Entrepreneurial development pathways for smallholder irrigation farming in KwaZulu-Natal: typologies, aspirations and preferences

by

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ABSTRACT

Smallholder irrigation in South Africa is strategically recognized as an important sector in addressing rural poverty, food insecurity and rising youth unemployment. However, despite the government's efforts and huge investment, the sector has failed to make a meaningful contribution to overcoming these challenges. The poor performance has been attributed to the failure of the existing programmes to develop the human and social capital to manage the schemes and effectively engage in market-oriented agricultural production. This has resulted in the inability of smallholders to utilize the opportunities availed through irrigation farming.

South Africa's national policies identify entrepreneurship as an appropriate intervention strategy for improving the performance of smallholder irrigation. However, to unlock entrepreneurship, a better understanding is required regarding smallholder farmer behaviour *vis a vis* the relevance/application of the concept to smallholders, and their aspirations, heterogeneity and preferences for irrigation water management. Thus, the objectives of the study were: to assess the validity and applicability of the mainstream concept of entrepreneurship to smallholder irrigation farming in South Africa and identify avenues of adaptation to make it relevant; to identify sources of smallholder heterogeneity and determine the farmer typologies in smallholder irrigation, accounting for psychological capital; to examine aspirations of smallholder farmers to expand irrigation crop production; and assess farmer preferences for managing irrigation water resources and their willingness to pay for irrigation water.

The data for the study came from a stratified random sample of 328 smallholders in and around Makhathini and Ndumo-B irrigation schemes in Jozini, KwaZulu-Natal, South Africa. The data were collected through a household questionnaire survey and focus group discussions. The study employed literature review, descriptive analysis and several empirical approaches (Principal Component Analysis, Cluster Analysis, Heckman two-step selection model and choice experiment modelling). The research uniquely introduced and integrated the concept of psychological capital to the

Sustainable Livelihoods Framework literature to enhance understanding of entrepreneurship among smallholder farmers.

The findings showed that smallholders do not conform to the mainstream definition of entrepreneurship which is mainly the result of the neoclassical economics paradigm. This does not, however, mean that such farmers cannot be entrepreneurial, but it highlights the need for redefining the concept to suit their context. A paradigm shift is required to improve the performance of smallholder irrigation and unlock entrepreneurial spirit, putting smallholder behaviour at the centre for which the concepts of psychological capital and behavioural economics are expected to play a bigger part. There is also a need to embrace indigenous knowledge, the multipurpose nature of smallholder farming, heterogeneity and creating an enabling environment. In the end, the study proposed a contextualized definition of entrepreneurship for smallholders which places more significance on the willingness and ability of entrepreneurial smallholders, through their own initiatives, to address their challenges, even in the midst of constraints.

The study revealed five farmer typologies in smallholder irrigation in South Africa: elderly and uneducated, cautious and short-sighted, financial capital and psychological capital endowed, social grant reliant, and land endowed rainfed farmers. Heterogeneity in these typologies is observed regarding psychological capital endowment, market access, collective action and access to credit. The results affirm the fact that the 'one size fits all' approach to agricultural policy and support is not appropriate. Heterogeneity among smallholders should be accounted for in future agricultural and rural development programmes. However, accounting for this heterogeneity is a double-edged sword. On one side it complicates tailor-made policy formulation and on the other side, if there is capacity, it makes the portfolio of policies and strategies impactful and relevant. Th study identifies psychological capital as important and recommends its recognition and nurturing as a key livelihood asset.

The findings suggest that farmers' willingness to expand irrigation farming activities is affected by positive psychological capital, access to markets, access to credit, land tenure security and membership to social groups. Their ability to achieve their

aspirations is determined by asset ownership, access to markets and local resource use conflicts. This evidence further demonstrates the importance of developing positive psychological capital among smallholders. The priority areas for improving access to agricultural credit and markets include, among others, value chain financing, reforming the existing agricultural credit schemes and investment in road and transport infrastructure. Smallholders' ability to achieve their aspirations and make better use of irrigation schemes should be enabled through improving access to physical capital assets, addressing land security concerns, and supporting institutions that promote social interaction and learning.

The findings from the choice experiment demonstrate that valuing and recognizing the scarcity of irrigation water is essential for its sustainable use. The results suggest the need for irrigation water pricing to reflect irrigation intensity. They also show that improving agricultural production and productivity, with market access can enhance farmers' willingness and ability to pay for irrigation water. The study reveals the need to consider multiple uses of irrigation water, while a focus on women smallholders has positive implications for sustainable management and use of irrigation water. It also recommends a shift towards volumetric water pricing at the farm or plot level in the irrigation schemes.

In sum, the study has shown why it is of critical importance to take the mindset and human behaviour as the locus of interventions to improve the performance of smallholder irrigation schemes. It recommends a psychological and behavioural economics approach to understanding farmers' decisions and behaviour and to provide the road map to realize the returns on investment in the smallholder irrigation sector. Agricultural extension approaches need to target for developing the psychological capital and entrepreneurial spirit of smallholders and supporting cooperatives deliver their mandate effectively. Furthermore, policies should assist in creating an environment that nurtures farmer entrepreneurial spirit, and that is supportive of smallholder entrepreneurs. This includes, but not limited to, encouraging and incentivizing own effort rather than embracing a culture of dependency.

PREFACE

The research contained in this thesis was completed by the candidate while based in the Discipline of Agricultural Economics, School of Agricultural, Earth and Environmental Sciences, College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg Campus, South Africa. The research was financially supported by the Water Research Commission under the Grant Number K5/2278/4.

