benefit to discussion group participation (Läpple *et al.* 2013). However, a follow-up study appraising the benefits of participation after incentives to participate were introduced found a much smaller effect (Läpple and Hennessy, 2015). The implication is that the benefit was at least partially attributable to why farmers choose to participate, not just if they participated or not.

This example illustrates the difficulties determining causation based on observational studies. Though causation is difficult to quantify with observational studies, events such as the introduction of incentives in the above example provide valuable opportunities to test findings and assumptions in natural experiments.

The strong associations reported in this literature review do, however, imply the potential to predict outcomes even if causality is unclear. This ability to predict outcomes could increase hiring and credit worthiness assessment success regardless of causality. Prioritisation of areas where future research should investigate causality can also take account of where the strongest associations have been found.

2.6.4 Endogeneity and collinearity

Related to the issues of causality is the issue of endogeneity. Generally, endogeneity occurs in three situations (Bascle 2008). The simplest form of endogeneity is caused by biased measurement of an independent variable (Bascle 2008).

Another form of endogeneity is where causality operates in two directions. In a farming context, farmers who are more profitable may be more likely to hold an attitude because they are more profitable and they may be more profitable because they hold the same attitude. Causality and reverse causality might both be occurring at the same time causing a causality loop. Finally, a latent/omitted variable may be correlated to both the dependent variable and a measured independent variable. As

the latent variable is not observed, the association between the independent variable and the dependent variable may be incorrectly interpreted. For example, causality may be assumed between two observed variables. However, it might in fact be a latent variable that is causally related to both observed variables.

It is challenging to disentangle these issues in observational studies and requires careful consideration of relationships between variables. One method to disentangle the second form of endogeneity is called 2 stage least squares approach (Bascle 2008). In this case, the potentially endogenous variable is estimated by other non-endogenous variables.

For example, in the case where the academic grade is the dependent variable, attendance in class might be endogenous. The latent variable, interest in the course, might be a causal antecedent to both grades and attendance. The 2 stage approach would, therefore, estimate the effect of attendance by assessing truly independent proxies of attendance such as the distance the student lives from class or if they also have a job (Bascle 2008).

Collinearity or multi-collinearity is an issue that affects multiple linear regression where two or more of the independent variables (predictors) are correlated. This affects the reliability of the estimates generated in the regression. Several approaches have been developed to detect multi-collinearity including variance inflation factors (VIF) (Stine 1995).

2.6.5 Research priorities

The primary goal of this thesis, as outlined in Section 1.5, is to identify the farmer attributes most associated with farm performance. This review has, for the first time, assessed the literature regarding a broad range of farmer attributes that have been tested for associations with performance in a systematic manner. This is a major contribution to the farm management literature.

Based on the literature review findings alone, farm manager recruitment, development and performance could now be improved strategically with an evidence-guided approach. However, much of the literature review's findings are based on only a few studies meaning a strong basis upon which to recommend application is currently lacking.

For example, management thinking's prominence in this review's conclusions is based on only one study. Lack of replication of results has unfortunately been the

norm and when concepts are reassessed, there has been no replication of published instruments to allow direct comparisons. For example, Mäkinen (2013), Hansson (2008) and Nuthall (2009) used three very different measures of LOC.

The 'Edinburgh Study of Decision-making on Farms' purposefully created numerous robust scales with the stated purpose they would be used by other researchers (Edwards-Jones *et al.* 1998). However, they have not been used to predict farm performance to date. Their extensive study assessed most of the variables identified in this review as being important including two measures of GCA. As their focus was not farm profitability, they did not explore this in detail in their published articles. If the data still exists, it could be used to answer some of the unanswered questions identified in this literature review.

The key questions this thesis and future research should ask is what is the relative importance of the five farmer attributes identified in Table 2-29, what other attributes are predictive of farm performance and how can farm performance be improved using these findings. Topics which are promising, but which have not been tested rigorously in agriculture include:

- Employee training - error management focus;
- Risk management;
- Intuition;
- Optimism and cynicism; and,
- Time allocation patterns.

Substantiating the predictive power of the five variables identified in Table 2-29 should, however, be the first priority.

2.6.6 Ideal study

To advance the understanding of the attributes that are associated with farm performance, a study could be observational. However, to establish causality and account for endogeneity, longitudinal and/or intervention based research would be required.

Several hundred participants would be required to include potentially confounding variables in statistical models. This is especially true if the sample is not from a discrete region or small country. A schema of some of these potential confounding variables is presented in Figure 2.4. These might include economies of scale, land quality and farm infrastructure. Consideration would have to be given to how farmer

attributes might influence these confounding variables so as to minimise endogeneity.

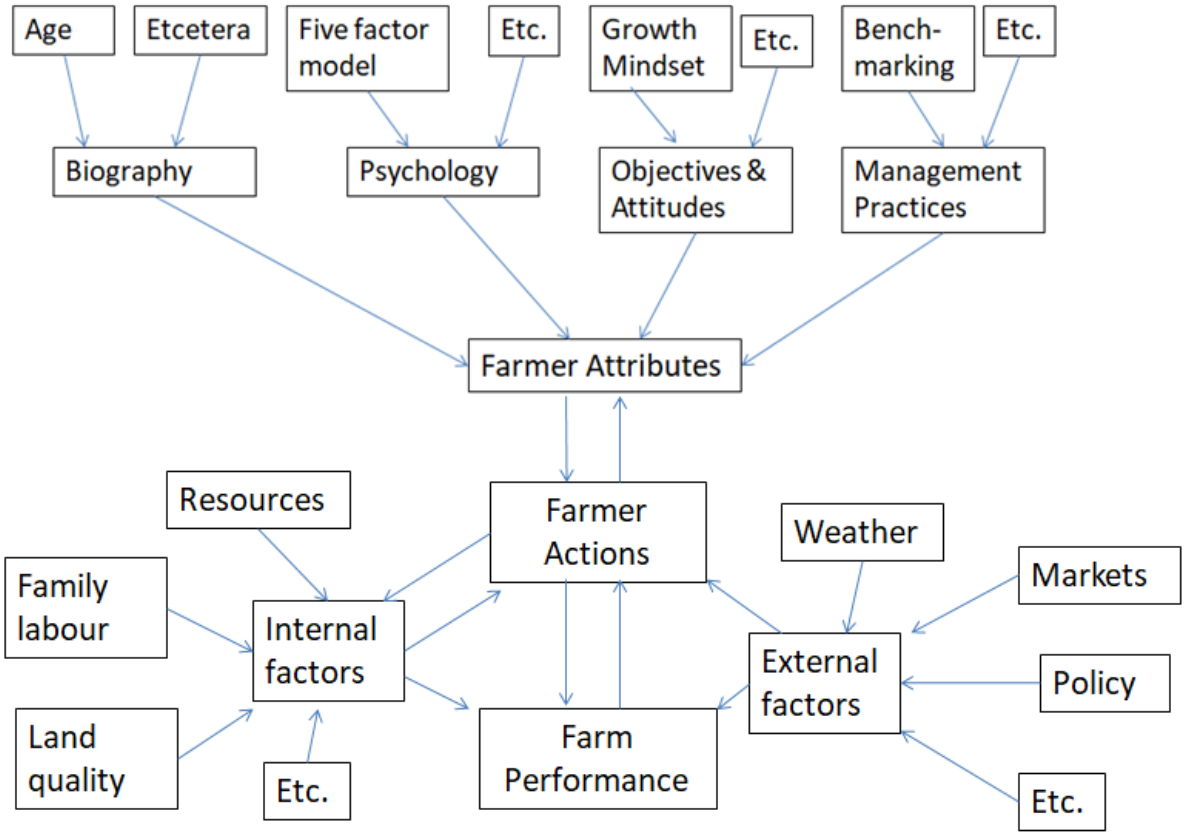

Figure 2-4 Drivers of farm performance

Potentially thousands of participants would be required if the study was carried out in diverse populations of farmers. This diversity could be in the sector, region or international. Several hundred farmers from each participant country or region within the country would be advisable. Large sample sizes would allow for more complex models which account for variables such as land type, sectors, region and policy differences.

However, for the moment, such models are likely to be overly complex and multiple smaller simpler studies confirming the basic associations and patterns would be the quickest most productive approach. Once a firm basis is created, complex comprehensive and detailed studies could build and elucidate a more nuanced and rounded understanding.

A farmer's choice to participate in research is likely related to their attitudes and so self-selection bias might influence the composition of participant samples. However,

for the purposes of this research, the exact prevalences of farmer attributes is of less practical importance than quantifying the associations with performance.

Existing farm surveys such as the FADN network will likely be the most expedient way to achieve a representative sample if a representative sample is deemed essential. The FADN data is explicitly designed to be an accurate representation of the agriculture sector in general.

To establish causality, several approaches could be taken. The first is a longitudinal study. This would entail observing changes in performance or relative performance for in situ managers over a period. Perhaps a more insightful approach would be focusing on management transitions (succession / hired). The attributes of the old and new managers could then be linked to changes in performance of the farm. This is similar to research into impacts CEO transitions in large companies (Demerjian *et al.* 2012).

Another approach would be to perform an intervention guided by the findings of this literature review. For example, candidates for a position might be assessed for the attributes associated with farm performance for a treatment group of positions. A control group of positions would hire for the position using established practice and the average performance of both groups could be compared. Farm staff recruitment agencies could facilitate such research for example.

One could also assess attributes of in situ farmers and provide tailored development (Aguinis & Kraiger 2009). This would imply both an intervention and longitudinal approach. 5 to 10 years might be a suitable time-frame to assess the efficacy of these interventions. How participants are encouraged or incentivised into such a long-term commitment should be considered as this can affect outcomes potentially biasing results (Läpple & Hennessy 2015).

This would require the development and trialling of interventions. Effective interventions with a firm evidence base to support their efficacy and value for money would be of significant value.

A comprehensive study with sufficient resources might include elements of all the above. It would assess all the variables identified as being potentially important in this review and potential confounding variables. In addition to quantitative approaches, it could also investigate findings from a qualitative perspective. Perceptions of potential interventions and likely drivers and barriers to their adoption

among farmers would also be of interest. This would help establish the level of demand there would be for applications based on these findings.

2.6.7 Research presented in this thesis

In the previous Section, consideration was given to the ideal research approach that, given sufficient resources, access to data and willing participants, would address the shortcomings identified in the literature review. Figure 2-4 outlined the potential factors that could influence farm performance and which ideally would be controlled for. This literature review has focused on the variables in the top of the figure that fit under the heading farmer attributes. This thesis continues this focus on farmer attributes.

Proceeding through this thesis to Chapter 3 and Chapter 4, a disconnect between the 'ideal study' described and the research reported will be evident. The reason for this is that the data for both studies were collected for commercial purposes with goals distinct from the goals of this thesis. As such, the analysed data is secondary in nature. The data collection in Chapter 3 occurred in early 2012 with only a superficial literature review completed due to a tight commercial timeline for the work.

Chapter 4 focuses exclusively on personality and the data was collected for another commercial project which was initially focused on the concept of emotional-social intelligence/competence discussed in Section 2.3.3. Both studies were thus initially carried out for commercial reasons and were subsequently utilized for the current thesis. The author of this thesis was the chief creator of the questionnaire used in Chapter 3 and performed all the analysis presented in this thesis.

Ideally, GCA and the other variables identified in Table 2-29 would have been included in the studies presented in Chapter 3 and Chapter 4. It is hoped that future research can address this shortcoming as well as account for the other variables outlined in Figure 2-2. Despite this, the novel research presented in this thesis is a major contribution to the understanding of how dairy farmer attributes are associated with farm performance.

3. ATTITUDES

3.1 Introduction

How manager attitudes, personality, behaviour and socio-demographic characteristics influence farm performance is only partially understood. A comprehensive analysis of the extant literature relating to how manager attributes relate to profitability has been presented in the literature review. Likely predictors of profitability identified included goals, personality, beliefs, attitudes, practices and manager education. The present study of eighty dairy farm businesses in GB expands this understanding clarifying the relative importance of some of these variables. This is done using a questionnaire completed by eighty dairy farmers and comparing their responses to their farm management accounts over a three-year period. A profit measure is selected to act as a proxy for farm manager performance and an exploratory correlation analysis is performed. A linear model is then presented predicting variation in the chosen measure of farm performance - Profit Before Resource Costs (PBRC). The findings are then summarized, interpreted, and discussed.

3.2 Materials and methods

3.2.1 Questionnaire

As part of a commercial project of limited duration, an 83-item questionnaire was developed in the winter of 2011/12 based on a limited literature review and the experience of farm management consultants. Given the limited literature review, many of the questions were derived from discussions with farm consultants and not from literature as would be best practice. In Tables 3-1 to 3-5 each question is presented in the order it was presented in the questionnaire with a comment/reference to the relevant literature review Section where applicable. These tables were created retrospectively after a complete literature review was completed. Questions relating to areas not found in the reviewed literature contain the comment ‘exploratory’.

The majority of items are statements to which participants agreed or disagreed. Farm management style, staff management practices, goals and objectives and biographical information were assessed. The questionnaire as used for data collection is presented in Appendix A.

Table 3-1 Section A of questionnaire (n=101) (1/2)

Questions	**Mean**	**Literature review section, reference & or Comment**
With TEN being the best, FIVE being average and ONE being the worst, how would you rate your management skills?	6.7	2.2.4 Nuthall (2009)
On average, how many hours do you work a week?	70.6	2.5.10 Exploratory
How many hours a week are spent doing managerial work? (E.g. planning, instructing, ordering, selling.)	13.6	2.5.10 Exploratory
On average, how many days holiday do you take a year?	12.7	2.5.10 Exploratory
Including yourself, how many layers of management exist on your farm?	1.6	2.5.6 Exploratory
I write down options and calculate financial consequences before making big decisions	2.0	2.5.1 Rougoor *et al.* (1998)
I worry about milk price a lot	2.9	2.3.1 Exploratory
I worry what others think of my farm	3.7	2.3.1 Exploratory
Talking to others about farming ideas stimulates and increases my enthusiasm for farming	2.0	2.5.1 Manevska-tasevska and Hansson (2011)
It is difficult adapting to new policies and rules	3.1	2.5.8 Exploratory
I tend to mull over big decisions a lot before acting	2.1	2.5.2 Rougoor *et al.* (1998)
I normally don't rest until the job is completed	2.4	2.3.3 Exploratory
I find farm walks and discussion groups essential	2.9	2.2.4 Exploratory
I rarely critically assess my own performance	3.3	2.2.4 Exploratory
I often seek the advice of third parties (E.g. accountant / vet / consultant)	1.6	2.5.2 Manevska-tasevska and Hansson (2011)
I often sell animals and assets when cash flow is tight and so don't always get the best price possible	4.2	Exploratory
I buy most of my inputs from 1 or 2 local suppliers	3.4	Exploratory
I prefer to rely on memory as opposed to making records whenever possible	3.6	2.5.4 Exploratory
I spend a lot of my time fixing problems rather than actually managing the farm	3.2	Exploratory Rougoor *et al.* (1998)
I consult my family and staff about issues and changes	1.9	2.5.1 Manevska-tasevska and Hansson (2011)
My family and / or staff often influence big decisions	2.2	2.5.1 Manevska-tasevska and Hansson (2011)
People think I work too hard	2.2	2.5.10 Exploratory
I have studied or seen firsthand agricultural systems in other countries different to my own.	3.0	2.2.4 Exploratory
I keep many written / electronic records to inform future decision-making	2.3	2.5.4 Trip *et al.* (2002)
I buy in bulk when possible to get the best prices	1.8	2.5.8 Exploratory

Table 3-1 Section A of questionnaire (n=101) (2/2)

	Percentage or mean response	Literature review section, reference & or Comment
Are you an active member of a buying group? (yes)	44%	Exploratory
How often do you compare farm spending and income to pre prepared budgets?		2.5.4 Trip *et al.* (2002)
at least once a month	46%	
at least once a year	36%	
less than once a year	6%	
never	13%	
How often do you compare farm spending and income to industry benchmarks?		2.5.4 Trip *et al.* (2002)
at least once a month	19%	
at least once a year	64%	
less than once a year	12%	
never	5%	
When selecting replacement genetics, which traits are most important to your farm? Please rank in order of importance. (1 most important, 6 least important)		Exploratory

Milk yield	3.2	Conformation Traits	2.8
Fat and protein content	4.3	Profit Lifetime Index (PLI)	3.1
Fertility	2.9	Lifespan	2.9

Experienced farm management researchers edited and proofed a questionnaire followed by pilot testing. The questionnaire was then posted to 234 Promar International clients during the spring of 2012. Following written, and verbal reminders, 101 responses resulted (a 43% response rate). Due to incompleteness and an outlier, 21 were discounted resulting in a final sample of 80. The participation in the study is illustrated in Figure 3-1.