The contents of this work have not been submitted in any form to another university and, except where the work of others is acknowledged in the text, the results reported are due to investigations by the candidate.

Signed: Professor E.W. Zegeye

Date: 19-03-2018

DECLARATION 1: PLAGIARISM

I, *Unity Chipfupa*, declare that:

i. The research reported in this thesis, except where otherwise indicated or acknowledged, is my original research.

ii. This thesis has not been submitted in full or in part for any degree or examination to any other university.

iii. This thesis does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

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I hereby agree to the submission of this thesis for examination:

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Professor E.W. Zegeye (Supervisor)

DECLARATION 2: PUBLICATIONS

The following publications (submitted and under review) form part of the research presented in this thesis.

Manuscript 1 - Chapter 3
Chipfupa U and E. Wale. Farmer typology formulation accounting for psychological capital: implications for on-farm entrepreneurial development. (Accepted: *Development in Practice*)

Manuscript 2 - Chapter 4
Chipfupa U and E. Wale. Explaining smallholders' aspirations to expand irrigation crop production in Makhathini and Ndumo-B, KwaZulu-Natal, South Africa. (Under review: *Agrekon*)

Manuscript 3 - Chapter 5
Chipfupa U and E. Wale. Smallholder willingness to pay and preferences in managing irrigation water in KwaZulu-Natal, South Africa: a choice experiment approach. (Under review: *Water SA*)

Conference contributions:
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Chipfupa U and E. Wale. 2017. Explaining smallholders' aspirations to expand irrigation crop production in Makhathini and Ndumo-B, KwaZulu-Natal, South Africa. Paper presented at the 55th Annual Conference of the Agricultural Economics Association of South Africa (AEASA), 19th-21st September 2017, Durban, South Africa

DEDICATION

This thesis is dedicated to my family and in loving memory of my father.

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TABLE OF CONTENTS

Page

ABSTRACT ii
PREFACE v
DECLARATION 1: PLAGIARISM vi
DECLARATION 2: PUBLICATIONS vii
DEDICATION viii
ACKNOWLEDGEMENTS ix
TABLE OF CONTENTS x
LIST OF TABLES xiv
LIST OF FIGURES xvi
LIST OF ABBREVIATIONS xvii
CHAPTER 1. INTRODUCTION 1
1.1 Background 1
1.2 Research problem and justification 7
1.2.1 Questioning the relevance of the mainstream entrepreneurship thinking to smallholders 8
1.2.2 The heterogeneity among smallholders and its implications 10
1.2.3 Aspirations for expanding land under irrigated crop production 11
1.2.4 Irrigation water management and willingness to pay for irrigation water 13
1.3 Objectives of the study 16
1.4 The data: cross cutting processes for the empirical chapters 17
1.4.1 Description of the study area 17
1.4.2 Types of smallholder irrigators in the study community 20
1.4.3 Sampling and data collection 21
1.5 Outline of the thesis structure 22
CHAPTER 2. TOWARDS REDEFINING AND MAKING RELEVANT ENTREPRENEURSHIP TO SMALLHOLDERS 24
2.1 Introduction 24
2.2 Entrepreneurship definitions 24

2.3 Applying the entrepreneurship concept: does it speak to smallholders? ...26
2.3.1 Entrepreneurial traits and values ...26
2.3.2 Indigenous knowledge, not mainstream innovation theory ...32
2.3.3 Endowment with the business mindset ...33
2.3.4 The entrepreneurial environment ...35
2.4 Redefining entrepreneurship for smallholders: a behavioural approach ...36
2.4.1 Integration of psychological capital ...37
2.4.2 Fostering an environment that cultivates positive PsyCap and entrepreneurial spirit ...38
2.4.3 Integration of behavioural economic principles ...39
2.4.4 Nurturing and integrating local/indigenous knowledge ...42
2.4.5 Embracing heterogeneity and the multi-purpose nature of smallholder farming ...43
2.4.6 Redefining the entrepreneurial smallholder ...43
2.5 Summary ...44
CHAPTER 3. FARMER TYPOLOGY FORMULATION: IMPLICATIONS FOR ON-FARM ENTREPRENEURIAL DEVELOPMENT ...46
3.1 Introduction ...46
3.2 Conceptual framework ...46
3.3 Empirical approach ...48
3.3.1 Principal component analysis ...48
3.3.2 Cluster analysis ...49
3.3.3 Measurement of psychological capital ...49
3.3.4 Other variables used in the farmer typology formulation ...50
3.4 Results and discussion ...51
3.4.1 Socio-demographic characteristics ...51
3.4.2 Psychological capital dimensions ...52
3.4.3 Livelihood asset dimensions ...53
3.4.4 Farmer typology classifications ...54
3.4.5 Characterization of farmer typologies ...58
3.5 Implications for on-farm entrepreneurship development ...61
3.6 Summary ...62
CHAPTER 4. EXPLAINING SMALLHOLDERS' ASPIRATIONS TO EXPAND IRRIGATION CROP PRODUCTION ...64

4.1 Introduction....64
4.2 Conceptual framework....64
4.2.1 Defining farmer aspirations to expand irrigation farming activities....64
4.2.2 Factors influencing farmer aspirations....66
4.3 Research methodology....69
4.3.1 Measurement of farmers' aspirations for irrigation expansion....69
4.3.2 The empirical model to explain farmers' aspirations to expand crop irrigation farming....70
4.3.3 Explanatory variables included in the regression....73
4.4 Heckman two-step selection model results and discussion....76
4.5 Summary....81
CHAPTER 5. SMALLHOLDER WILLINGNESS TO PAY AND PREFERENCES IN MANAGING IRRIGATION WATER: A CHOICE EXPERIMENT APPROACH....83
5.1 Introduction....83
5.2 Research methodology....83
5.2.1 Why the CEM?....83
5.2.2 Theoretical framework of the CEM....84
5.2.3 The design of the choice experiment....86
5.3 Results and discussion....90
5.3.1 The comparative descriptive results....90
5.3.2 The results of the choice experiment....92
5.3.3 Preferences in managing irrigation water across farmer categories....95
5.3.4 Farmers' WTP for different attributes....97
5.4 Summary....98
CHAPTER 6. CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH DIRECTIONS....100
6.1 Recapping the purpose of the research....100
6.2 Conclusions....101
6.2.1 Redefining and making relevant entrepreneurship to smallholders....101
6.2.2 Farmer typologies and implications for entrepreneurial development....102
6.2.3 Explaining smallholders' aspirations to expand irrigation activities....103
6.2.4 Smallholder WTP and preferences in managing irrigation water....104
6.3 Policy and farm management implications....105

6.4 Future research possibilities....108
REFERENCES....111
APPENDIX A: TABLES AND FIGURES....134
APPENDIX B: STUDY QUESTIONNAIRE....139
APPENDIX C: FGD CHECKLIST....159
APPENDIX D: ETHICAL CLEARANCE....161
APPENDIX E: TURNITIN REPORT....162

LIST OF TABLES

Table **Page**

Table 1.1. Study sample distribution by location, gender and farmer category 21

Table 2.1. Entrepreneurship: a sample of mainstream definitions.....25

Table 2.2. Estimated farm and non-farm income sources (N = 328).....31

Table 2.3. Smallholder objectives in farming (N=327).....34

Table 3.1. PsyCap construct measurements.....50

Table 3.2. Variables used in farmer typology determination.....51

Table 3.3. PsyCap dimensions.....52

Table 3.4. Household livelihood asset dimensions.....54

Table 3.5. Distribution of farmer typologies by study area 57

Table 3.6. Distribution of farmer typologies by category of sampled farmers.....57

Table 3.7. Characteristics of farmer typologies based on selected entrepreneurship related indicators.....59

Table 4.1. Description of explanatory variables used in the Heckman two-step selection model.....75

Table 4.2. The Heckman two-step selection model results 77

Table 5.1. Attributes used in the choice experiment.....87

Table 5.2. Example of a choice set employed in the study.....90

Table 5.3. Demographic and other characteristics of the sample farmers.....91

Table 5.4. Test for the IIA assumption 92

Table 5.5. Mixed logit estimation results for all farmers (n=327).....93

Table 5.6. Mixed logit estimation results for different farmer categories and study areas 96

Table 5.7. Mean WTP estimates for irrigation water*.....98

Table A.1. Communalities from PCA on PsyCap measures 134

Table A.2. Communalities from PCA on household livelihoods assets dimensions.134

Table A.3. PsyCap measures inter-item correlation matrix.....135

Table A.4. Livelihood measures inter-item correlation matrix.....136

Table A.5. ANOVA results from CA 138

Table A.6. Conditional logit results.....138

LIST OF FIGURES

Figure **Page**

Figure 1.1. Map of the study area 18

Figure 2.1. Crops grown by the sampled farmers (N=328) 28

Figure 2.2. Reasons for farmers' unwillingness to pay for water (N=106) 30

Figure 3.1. PsyCap in the modified Sustainable Livelihoods Framework 47

Figure 3.2. Final cluster centres from CA 55

Figure 4.1. Factors influencing farmer aspirations 67

Figure A.1 Dendrogram generated through hierarchical clustering 137

LIST OF ABBREVIATIONS

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
CA	Cluster Analysis
CEM	Choice Experiment Method
CVM	Contingent Valuation Method
FAO	Food and Agriculture Organization of the United Nations
IIA	Independence from Irrelevant Alternatives
IMR	Inverse Mills Ratio
KMO	Kaiser-Meyer-Olkin
MIS	Makhathini Irrigation Scheme
NIS	Ndumo-B Irrigation Scheme
OLS	Ordinary Least Squares
PCA	Principal Component Analysis
PCQ	Psychological Capital Questionnaire
PsyCap	Psychological Capital
PTO	Permission to Occupy
SA	South Africa
SLF	Sustainable Livelihoods Framework
VCF	Value Chain Financing
VIF	Variance Inflation Factor
WRC	Water Research Commission, South Africa
WTP	Willingness to Pay
ZAR	South African Rand

CHAPTER 1. INTRODUCTION

1.1 Background

Smallholder agriculture remains an important economic activity in reducing rural poverty through increased food security, nutrition and growth in markets and trading opportunities (Nwanze, 2014; IFPRI, 2016). A focus on smallholder agriculture for sub-Saharan Africa is not a choice but a priority given the millions of the rural poor whose main livelihood is derived from agriculture. 'African nations cannot afford to ignore smallholder agriculture, however difficult its prospects may seem' (Delgado, 1999, p165). Globally, there are approximately 450-500 million smallholder farms (Conway, 2014; IFPRI, 2016) of which an estimated 9% are in sub-Saharan Africa (Lowder *et al.*, 2016). The figures for South Africa (SA) show that there are more than 4 million smallholders in the rural areas (Aliber and Hart, 2009). Using an average household size of 3.3 (Statistics South Africa, 2017), this translates to 13.2 million people. According to the World Development Report 2008, half of the world's population in developing countries and rural areas (1.5 billion people) are in smallholder households (World Bank, 2007). These figures demonstrate that as individuals, smallholders might be vulnerable but in total, they are a fortune (Prahalad, 2005), central to the achievement of the Sustainable Development Goals. Rural development policy in the world and Africa cannot succeed ignoring smallholders.