Table 3-2 Section B of questionnaire Staff on the farm

Questions				**Literature review section, reference & or Comment**
Including yourself, paid staff and unpaid family labour, how many staff work on your farm?		3.1		2.5.6 Exploratory
Staff entering the industry lack important skills and knowledge		2.8		2.4.2 Exploratory
Staff understand the long-term objectives of the farm business		2.6		2.5.6 Rosenburg and Cowen (1990)
Paying for staff training is a worthwhile investment		2.2		2.5.7 Aguinis and Kraiger (2009)
I don't usually pay for staff training as they may leave after and/or I would rather do it myself		3.4		2.5.7 Aguinis and Kraiger (2009)
I hire staff with skills I lack		2.6		2.5.6 Aguinis and Kraiger (2009)
What training do you and your staff do at least once a year? (Counting the options ticked, the mean was 0.8)		0.8		2.5.6 Aguinis and Kraiger (2009)
Organised training, by you or an employee, for other staff on farm	20%	Formal training, off-farm	28%	
Formal training, by a 3rd party, on farm	49%	No formal training	33%	

Table 3-3 Section C of Questionnaire – Goals and Objectives

Questions	Percentage or mean	Literature review section, reference & or Comment
Have clearly defined goals and objectives for your business?	82% (yes)	2.4.1 Rougoor *et al.* (1998)
If yes, are they written down	28% (yes)	
In 10 years time, your business size is likely to be?		2.4.1 Exploratory
Larger 59% Same size 24%	Smaller 5%	Sold 11%
Is there an identified successor for the farm?	50.4	2.4.1 Gasson (1973)
During particularly profitable years how have you mostly used the surplus?		Exploratory
Reinvestment on farm to minimise tax 37%. Personal drawings 1% Early repayment of loans 14%		Capital investment on farm 51%. Invested off-farm 10%.
I plan for plenty of leisure time and holidays	3.6	2.4.1 Gasson (1973)
Environmental compliance is a significant burden	2.4	2.4.1 Barnes (2006)
I reduce financial risk by diversifying my income	3.6	2.4.1 Nuthall (2009)
I reduce financial risk by keeping cash reserves & minimising debt	3.5	2.5.9 Nuthall (2009)
I get the most output from cows and land possible	2.1	2.4.1 Exploratory
I strive to create a pleasant and enjoyable working environment for both myself and my staff	1.8	2.4.1 Exploratory
I actively try to reduce pollution	1.8	2.4.1 Barnes (2006)
I enjoy testing new production systems and products	2.8	2.5.8 Exploratory
I am actively planning for retirement	3.1	2.4.1 Exploratory
Increasing net worth is essential to long-term success	1.6	2.4.1 Exploratory
Increasing turnover is essential for long-term success	2.5	2.4.1 Exploratory
I don't borrow unless it is absolutely necessary, so non-critical investment is limited to cash surpluses	3.2	2.5.9 Nuthall (2009)
Loans are essential for success	2.3	2.4.1 Exploratory
I take part in community activities and/or socialise regularly	2.6	2.4.1 Gasson (1973)
Having the best infrastructure, machinery and equipment is essential for long-term success	2.8	2.4.1 Exploratory
Happy well-fed cows always repay the investment	1.7	2.4.1 Exploratory
I am a farmer by circumstance rather than choice	4.0	Exploratory Gasson (1973)
My living standard is my main priority when farming	3.2	2.4.1 Gasson (1973)
Appearing to be successful is very important	3.6	2.4.1 Gasson (1973)
Content cows are a major source of pride	1.6	2.4.1 Gasson (1973)
Increasing yields is the most efficient way to increase profit	3.3	2.4.1 Exploratory

Questions	Percentage or mean	Literature review section, reference & or Comment
I review my cash flow at least once a month	2.3	2.5.4 (Rougoor *et al.* 1998)
Cutting costs is the most efficient way to increase profit	2.9	2.4.1 Exploratory
My farm is completely orientated towards maximising profit	2.5	2.4.1 Exploratory
My farm is a family heirloom to be passed on	3.0	2.4.1 Gasson (1973)
Most jobs on the farm bore me	4.5	2.4.1 Gasson (1973)
I enjoy farming and the lifestyle it affords me	1.6	2.4.1 Gasson (1973)

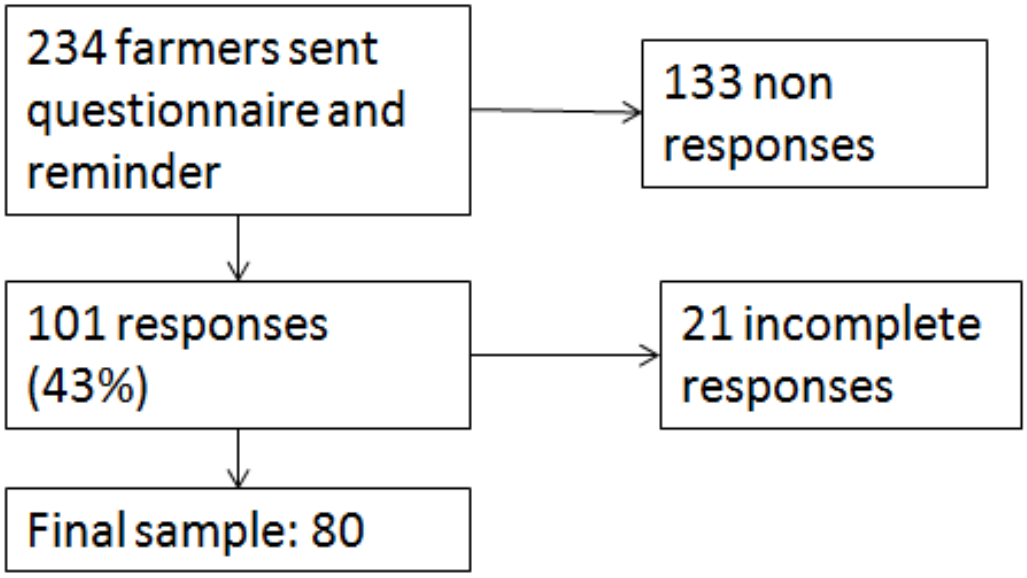

Figure 3-1 Study participation illustration

Table 3-4 Section D of questionnaire 'Personal views on management' (LOC)

Questions		**Literature review section, reference & or Comment**
It is safer not to rely on others to get important jobs done well and on time.	3.1	2.3.4 Exploratory
I never try anything that might not work	3.8	2.5.8 Exploratory
New methods and technologies that are not fully proven are not worth the risk	3.4	2.5.8 Exploratory
When I know I'm right I can be very determined and can make things happen	1.9	2.5.8 Exploratory
Some people are just lucky and everything works out for them easily	3.7	2.3.5 Nuthall (2009)
I can rely on staff to get jobs done well and on time	2.1	2.3.5 Nuthall (2009)
Staff sometimes struggle to do even simple tasks properly	3.7	2.3.5 Nuthall (2009)
Poor results are usually due to things completely out of my control	3.5	2.3.5 Nuthall (2009)
Good managers are born, not trained	3.5	2.3.5 Nuthall (2009)
When things go wrong I sometimes lose my cool and don't salvage the situation as well as possible	3.4	2.3.5 Nuthall (2009)
I reckon 'good luck' doesn't exist - 'luck' is really good management and 'bad luck' poor management	2.4	2.3.5 Nuthall (2009)
I plan ahead to ensure my goals are achieved, and often do budgets and commit my ideas to paper	2.5	2.3.5 Nuthall (2009)
It is within in my control whether or not my farm will be successful in the long-term	1.6	2.3.5 Nuthall (2009)
Management is a skill that can be honed and improved	1.5	2.3.5 Nuthall (2009)
I have managed to largely achieve my goals to date	2.1	2.3.5 Nuthall (2009)

Table 3-5 Section E of questionnaire 'Your details'

Questions		**Literature review section, reference & or Comment**
Age:	51	2.2
Gender (% Male)	98%	2.2
How many years have you lived on your current farm?	38	2.2 Nuthall (2009)
Including yourself, how many generations of your family have been farmers?	4.7	2.2 Gasson (1973)
How much insight into farm management did you gain 11 to 15 years of age?	3.5	2.2.2 Nuthall (2009)
16 to 20 years of age?	2.2	2.2.2 Nuthall (2009)
What age did you leave full-time education?	18.3	2.2.3 Nuthall (2009)
Post GSCE qualifications. Ranked 0 - 5. 0 = none, 5 = post graduate degree	2.2	2.2.3 Nuthall (2009)
The farm provides x% of your personal drawings?		2.5.9 Exploratory
<60% of income : 9%.	60 - 90% of income 23%.	91-100% of income 65%.
Please list other sources of drawings/business interests (e.g. dividends, house rental or private businesses)		2.5.9 Exploratory

3.2.2 Sample characteristics

Participants subscribed to Promar International's Farm Business Accounts service (Promar International is a large agriculture consultancy firm with whom the author was embedded with for two years as part of a Knowledge Transfer Partnership with the University of Reading). Full financial accounts were thus available for the farm businesses that participated. Most participants had used the service for several years and so farm performance over many years could be assessed. The data's primary purpose was to create farm management accounts and to form the basis of tax returns. The accounts were bank reconciled and so of high accuracy and quality. The study participants were either specialist dairy or mixed dairy and were not especially representative of dairy farms in GB. That sampling was limited to the clients of Promar and farmers could opt out are both reasons for this.

The size of participant businesses milking herds varied from 34 to 453 with a sample average herd size of 198 (Table 3-6), larger than the UK average of 126 (DairyCo, 2013a). Areas such as south Wales and Scotland were underrepresented. However, in some respects, the sample matched dairy farmers in GB. The average yield per cow was 7,595 litres, similar to the UK average of 7,604 in 2011/12 (DairyCo, 2013b) and the average age of the participants was 51 compared to the national average of 51.4 (FBS, 2012).

Table 3-6 Summary sample statistics (n=80)

	Value	Standard deviation	Farm Business Survey (2012)
Age	50.5	9.2	51.4
Cows	198	110	126
Yield/cow (L)	7,595	1,210	7,604
PBRC (£)	153,459	89,800	
PBRC + Wages (£)	216,050	114,501	
PBRC/ Turnover	22%	8%	
(PBRC + Wages) / Turnover	31%	7.6%	

3.2.3 Farm performance measure

Literature review Section 2.6 discussed the different biases inherent to different measures of farm performance used in previous studies. Given the available data, a profit-based measure was deemed the most appropriate proxy of MC in this study. The measures 'Return on Assets' and 'Return on Equity' were considered, but discounted as land valuations were not updated regularly in the data set. NFI was identified as being a relatively fair measure of profitability to assess the performance of a manager as it adjusts for rent and unpaid family labour. However, it was not possible to calculate NFI in this study as an estimate of unpaid family labour was unavailable.

A similar measure of profitability was thus selected. PBRC is a profitability measure that does not include costs such as rent or finance. Rent and finance

are mostly attributable to the farm's resource endowment, upon which, at least in the short term, the ability of the current manager will have little limited impact on.

Table 3-7 PBRC in farm management accounts

BUSINESS TRADING SUMMARY	
	31-Dec-13
	£
Livestock	608,856
Crops	6,250
Forage	380
Commercial	0
Sundry	26,662
BUSINESS TURNOVER	642,147
Livestock	190,726
Crops	4,785
Forage	37,654
Commercial	0
Sundry	0
VARIABLE COSTS	**233,165**
Livestock	418,130
Crops	1,465
Forage	-37,274
Commercial	0
Sundry	26,662
BUSINESS GROSS MARGIN	**408,982**
Wages	51,136
Power and Machinery	93,366
Administration	23,241
Property Charges	28,047
DIRECT OVERHEAD COSTS	**195,790**
PROFIT (before resource costs)	**213,192**
Land Rent	10,975
Quota Leasing	0
Machinery, Fixtures Investment Depreciation	37,016
Finance Charges (incl interest and charges)	21,207
TOTAL RESOURCE COSTS (incl depreciation)	**69,198**
PROFIT	**143,993**

To adjust for business size, PBRC/turnover was calculated. As can be seen in Table 3-7, PBRC does not include rent or depreciation charges but does include wages.

Imputing unpaid family labour was not possible with the available data but wages were accurately recorded. Therefore, PBRC and PBRC/turnover were also calculated with wages added back to the profit. This was done to adjust for any unpaid family labour. This is, in one sense, a superior measure to NFI as only bank-reconciled figures were used and the farmer was not required to estimate unpaid family labour that might introduce inaccuracy.

To minimise the effect of annual variation, the three year average for each of the four measures were calculated over three financial years - 2011/12 to 2013/14. The questionnaire was collected during the spring of 2012, near the end of the first of these three financial years. Thus, the questionnaire collection occurred one-third of the way through the first financial period assessed. The four profit measures each adjust for certain biases that might mask the influence of the farm manager but are inherently similar, and generally highly correlated. The correlations do, however, go as low as 0.43 (Table 3-8).

Table 3-8 Correlation matrix of dependent variables (Pearson's r)

	PBRC	PBRC + Wages	PBRC/ TO	(PBRC + Wages) / Turnover
PBRC	1.00	0.93	0.65	0.62
PBRC + Wages	0.93	1.00	0.43	0.58
PBRC/ TO	0.65	0.43	1.00	0.81
(PBRC + Wages) / Turnover	0.62	0.58	0.81	1.00

Table 3-9 Profit component loadings

Label	PC1 (Profit component)
Average PBRC	0.92
Average PBRC + Wages	0.86
Average PBRC/Turnover	0.85
(Average PBRC + Wages)/Turnover	0.87

To identify a single profit measure, Principal Component Analysis (PCA) was performed on the four profit measures. The package 'psych' (Revelle, 2015) for 'R' open source statistical analysis software was used for the PCA analysis (R Core Team 2013). Promax rotation, which does not assume components are independent, was specified. Using the Kaiser criterion, one significant component was retained (Eigenvalues 3.07, 0.72, 0.20, 0.01). This component is henceforth referred to as profitability. The loadings of which, are presented in Table 3-9. This is the proxy used for MC and is the dependent variable in this study.

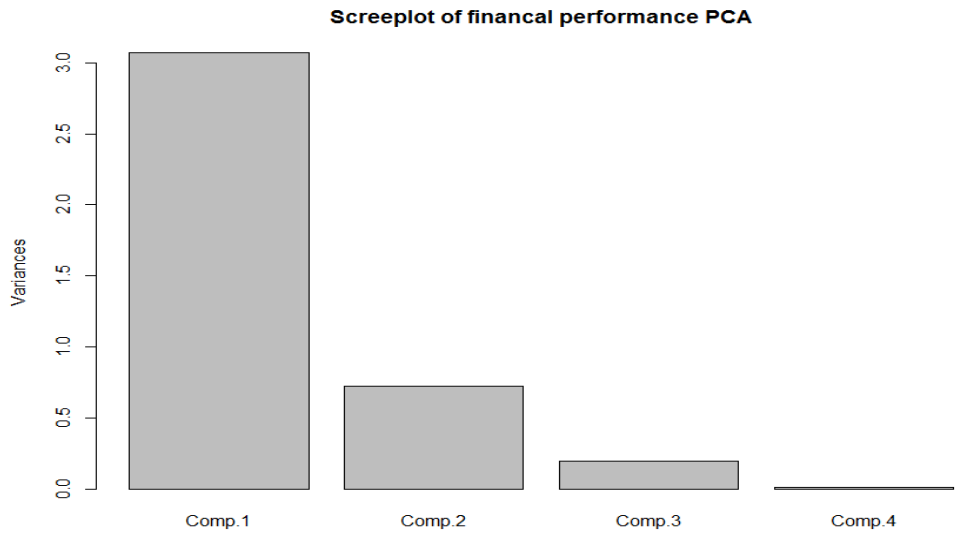

Figure 3-2 Scree plot for financial variables PCA

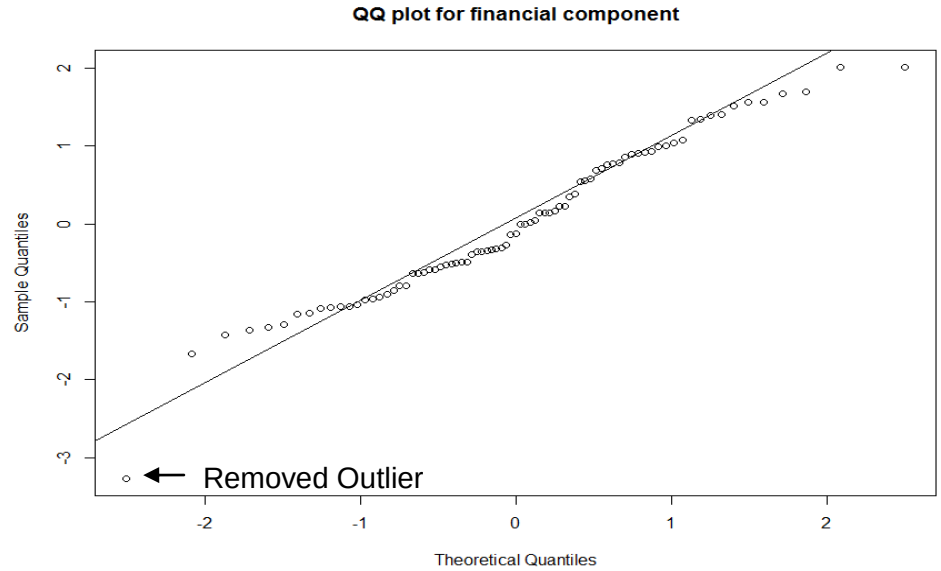

Figure 3-3 QQ plot of component 1's scores illustrating the normality of the profitability measure.

The first of the components predicted 77% of variation, while the second, 18%. The third component accounted for 5% of variation. Figure 3-2 illustrates first the scree used to determining the number of profitability components to retain and secondly the QQ plot used to inspect the distribution of the data and identify an outlier.

3.3 Exploratory data analysis

A scatter plot with profitability and a histogram of each variable was inspected. Many of the responses distributions were skewed significantly with most participants answering similarly such as in the examples in Figure 3-4 and Figure 3-5.

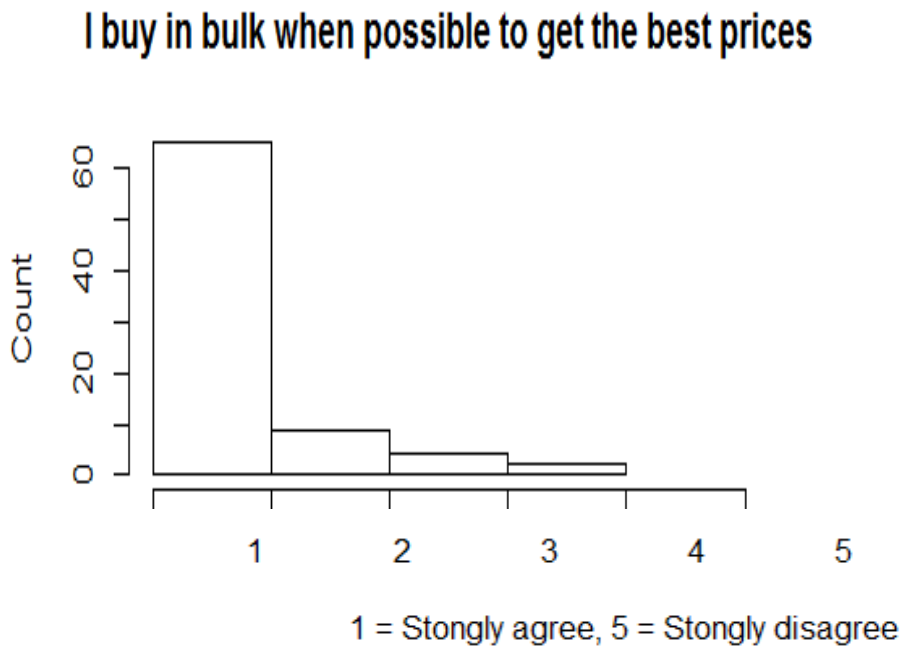

Figure 3-4 Histogram of bulk buying behaviour

Some questions had a broad range of responses such as in Figure 3-6. Statistically significant correlations to financial performance close to or at the p-value of 0.05 threshold are listed in Table 3-10 along with mean scores and standard deviations for each response. Spearman's non-parametric correlation analysis was used which does not have a normality assumption.