The World Bank asserts that the expansion of smallholder farming is effective in reducing poverty and the food expenditure bill of the poor (World Bank, 2008). Since 2000, smallholder agriculture has been viewed as the driver of long-term poverty reduction in Africa (Djurfeldt, 2013). This notion is supported by evidence from the green revolution which demonstrates that investment in smallholder agriculture can transform rural economies and greatly reduce the levels of poverty among the rural people (Delgado, 1999; Rosegrant and Hazell, 2000). Statistics confirm that the green revolution in India resulted in the drop in poverty levels from 50% in the 1970s to 35% in the late 1990s (Salami *et al.*, 2010). Ravallion (2001) showed that improving the income of the poor by 1% can reduce poverty by at least twice as much. Thus, growth in smallholder agriculture can lead to an accelerated reduction in poverty and income inequality (Anríquez and Stamoulis, 2007; Salami *et al.*, 2010; Larson *et al.*, 2016).

Notwithstanding its impact on poverty, sustainable smallholder agriculture has an important contribution to food security and employment creation. Approximately 80% of the food in the developing world is produced by smallholders, who also feed an estimated third of the world's population (IFAD, 2012). They also produce over 90% of the agricultural output in sub-Saharan Africa (Torero, 2014). The growth prospects of commodities and markets for small produce, spurned by rising incomes and global aggregate demand for horticultural produce create opportunities for expansion of production and agro-processing industries (Poulton *et al.*, 2010; Salami *et al.*, 2010). This potentially results in the creation of millions of jobs for the rural poor. For SA, primary agriculture is the major employer and significant contributor to rural livelihoods (Rukuni, 2011; DAFF, 2012b).

Despite its importance, the smallholder agricultural sector does not receive the policy and institutional support essential to its growth (IFPRI, 2016). The sector also faces numerous challenges that make it difficult to realize its potential. The challenges include the changing social profile of farming households due to male migration, limited access and inefficient use of resources, and difficulties in operating smallholder farms as businesses (Livingston *et al.*, 2014; Thapa and Gaiha, 2014). Other challenges include the negative impacts of climate change and limited institutional and social capital to influence policy (Mudhara, 2010). They also face high unit transaction cost in accessing information, capital and markets (Poulton *et al.*, 2010; Torero, 2014). Their heterogeneity and complexity further increase the difficulty of transforming the sector in Africa (Torero, 2014). Moreover, this is further exacerbated by low levels of education, poverty, poor physical and information communication systems and subdued economic activity in the rural areas (Poulton *et al.*, 2010). Furthermore, several other entrenched factors such as the mindset of smallholders that is inclined towards subsistence rather than profit orientation and their risk aversion behaviour subdue the economic benefits from the sector. Coupled with poor farm record keeping (Diagne and Zeller, 2001) and lack of distinction between farm and family operations (Alsos *et al.*, 2011a), it further complicates the operation of smallholder farming as a business.

The biggest challenge for sub-Saharan Africa is how to develop a more sustained productivity driven base for competitive commercial agriculture (Livingston *et al.*,

2014). As such one of the means to increase smallholder agricultural productivity is investment in smallholder irrigation. Livingston *et al.* (2014) reiterate the need for improved water management and greater use of irrigation to increase productivity. Irrigation reduces risks that smallholders face particularly related to nature dependence of the sector. It benefits the poor through higher production, higher yields and higher all-round farm and non-farm employment (Hussain and Hanjra, 2004; Smith, 2004; Chazovachii, 2012). Evidence from the green revolution in Asia also showed that when irrigation is combined with availability of inputs and improved crop varieties, it enables all year-round production and increases yields (Burney and Naylor, 2012). The sector is now increasingly recognized as one with notable potential in Africa (Grimm and Richter, 2006). Many studies have demonstrated the role of smallholder irrigation in poverty alleviation and enhancing food and nutrition security in sub-Saharan Africa (Hussain and Hanjra, 2004; Hanjra *et al.*, 2009; Burney and Naylor, 2012; Dube, 2016). Cousins (2013) study of smallholder irrigation in South Africa through cases studies of irrigation schemes in KwaZulu-Natal province showed that where they have access to fertile soils, irrigation water and markets, smallholders can be productive and profitable.

It, therefore, follows that one of the strategies SA is pursuing to address rural poverty and income inequality is the smallholder irrigation revitalization programme (National Planning Commission, 2013). Currently, approximately 1.5 million hectares of land are under irrigation of which 3.3% (50,000 ha) are under smallholder irrigation (DAFF, 2012a). The Irrigation Strategy 2015 indicates a potential for further expansion by 34,863 ha (DAFF, 2015) while the National Planning Commission (2013) puts this figure at 500,000 ha of land. This means according to the government, there is potential for expanding land under smallholder irrigation. The revitalization programme is important given the high levels of poverty and income inequality in the country (Gini coefficient ranging between 0.65-0.7 (Statistics South Africa, 2014a)). An estimated 36.9% of SA's population in 2011 was living below the lower-bound poverty line (ZAR501/month) (World Bank, 2016). Poverty levels are highest in the rural areas (former homelands) where approximately 58.3% of poor people live (Statistics South Africa, 2014a). The increasing income gap in the country, where 10% of the population

earns 55-60% of all income (Orthofer, 2016), is negatively affecting wellbeing, social cohesion and economic growth (OECD, 2014; ILO, 2015).

The smallholder irrigation sector is regarded as a solution to addressing the above challenges and achieving sustainable rural development (increasing food security, incomes and employment) (The Presidency, 2009; Economic Development Department, 2011; DAFF, 2012a; National Planning Commission, 2013). Denison and Manona (2007a) state that the revitalization of smallholder irrigation in SA provides an opportunity to increase agricultural productivity and incomes for smallholder farmers. In addition to increasing yields and promoting year-round farming, smallholder irrigation will eventually lead to greater commercialization in the sector (Hussain and Hanjra, 2004) and rural economic growth. However, as will be discussed in Section 1.2, the investment made in smallholder irrigation thus far, has realized very little benefits/ returns (Inocencio *et al.*, 2007).

The South African government is currently promoting entrepreneurship in the smallholder agricultural sector as a strategy for developing rural economies and enhancing rural livelihoods. Among other strategies, there is a consensus that unlocking entrepreneurship provides the right pathway for improving the performance of the sector and reducing poverty (Rukuni, 2011; Juma and Spielman, 2014). Tollens (2002) posits that, for small farmers, entrepreneurial development has a positive relationship with agricultural growth at all levels of the economy. Poor people in developing countries can be entrepreneurs (Frederick and Kuratko, 2010). However, the culture of entrepreneurship in SA and specifically the agricultural sector is low. The latest Global Entrepreneurship Monitor report (2016/2017) shows that only 10.1% of South Africans have entrepreneurial intentions while the proportion of the population in total early-stage entrepreneurial activity is 6.9% (Herrington and Kew, 2017). Only 2.9% of those starting businesses are in the agricultural sector which warrants more attention on entrepreneurial development among smallholders. But the promotion of on-farm entrepreneurship alone will not achieve much if limited attention is given to first understanding or characterising the smallholders in relation to entrepreneurship.

‘Entrepreneurship is a very slippery concept in society today’ (Maluleke, 2016, p1). The concept is broad and multifaceted with no single definition applicable across the board (Rosa, 2013). The Oxford English Dictionary defines entrepreneurship as ‘the activity of making money by starting or running business, especially when this involves taking financial risk’ (Oxford English Dictionary, 1989). This definition represents the core of the mainstream neoclassical economics ideology which is currently applied to many sectors, including smallholder agriculture, irrespective of their contextual differences. In agriculture, entrepreneurship is considered as ‘agripreneurship’, which is simply defined as the application of the mainstream entrepreneurship principles to agriculture or agriculture related businesses (Mukembo and Edwards, 2016). This definition is not context specific and does not differentiate between different types of farmers, a critical aspect considering the heterogeneity in smallholder farming. Djurfeldt (2013) posits that the African smallholder does not conform to the mainstream entrepreneurship view of an entrepreneur.

Working with smallholders is complicated by their heterogeneity (Mudhara, 2010). At the policy level, it makes policy recommendations and implementation challenging because it calls for heterogenous strategies, not ‘one size fits all’. Failure to account for this heterogeneity and limited understanding of its implications could be another reason why the investment in smallholder irrigation has brought so little in return. The literature on smallholder typology suggests that different types of farmers pursue different livelihood strategies (Chapoto *et al.*, 2013; Torero, 2014; Pienaar and Traub, 2015). However, public-sector institutions responsible for agricultural development fail to recognize this heterogeneity because differentiated and context-specific strategies and policies are far more challenging to design, implement and manage (Berdegué and Fuentealba, 2014). Smallholders are not a homogenous group but have diverse features, respond to incentives differently, operate in different farming systems and local conditions, have unique opportunities and face different farming constraints (Chancellor, 1999; Chapoto *et al.*, 2013; Goswami *et al.*, 2014; Torero, 2014). Their farming decisions are predictable only if we understand the heterogeneous and complex context effects. These decisions may appear “irrational” for mainstream economists (Ariely, 2008), however, they are rational to the smallholders themselves.

The successful transformation of smallholder agriculture to viable farm businesses is dependent on understanding the aspirations of smallholders. This is critical in the design of agricultural policy strategies and also in targeting interventions to the right set of people (Kosec *et al.*, 2012). As shown earlier, such a focus is important, at a time when SA is emphasizing the expansion of smallholder irrigation farming as a key driver towards inclusive rural transformation (National Planning Commission, 2013; DAFF, 2015). The past, present and future investments in the sector by the government offer a unique opportunity to take smallholders to the next level. However, there is a need for in-depth understanding of their aspirations and hence their behaviour to enhance the effectiveness of such rural transformation strategies (Prendergrast *et al.*, 2008).