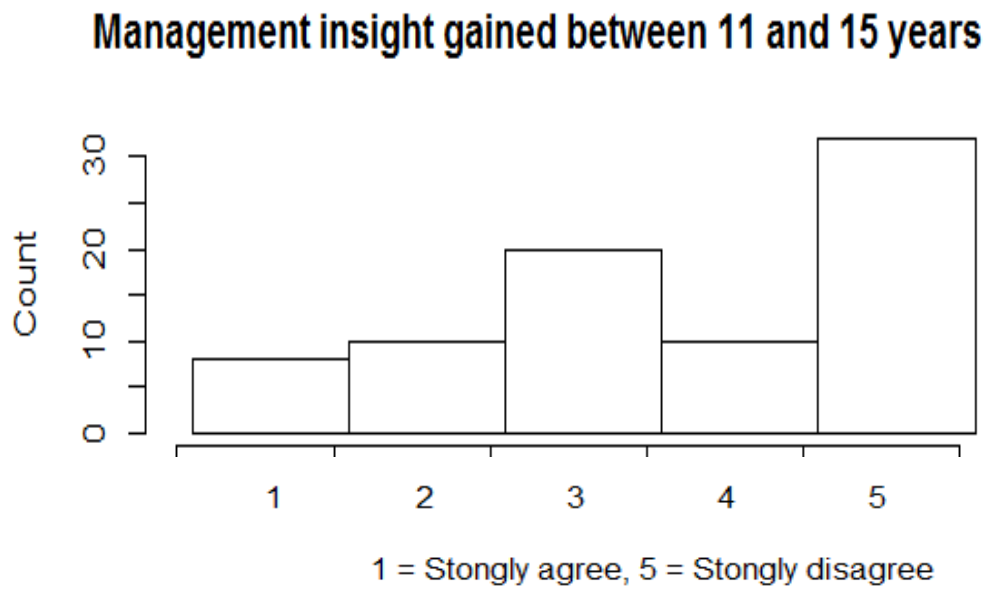

Figure 3-5 Histogram of self-assessed management insight gained between the ages of 11 and 15 years old

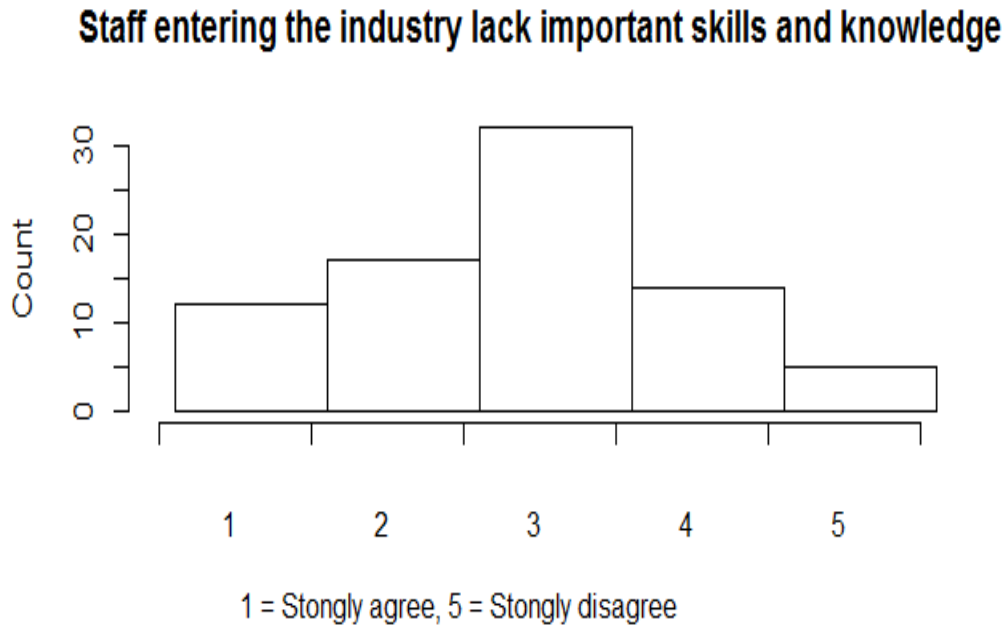

Figure 3-6 Histogram of attitudes relating to novice staff skills

3.3.1 Correlations to performance

An indicator of late responder bias was found in that financial performance was significantly negatively correlated to days taken to return the survey (Table 3-10). This would indicate the sample is skewed more towards higher performers. The hours worked and the date of questionnaire return were also marginally correlated indicating the busiest participant farmers returned their surveys later (Spearman's rho=0.21, p=0.07).

Table 3-10 Correlations to profitability, mean and standard deviation

	Variable	rho	N	p	Relation-ship	Mean	Std Dev	Comment/ Interpretation
1	My farm is completely orientated towards maximising profit*	0.31	80	0.006	Positive	2.5	1	Most farmers did not agree strongly with this statement.
2	People think I work too hard	0.30	80	0.008	Negative	2.1	1.1	Most participants agreed with this statement.
3	I buy in bulk when possible to get the best prices*	0.30	80	0.006	Positive	1.8	1	Indicative of strategic and planned purchasing, most agreed with this statement.
4	Increasing turnover is essential for long term success	0.29	80	0.010	Negative	2.5	1.1	
5	When things go wrong I sometimes lose my cool and don't salvage the situation as well as possible*	0.29	80	0.010	Negative	3.4	1.3	Indicative of emotional stability.
6	How much insight into farm management did you gain between 11 and 15 years old*	0.29	80	0.008	Negative	3.6	1.4	Agreement may indicate aversion to learning new methods and techniques.
7	Training provision to staff **	0.29	80	0.008	Positive	0.8	0.8	Count of training provided, off farm, on farm, other. (0-2)
8	I worry about milk price a lot	0.28	80	0.011	Negative	2.9	1.1	
9	I buy most of my inputs from 1 or 2 local suppliers	0.28	80	0.012	Negative	3.5	1.4	Related to item three. There was a broad distribution in responses to this question.
10	Level of educational attainment of manager **	0.27	80	0.015	Positive	2.2	1.7	Scale 0- 5. 5= University level education

(1/2) Response of 1 generally is agree strongly with the statement, 5 disagree strongly. Variables included in linear regression model in Table 3-11 (*). Non likert scale variables – see associated comment (**)

Table 3-10 Correlations to profitability, mean and standard deviation

	Variable	rho	N	p	Relation-ship	Mean	Std dev	Comment / Interpretation
11	How much insight into farm management did you gain between 16 and 20 years old	0.26	80	0.019	Negative	2.1	1.2	See item 6
12	I don't usually pay for staff training as they may leave after and / or I would rather do it myself	0.25	80	0.024	Negative	3.4	1.2	Related to item 7 and 19. Indicating of a cynical outlook and poor people management skills.
13	Content cows are a major source of pride*	0.25	80	0.024	Negative	1.7	0.8	Perhaps better farmers take cow comfort as a given.
14	How important is the trait milk yield when selecting replacement genetics? **	0.24	80	0.034	Negative	3.2	1.7	Broad range of responses received. Relative rank of 6 variables.
15	Days for questionnaire return**	0.23	77	0.042	Negative	22	23	Speed of return associated with profitability
16	I get the most output from cows and land possible	0.23	80	0.036	Positive	2.1	1.1	See item 1
17	Increasing net worth is essential to long term success	0.23	80	0.03	Positive	1.5	0.7	Most agreed with this statement.
18	Staff entering the industry lack important skills and knowledge	0.22	80	0.045	Positive	2.8	1.1	See item 7 and 12. Appreciating that new staff need training is associated with greater profitability.
19	Age leaving full time education **	0.21	80	0.065	Positive	18	2.6	Less predictive than item 10, level of attainment.
20	My family and / or staff often influence big decisions	0.21	80	0.059	Positive	2.2	1.1	Most agreed with this statement.

(2/2) Response of 1 generally is agree strongly with the statement, 5 disagree strongly. Variables included in linear regression model in Table 3-11 (*). Non likert scale variables – see associated comment (**).

However, no correlation was found between hours worked and financial performance. The same is true for general self-rated management ability indicating effort in the form of hours and general self-rated management ability are not predictive of financial performance. Respondents were also asked how surplus profits were used during profitable years. Nine of the 80 respondents reported investing profits off farm and were more profitable than those who did not (t test, p =0.06).

Eleven farmers reported repaying loans early and these were significantly less profitable than who do not repay loans early (t test, p=0.04). Early loan repayment may be overly cautious and an inefficient use of resources. Alternatively, it may be a sign of a stressed business correctly choosing to repay expensive forms of credit.

The largest relationship based on Spearman's rho correlation coefficient is with respondents' own assessment of their farms' orientation towards profit. This and five other variables are included in a linear regression model in Section 3.4 and are discussed in more detail there and in Section 3.5.

3.3.2 Age, Management Experience and Education

Age and years of management experience were not correlated to financial performance. Several potential nonlinear relationships were also tested but no associated was found with performance. Level of educational attainment was associated with profitability (rho = 0.27, p=0.015). 14 of the 80 participants had a university agricultural education (Figure 3-7) and they were not significantly more profitable than the non-university graduates (p=0.13).

51 of the 80 respondents had some form of agricultural education beyond A Levels and were significantly more profitable than those without an agricultural education (t-test, p<0.001). Läpple *et al.* (2013) reported that discussion group participation significantly predicted financial performance.

Läpple *et al.* (2013) also reported that agricultural education moderated the beneficial effect they found for discussion group participation. Those with the least education benefited the most from participation. It is therefore of note that the least educated had more negative views of discussion groups in the present study. Educational attainment and viewing farm walks and discussion groups as essential were negatively correlated (rho = -0.29, p=0.01).

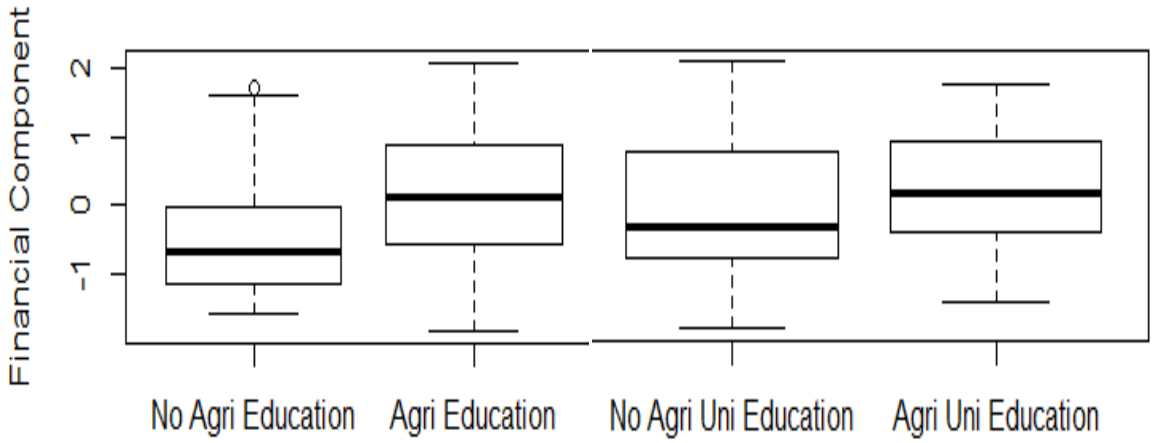

Figure 3-7 Agricultural and university agricultural education

3.3.3 Variables not correlated to profitability

The most prominent variables that are not predictive of performance are discussed in this section. The literature review concluded that age, decision-making processes, and LOC were unlikely to be associated with farm profitability. This is supported by the negligible non-significant correlations to profitability found in this study (not presented). The correlations did not approach the p-value of 0.05 or less significant threshold for presentation in Section 3.3.1. For example, LOC which was assessed in very similar manner as Nuthall (2009) proved to be not correlated to profitability with Spearman's rho of just 0.11 ($p=0.32$). This is contrary to the findings of Nuthall (2010a) but consistent with the recent findings of Herrmann (2016).

Also of note was that participant farmers own general self-rated management ability was not associated with profitability. The literature review identified self-rated ability on specific management skills as likely to be highly predictive of profitability based on Nuthall (2010a). He found that 25% of profitability could be predicted by assessments of five specific skills. This indicates self-assessment accuracy depends on multiple specific measures. The broad measure used in this study thus lacked predictive validity. All the questions were assessed for associations to profitability and if were not included in section 3.3.1 Correlations to performance, they were not significantly associated with profitability at the $p< 0.05$ threshold.

3.4 Linear regression model

To assess the relative importance of the variables correlated with farm profitability, multi-variate linear regression was performed. Variables with the largest correlations to financial performance in Section 3.3 were included in an initial model and variables were eliminated based on p-values and model AIC values. This is similar to a stepwise model selection approach (Vandermersch and Mathijs, 2004). This continued until all variables in the model were significant. The final model presented in Table 3-11 contains six variables.

Table 3-11 Linear model for predicting profitability R2 = 0.40 (Adj = 0.35).

	Variable	β	Co-efficient	Std. Error	T - value	p - Value
	Intercept		-0.14	0.51	-0.28	0.78
1	My farm is completely orientated towards maximising profit	0.31	0.32	0.09	-3.36	0.00
2	How much insight into farm management did you gain between the ages of 11 & 15	-0.26	-0.19	0.07	2.85	0.01
3	When things go wrong I sometimes lose my cool and don't salvage the situation as well as possible	-0.26	-0.20	0.07	2.71	0.01
4	Staff entering the industry lack important skills and knowledge	0.25	0.22	0.09	-2.64	0.01
5	Content cows are a major source of pride	-0.24	-0.32	0.13	2.51	0.01
6	I buy in bulk when possible to get the best prices	0.18	0.18	0.09	-2.00	0.05

To calculate the Variance Inflation Factor of the linear models and assess collinearity, R package fmsb was used (Nakazawa 2013). Most of the variables are independent of each other and a VIF of 1.4 was calculated, well below the thresholds of 2.5 to 10 where co-linearity would be considered an issue (Stine 1995). Various interaction effects were tested for but were insignificant. The QQplot of the model residuals indicates they are mostly normally distributed (Figure 3-8). The R^2 value of 0.40 for the model indicates 40% of the variation in profit was predicted by these six questions. To translate the results into pounds and percentages, the model was run

again with each of the four original profitability measures (Table 3-12). Large differences in profit are associated with each 1 of 5 point difference in each Likert scale response to each of the six questions.

Table 3-12 Model values for predicting four PBRC measures

	Variable	PBRC (£)	PBRC/ Turnover (%)	PBRC + wages (£)	(PBRC+ wages) / Turnover (%)
	Intercept	180,283	18.3	248,060	26
1	My farm is completely orientated towards maximising profit	30,951	2.5	28,220	1.5
2	How much insight into farm management did you gain between the ages of 11 & 15	-19,060	-1.5	- 14,814	-1.3
3	When things go wrong I sometimes lose my cool and don't salvage the situation as well as possible	- 10,998	-1.6	- 13,482	-1.8
4	Staff entering the industry lack important skills and knowledge	15,874	1.3	21,675	1.8
5	Content cows are a major source of pride	- 22,788	-1.9	-32,130	-2.6
6	I buy in bulk when possible to get the best prices	19,060	0.3	30,594	0.9
	Model R^2	0.33	0.31	0.30	0.35

For example, a change of ~£31,000 PBRC is predicted for a one-point change in the response to how orientated a farm is to maximising profit. This is the most influential variable on profitability in the model. The focus on profit is presumably primarily at the discretion of the manager but could be somewhat endogenous. The second most important variable related to self-assessed management insight gained during teenage years. Indicating that they learned a 'great deal' is negatively associated with profitability. These variables and the remaining four model variables are discussed in detail in Section 3.5.

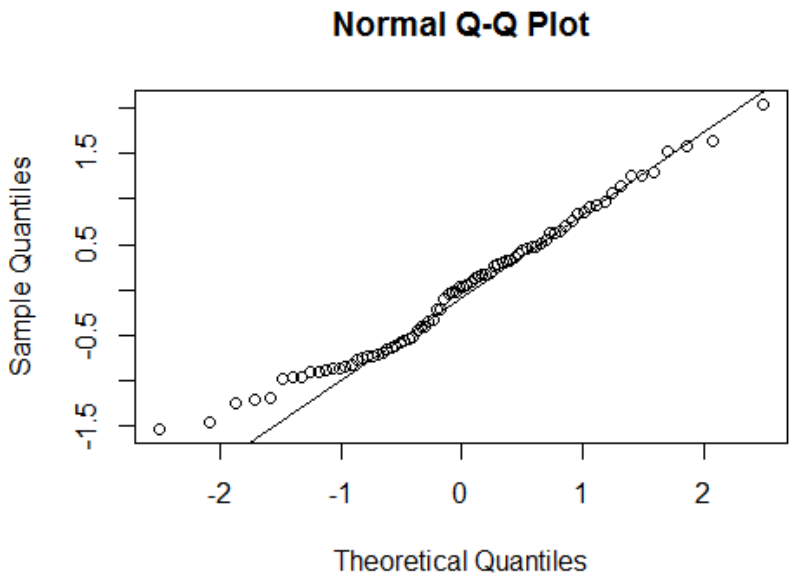

Figure 3-8 QQplot for the residuals from the linear model in Table 3-11

3.5 Findings, interpretation and summary

3.5.1 Profitability Objective

This study has identified that certain farmer attitudes, beliefs, goals and practices are associated with profitability on dairy farms in GB. The linear model's most important variable by standardised coefficient (β) was how much participants agreed that their farm is completely orientated towards maximising profit.

That farmers are motivated by factors besides profit is well-documented (Edwards-Jones, 2006; Gasson, 1973) but the large effect on profitability is noteworthy. The correlation coefficients show that about 10% of profitability variation could be predicted by how profit focused a participant farmer was. Most agreed tentatively (33/80), a few agreed strongly (12/80), (20/80) were neutral and (15/80) disagreed (Figure 3-9). By these farmers own assessment, there is scope for these dairy farms to be more profit orientated.

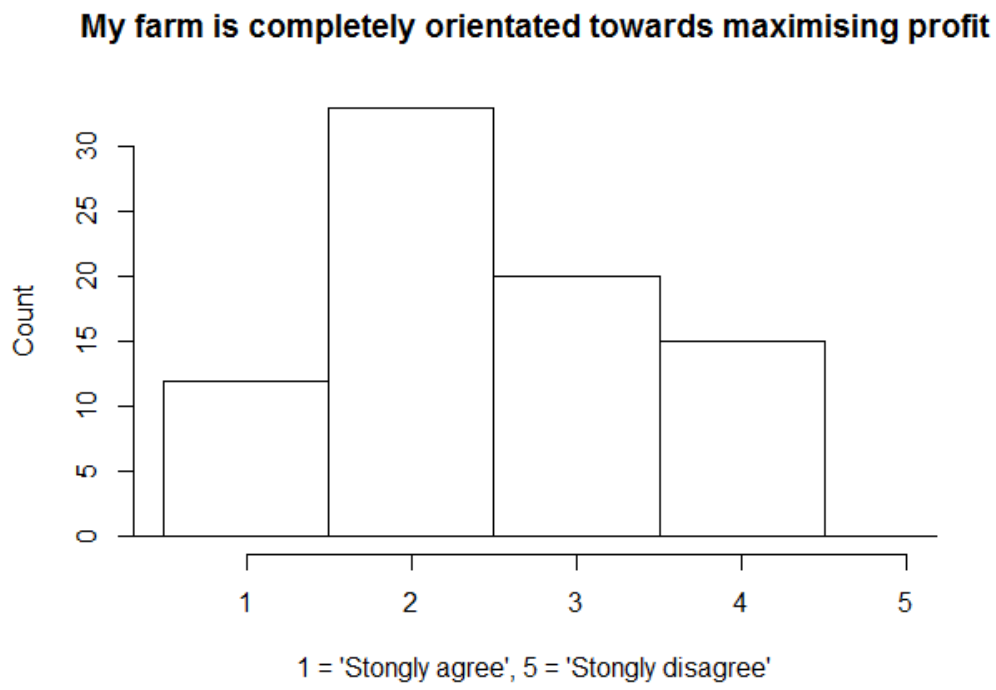

Figure 3-9 Histogram of responses regarding farms focus on profit

3.5.2 Growth Mindset

Variable 2 and 4 of the model related to attitudes towards learning and staff. Those indicating they gained a 'great deal' of management insight during their teenage years and those believing that novice staff are adequately skilled were less profitable. Together, they indicate a potentially important underlying variable - a 'growth' or 'fixed' view of human ability as discussed in literature review Section 2.4.2. Someone who generally believes that people can change and develop, especially with concerted effort is said to have a 'Growth Mindset'. The converse to this is a person that believes that people do not really change over time who would be described as having a 'fixed mindset'.