Efficient utilization of water should also underpin smallholder irrigation transformation. Globally, irrigated agriculture uses nearly 70% of freshwater withdrawn from the rivers and aquifers, and the figure is even higher for sub-Saharan Africa (87%) (FAO, 2011). The improved performance of irrigation systems compared to rainfed agriculture has triggered the expansion of irrigation farming. Consequently, this has increased the demand for water, adding to the growing concerns of water scarcity, amid other competing water uses. Like many other sub-Saharan countries, SA also faces the water scarcity problem. The average annual rainfall in the country is very low, approximately 500mm (Speelman *et al.*, 2011; Schreiner, 2015). Climate change has resulted in unpredictable and inconsistent rainfall patterns, and drought. There are concerns that by 2030, available water in the country's catchments will not be enough to meet the national water requirements (Schur, 2000). Recent reports show a water crisis in some provinces such as Western Cape (Department of Water and Sanitation, 2017). In light of this situation, research has been focusing on finding ways and means of improving efficiency in irrigation to increase water available for other uses (Reinders *et al.*, 2013). Without sustainable and efficient utilization of the available water resources, there could be dire implications for global food security, rural employment and existence of other industries directly or indirectly linked to agriculture.

This study aims to contribute towards appropriate entrepreneurial pathways in smallholder irrigation and improving the performance of smallholders in and around irrigation schemes in SA. It reveals and initiates a debate on critical aspects important

for the rural development agenda. The following section (Section 1.2) elaborates in detail the research problem and justification of the study. Section 1.3 gives the specific objectives while the data collection process is described in Section 1.4. Finally, the outline of the rest of the thesis is provided in Section 1.5.

1.2 Research problem and justification

The South African government has made considerable efforts to revitalize smallholder irrigation, stimulate productivity, increase food security and household incomes. However, the return on the amount invested in irrigation infrastructure is rather poor (Legoupil, 1985; Van Averbeke *et al.*, 1998; Fanadzo *et al.*, 2010; Mbusi, 2013). The irrigation sector continues to depend on government for maintenance and operational costs through an annual subsidy of approximately USD30 million per annum (Schreiner, 2015). These include costs for refurbishing the irrigation infrastructure (canals, pipes, water pumps) and other agricultural equipment and machinery. The government is still supporting some irrigation schemes such as Makhathini with operational costs for water use charges (water and electricity fees) and scheme management/administration. This is due to limited implementation of cost recovery and maintenance plans and a lack of transfer of ownership and management of the scheme to the smallholders by government. Thus, there are largely no incentives for smallholders in irrigation in SA and they have remained mostly inefficient, with low productivity and poor participation in markets. The irrigation schemes have not made any meaningful contribution to food security and employment creation (Vink and Van Rooyen, 2009; Van Averbeke *et al.*, 2011).

The poor performance of smallholder irrigation schemes is attributed to several factors including limited investment in the human capital, weak institutional arrangements and lack of technical skills of smallholders (Van Averbeke *et al.*, 2011). Other reasons include poor collective governance of schemes, limited entrepreneurship spirit and skills to operate farms as businesses, unsecure land tenure systems and poorly defined water use and management systems (Fanadzo, 2012; Juma and Spielman, 2014; Muchara *et al.*, 2014b). Addressing these issues will provide incentives that enhance smallholder ownership and participation in the management of irrigation schemes.

However, it seems the revitalization programme was not fully implemented according to its design as outlined by DAFF (2012a). The primary focus has been on the rehabilitation of irrigation infrastructure with little effort in developing the human and social capital needed to manage the schemes sustainably, engage in productive agriculture and participate effectively in the existing value chains (Bembridge, 2000; Fanadzo *et al.*, 2010; DAFF, 2012a). The programme has failed to identify, encourage and unlock farmers' entrepreneurial spirit as the necessary driver to achieve more in farming. There is limited understanding of how entrepreneurial development and ultimately improved performance of smallholder irrigation can be achieved. Thus, more empirical knowledge is needed regarding the application of the concept of entrepreneurship to smallholders, and the implications of farmer heterogeneity, aspirations, and their preferences in irrigation water management on entrepreneurial development.

1.2.1 Questioning the relevance of the mainstream entrepreneurship thinking to smallholders

Entrepreneurship in smallholder agriculture in Africa has received limited attention in both research and development (Juma and Spielman, 2014). Alsos *et al.* (2011b) state that the agricultural sector, especially smallholder agriculture, is traditionally not associated with high levels of entrepreneurship and hence has largely been excluded from entrepreneurship research. Moreover, among the studies on agricultural entrepreneurship, most are from the western countries (e.g. McElwee, 2008; McElwee and Bosworth, 2010; Díaz-Pichardo *et al.*, 2012; Phelan and Sharpley, 2012) and few from India (e.g. Bhardwaj and Singh, 2015; Narayanan *et al.*, 2016). The few existing studies on the application of the concept in the context of sub-Saharan Africa (e.g. Becx *et al.*, 2011; FAO, 2014; Juma and Spielman, 2014) identify the importance of entrepreneurship in smallholder agriculture, especially linking farmers to markets and financial institutions. However, they fall short of examining the extent to which the mainstream entrepreneurship concept can be translated and applied to the smallholder in Africa. The focus of most of the literature is on the traditional entrepreneurship principles applicable to the large corporate sector, namely, innovation, risk taking, skills development, profits, business development, and capitalization. Seldom have attempts

been made to question the relevance of the mainstream thinking and adapt and redefine entrepreneurship for smallholders in Africa.

The mainstream definition of entrepreneurship as currently applied to smallholder agriculture is, therefore, detached from and is not contextually relevant to smallholder realities in SA. It makes no provision for essential elements of smallholder farming such as heterogeneity, risk aversion, satisficing behaviour, the importance of family labour, and indigenous knowledge, among others. There are bound to be differences in how entrepreneurship is conceived between industrial or corporate sectors and the smallholder agriculture sector (Alsos *et al.*, 2011b). Within agriculture, differences also exist across sectors (smallholder versus commercial), regions and between different farmers. This means that no single definition of the concept will be relevant in all situations. The literature on smallholders' entrepreneurial spirit is also thin, providing limited insights on entry points to transform the sector. Lessons from studies in western countries (e.g., Alsos *et al.* (2011a); Ismail *et al.* (2012); Krige and Silber (2016)) are also not completely applicable to the African context. Thus, before the applicability of the mainstream concept of entrepreneurship to smallholders is interrogated, carefully examined and a contextualized definition is arrived at, research is unable to make appropriate recommendations needed to enhance their entrepreneurial spirit.

A plausible approach, aligned to this study, is to characterize the entrepreneurial spirit of different farmers, the first thing that drives entrepreneurship. An agripreneur has to be proactive, curious, determined, persistent, hard-working and organized (Singh, 2013). One must be at odds with the *status quo* to be an entrepreneur, i.e., if one is satisfied with the *status quo*, he/she is inclined to maintain it which ruins entrepreneurship. Unfortunately, not every farmer possesses such attributes, and indeed on-farm entrepreneurship is not about making every farmer an entrepreneur as not all farmers have the willingness and more importantly the endowment. Etzioni (2011) writes that individuals have a strong tendency to remain at the *status quo*, fearing that the costs are more than the benefits, what in behavioural economics is also known as *status quo* bias. Thus, the objective of behaviourally characterizing farmers' entrepreneurial spirit and hence defining entrepreneurship for smallholders, is to identify farmers with a higher propensity for on-farm entrepreneurship. Targeting these

farmers will have spillover demonstration effects for others to follow. Characterizing the farmers makes it possible to support and use agricultural extension strategies to encourage the other farmers to follow a similar entrepreneurial development pathway.

1.2.2 The heterogeneity among smallholders and its implications

The difficulty of developing and delivering technologies that fit the needs of smallholders is enormous, and it is influenced by multiple factors. These include farm-level heterogeneity (farm size, soil quality, slope, irrigation, and rainfall), heterogeneity among farmers (gender, age, education, risk preferences, psychological capital endowment), and social dynamics such as access to extension, learning from others, and related network learning effects (Juma and Spielman, 2014; Torero, 2014). There is a tendency to ignore this diversity although studies on farm typology (e.g. Chapoto *et al.*, 2013; Goswami *et al.*, 2014; Torero, 2014; Pienaar and Traub, 2015) have repeatedly demonstrated its prevalence and policy implications. Evidence from SA has also shown the existence of different farm types in smallholder irrigation (Denison and Manona, 2007a; Denison *et al.*, 2015). This confirms the huge diversity in smallholders and their farms which has major implications on entrepreneurship development in smallholder irrigation.

Understanding farmer heterogeneity and its implications on entrepreneuriship is thus important for the success of the revitalization of smallholder irrigation in SA. Heterogeneity (in attitudes, objectives, decision-making or resources) affects a smallholder's entrepreneurial development process or their transition towards more commercial agricultural production (FAO, 2014). According to Chapoto *et al.* (2013), unpacking smallholder heterogeneity is critical in transition to commercial farming. Capturing smallholder heterogeneity assists in identifying and prioritizing strategies for improving market access for different types of smallholders (Torero, 2014). Indeed, for sustainable development, policy decisions in agriculture should account for spatial differences (Kruseman *et al.*, 2006; Torero, 2014) and farmer preferences (Wale and Yalew, 2007). Regarding technology development and agricultural extension for profitable farming, accounting for the dynamics of farmers' heterogeneity will address the discrepancy between farmers' needs and the attributes of technologies developed

and extended (Wale and Yalew, 2007). It can also improve the effectiveness of programmes by targeting policy interventions to regions or households with the greatest productive potential (Torero, 2014). To match farmers' needs with available support programmes, there is a need to understand their heterogeneity and the complexity of their farming systems. Ignoring farmer heterogeneity, whatever the source could be, has negative implications for the success of rural development policy and programmes.

The existing extensive literature on smallholder heterogeneity has not given much attention on the implications of farmers' mindsets on farm/farmer typologies. This study contributes to this knowledge gap. The approach to farmer typology formulation in past studies has largely relied on the Sustainable Livelihoods Framework (SLF). The traditional five livelihood assets (human, physical, financial, natural and social capitals) formed the basis for characterizing farming systems in typology studies such as Bigodeza *et al.* (2009), Goswami *et al.* (2014) and Pienaar and Traub (2015). However, although the effects of psychological, social, cognitive and emotional factors on the economic decisions of individuals and institutions, and their consequences on resource allocation are the subjects of behavioural economics (Baddeley, 2017), psychological capital as a livelihood asset has not yet been integrated to the SLF. This means the conventional SLF approach to farmer typology formulation misses heterogeneity in smallholders introduced by differences in positive psychological capital (PsyCap) endowment (Luthans, 2004). Studying on-farm entrepreneurship without accounting for PsyCap is missing the key factor -personal mindset- in the transformation of smallholder agriculture in rural SA, using available resources such as the irrigation schemes. PsyCap as a livelihood asset is explained in detail in Section 2.4.1 and Section 3.2.