Many participant farmers appear to have a fixed view and this is associated negatively with farm performance. Several related variables were also strongly correlated to profitability but were not included in the model. The largest of these was the provision of training by managers to themselves and staff (rho - 0.29), as was the level of educational attainment of the manager. In particular, an agricultural qualification appears beneficial. These correlations support the assertion that a Growth Mindset is associated with profitability.

Two other questions were asked that appear directly related to Growth Mindset. These were 'Management is a skill that can be honed and improved' and 'Good managers are born, not trained'. Responses to both did not correlate to profitability, perhaps due to social desirability bias. The training provision and perceptions of learning questions were perhaps not as impacted by social desirability bias.

Interventions to increase Growth Mindset have been shown to affect self-rated performance in some contexts (Visser 2013). Heslin and Vandewalle (2008) illustrated that a Growth Mindset can be created among managers and that it remained 6 weeks after the intervention. Therefore, it is possible that farm managers with a fixed mindset could be coached to have more of a Growth Mindset and so potentially improve performance.

Growth Mindset has been shown to be important in many contexts, e.g. manager mindset influences how employee appraisal accuracy (Heslin & Vandewalle 2011). However, this is one of the first studies where profitability has been associated directly with Growth Mindset like variables. As such the current finding has implications for management studies in general, not just for dairy farmers in GB (Heslin and VandeWalle, 2008; Mischel, 2014).

3.5.3 Personality and attitudes

Variable 3 and 6 of the linear model appear indicative of personality, the first of which was how participant farmers react when things go wrong and those that 'lose their cool' were less profitable. Variable 6, 'buying in bulk when possible' appears related to the finding that Detail Conscious behaviour is related to profitability (Section 4.4.1 Detail Conscious). These findings indicate that emotionally stable and conscientious dairy farmers are likely to be more profitable which is consistent with research in other sectors (O'Boyle *et al.* 2010).

Finally, variable five, having pride when cows are content might indicate that this is seen as an achievement or optional. Content cows are likely to be taken as a given by better managers. This interpretation is consistent with the findings of Vandermersch and Mathijs (2004) and Braun (2012).

3.5.4 Findings summary

The areas found to predict profitability in the model in descending order of importance following are:

- Profit objective;
- Growth Mindset - beliefs about their own and staff development;
- Attitude - viewing content cows as a source of pride: and,
- Purchasing behaviour.

Several other variables such as if the participant agreed that other people think they work too hard were also strongly correlated to profitability (Table 3-10) but were not included in the model.

3.6 Discussion

This study progresses our understanding of how dairy farmers' attributes are associated with financial performance. Business goals, temperament, purchasing behaviour and Growth Mindset are found to be associated with profitability. A model consisting of six question responses has been presented that predicts 40% of profitability variation. Most of these questions related to attitudes and personality.

These attitudes are amenable to change to some extent and farmers should examine the six model variables in particular against their current outlook. Profit focus, emotional stability, conscientiousness and a Growth Mindset have been identified as important.

Encouraging a more profit-focused culture among managers and an increased Growth Mindset are likely to improve dairy farm profitability. It is also reasonable to assume these associations will be present in other agricultural sectors as they are consistent with the general occupational research literature (O'Boyle *et al.* 2010). Attitudes and behaviours deriving from underlying personality traits such as having pride in content cows and purchasing behaviour may be more difficult to address with *in situ* farmers but can certainly be managed.

The model explained 40% of the variation in financial performance. From such a parsimonious model, this was more than satisfactory. A similar study of Flemish farmers with five variables produced a model that explained just 20% of the variation in performance (Vandermersch and Mathijs, 2004).

The main weaknesses of the current study are that the sample was not especially representative and GCA and personality were not assessed. There is also the potential for confounding as variables such as land type, region and tenure as the sample size was small and this would have complicated the models significantly. The findings remain robust, however, as they have been interpreted in the context of the

extensive literature review. There is a clear case for further research to address the gaps in the current study and the extant literature.

Participants' subsequent financial performance could be performed to create a longitudinal study utilising the existing questionnaire data. The association of variables with change in performance over many years could then be assessed. Causality and endogeneity could thus be clarified, a relevant concern in cross-sectional studies such as this.

Other variables should also be considered. These include those correlated to profitability (Table 3-10) but which are not included in the model (Table 3-11) and the variables not assessed in this study likely to be of importance such as intelligence and personality. Large improvements to dairy farm business performance are possible through the provision of training to *in situ* farmers and the improved selection of candidate farm managers and staff. Sociodemographic characteristics did not warrant inclusion in the final model and so appear to be of secondary importance when predicting performance if attitudes have been assessed.

4. PERSONALITY AND FARM PROFITABILITY

4.1 Introduction

Though personality has been shown to associate strongly with occupational performance in general, it has rarely been studied in agriculture (Nuthall 1999; Austin *et al.* 2001). The scale of personality's association with farm profitability is therefore unknown (Austin *et al.* 2001; Nuthall 2010c; Hansson 2008). Meta-analyses are reported in other sectors where personality and intelligence predict more than 40% of the variation of job performance (O'Boyle *et al.* 2010). That such a magnitude of potential variation has not been explored within farming is curious. Increasing the understanding of the role of farmer personality may thus provide novel approaches to improving agricultural productivity. The prospect of improving profitability is promising if agriculture is similar to other sectors. This study assesses if farmer personality is associated with profitability and which aspects of personality are most strongly associated.

4.2 Materials and Methods

The objective of this study was to assess the relationship between personality and farm profitability. To this end, a sample of farmers had their personality assessment scores compared to the financial performance of their farm business. In this Section, the participants' characteristics, the profitability measure used, the personality assessment, and the analysis methods used are introduced and described.

4.2.1 Sample characteristics

In late spring and early summer of 2015, 180 dairy farm managers in England and Wales were asked to take part in a commercial research project carried out by Promar International for AHDB dairy. The research clashed with silage season, making recruitment challenging but an acceptable response rate of 32% was achieved and 58 dairy farm managers completed a personality assessment. Workload was cited as the most common reason for not participating. Financial data was not forthcoming from two participants.

The date the assessment was entered electronically was negatively correlated to profitability, but not significantly at the 0.05 level. As in Chapter 3, this indicates a potential late responder bias where less profitable farm managers were less likely to respond. Some participants used a paper form and the return date was not recorded

and so the date it was entered into the system electronically was the only available data. This is likely a source of bias as those that completed the paper version would have appeared to complete it later based on the electronic system data. The sample is not especially representative of England and Wales for farm size and system with smaller herds underrepresented in particular (Table 4-1).

Table 4-1 Participant farm businesses summary statistics (N=40)

	Value	Standard deviation	National Average
Herd size	210	108	141[1]
CFP/ Litre	5.3p	5p	4.35p[2]
CFP/ Cow	£390	£353	Not available
Litres per cow	7,362	1,620	7944[1]

[1] Herd size England & Wales, Litres per cow UK (AHDB Dairy 2016a). Mostly English reference sample [2](Vickery *et al.* 2015).

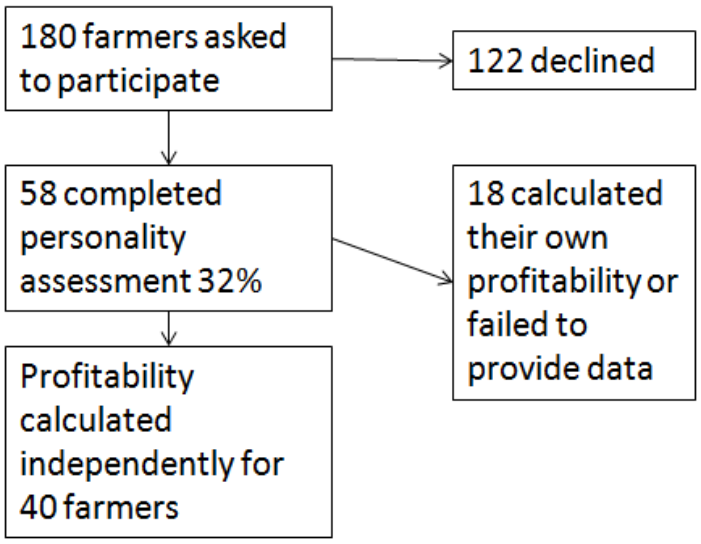

Figure 4-1 Participant engagement.

4.2.2 Profitability data

Forty (out of 58) respondents had independently created farm management accounts by Promar International that provided the accounting data for this study directly. 16 farm managers completed spreadsheets by themselves to calculate their own 'comparable profit' (AHDB 2016). Comparable farm profit is the standard excel based

benchmarking tool used in dairying in the UK and is particularly used by discussion groups.

> *'In order to make the businesses comparable rents, interest payments, drawings, tax and capital expenditure have been excluded from the figures and a labour charge of £20,000 per full time partner/director has been included. Single payment has also been excluded from income. It should be noted that depreciation has been included in these figures.' (Vickery et al. 2015)*

However, the farmer calculated data was suspected to be less accurate than the independently calculated data and stronger statistical relationships emerged when using only the independently calculated profitability measures. No such disparity in accuracy was evident when the volume of milk produced was the variable of interest. The 16 farm managers that contributed their financial data directly thus appear to have not calculated their profitability reliably or consistently. For this reason, only the independently calculated data provided by Promar International based on their bank reconciled farm management accounts were used. This resulted in a sample of just 40 for the profitability analysis and 56 for the litres produced analysis. The distribution of the profit per litre measure is presented in Figure 4-2. For comparisons between farm managers and the population norm, all 58 completed assessments were used, including the two participants who completed personality assessments but failed to provide any financial or production information.

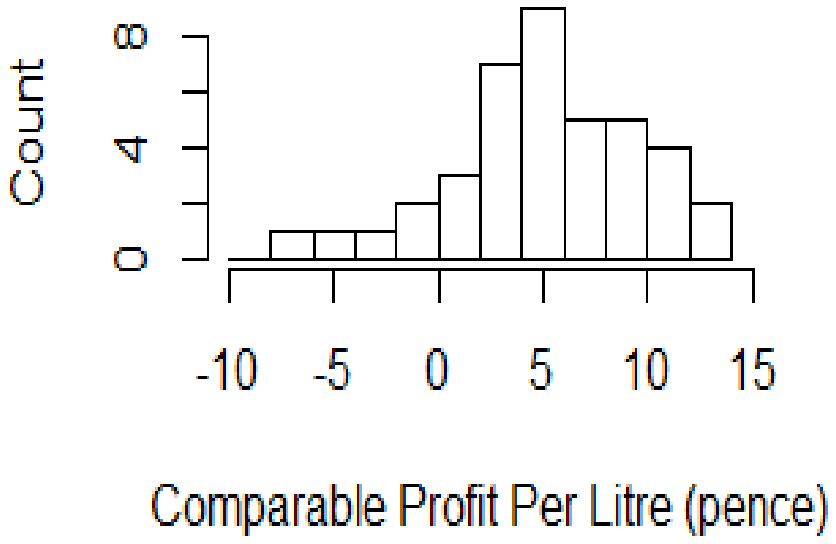

Figure 4-2 Histogram of CFP per litre for the sample

4.2.3 Occupational Personality Questionnaire

Occupational Personality Questionnaire TM (OPQ) is a personality inventory designed for use in occupational contexts for selection and training. It is based on prominent models from psychology and management (Saville *et al.* 1996). The OPQr version employed in this study takes 25 to 45 minutes to complete. OPQr is a short, forced choice format with normative properties (British Psychological Society, 2016). The OPQ has received an endorsement from the British Psychological Society having being rigorously tested for validity and reliability (Smith and Banerji, 2007). OPQ's incremental validity for predicting performance beyond ability measures has also been established (Bartram, 2013; Furnham *et al.* 2014). The OPQr was thus a suitable tool for the current study where farmer personality is the topic of interest.

Table 4-2 shows an example OPQr question block. In each block, three statements were presented. Participants then selected the statement most like and the statement least like them - a forced-choice format. The forced choice format helps counteract social desirability bias and is relatively efficient compared to other question formats (Brown & Bartram 2009). However, participants complained about the time required to complete the 104 question blocks and the repetition of questions and one started but did not complete the assessment. Spam filters and browser incompatibility were also issues for some participants.

Thirty-two psychological scores relevant for occupational contexts are presented in the standard OPQ report based on answers to these 104 blocks and are presented in tables 4-3 to 4-5. In addition, an Emotional and Social Competence (ESC) report was derived from the same 104 question blocks, generating an additional twenty-one ESC measures and these are presented in Sections 4.2.4. All the measures were available as STEN scores (Standardised TEN) generated with a reference norm population described in the Section 4.2.5.

Table 4-2 Example OPQ forced choice question block.

	Most like me	Least like me
I like helping people	X	
I enjoy competitive activities		
I view things positively		X

Table 4-3 Relationships with people measures

Measure	Low scorers	High scorers
Affiliative	Comfortable spending time away from people, values time spent alone, seldom misses the company of others	Enjoys others' company, likes to be around people, can miss the company of others
Caring	Selective with sympathy and support, remains detached from others' personal problems	Sympathetic and considerate towards others, helpful and supportive, gets involved in others' problems
Controlling	Happy to let others take charge, dislikes telling people what to do, unlikely to take the lead	Likes to be in charge, takes the lead, tells others what to do, takes control
Democratic	Prepared to make decisions without consultation, prefers to make decisions alone	Consults widely, involves others in decision-making, less likely to make decisions alone
Independent Minded	Accepts majority decision, prepared to follow the consensus	Prefers to follow own approach, prepared to disregard majority decisions
Modest	Makes strengths and achievements known, talks about personal success	Dislikes discussing achievements, keeps quiet about personal success
Outgoing	Quiet and reserved in groups, dislikes being centre of attention	Lively and animated in groups, talkative, enjoys attention
Outspoken	Holds back from criticising others, may not express own views, unprepared to put forward own opinions	Freely expresses opinions, makes disagreement clear, prepared to criticise others
Persuasive	Rarely pressures others to change their views, dislikes selling, less comfortable using negotiation	Enjoys selling, comfortable using negotiation, likes to change other people's views
Persuasive	Rarely pressures others to change their views, dislikes selling, less comfortable using negotiation	Enjoys selling, comfortable using negotiation, likes to change other people's views
Socially Confident	Feels more comfortable in less formal situations, can feel awkward when first meeting people	Feels comfortable when first meeting people, at ease in formal situations

Table 4-4 Thinking style measures

Measure	Low scorers	High scorers
Adaptable	Behaves consistently across situations, unlikely to behave differently with different people	Changes behaviour to suit the situation, adapts approach to different people
Behavioural	Does not question the reasons for people's behaviour, tends not to analyse people	Tries to understand motives and behaviours, enjoys analysing people
Conceptual	Prefers to deal with practical rather than theoretical issues, dislikes dealing with abstract concepts	Interested in theories, enjoys discussing abstract concepts
Conscientious	Sees deadlines as flexible, prepared to leave some tasks unfinished	Focuses on getting things finished, persists until the job is done
Conventional	Favours changes to work methods, prefers new approaches, less conventional	Prefers well established methods, favours a more conventional approach
Data Rational	Prefers dealing with opinions and feelings rather than facts and figures, likely to avoid using statistics	Likes working with numbers, enjoys analysing statistical information, bases decisions on facts and figures
Detail Conscious	Unlikely to become preoccupied with detail, less organised and systematic, dislikes tasks involving detail	Focuses on detail, likes to be methodical, organised and systematic, may become preoccupied with detail
Evaluative	Does not focus on potential limitations, dislikes critically analysing information, rarely looks for errors or mistakes	Critically evaluates information, looks for potential limitations, focuses upon errors
Forward Thinking	More likely to focus upon immediate than long-term issues, less likely to take a strategic perspective	Takes a long-term view, sets goals for the future, more likely to take a strategic perspective
Innovative	More likely to build on than generate ideas, less inclined to be creative and inventive	Generates new ideas, enjoys being creative, thinks of original solutions
Rule Following	Rot restricted by rules and procedures, prepared to break rules, tends to dislike bureaucracy	Follows rules and regulations, prefers clear guidelines, finds it difficult to break rules
Variety Seeking	Prefers routine, is prepared to do repetitive work, does not seek variety	Prefers variety, tries out new things, likes changes to regular routine, can become bored by repetitive work

Table 4-5 Feelings and emotions measures

Measure	Low scorers	High scorers
Achieving	Sees career progression as less important, looks for achievable rather than highly ambitious targets	Ambitious and career-centred, likes to work to demanding goals and targets
Competitive	Dislikes competing with others, feels that taking part is more important than winning	Has a need to win, enjoys competitive activities, dislikes losing
Consistency	Has responded less consistently across the questionnaire	Has responded more consistently across the questionnaire
Decisive	Tends to be cautious when making decisions, likes to take time to reach conclusions	Makes fast decisions, reaches conclusions quickly, less cautious
Emotionally Controlled	Openly expresses feelings, finds it difficult to conceal feelings, displays emotion clearly	Can conceal feelings from others, rarely displays emotion
Optimistic	Concerned about the future, expects things to go wrong, focuses on negative aspects of a situation	Expects things will turn out well, looks to the positive aspects of a situation, has optimistic view of the future
Relaxed	Tends to feel tense, finds it difficult to relax, can find it hard to unwind after work	Finds it easy to relax, rarely feels tense, generally calm and untroubled
Tough Minded	Sensitive, easily hurt by criticism, upset by unfair comments or insults	Not easily offended, can ignore insults, may be insensitive to personal criticism
Trusting	Wary of others' intentions, finds it difficult to trust others, unlikely to be fooled by people	Trusts people, sees others as reliable and honest, believes what others say
Vigorous	Likes to take things at a steady pace, dislikes excessive work demands	Thrives on activity, likes to keep busy, enjoys having a lot to do
Worrying	Calm before important occasions, less affected by key events, free from worry	Nervous before important occasions, worries about things going wrong

The descriptions of the OPQ measures are outlined in Tables 4-2 to 4-5. Section 4.2.4 presents the descriptions on the ESC measures. It was these measures that were hypothesized initially to be associated with farm profitability. The OPQ measures were included in the output data but were not the focus of the original research. The analysis presented here is a broader reanalysis to see what associations exist with profitability. Conscientiousness is the personality variable that

is most consistently associated with job performance in the literature. It was thus expected that this and related variables for farm managers in the sample would be associated with farm profitability.

4.2.4 Emotional and social competence report output measures.

Accurate Self Assessment Knowing one's strengths and limitations. Being open to candid feedback, continuous learning, and self-development.

Achievement Drive Striving to improve or meet a standard of excellence. Being focussed on achieving results, setting challenging goals and taking calculated risks.

Adaptability Being flexible in responding to change. Adapting one's responses to fit fluid circumstances with shifting priorities.

Building Bonds Nurturing instrumental relationships. Cultivating/maintaining informal networks, seeking out mutually beneficial relationships.

Change Catalyst Initiating or managing change. Recognising and championing the need for change.

Communication Listening openly and sending convincing messages. Being effective in 'give and take' situations.

Conflict Management Negotiating and resolving disagreements. Handling conflict to achieve win-win solutions.

Conscientiousness Taking responsibility for personal performance. Meeting commitments and adopting an organised approach to one's work.

Developing Others Sensing others' development needs and bolstering their abilities. Sincere interest in mentoring and coaching.

Emotional Awareness Recognising one's emotions and their effects. Listening to one's intuitions and incorporating these in decision-making.

Influence Having effective tactics for persuasion. Being skilled at winning people over and adapting presentations to suit the listener.

Initiative Displaying proactivity. Being prepared to act on opportunities and bend the rules when necessary to get the job done.

Leadership Inspiring and guiding individuals and groups. Leading by example and arousing enthusiasm for a shared vision.

Organisational Awareness Reading social and political currents. Showing political savvy by accurately gauging organisational/external realities.

Persistence Persevering with an activity despite obstacles and setbacks. Operating from hope of success rather than fear of failure.

Self Confidence Having a strong sense of self-worth and capabilities. Demonstrating self-assurance and the ability to make sound decisions despite uncertainties and pressures.

Self Control Keeping disruptive emotions and impulses in check. Displaying resilience in the face of set-backs and staying focussed under pressure.

Service Orientation Anticipating, recognising, and meeting customer needs. Understanding customer needs and matching to services/products.

Teamwork and Collaboration Creating group synergy in pursuing collective goals. Participating enthusiastically; being helpful and sharing with the team.

Understanding Others Sensing others' feelings and perspectives, and taking an active interest in their concerns. Sensitivity and understanding.

4.2.5 Norm population

To calculate scores on these personality measures for participant farmers, their responses were compared to a norm population that was a representative general working population of UK English speaking countries. This includes people from India and Australia for example (SHL Group Limited, 2011). People from all socio-economic, educational and occupational backgrounds were included in this norm population.

> *'The OPQ32r international 'general population norm' is a work population norm, drawn from country-specific (or regional) work population norms (CEB, 2011-2012) that include people actively seeking employment and those in employment; it is therefore a generic norm of people who can be employed, including people not currently in employment, students, and graduates (with varying employment length and all education levels)'.* (SHL Group Limited 2015)

The characteristics of the norm population are detailed in the technical manuals available online from SHL/CEB website (SHL Group Limited 2015). Socio-demographic data about participants in the current study was not collected but they

are likely to have similar characteristics to national averages and the sample in the study reported in Chapter 3. The forty farmers whose financial data was calculated independently were also clients of Promar International like the sample in Chapter 3. The main population norm characteristics of note that contrast with average dairy farmers in the England and Wales are as follows:

- A gender ratio of 61:39 male to female. Farmers in England and Wales are 95% male (Wilson *et al.* 2013);
- 37% of the norm population were 29 or younger. Only 6.7% of the norm group were over the age of 50, while the average age of dairy farmers is 51 (Farm Business Survey Team 2012) and was 50.5 in the study reported in Chapter 3;
- 32.6% of the norm population had postgraduate degrees, much higher than farmers at about 3% (Wilson *et al.* 2013); and,
- Only 40% of the norm population had managerial responsibilities compared all the farmer participants.

Fifty-three psychological and ESC variables were extracted from individual farm managers' assessments. These measures were calculated by SHL against the norm population and presented as STEN (standardised ten) scores in reports for the participants (Table 4-3). Each score indicates how likely the respondent has a particular competence/trait compared to the norm population. Mean STEN scores for a norm population are by definition 5.5 and have a standard deviation of 2 for the norm population (Macnab *et al.* 2005). These STEN scores were extracted from the individual participant's reports and are the independent variables in this study.

Table 4-3 Likelihood of having a particular competence by STEN score.

STEN Score	1	2	3	4	5	6	7	8	9	10
Competence likelihood	Unlikely		Less likely		Average		Quite Likely		Very Likely	

4.2.6 Analysis methods

To compare the participant's scores with the population norm mean of 5.5, one-sample t-tests were performed. Microsoft Excel's t-test function was used specifying

two tails and unequal variances using a dummy array of values 5.5 as the norm population. To assess the relationship between personality measures with both litres produced and profitability, correlation analysis was performed. To assess the relative importance of variables correlated to profitability, linear regression was also performed. The 'cor' and 'lm' function in R statistical software was used (R Core Team 2013). P-values of correlations were calculated using the 'rcorr' function of the Hmisc package for R (Harrell Jr 2016). To assess the Variance Inflation Factor of the linear models, package ‘FMSB’ was used (Nakazawa 2013).

4.3 Results

In this Section, the results of three types of analysis are presented. First, the scores of farm managers are compared with the reference norm sample using one-sample t-tests. Secondly, correlation analyses between personality measure STEN scores with litres produced and profitability measures are reported. Finally, two linear models predicting profitability are presented.

4.3.1 Comparison with norm population

Participant dairy farmer personality scores were compared to the norm population, UK English speaking general population. As the OPQ reports are reported as standardised ten (STEN) scores, the mean of the norm population described in Section 4.2.3 for each measure is by definition 5.5. Table 4-4 and Table 4-5 report the mean scores for farm managers, the standard deviation of farmer sample, and the p-value indicating if farmers’ scores were statistically distinct from the norm population mean score of 5.5. For 39 of the 53 measures (OPQ & ESC), the farm managers' scores differed significantly from a norm population mean score of 5.5.

21 of 32 OPQ measures and 18 of 21 ESC measures were statistically different. Participant farmers scored higher on several personality measures (OPQ) and lower on most ESC measures. For example, farm managers scored lower on Conscientiousness and Detail Conscious measures but higher on Modest.

Table 4-4 One sample t-test p-value, farm managers to population norm, two tails, n=57.* (1/2)

	Report	Farmer Mean	Farmer Std Dev	p-value
Conscientiousness	ESI	3.35	1.97	0.00
Detail Conscious	OPQ	3.54	1.90	0.00
Independent Minded	OPQ	7.23	1.68	0.00
Service Orientation	ESI	3.75	1.79	0.00
Conscientious	OPQ	3.54	2.10	0.00
Achieving	OPQ	4.05	1.77	0.00
Building Bonds	ESI	3.91	2.05	0.00
Emotionally Controlled	OPQ	7.12	2.11	0.00
Persuasive	OPQ	4.28	1.66	0.00
Behavioural	OPQ	4.14	1.87	0.00
Rule Following	OPQ	4.14	1.90	0.00
Innovative	OPQ	4.42	1.77	0.00
Accurate Self Assessment	ESI	4.42	1.80	0.00
Understanding Others	ESI	4.26	2.10	0.00
Emotional Awareness	ESI	4.32	2.05	0.00
Caring	OPQ	4.32	2.10	0.00
Communication	ESI	4.35	2.10	0.00
Consistency	OPQ	6.21	1.40	0.00
Modest	OPQ	6.47	1.93	0.00
Teamwork and Collaboration	ESI	4.54	1.95	0.00
Achievement Drive	ESI	4.60	1.84	0.00
Evaluative	OPQ	4.61	1.81	0.00
Organisational Awareness	ESI	4.49	2.07	0.00
Adaptable	OPQ	4.70	1.70	0.00

* Being STEN scores, the reference population has a mean of 5.5. Ordered by p-value up.

Table 4-5 One sample t-test, farm managers compared to population norm, two tails, n=57. *(2/2)

	Report	Farmer Mean	Farmer Std Dev	p-value
Influence	ESI	4.60	1.93	0.00
Developing Others	ESI	4.54	2.07	0.00
Socially Confident	OPQ	4.63	1.96	0.00
Change Catalyst	ESI	4.58	2.09	0.00
Affiliative	OPQ	4.61	2.05	0.00
Conceptual	OPQ	4.65	2.14	0.00
Persistence	ESI	4.61	2.26	0.00
Outspoken	OPQ	4.72	2.03	0.01
Leadership	ESI	4.70	2.12	0.01
Democratic	OPQ	4.61	2.45	0.01
Variety Seeking	OPQ	4.79	2.09	0.01
Initiative	ESI	4.81	2.07	0.01
Self-Control	ESI	6.18	2.13	0.02
Self Confidence	ESI	4.93	1.87	0.03
Data Rational	OPQ	4.93	2.07	0.04
Worrying	OPQ	5.98	1.89	0.06
Conventional	OPQ	6.00	2.01	0.07

* Being STEN scores, the reference population has a mean of 5.5. Ordered by p-value up.

The mean of 18 ESC scores was (4.5) while the mean of the 21 statistically different OPQ scores was 4.8. The norm population mean is 5.5. It can thus be concluded that participant dairy farmers were on average less competent in these ESC competencies in particular compared to the population norm.

These findings are of potential interest from a range of perspectives including informing communication and policy affecting farmers. Discussion and efforts to improve the mental health of farmers may also be informed by these findings. The level of heterogeneity within the participant group appears similar to that observed in the reference population with a standard of about 2 for most variables as reported in

table 4-4 and 4-5. That the standard deviation amongst this group of this ostensibly similar group of farmers is similar to that of general working population indicates a high level of heterogeneity among farmers. Descriptions of these measures and the other measures are included in Sections 4.2.3 & 4.2.4.

4.3.2 Correlations to profitability (n=40)

Four variables had large and significant correlations to both profit per cow and profit per litre. Many measures had large correlation coefficients to profit in comparison to those reported in Chapter 3. However, many were not statistically significant, likely due in part due to the smaller sample size of 40 providing less statistical power (Table 4-6). Detail Conscious, Leadership and Relaxed are the most correlated to profitability and as they are included in a linear model to predict profitability, they are discussed in detail in Section 4.3.4 and Section 4.4.

Table 4-6 Profit and personality correlation (n=40)

	Rho	p-value	Rho	p-value
	Profit/Litre		Profit/Cow	
Detail Conscious (OPQ)	0.48	0.00	0.45	0.00
Leadership	0.46	0.00	0.43	0.01
Relaxed	-0.35	0.03	-0.37	0.02
Conscientiousness (ESC)	0.35	0.03	0.33	0.04
Controlling	0.30	0.06	0.29	0.07
Democratic	0.29	0.07	0.26	0.11
Social Skills	0.29	0.07	0.24	0.14
Conscientious (OPQ)	0.26	0.10	0.26	0.10
Self-Control	-0.21	0.19	-0.29	0.07

A high scorer for Detail Conscious 'focuses on detail, likes being methodical, organised and systematic'. A low scorer is 'unlikely to become preoccupied with

detail, less organised and systematic, dislikes tasks involving detail'. Leadership is described as 'Inspiring and guiding individuals and group. Leading by example and arousing enthusiasm for a shared vision'. A high scorer on Relaxed 'finds it easy to relax, rarely feels tense, generally calm and untroubled'. A low scorer 'tends to feel tense, finds it difficult to relax, can find it hard to unwind after work'. Relaxed was negatively correlated with profitability.

4.3.3 Correlations to milk volume

The largest correlations to milk volume were to measures Innovative and Achieving (Table 4-7). Innovative high scorers are described as people who usually 'generates new ideas, enjoys being creative, thinks of original solutions' while low scorers usually are 'more likely to build on than generate ideas, less inclined to be creative and inventive'. Achieving high scorers are described as 'ambitious and career-centered, likes to work to demanding goals and targets' while low scorers generally 'sees career progression as less important, looks for achievable target rather than highly ambitious targets'.

Table 4-7 Correlations to litres of milk produced (n=56)

	Correlation	p-value
Innovative	0.38	0.004
Achieving	0.37	0.005
Conventional	-0.31	0.019
Variety Seeking	0.30	0.024
Achievement Drive	0.29	0.028
Initiative	0.29	0.031
Controlling	0.26	0.052
Adaptability	0.26	0.054
Worrying	-0.25	0.058

It is likely that managers' Innovativeness and Achievement drive influenced decisions to expand production. Four other variables are also correlated to litres produced including Conventional (negatively) and Variety Seeking.

4.3.4 Profitability linear models

Comparable Farm Profit per cow and per litre are the two dependent variables this study. To this end, linear models to predict variation in these two variables were developed using the personality measures correlated to the same profitability measures. An initial model was created with the 20 variables most correlated to profitability. The least significant variable was then removed and the model re-run. This procedure iterated until all the variables were statistically significant, similar to the stepwise procedure used by Vandermersch and Mathijis (2004). Models with an adjusted R^2 of 0.41 for the profit per litre and 0.38 for the profit per cow resulted. Multicollinearity was tested for and the VIF for both models was below 2 and so not considered an issue (Stine 1995). The same three variables emerged in predicting both outcomes; Detail Conscious, Leadership and Relaxed (Table 4-8 and Table 4-9).

A high scorer for Detail Conscious 'focuses on detail, likes being methodical, organised and systematic'. A low scorer is 'unlikely to become preoccupied with detail, less organised and systematic, dislikes tasks involving detail'. High scorers were much more profitable. Scoring one STEN score higher (half a standard deviation) predicts £72 per cow or 1p per litre greater profit per year.

A similar change in Leadership score is modelled to result in a £55 per cow or 0.8p per litre change in profit per year. Leadership is described as 'Inspiring and guiding individuals and group. Leading by example and arousing enthusiasm for a shared vision.'

Table 4-8 Profit / litre predicted by personality variables

	β	Estimate	Standard Error	t-value	Pr(>|t|)
(Intercept)		1.03p	2.16p	0.47	0.638
Detail Conscious	0.40	1.00p	0.31p	3.22	0.003
Leadership	0.34	0.79p	0.29p	2.72	0.001
Relaxed	-0.31	-0.61p	0.24p	-2.49	0.017

(N=40, R^2=0.48, Adj R^2=0.41)

Finally, Relaxed was negatively associated with profit with each STEN score increase associated with a negative change in profit of £-49 per cow and -0.6p. A

high scorer on this 'finds it easy to relax, rarely feels tense, generally calm and untroubled'. A low scorer 'tends to feel tense, finds it difficult to relax, can find it hard to unwind after work'.

It is clear that strong associations have been found between these measures and farm performance, in particular, Detail Conscious. Each of the three variables included in the profitability models are discussed and interpreted in detail in Sections (4.4.1 - 4.4.4).

Table 4-9 Profit / cow predicted by personality variables

	β	Estimate	Standard Error	t-value	Pr(>|t|)
(Intercept)		£137.66	0.477	-1.554	0.129
Detail Conscious	0.38	£71.84	0.069	2.994	0.005
Leadership	0.31	£54.67	0.064	2.449	0.019
Relaxed	-0.32	£-48.72	0.054	-2.596	0.014

(N=40, R^2=0.43, Adj R^2=0.38)

4.3.5 Key findings

Four key findings from this study are:

- Dairy farm managers in England and Wales have distinct personalities from the norm population. Statistically significant differences in mean scores for 39 of the 53 personality measures support this conclusion;
- Six personality measures correlated with litres of milk produced;
- Four measures correlated strongly to farm profitability; Detail Conscious, Leadership, Relaxed and Conscientiousness; and,
- Detail Conscious, Leadership and Relaxed measures cumulatively predict approximately 40% of farm profitability in a linear model.

4.4 Discussion

This discussion begins with an overview of how farmers in the sample compare the reference norm population, in sample variation and the associations between this variation and farm performance. The potential implications for the mental health of farmers are then discussed. Then specific Sections discuss the major issues and implications of the study in detail. First, each of the three variables included in the

profitability models are discussed and interpreted in detail (Section 4.4.1 - 4.4.4). Observations regarding data sources, future research (4.4.5) and weaknesses of the current study (4.4.6) are then discussed. Finally, the ESC constructs lack of association to profitability is discussed (4.4.7).

Participant dairy farmers are distinct psychologically from the population norm of people available to work in UK English speaking countries with 39/53 variables being significantly different (Table 4-4 & Table 4-5). This was to be expected as farm managers are quite different in many regards from the general working population of UK English speaking countries used as population norm. Of note, however, is that participants had a similar level of heterogeneity as the population norm as indicated by the standard deviation in responses despite being drawn from a relatively homogenous population. In general, participants scored lower than the population norm.

The level of standard deviation indicates that one size fits all approaches maybe not be appropriate for interventions with farmers (Wilson *et al.* 2013). The cause of this diversity is unclear. It is possibly attributable to cultural diversity between families as well genetic predilections. These might be propagated by the strong role of inheritance in farming.

The isolated and rural nature of farming may also partially explain this diversity and the lower scores on ESC measures in particular. The lower scores on general occupational measures may be attributable to the role of inheritance and the subsequently lower selection pressure for farm management positions than other sectors.

This raises the question, are these lower scores associated with reduced profitability? This study has reported substantial and significant relationships indicating that these scores are indeed associated with profitability. In particular, the most profitable participant farmers tended to score much higher on the Detail Conscious and Leadership measures of personality and lower on Relaxed.

Participant dairy farm managers scored a standard deviation lower on Detail Conscious (mean =3.54) compared with the norm population (5.5) described in Section 4.2.3. This indicates farm managers are much less likely to focus on detail, be methodical, organised and systematic compared the population norm and compared to many of the other measures they were assessed on.

Farmers are generally their own bosses, perhaps explaining this difference from the reference population who are generally employees. Leadership was the other positively related variable and had a mean of 4.7, just a quarter of a standard deviation lower than the norm population.

Participant dairy farmers were found to have a similar mean score for Relaxed to the norm population (5.3) and the measure was negatively associated with profitability. High scorers on Relaxed are likely to be less proactive in preventing problems as they can tolerate problems when they arise. The more anxious and worried manager, scoring lower in Self-Control and Relaxed, goes out of their way to prevent such occurrences.

The mental health of farmers has become a topic of significant concern in the last two decades (Thomas *et al.* 2003; Fraser *et al.* 2005). These papers discussed the particular risks to mental health farmers face. This includes farming's isolated nature and the high levels of individual responsibility. The evidence about the extent mental health issues affect farmers relative to non-farmers is contradictory with some reporting higher rates of depression and suicide and some reporting less. In the UK, it appears to be less (Fraser *et al.* 2005) but comprehensive research is lacking and potentially greater stigma associated with mental health in the farming community may be masking the true prevalence.

Looking at the results of this study, it is clear that the participant farmer sample had distinct personality scores means and distributions. In particular, they are more independent-minded, tend to build bonds less, are much more emotionally controlled (conceal feelings), display lower emotional awareness within themselves and others, are less adaptable and more prone to worrying and anxiety. These trends do not, superficially at least, appear conducive to mental health. The use of personality inventories in farming for coaching and development purposes might have potential additional benefits such as identifying and facilitating assistance of farmers potentially susceptible or experiencing mental health issues.

The remainder of this discussion Section discusses the study's findings in greater detail in relation to associations with farm profitability.

4.4.1 Detail Conscious

The Detail Conscious measure relates positively to profitability. A high scorer 'focuses on detail, likes being methodical, organised and systematic'. A low

scorer is 'unlikely to become preoccupied with detail, less organised and systematic, dislikes tasks involving detail'. The sample of dairy farmers assessed had relatively low scores compared to other competencies assessed and the norm population used in this study. Half of participant dairy farm managers had STEN scores of three or below. The median dairy farmer in the sample was thus scored at least a standard deviation less Detail Conscious than the norm population.

Potential explanations include that many farmers may only have worked for family members before becoming managers themselves and that family owned and managed farms provide job security that is likely to reduce incentives for Detail Conscious behaviour expected in other contexts. Further research both quantitative and qualitative may be required to understand this finding fully. However, farming does not preclude Detail Conscious behaviour as several high scorers were observed in this study (Figure 4-3) and these tended to be much more profitable.

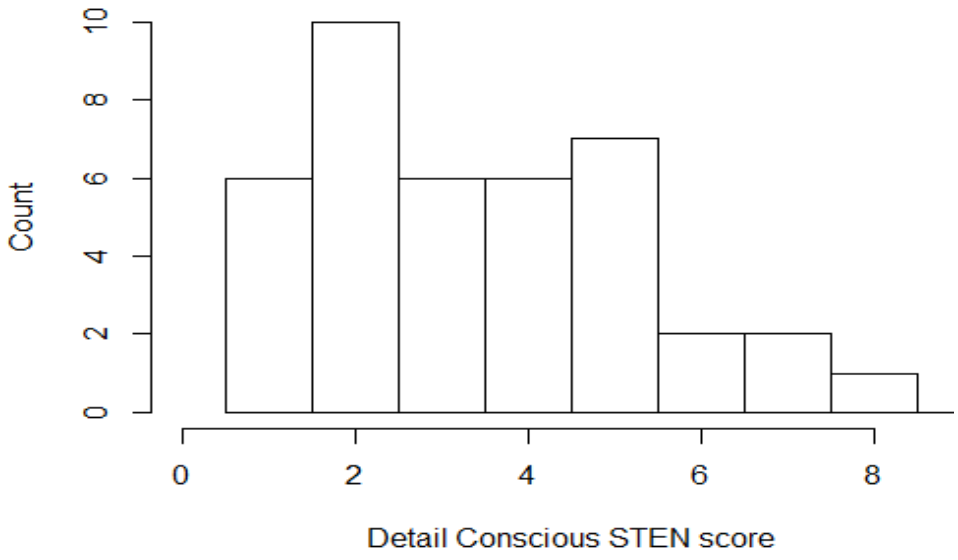

Figure 4-3 Detail Conscious score distribution of participating farmers.

The correlation of 0.48 indicates that the Detail Conscious measure of farm managers co-varies with approximately 24% of the variation in profit. This is the largest correlation reported in this thesis. The regression model indicates that a change in STEN score of just one (half a standard deviation in the norm population) predicts a change in profit per cow of £71. Assuming a 150 cow herd, the UK average (Ashbridge 2014), this implies over £10,000 profit differential a year for a one-point change in managers' scores. The relationship between Detail Conscious

behaviour and profitability should be communicated to farm managers along with the finding that it is far from the norm in the industry.

Starting from a low base and with the largest single correlation observed in this thesis, this offers the greatest potential return for achieving farm performance improvements. If farm managers could become more Detail Conscious, large improvements to performance may follow. The models suggest that effecting a two or three point change in this score could have large and recurring benefits. Expending effort to achieve this could thus potentially represent a good return on investment for farmers.

4.4.2 Conscientiousness and related measures

This Section outlines the differences between Conscientiousness, Conscientious and Detail Conscientious measures. Appreciating the subtle nuances between these measures will likely aid the application of the main finding of this study and thesis. That is that the Detail Conscious measure is the most strongly associated measure to profitability assessed in this study and thesis.

Conscientiousness is one of the five factors constituting the Five Factor Model (McCrae & Costa 1985) also known as the Big Five or NEO five. This measure differs from the 'Conscientious' from the OPQ report. The OPQ scores Conscientious and Detail Conscious exist within the 'Conscientiousness' factorial space (Brown & Bartram 2009). Conscientious and Detail Conscious, therefore, measure specific aspects of 'Conscientiousness'.

Conscientiousness is described as 'Taking responsibility for personal performance. Meeting commitments and adopting an organised approach to one's work.' This measure correlated with profit per litre and cow significantly (0.35 & 0.33). In contrast, a high scorer for Conscientious is described as someone who 'focuses on getting things finished, persists until the job is done' and low scorer as someone who 'sees deadlines as flexible, prepared to leave some tasks unfinished'. Conscientious correlated (0.26) to both profit measures but was not statistically significant (p=0.10).

Finally, a high Scorer on the Detail Conscious measure is described as 'focuses on detail, likes to be methodical, organised and systematic, may become preoccupied with detail' while a low scorer is 'unlikely to become preoccupied with detail, less organised and systematic, dislikes tasks involving detail'. The correlation to profit was the highest of all three measures (0.48 & 0.45).

Among these three very similar measures, it is thus being organised, systematic and detail focused (Detail Conscious) that is most predictive of profitability. This is followed by the broader measure of generally taking responsibility for achieving commitments (Conscientiousness) which would include the Detail Conscious attributes amongst others. Finally, dogged drive to complete tasks quickly (Conscientious) was found to be only marginally associated with profitability. Targeted discussion and efforts could be delivered to farmers to help improve performance with this nuanced understanding of what likely drives profitability.

4.4.3 Leadership

Leadership is described as

> *'Inspiring and guiding individuals and group. Leading by example and arousing enthusiasm for a shared vision.'*

The important role of Leadership is for the first time confirmed empirically among farm managers by these findings (Table 4-6, 4-8 and 4-9). The regression models predict that if two farmers only differed in their Leadership measure by one STEN score, half a standard deviation, the one that scored higher would achieve £55 more profit per cow or just under £8,000 more a year for a 150 cow herd.

This somewhat validates retrospectively the funding of Leadership training courses for farm managers in the UK. How effective these programs have been to date have been assessed primarily on participant feedback. The effect of leadership training on profitability is still, however, unknown.

Farmers are starting from a higher base than Detail Conscious measures as they have comparable levels of leadership to the norm population. Combined with the smaller effect size observed, Leadership will probably provide slightly less scope for improvement on farm than Detail Consciousness. This assertion is dependent on the assumption that it is equally easy to change both measures. It also assumes that changing each measure subsequently translates into performance increases as predicted by the presented models.

4.4.4 Relaxed & Self-Control

The variable Relaxed had a large negative correlation to profitability and was included in the final models. A high scorer on the Relaxed measure 'finds it easy to relax, rarely feels tense, generally calm and untroubled' and a low scorer 'tends to

feel tense, finds it difficult to relax, can find it hard to unwind after work'. A constant drive to succeed manifesting as tenseness and an always-on approach appears beneficial in dairy farming, financially at least. This finding was contradictory to expectations. Relaxed exists in the factorial space of Emotional Stability (Bartram 2013) which is thought to be an important positive predictor of performance in general while these results indicate that some aspects of emotional stability are not beneficial from a farm financial perspective.

Relaxed was almost not included in the model presented in this study. Relaxed is highly correlated to the measure Self-Control (cor =0.73) and a model substituting Relaxed for Self-Control had a higher adjusted R^2. However, the presented model was selected for two reasons.

First Self-Control was not significantly correlated to profit per litre whereas Relaxed was. Secondly, the interpretation of the Self-Control finding remains unclear. Self-Control was negatively associated with profit contrary to expectations. Self-Control, an Emotional Social Competence, is described as 'Keeping disruptive emotions and impulses in check' and 'Displaying resilience in the face of setbacks and staying focused under pressure.' Another definition is 'the capacity to regulate one's thoughts, feelings, and actions' (Miller *et al.* 2015).

Self-Control is widely viewed as positive and is often discussed in terms of the marshmallow test (Mischel 2014). This is the observation that children who can resist eating a treat (e.g. a marshmallow) in the expectation of getting more treats later as a reward tend to perform better academically subsequently. Those who fail to resist temptation and eat the initial treat, demonstrating a lack of self-control, tend to do worse academically subsequently. Farm managers scored 6.18 on Self-Control, higher than the 5.5 of the norm population but high scorers were also less profitable.

This indicates it is, in fact, detrimental financially. A potential mechanism for the effect is that Self-Control low scorers find problems and crisis extremely difficult to deal with. They may thus be more likely to proactively work to prevent them, a likely financially prudent approach. This hypothesis is supported by the very strong correlation to the Relaxed (cor = 0.73) for which high scorers may be expected to be less pre-emptive and more reactionary. The proprietary nature of the OPQ means it is unclear how close their operationalisation of Self-Control measure matches other Self-Control researchers' operationalisation of the construct. Further research is thus required to clarify these findings.

In summary, these findings relating to Relaxed and Self Control are contrary to expectation and difficult to interpret. It appears, that a relatively anxious farmer will perform better than a relaxed or average scoring farmer. How these findings might be used to help *in situ* farmers improve performance is unclear along with potential implications for the mental health of farmers. Though the OPQ report can produce measures of emotional stability (neuroticism), this was not available for analysis in this study. Further research is thus required to tease apart the importance of different aspects of the Emotional Stability personality trait.

4.4.5 Limitations of the present study

As in Chapter 3, the sample was small and not especially representative. From the point of view of getting a complete view of what predicts farm manager performance, GCA was also a major omission. Confound variables such as region, tenure and soil type might be included in future studies. However, as a study of how personality associates with performance, this study contributes significant and unique insights to the literature.

4.4.6 Data quality and future research

Future research should address the above weaknesses with the use of OPQ or alternative psychological inventory, a reputable GCA measure and quality financial data with a larger fully representative sample and with different populations of farmers. The OPQr instrument has proven effective for use with farm managers. However, non-proprietary alternatives should be considered. The OPQ's opaqueness is a significant impediment from a research perspective and it would be relatively expensive for farm managers who may wish to use the tool themselves.

This sample contained data from farm managers who calculated their profit per cow and per litre as well as those whose profit was calculated independently. Clear trends did not emerge using the full dataset, but did when the farm manager calculated data was discarded from the analysis. A comparison of the two sources indicated lower profitability among the farmers who calculated their own profit and higher standard deviation in figures provided. It is likely that farm managers do not consistently provide accurate financial measures in a research context. They may vary in how they calculate financial performance, may be prone to guessing or approximating figures, and/or are adjusting them consciously or unconsciously. The quality of such data is therefore suspect and needs to be treated as such.

When farm managers are required to provide complicated data, it would be prudent to actively check the quality of a subset of the data or require larger samples, which might ameliorate some of the data quality issues. Other researchers have successfully done so with samples of several hundred farm managers and have reported statistically significant results (Nuthall 2010c).

However, using existing quality financial data should be the first preference for future research. Despite raising some additional data protection issues, it is much more accurate and less demanding on participants but may limit sample size significantly depending on the source or data. Ensuring a larger, more diverse and fully representative sample would increase statistical power and confirm the findings relevance to farmers across sectors and regions. The greater statistical power may also result in finding more variables predictive of performance.

4.4.7 Emotional Social Competence

Of the three variables in the regression model, only Leadership was from the ESC report. Other measures of ESC were not included though one variable, self-control, if it had been included, would have indicated that parts of ESC are in fact negatively associated with profit.

This supports the conclusions of the literature review (Section 2.3.3) that Emotional Intelligence is, as an overly broad construct, relatively ineffective in predicting farm performance. Certain aspects of it such as Leadership and Self-Control are relevant but these should be discussed and studied as discrete measures. Most of the concepts within ESC did not correlate to farm profitability. Further study of broad ESC measures as predictors of farm profitability is thus unlikely to be fruitful.

4.5 Conclusions

Three personality measures predicted ~40% of the variation in farm financial performance in a sample of dairy farmers in England and Wales. 'Detail Conscious' and 'Leadership' measures positively and 'Relaxed' negatively predicted profitability. A wide range of scores on these variables existed among farm managers and the mean scores of some key attributes are distinct from the norm population used in this study. Selection and training of managers is likely to be improved by increased assessment of such personality measures. Training providers and consultants to farm managers should consider how to achieve this.

The apparent need to increase Detail Conscious behaviour among dairy farmers is the most pressing issue arising as there appears to be a systemic bias against this apparently beneficial trait among dairy farmers in England and Wales. Large improvements in profitability may be attainable by measuring and managing the three identified measures of dairy farm managers' personality.

Coaching could be used to target specific attributes. The case for using the five-factor model as a framework to guide coaching has also been made (Mccormick & Burch 2008) by some authors using case studies. However, coaching is relatively expensive given its one to one nature (De Meuse *et al.* 2009). As has been highlighted in this Chapter, many farmers score low on detail consciousness and this is the factor most associated with profitability. Materials, seminars and courses could, therefore, be developed to target Detail Consciousness, in particular, reaching many farmers efficiently.

However, the effectiveness of any intervention such as training targeting Detail Conscious behaviour and Leadership requires investigation. As an observational cross-sectional study, endogeneity, in particular from potential unmeasured (latent) variables, mean that concrete causal conclusions cannot be made based on these results. Further research with larger, more representative and diverse samples of managers with interventions would be required to make firm assertions regarding causality.

5. SUMMARY FINDINGS, DISCUSSION, IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The central question this thesis set out to answer was:

'What are the farmer attributes most associated with profitability?'

This broad question has been addressed comprehensively in this thesis. A list of the key farmer attributes found to be associated with farm profitability is summarised in Section 5.1 below in the same order the topics were assessed in the Literature Review. Discussion of the most important findings can be found in Section 5.1.4 Psychology and Section 5.1.5 Attitudes and objectives. Section 5.2 contains a critique of past research identifying two common pitfalls and what characteristics productive studies tended to have. Potential applications of the thesis's findings are outlined in Section 5.3. Section 5.4 outlines a rationale for pursuing the potential outlined in 5.3 along with arguments for further related research. Priorities for such research are then proposed in Section 5.5 followed by some concluding remarks in Section 5.6.

5.1 Attributes associated with farm performance

5.1.1 Age and experience

A manager's age and experience are often considered when studying performance in occupational contexts. However, these have in fact have consistently been found not be associated with farm profitability (see Section 2.2.2). Chapter 3 reaffirms this conclusion with no link to profitability being found among 80 dairy farmers in GB. There is a clear consensus in the literature, supported by Chapter 3's findings, that farmer age and years of experience are not are not discernibly associated with profitability. There is currently no evidence strongly linking an explicit measure of experience *per se* to farm profitability. However, the reviewed research only measured years of experience. Future studies could develop novel assessments of quality and diversity of farmer experience as potential predictors of farm profitability.

Of note from Chapter 3, were responses regarding insight into farm management gained during the participants' teenage years. Those who reported learning a 'great deal' between the ages of 11 and 15 were less profitable. Attitudes towards learning and experience are therefore important and this is supported by associations with

education discussed in the next Section. These findings align closely with the growth versus fixed mindset concept (Heslin & Vandewalle 2008). Farmers in the study sample in Chapter 3 who believed they and others can develop and improve with conscious effort, were more profitable than fixed mindset participant farmers who believed characteristics are set and innate.

5.1.2 Education

Education has consistently been found to be associated with financial performance in the literature, as well as in study reported in Chapter 3. However, approaches to quantifying educational attainment have varied. The simplest approach that has resulted in the strongest statistical relationships is to assess if the manager received an agricultural education or not (Hansson & Öhlmér 2008; Läpple & Hennessy 2015). The effect of education observed in the literature ranged from 0-15% of variation explained.

Chapter 3 reported that having an agricultural education or not (t-test, $p<0.001$) or level of educational attainment can predict about 7% of the variation in profitability (Spearman's rho = 0.27). The age a farmer leaves full-time education and other approaches are less effective in predicting profitability, producing smaller, often-non significant, effects. Specific personal competencies such as IT knowledge and skills have so far not been found to be associated with performance (Section 2.2.4). In conclusion, educational attainment and having agricultural education, in particular, is a moderately associated with farm management performance.

5.1.3 Extension and advisory services

The implicit purpose of advisory and extension services is to help their clients become more profitable. However, the evidence base to support their effectiveness in improving profitability is surprisingly thin. The strongest effect observed was from an Irish study of discussion group participation that found a 12% greater gross margin associated with participation as opposed to non-participation (Läpple *et al.* 2013). In a follow-up study, however, participation was incentivised by a €1,000 annual payment to farmers. No significant benefit to participation was observed for these late joiners (Läpple and Hennessy, 2015). However, managing and improving the farmer attributes identified in this thesis as important for profitability is likely to increase extension and advisory service effectiveness.

In summary, extension and advisory services are likely to be beneficial to farm businesses but more research is required to discern if it is clearly associated with farm profitability and if extension effectiveness can be improved.

5.1.4 Psychology

Psychometric traits of farmers are the most closely associated variables with farm profitability of the farmer attributes assessed in this thesis. A key finding. Of these, GCA is likely to be the most important of these. 30-40% of performance variation can be predicted by GCA alone in non-farming contexts (O'Boyle *et al.* 2010) but there is only one published study linking GCA and farm profitability. Verbal and non-verbal assessments were performed and it was found that low IQ farmers on average achieved 25% lower gross margin than other farmers. The topic was not explored in detail by the authors and was presented as an ancillary finding (McGregor *et al.* 1996). Ascertaining how closely associated GCA is to farm profitability thus requires further research. To assess the relative importance of GCA, the other variables identified as important in this thesis such as personality should be assessed concurrently.

Like IQ, personality has only been superficially explored as a predictor of farm profitability prior to this thesis (Nuthall 2009). Chapter 4 reported that Detail Conscious behaviour - a sub-component of Conscientiousness, a Leadership behaviour measure, and a Relaxed measure cumulatively predicted 40% of farm profitability variation. This is comparable to what GCA has predicated in other contexts (O'Boyle *et al.* 2010). Correlation analysis indicated that 22-24% of profit variation could be explained by either Detail Consciousness or Leadership alone.

Detail Conscious behaviour's strong association with profitability is consistent with the importance of Conscientiousness (a much broader measure) found in other sectors (O'Boyle *et al.* 2010). Within farming, one study reports variables labelled 'concern for correctness' and 'conscientious planner' were associated with performance (Nuthall 2010c). Both these findings were of a much smaller effect size than that found in Chapter 4 indicating the specific measure Detail Conscious is likely a particularly important aspect of profitable farming.

In summary, the largest relationships to farm profitability reported in this thesis and manager performance in general in the literature review were psychological measures (Table 5-1). GCA and personality assessments are relatively demanding of

participants. For that reason, the results presented in the next Section that are generally based on responses to just two or three questions, may from an applied perspective, be of equal or greater importance. These are attitudes and objectives.

Table 5-1 β values from the models presented in Chapter 3 and 4

Variable	β	Source
Detail Conscious	0.40	Chapter 4
Leadership	0.34	Chapter 4
Relaxed	-0.31	Chapter 4
My farm is completely orientated towards maximising profit	0.31	Chapter 3
When things go wrong I sometimes lose my cool and don't salvage the situation as well as possible	-0.26	Chapter 3
How much insight into farm management did you gain between the ages of 11 & 15	-0.26	Chapter 3
Staff entering the industry lack important skills and knowledge	0.25	Chapter 3
I buy in bulk when possible to get the best prices	0.18	Chapter 3

5.1.5 Attitudes and objectives

Attitudes and objectives were identified in the literature review as being relatively strongly associated with profitability, in particular, entrepreneurial and strategic attitudes. The research detailed in Chapter 3 affirmed these findings. 'My farm is completely orientated towards profit' and buying inputs in bulk which is indicative of a strategic mindset were strongly associated with profitability (rho = 0.30 & 0.29).

Managers' assessments of how much they learned in their teenage years were negatively associated with profitability (Chapter 3). Farmers believing novice staff lack important knowledge and skills was also positively associated with profitability. Having a Growth Mindset, as opposed to a Fixed Mindset, view of ability thus appears to be an important predictor of farm profitability (Mischel 2014; Heslin & Vandewalle 2008). The literature review also found that Growth Mindset is generally beneficial but Chapter 3 is one of the first times Growth Mindset like variables have been directly linked to business profitability.

The associations for individual attitudes and beliefs discussed above are weaker individually than for GCA or personality measures. However, these attitudes and beliefs are likely more malleable than GCA and personality. As such, changing these attitudes and beliefs may improve performance more in the short to medium-term than managing GCA and personality. Cumulatively, the six questions presented in the model in Chapter 3 predicted a comparable proportion of profitability variation as the three personality measure model in Chapter 4. There is thus likely to be similar scope for improvement by managing and changing attitudes and objectives as there is for personality.

In conclusion, farmer attitudes and beliefs individually tend to be moderately associated with profitability but, cumulatively, have the potential to be a major predictor of farm profitability. Assessing attitudes and beliefs may also be easier than assessing psychological measures. They might thus represent the greatest ROI in attempts to improve the performance of *in situ* farm managers given they are relatively malleable compared to relatively fixed attributes like GCA and personality.

5.1.6 Management practices

The use of specific management practices, such as benchmarking, has generally been found to be only partially or not all discernibly associated with profitability. One exception would be buying products in bulk and shopping around. This was discussed in previous Sections in the context of it being indicative of a strategic and profit-oriented mindset. However, the following management practices may be beneficial to some extent, though the relationship and supporting evidence is weak:

- being proactive and innovative;
- actively managing risk;
- setting challenging but attainable targets and goals for the short and medium-term;
- engaging an experienced expert to perform a training needs assessment and provide training to staff;
- monitoring the outcomes of decisions;
- when making investments, calculate payback, NPV and cash flow; and,
- paying more attention to information sources.

The effect size for these are small and these findings have either not been replicated in agriculture or, if they have, have only been done so once. Based on the available evidence these are, therefore, relatively unimportant predictors of farm profitability but are likely to be relatively easy to address on farm. As such, interventions may have comparable ROI.

5.1.7 Thesis findings summary

The extensive literature review (Chapter 2) and the two novel empirical studies presented in Chapter 3 and 4 provide a new and comprehensive understanding of what is known about how farmer attributes associated with farm performance. The factors that have been found to associate with farm profitability strongest are now summarised in this Section. Based on the effect sizes, the quality, and agricultural relevance of the reviewed literature, careful consideration has been given as to whether to include a variable in this summary or not. Omitted measures have been found either not to be relevant or have been insufficiently tested. Based on this assessment, it is concluded that the key farm management attributes found to predict profitability are as follows:

- GCA;
- Detail Conscious behaviour, strategic planning and purchasing behaviour;
- Leadership behaviour;
- attitudes beliefs about themselves and their business. In particular how entrepreneurial / profit orientated they view themselves;
- agricultural education and having a Growth Mindset; and,
- prevention of / reaction to difficult situations, Relaxed and Self Control measures.

For those who aim to improve the productivity, competitiveness and profitability of agriculture, these are significant findings. For the first time, a strong evidence base exists to begin managing farmer attributes as a way to improve farm performance.

The effect sizes observed in the literature review and the two models' R^2 values of 0.40 and 0.48 in Chapters 3 and 4 indicate large improvements in the economic sustainability of dairy production are possible. These findings and their scale may be surprising. However, such effect sizes have been reported in other sectors and there is no obvious reason that farm businesses should be less influenced by the vagaries of their managers.

In fact, one might expect a larger effect with farmers. As family farm managers attain their role without an open hiring process, more variation in manager capacity, and thus farm performance, is likely. The central role of the farmer on most farms may compound this, as they are often the only full-time employee. The findings presented in this thesis are not guaranteed to identify the best manager in every context or example. However, the likelihood of selecting and training better farm managers can be increased. The findings of this thesis could thus enable improvements in farm management and farm business profitability.

5.2 Critique of past research

This thesis was designed to create a strong basis for realising gains in farm business performance by systematically identifying the farmer characteristics most associated with farm performance. Chapter 2 reviewed a large body of research and identified what farm manager attributes are likely to be most associated with farm profitability. However, most of the agriculture-based research to date has explained manager performance variation to a much smaller extent than in other sectors, and, indeed this thesis. A critical assessment of this agriculture-based research that has preceded this thesis is presented in this Section. Research on what farm managers' attributes predicts success has generally fallen into one of two pitfalls. These pitfalls may, partially at least, explain the disparity in results observed the literature. This first of these is hereby dubbed the 'Opportunist pitfall'.

5.2.1 Opportunist pitfall

Opportunist studies generally can be defined by the use of inappropriate secondary data to answer the stated question of interest rather than collecting appropriate data. This may be motivated by convenience or with the intention of justifying the continued existence of the secondary data source. This has led to some researchers to use wildly inappropriate proxies for the purported variables of interest.

For example, Vanhuyse (2016) used the age of a farmer and if the spouse worked on the farm as a proxy of experience. She then went on to conclude that 'experience' was not predictive of farm performance, a tenuous assertion given the proxies used. As illustrated in Chapter 2, age and experience have repeatedly failed to predict outcomes. Age was again confirmed not to be associated performance by Vanhuyse (2016). Studies often also focus on farmer practices which have consistently failed to

predict performance to a relevant extent (Vanhuyse 2016; Gloy & LaDue 2003; Langton 2013).

Avoiding expending resources to collect appropriate data may appear efficient but with regards to improving our understanding of the drivers of successful farm management, that approach has so far been mostly fruitless. These studies dominate the limited agriculture literature relating to the importance of the farm manager. Readers of the resulting publications may surmise that there is almost no effect due to managers (Barnes 2006; Gloy & LaDue 2003; Vanhuyse 2016; Wilson *et al.* 2001). This thesis has shown this is clearly not the case. The negative findings, however, have likely discouraged research that might have collected appropriate data. It is hoped that this critique will help break this cycle and encourage appropriately resourced research that have a greater prospect of resulting in tangible improvements for farm businesses.

5.2.2 Everything but the kitchen sink

The 'everything but the kitchen sink approach' pitfall is much rarer than the opportunist studies. Aware of the lack of quality research on the topic in agriculture, two studies have attempted, apparently indiscriminately, to quantify many variables that might be relevant in one study rather than selecting and testing high prospect variables comprehensively. This has led for example to the use of poor proxies of GCA (Nuthall 2009) when it is likely the single most important variable. As a result, and despite the significant effort both these studies have employed, they produced few actionable findings for farm management. This again discourages further research.

In such one study, a complex Structural Equation Model of farm MA was created which was difficult to understand (Nuthall 2009). Nuthall's (2009) main finding that experience is the most important aspect of MA appears to be incorrect and based on an erroneous factor label (see literature review Section 2.2.2). In the other study, no substantive findings were reported relevant to improving farm performance (Solano *et al.* 2006).

5.2.3 Concise studies

Papers that have avoided the 'opportunist' or the 'everything but the kitchen sink approach' are hereby dubbed 'concise papers'. To date, these few studies have focused on areas that had a strong prospect of predicting farm performance. Two

noteworthy papers qualify - Mäkinen (2013) and Hansson (2008) as well as a recently completed doctoral thesis (Herrmann 2016).

Chapter 4 of this thesis could be described as a concise study as it focuses only on personality. Chapter 3 began as an 'everything but the kitchen sink' approach to begin with (see questionnaire in Appendix A) but the analysis, and resulting findings and interpretation, provide clear outputs akin to the concise studies. Emulating and developing the concise studies may help researchers avoid the two outlined pitfalls.

5.3 Implications of this research

This thesis set out to deliver actionable and practical findings to guide and positively influence farmers and management within agriculture. Having summarised the findings of both empirical Chapters (3 & 4) in Section 5.1, and appraising research approaches in 5.2, this Section, 5.3, discusses the potential applications of this thesis's findings in detail. Evidence and needs-based interventions targeting psychological and attitudinal attributes are the focus. Beginning with GCA, followed by personality, attitudes and beliefs, specific potential applications of specific findings are discussed.

Biographical and specific management practices such as age and benchmarking were assessed in the literature review but were generally not, or only weakly, associated with profitability (Section 2.5). Neither Chapter 3 nor 4 contradicted these findings. For this reason, biographical variables, with the exception of education which was associated with profitability, are not discussed further in this thesis.

As personality and intelligence cannot easily be changed, the general recommendation is to manage attributes in a manner that is most likely to improve outcomes. How this might be done with specific measures is discussed (5.3.1 – 5.3.3). The end users or who should apply these findings is discussed in Section 5.3.4. Finally, a discussion of policy implications of the findings is presented in Section 5.3.5.

5.3.1 General Cognitive Ability

GCA is not readily improvable for *in situ* managers. This may partly explain why no study of farmers to date has focused on GCA of managers as a predictor of farm performance as potential applications may not be immediately clear. However, it is clear that GCA is an important variable in predicting farm performance. This

assertion is based on the substantial evidence base in other contexts (O'Boyle *et al.* 2010), and one study of farmers which partially assessed the topic (McGregor *et al.* 1996).

Providing tailored support to low GCA farmers could be an effective way of improving farm performance. The most direct approach would be for low or average GCA farmers to hire or collaborate with appropriately skilled people. What constitutes appropriately skilled in this case, is an open question. More drastically, low GCA farmers may be encouraged to lease their farm to others. It is likely that a low GCA manager would be financially better off in such arrangements and the farm performance and productivity would be increased.

Other approaches could include support in the form of discussion groups or advisers. GCA is correlated with academic performance (Schmidt & Hunter 2004) and low GCA farmers are likely to have lower levels of education. Läpple *et al.* (2013) illustrated that discussion groups are particularly beneficial for those with no agricultural education. Discussion groups may, therefore, be an appropriate support for low GCA farmers given the link between GCA and education (Nuthall 2009). However, significantly mitigating the effects with *in situ* low GCA farmers is unlikely to be practical. Developing prospective farmers GCA throughout childhood and adult education is thus important. An agricultural qualification, in particular, appears beneficial. There is also evidence to indicate that those with lower GCA can and do compensate by being more conscientious (Rammstedt *et al.* 2016). Conscientiousness has a small negative correlation to GCA (Rammstedt *et al.* 2016). This may indicate that more intelligent people find work easier, perhaps becoming bored to an extent and so resulting in less detail conscious behaviour. Conversely, lower GCA people might compensate by being more detail conscious. Encouraging increased Detail Conscious behaviour may thus be particularly beneficial among low GCA farmers.

5.3.2 Personality

Farmers scored much lower on the Detail Conscious measure than the reference norm population used to generate participant scores in Chapter 4. Detail Conscious behaviour had the strongest association with performance found in the two studies presented in this thesis with a Spearman's rho correlation of 0.48. This is the most

actionable finding in this thesis. It is a simple, intuitive finding and may be possible to manage Detail Conscious behaviour to effect improvements in farm performance. Unlike GCA, it is likely to be amenable to change.

The model presented in Chapter 4 indicates a large potential for improved farm management, and so profitability, if the reported associations are causal in nature. Consider the median farm manager from the sample in Chapter 4 whom is a standard deviation less Detail Conscious than the reference population. The model predicts that increasing the median farmers' Detail Conscious competency to that of the reference population mean would increase profitability by more than 20%.

How difficult it would be to achieve this increase in Detail Consciousness is unclear. Further to this, if the model predictions derived from an observational cross-sectional study would translate into profitability as predicted is unclear. Accounting for all other important factors that affect profitability, a longitudinal or experimental design would be required to clarify this.

Only 16% of participants in the Chapter 4 study scored above the 5.5 population norm mean indicating a bias against this competency in farm management. The cause of this is unknown and, until clarified, it will be difficult to address. However, if just a fraction of the predicted benefit is realised, interventions targeting Detail Conscious behaviour are likely to be very worthwhile investments.

Participant farmers' Leadership competency score was associated with profitability to a similar extent. However, the scope for increasing performance is less than the Detail Conscious competency. The effect size was smaller, and participant farmers were starting from a relatively higher base on this measure scoring close to the reference population norm. This indicates there is less room for farm managers to improve their Leadership competency.

If farmers lose their 'cool' when things go wrong was an important variable in Chapter 3. In the sample studied, 28% of farmers agreed strongly, or agreed moderately, with the statement. This indicates that a significant proportion of farmers may have self-control/anger issues. Addressing these will also likely prove worthwhile.

5.3.3 Attitudes and beliefs

Attitudes and beliefs associated with profitability should be promoted. Profit focus, a Growth Mindset, strategic planning and purchasing behaviour have all been found to be strongly associated with profitability. There are established methods available to

promote desirable attitudes and practices among farmers as it has been a recurring research focus (Sutherland 2010; Garforth *et al.* 2006; Beedell & Rehman 1999; Jones *et al.* 2016). For example, methods based on the Theory of Planned Behaviour could be used (Ajzen 1991).

5.3.4 End users

The focus in this Section is highlighting the areas, which based on our current understanding, are likely to be fertile areas to assess, benchmark, manage and select for in farm management. The findings of this thesis should be of significant value to four stakeholder groups in particular:

- future and current farmers;
- farm advisors and educators;
- recruiters of farm managers; and,
- third-party investors in farm businesses (e.g. banks).

The research presented here can, perhaps, have the most immediate impact in educational contexts. Agricultural courses can include a focus on the topics identified as associated with profitable farming for example. Students could complete assessments that could estimate how they might perform as managers. This would allow tailoring of development and learning strategies to individual students' needs.

Simply informing farmers of the identified relations and/or benchmarking farmers on important traits would be a beneficial first step. Coaching could be used to target specific attributes (De Meuse *et al.* 2009). The case for the use of the five-factor model as a framework to guide coaching has also been made (Mccormick & Burch 2008). However, this would be a relatively expensive approach given the one to one nature of coaching. Many farmers score low on detail consciousness and this is the factor most associated with profitability. Seminars and courses could thus be developed to help many farmers efficiently.

The largest and most quickly realisable benefits from the application of these findings are likely to be when hiring managers or staff. How personality assessments compare with the best practice hiring methods such as competency assessment and situational judgment tests is unclear for predicting performance. However, personality assessments could serve the dual purpose of helping select the candidate with the

best prospect of performing well and guiding the selected candidate's development and training.

Recruiters of farm staff and farm managers could assess candidates' Leadership and Detail Conscious competencies. With large applicant pools, an algorithm could help filter applicants and guide close final decisions. Potential farm investors or creditors can also gain insight into the prospects of farmers with a similar approach. Talented younger farmers with less experience may well benefit for example. Similarly, farm advisors and farmers could identify where improvements are possible within in situ farmers.

5.3.5 Policy implications

In the preceding discussions, the implications for individuals, businesses and educators were discussed. The implications of broader, more strategic importance for governments, farmer organisations, research authorities and boards are outlined here. First and foremost, those who fund and carry out research in agriculture should prioritise more research in this extremely promising area. The research in this thesis has shown that a large proportion of the variation in farm performance is associated with, and likely mostly attributed/caused by, variation in farm manager attributes. Section 5.1.7 concluded that more than half the variation in farm performance may be predictable by assessing farmer attributes alone. Farmer attributes should thus become a high priority area of research. Its current status as a novelty or sporadically investigated niche topic is no longer tenable.

Section 2.6.6 outlined the considerations future research should take account of when validating, expanding and deepening our understanding of how farmer attributes are associated with farm performance. Research investigating if, and how, interventions might be made to improve farm performance should follow to provide evidence-based tools and approaches to farmers, advisors and policymakers.

The implications for policymakers are also important. In addition to supporting and funding the above research, the existing evidence base is sufficient to begin considering potential applications through policy. Agricultural programs should begin to include supports for farm advisors to consider assessing and benchmarking the attributes of farmers. Extension efforts such as discussion groups may be ideally suited for this but training and development of advisors will be required. The input of consultants and advisors from outside of agriculture with experience of leadership

training, executive coaching and occupational development service would be beneficial.

As introduced in the previous Sections, personality and attitudes are amenable to change and positive changes can be facilitated by policy. These considerations will be of interest to all agricultural governmental departments. The prospect of Brexit has large implications for the funding of the Common Agriculture Policy within the EU and a novel and bespoke agricultural policy is likely to be developed in the UK.

The EU, and the UK to an even greater extent, are expected to reduce subsidies and move towards a more market-oriented system. Interventions and supports which will build the capacity of farmers and allow them to become more efficient will, therefore, be of interest. The return on investment from investing the human capital of farmers using an evidence-based approach building on this thesis' findings are in the author's estimation likely to greatly exceed that of current supports.

The priorities for research outlined earlier in this Section could substantiate this assertion. The return on investment is likely to be high as assessing and managing farmer attributes is a very novel approach. There is thus likely to be a lot of approaches that offer disproportionately large benefits. Detail conscientiousness and Growth Mindset are both candidate topics that might deliver large benefits. Building the evidence base to support this will be essential to improving the efficacy and benefits derived from this work.

5.4 Rationale for application and future research

Farm managers face less competitive pressure than managers in other sectors. Prevalent family ownership, subsidies and increasing land values (AHDB Dairy 2016b) shield farmers in many respects. The low performance of lower GCA farmers reported by McGregor *et al.* (1996), indicates that a proportion of farmers have an I.Q. level ill-suited for farm management. This has more than just economic implications. The animal welfare, environmental impact and efficiency of the sector are also being affected. The consequences of a disorderly exit when farms do fail are also significant for the farmer and their family.

Unlike in some other sectors, the performance of the farm manager is generally not managed or optimised. The ROI from the application of the findings presented in this thesis to aid management and optimisation of farm management should be assessed. Given the large variation attributable to managers found in this thesis, a

large ROI from such research is likely compared to say research with live animals. It is likely that MC can be significantly improved in agriculture. Farming may offer unique challenges but this should not render efforts to improve management any less beneficial or necessary.

In general, people overwhelmingly report wanting to be more conscientiousness (Hudson & Roberts 2014). Magidson *et al.* (2014) concluded that personality traits, and in particular conscientiousness can be changed referring in particular to literature from medical contexts where interventions have successfully resulted in desired behaviour changes. The ability, desired direction and scale of the likely return all, therefore, align to support development and application of these findings.

The benefits will be broad, and potentially important. Farmers, their families and employees increasingly competitive and sustainable businesses will benefit rural and national economies. More profitable farm businesses tend to have better animal welfare and environmental outcomes as better, more efficient, farmers tend to have more consistent animal care, higher production and less waste (Barnes 2006; Austin *et al.* 2001; Lusk & Norwood 2011; Groot *et al.* 2012). Working to improve MC will thus have benefits beyond the economic. As people in general report wanting to be more conscientious (Hudson and Roberts, 2014), there may be a strong demand for supports and interventions to help farmers align their attributes to those associated with profitable farming.

The biggest beneficiaries are naturally likely to be gained by farm managers themselves. Communicating this effectively this may, however, be challenging. As such, a strong evidence base will likely be essential for widespread adoption. This thesis is a major step towards creating such an evidence base. Performing larger, more comprehensive studies and communicating the findings in an effective manner to farmers will be important next steps before significant benefits can be derived from applying findings of this type of research.

Research designs which can shed light on causality, longitudinal or experimental approaches, for example, would be very informative either underlining the importance of the identified variables or indicating a more complex set of relationships than currently understood.

The models presented in this thesis in Chapter 3 and 4 predict over 40% of the variation in profitability. Assuming causality is as modelled, an improvement in profitability between 5% and 20% is reasonably expected to be feasible for most

farms with sufficient intervention. Improvements in animal welfare and environmental management are also likely. This should be sufficient reason to prioritise the study of farmer attributes as predictors of farm outcomes in the future.

5.5 Future research priorities

In this Section, recommendations and priorities for future research are presented. Careful design of studies is essential from the outset so that the data most likely to be useful is collected. For example, should narrow personality measures such as Detail Conscious behaviour or broader variables such as Conscientiousness from the Five Factor model be used? In this thesis, it was found that narrow variables predicted more variation but some argue that narrow traits have lower 'criterion-related validity' and reliability (Rauch & Frese 2007).

Future researchers may also consider the following:

- farmer GCA is probably the biggest predictor of farm performance but has not been studied in agriculture;
- the relative importance of major variables is unclear and assessing these in one model would help address this;
- financial data sourced directly from farmers can be of low quality (as illustrated in Chapter 4);
- quality data should be sourced from independent farm management accounts or the Farm Accountancy Data Network;
- Farm Accountancy Data Network data is, however, currently insufficient on its own. Collection of supplementary data directly from farmers in the form of questionnaires, interviews or supplementary modules is essential if using this source;
- a representative sample will improve the validity of research findings - both studies presented in this thesis were not especially representative;
- many variables have repeatedly been found not be associated with profitability, so researchers are advised to avoid further duplication; and finally,
- methods of predicting performance not assessed in this thesis should be explored - e.g. work samples, integrity tests, job knowledge tests, situational judgement tests and structured interviews (Ryan & Tippins 2004)
- Farmer attributes associated with levels of non-financial public goods such as employment, social and environmental sustainability.

Disseminating these findings will be essential to realising farm management improvements. The studies reported in Chapter 3 and 4 have been accepted for presentation at conferences and will be submitted for publication in relevant journals. As a review paper has not been published since 2001 (Nuthall 2001), a review paper may also be created and similarly disseminated. If and how the findings should be communicated to the broader agricultural sector will then need to be assessed.

5.6 Concluding remarks

Farmer attributes can predict more than 40% of farm profitability variation. This was independently demonstrated in both a study of just attitudes and a study of just personality. This is more impressive given that the likely biggest single predictor as outlined in the literature review, GCA, was omitted from both the novel studies presented in this thesis. It is thus likely that the variation in farmer attributes is a major and perhaps most important predictor of farm performance. A comprehensive study of farmer attributes will likely explain an even greater proportion of farm profitability variation. The author would expect this to be at least greater than 50% and perhaps as high as 65%. Considering farmers' role in food security, environmental management and the economy, it is no longer tenable that research into farm profitability generally treats farmers as a 'black box' to be worked around.

Avenues to improve farm performance should be pursued. Developing and managing farm managers with insights, such as those outlined in this thesis, could be an effective way to increase agricultural sustainability. Given the large effects observed, it might, in fact, prove to be crucial. The feasibility of achieving large improvements on real farms remains untested but a 5% – 20% increase in farm profitability is likely to be attainable with sufficient intervention.

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APPENDICES

A. EXPLORATORY QUESTIONNAIRE

Farm Success and Management Study

Promar International Ltd,
Alpha Building,
London Road, Nantwich,
CHESHIRE, CW5 7JW

15/03/2012

Dear

Some time ago, I wrote to you inviting you to take part in the above survey. You will remember that it is part of a study examining farm management practices in the dairy industry. However, if our records are correct, you have not yet had time to fill in and return the questionnaire in the pre-paid envelope provided.

The response to our survey, so far, has been most encouraging. However, we would not like to leave out those who have been too busy to take part as we would like to include as many people as possible from all parts of the country. We would, therefore, still be very grateful if you could help us by completing the questionnaire.

In case the original questionnaire has been mislaid, a further copy is enclosed in this document together with a pre-paid envelope for its return. We are aware privacy concerns are paramount and your responses will be treated in the strictest confidence, used only for the purposes of this study and will not be passed on to third parties. The results of the survey will be published using data for groups only. Individuals' data will not be revealed.

By completing the survey you are agreeing to take part. If, however, you wish to withdraw at any stage, please contact me and I will withdraw your responses from the analysis. If you have any questions regarding this survey please email XXXXXXXXX. Alternatively call XXXXXXX and ask for Niall O'Leary.

Kind regards,

Niall O'Leary

Niall O'Leary
*(*Project leader*)*

Guidelines

1. This should <u>only</u> be completed by the person with the primary responsibility for day to day decision-making on your farm.
2. Please answer all questions to reflect <u>your</u> farm situation as accurately as possible. While some questions may appear irrelevant in isolation, they remain important parts of the survey.
3. Please turn over the page to begin the survey.

A. Management style ***FBA account code: XXXX***

1	With TEN being the best, FIVE being average and ONE being the worst,how would you rate your management skills?	/10
2	On average, how many hours do you work a week?	hours
3	How many hours a week are spent doing managerial work? (E.g. planning, instructing, ordering, selling.)	hours
4	On average, how many days holiday do you take a year?	days
5	Including yourself, how many layers of management exist on your farm?	

Please tick ONE box that indicates your level of agreement with the following statements on a scale of 1 - 5.		Agree strongly 1	2	3	4	Disagree strongly 5
6	I write down options and calculate financial consequences before making big decisions	❑	❑	❑	❑	❑
7	I worry about milk price a lot	❑	❑	❑	❑	❑
8	I worry what others think of my farm	❑	❑	❑	❑	❑
9	Talking to others about farming ideas stimulates and increases my enthusiasm for farming	❑	❑	❑	❑	❑
10	It is difficult adapting to new policies and rules	❑	❑	❑	❑	❑
11	I tend to mull over big decisions a lot before acting	❑	❑	❑	❑	❑
12	I normally don't rest until the job is completed	❑	❑	❑	❑	❑
13	I find farm walks and discussion groups essential	❑	❑	❑	❑	❑
14	I rarely critically assess my own performance	❑	❑	❑	❑	❑
15	I often seek the advice of third parties (E.g. accountant / vet / consultant)	❑	❑	❑	❑	❑
16	I often sell animals and assets when cash flow is tight and so don't always get the best price possible	❑	❑	❑	❑	❑
17	I buy most of my inputs from 1 or 2 local suppliers	❑	❑	❑	❑	❑
18	I prefer to rely on memory as opposed to making records whenever possible	❑	❑	❑	❑	❑
19	I spend a lot of my time fixing problems rather than actually managing the farm	❑	❑	❑	❑	❑
20	I consult my family and staff about issues and changes	❑	❑	❑	❑	❑
21	My family and / or staff often influence big decisions	❑	❑	❑	❑	❑
22	People think I work too hard	❑	❑	❑	❑	❑
23	I have studied or seen firsthand agricultural systems in other countries different to my own.	❑	❑	❑	❑	❑
24	I keep many written / electronic records to inform future decision-making	❑	❑	❑	❑	❑
25	I buy in bulk when possible to get the best prices	❑	❑	❑	❑	❑

26. Are you an active member of a buying group? Yes ❑ / No❑

27. How often do you compare farm spending and income to pre prepared budgets?***(Please tick one)***

at least once a month ❑ / at least once a year ❑ / less than once a year ❑ / never ❑.

28. How often do you compare farm spending and income to industry benchmarks?
(Please tick one)

at least once a month ❑ / at least once a year ❑ / less than once a year ❑ / never ❑.

29. When selecting replacement genetics, which traits are most important to your farm? *Please rank in order of importance. (1 most important, 6 least important)*

Trait	**Rank**	**Trait**	**Rank**
Milk yield		Conformation Traits	
Fat and protein content		Profit Lifetime Index (PLI)	
Fertility		Lifespan	

B. Staff on your farm

1. Including yourself, paid staff and unpaid family labour, how many staff work on your farm?

Full time ☐ Part time ☐ Seasonal ☐

2. How many of these staff are family members? ☐

Please tick ONE box that indicates how much you agree with the following statements on a scale of 1- 5.		Agree strongly 1	2	3	4	Disagree strongly 5
3	Staff entering the industry lack important skills and knowledge	❑	❑	❑	❑	❑
4	Staff understand the long term objectives of the farm business	❑	❑	❑	❑	❑
5	Paying for staff training is a worthwhile investment	❑	❑	❑	❑	❑
6	I don't usually pay for staff training as they may leave after and / or I would rather do it myself	❑	❑	❑	❑	❑
7	I hire staff with skills I lack	❑	❑	❑	❑	❑

8. What training do you and your staff do at least once a year? (Please tick all appropriate)

- ☐ Organised training, by you or an employee, for other staff on farm
- ☐ Formal training, off farm
- ☐ Formal training, by a 3rd party, on farm
- ☐ No formal training

Other training (Please explain) _____

_____

C. Goals and objectives

1. Do you have clearly defined goals and objectives for your business? Yes ❑ No ❑

1.b If yes, are they written down?Yes ❑ No ❑

2. In 10 years time, your business is likely to be; (Please tick one)
the same size ❑ / smaller ❑ / larger ❑/ sold ❑.

3. Is there an identified successor for the farm?Yes ❑ / No ❑

4. During particularly profitable years how have you mostly used the surplus? (Please tick one)
Reinvestment on farm to minimise tax ❑ / capital investment on farm ❑ / personal drawings ❑ / early repayment of loans❑ / invested off farm ❑.

Please tick ONE box that indicates your level of agreement with the following statements on a scale of 1 - 5.		Agree strongly 1	2	3	4	Do not agree 5
5	I plan for plenty of leisure time and holidays	❑	❑	❑	❑	❑
6	Environmental compliance is a significant burden	❑	❑	❑	❑	❑
7	I reduce financial risk by diversifying my income	❑	❑	❑	❑	❑
8	I reduce financial risk by keeping cash reserves and minimising debt	❑	❑	❑	❑	❑
9	I get the most output from cows and land possible	❑	❑	❑	❑	❑
10	I strive to create a pleasant and enjoyable working environment for both myself and my staff	❑	❑	❑	❑	❑
11	I actively try to reduce pollution	❑	❑	❑	❑	❑
12	I enjoy testing new production systems and products	❑	❑	❑	❑	❑
13	I am actively planning for retirement	❑	❑	❑	❑	❑
14	Increasing net worth is essential to long term success	❑	❑	❑	❑	❑
15	Increasing turnover is essential for long term success	❑	❑	❑	❑	❑
16	I don't borrow unless it is absolutely necessary, so non-critical investment is limited to cash surpluses	❑	❑	❑	❑	❑
17	Loans are essential for success	❑	❑	❑	❑	❑
18	I take part in community activities and / or socialise regularly	❑	❑	❑	❑	❑
19	Having the best infrastructure, machinery and equipment is essential for long term success	❑	❑	❑	❑	❑
20	Happy well fed cows always repay the investment	❑	❑	❑	❑	❑
21	I am a farmer by circumstance rather than choice	❑	❑	❑	❑	❑
22	My living standard is my main priority when farming	❑	❑	❑	❑	❑
23	Appearing to be successful is very important	❑	❑	❑	❑	❑
24	Content cows are a major source of pride	❑	❑	❑	❑	❑

Please tick ONE box that indicates your level of agreement with the following statements on a scale of 1 - 5.		Agree strongly 1	2	3	4	Don't agree 5
25	Increasing yields is the most efficient way to increase profit	❑	❑	❑	❑	❑
26	I review my cash flow at least once a month	❑	❑	❑	❑	❑
27	Cutting costs is the most efficient way to increase profit	❑	❑	❑	❑	❑
28	My farm is completely orientated towards maximising profit	❑	❑	❑	❑	❑
29	My farm is a family heirloom to be passed on	❑	❑	❑	❑	❑
30	Most jobs on the farm bore me	❑	❑	❑	❑	❑
31	I enjoy farming and the lifestyle it affords me	❑	❑	❑	❑	❑

D. Personal views on management

Please tick ONE box that indicates your level of agreement with the following statements on a scale of 1 - 5.		Agree strongly 1	2	3	4	Don't agree 5
1	It is safer not to rely on others to get important jobs done well and on time.	❑	❑	❑	❑	❑
2	I never try anything that might not work	❑	❑	❑	❑	❑
3	New methods and technologies that are not fully proven are not worth the risk	❑	❑	❑	❑	❑
4	When I know I'm right I can be very determined and can make things happen	❑	❑	❑	❑	❑
5	Some people are just lucky and everything works out for them easily	❑	❑	❑	❑	❑
6	I can rely on staff to get jobs done well and on time	❑	❑	❑	❑	❑
7	Staff sometimes struggle to do even simple tasks properly	❑	❑	❑	❑	❑
8	Poor results are usually due to things completely out of my control	❑	❑	❑	❑	❑
9	Good managers are born, not trained	❑	❑	❑	❑	❑
10	When things go wrong I sometimes lose my cool and don't salvage the situation as well as possible	❑	❑	❑	❑	❑
11	I reckon 'good luck' doesn't exist - 'luck' is really good management, and 'bad luck' poor management	❑	❑	❑	❑	❑
12	I plan ahead to ensure my goals are achieved, and often do budgets and commit my ideas to paper	❑	❑	❑	❑	❑
13	It is within in my control whether or not my farm will be successful in the long term	❑	❑	❑	❑	❑
14	Management is a skill that can be honed and improved	❑	❑	❑	❑	❑
15	I have managed to largely achieve my goals to date	❑	❑	❑	❑	❑

E. Your details

Age: ____ Gender M ❑ / F ❑ Name: _____

Contact email address: _____

1. How many years have you lived on your current farm? Year ☐

2. How many years have you managed your current farm? Year ☐

3. How many years did you manage any previous farms(s)? Year ☐

4. Including yourself, how many generations of your family have been farmers? ☐

Up to 20 years of age, how much insight into farm management did you gain:(Tick one of the five boxes)

5. 11 to 15 years of age?A GREAT DEAL ❑ ❑ ❑ ❑ ❑ NOT MUCH

6. 16 to 20 years of age? A GREAT DEAL ❑ ❑ ❑ ❑ ❑ NOT MUCH

7. What age did you leave full time education? ☐

8. Please state any post secondary qualifications (beyond GSCE / O level) and area of study.

_____

9. The farm provides: less than 60% ❑/ 60 to 90% ❑ / 91 to 100% ❑ of your personal drawings. (Please tick one)

10. Please list other sources of drawings / business interests (e.g. dividends, house rental or private businesses) _____

If you have any comments please write them here.

_____

_____

_____

_____

_____

Promar International would like to thank you for your cooperation in completing this survey. Please return this survey in the enclosed, addressed and postage paid envelope.

B. PERSONALITY STUDY QUESTIONNAIRE

Personality Questionnaire (paper version)

You recently agreed to participate in some research with Promar International funded by Dairy Co. Thank you very much for taking part. In a nutshell we are asking you to complete the questionnaire as soon as you can. The confidential results produced from your answers to the questionnaire will be used as part of the research and you may also have agreed or be invited to participate in a short discussion together with feedback on the results from your questionnaire. Please follow the instructions on how to complete the questionnaire below.

We are working on a very tight timescale to complete this research by mid June. Therefore we really appreciate it if you would complete the questionnaire as soon as possible in order for us to deliver the project on time

Instructions

You will be presented with a block of three statements. Your task is to choose which statement is **most** true or typical of you and which is **least** like you **in each block.**

Simply select the relevant option to choose which statement is most and which is least like you.

EXAMPLE

Your task is to choose which statement is **most** true or typical of you and which is **least** like you **in each block.**

	Most like me	Least like me
I like helping people	X	
I enjoy competitive activities		
I view things positively		X

In the above example 'I like helping people' is chosen as most typical or most like me. 'I view things positively' is chosen as least typical or least like me.

Please remember:

- Be as discerning and honest as you can
- There are no right or wrong answers
- Do not give an answer because you think it is the right thing to say or it is how you might like to be

Please be honest in the responses you provide as this information will be used to support the dairy industry.

You may find some of the choices difficult but please try your best.

Although there is no time limit, you should work as quickly as you can and do not ponder at length over any one set of statements.

It should take you between 25-35 minutes to complete the questionnaire

(104 question blocks removed due to proprietary nature of the instrument.)

Please Enter Your Name here

Name: _____

Farm Name: _____

Please return the completed questionnaire in the freepost envelope provided.