1.2.3 Aspirations for expanding land under irrigated crop production

The future of smallholder agriculture in SA is tied to the expansion of smallholder irrigation through the extension of existing schemes or establishment of new ones (DAFF, 2015). The desire to expand land under irrigated crop production also represents aspirations of most smallholders given the frequent droughts and inconsistent and unreliable rainfall. National policies, e.g., the National Development

Plan 2030 and the Irrigation Strategy 2015, place irrigation expansion at the forefront of sustainable smallholder agriculture development in SA (National Planning Commission, 2013; DAFF, 2015). However, the potential for expansion is limited given the country's scarce natural resources (DAFF, 2015). This means, it is critical, using the available resources, for policy to ensure that irrigation expansion achieves the targeted objectives of food security, employment creation and increasing incomes of the rural farmers.

One way of doing this is to focus on the farmer, the beneficiary of the programme. The achievement of the objectives of irrigation expansion will depend greatly on the ability of the smallholder farmer to recognize and utilize the opportunities presented through the expansion programme. This ability is influenced by their aspirations as they relate to irrigation expansion. Although the literature on aspirations in general (from the field of psychology) is extensive (focusing on aspiration formation and life outcomes), the concept is foreign to empirical research in smallholder agriculture. There is limited literature and understanding on what affects smallholder aspirations in farming, in this case their desire to expand their operations. A scan through the literature reveals a few studies on farmer aspirations but none focusing on irrigation expansion (Schwarz *et al.*, 2009; Leavy and Smith, 2010; Kosec *et al.*, 2012; Kibirige, 2013; Bernard and Taffesse, 2014; Mekonnen and Gerber, 2016). Moreover, the existing literature fails to distinguish factors affecting one's willingness/interest and those for capability/ability to achieve one's aspirations, which could be different for irrigation expansion. This gap in knowledge means research is unable to assist policy makers to make appropriate decisions as regards this key policy strategy. Thus, this study addresses this gap by giving special attention to aspirations to expand irrigation activities in and around the irrigations schemes. It also models aspirations as a two-step decision process, involving willingness in the first step and ability in the second step (more details on this are provided in Chapter 4).

Aspirations influence future decisions and behavior of people especially those related to savings, investment and credit-seeking (Bernard *et al.*, 2014; Genicot and Ray, 2014; Mekonnen and Gerber, 2016). Likewise, it is envisaged that farmer aspirations to

expand irrigation activities[1] will influence their decisions regarding agricultural development. Bernard *et al.* (2014) indicate that despite the possibility of higher returns, poor people do not invest due, among others, to low aspirations. In their research, they concluded that changing aspirations affects several future-oriented behaviors of people. Strong and positive aspirations result in a strong vision and commitment to growth while the lack of them leads to being less focused and/or maintaining the *status quo* and losing the incentive to disrupt the system. The other challenge is the poverty of smallholders' capacity to absorb potential risk. Recent research has shown that low aspirations have a negative effect on the willingness to take risks (Dalton *et al.*, 2017; Posel and Rogan, 2017) with negative implication on on-farm entrepreneurship. Thus, understanding what influences farmers' aspirations to expand irrigation farming activities will play a critical role in agricultural and rural development policy. It shows the challenges of conceptualizing and realizing entrepreneurship among smallholders. It also sheds more light on how to unlock on-farm entrepreneurship among smallholders, taking advantage of government investment in irrigation infrastructure and other services.

1.2.4 Irrigation water management and willingness to pay for irrigation water

Water in most smallholder irrigation schemes in SA is provided as a free commodity, subsidized exclusively by the government (Muchara *et al.*, 2014b). The Draft Pricing Strategy for Water Use Charges drawn in terms of the National Water Act of 1998 gives provisions for subsidized water pricing rates, including operations and maintenance charges, for irrigation schemes benefiting resource poor communities (Department of Water and Sanitation, 2015). The policy states that farmers in such communities incur no charge for the initial five years and after that, the water charges are phased in the next five years at a rate of 20% per annum. The pricing strategy attempts to balance economic efficiency and the social equity side of irrigation water provision, especially for previously disadvantaged communities, e.g., black farmers. However, this has created perceptions that water is a free good and situations where smallholder irrigation

[1] Irrigation expansion can either be through intensification of production on the same land or increasing land under production. This study considers only one of these two and discusses expansion of irrigation activities in terms of increasing land under smallholder irrigation production. This is an important objective of South Africa as indicated in the National Development Plan Vision 2030.

schemes are dependent on the government for operation and maintenance costs (Backeberg, 2006). Thus, until the commitments to gradually phase in the full cost of providing irrigation water are met, the current irrigation water charges will have minimum impact on irrigation practices in smallholder farming.

The current water management arrangements in smallholder irrigation schemes in SA provide no incentive for sustainable utilization of water, maintenance of irrigation infrastructure and collective management of the schemes (Muchara *et al.*, 2014b). Though irrigation water supply is controllable, the poverty of irrigation infrastructure and regulations means it is often considered as common pool resource (non-excludable, but rival in consumption) (Barton and Bergland, 2010). This makes it difficult to monitor or even charge for volumetrically.

The problems of managing common pool resources such as water are well documented by Hardin (1968) and Ostrom (1990). Their work shows that there is a tendency by individuals to undervalue common pool resources resulting in their unsustainable extraction. Hardin (1968) calls this the 'tragedy of the commons' and it arises when users realize that they can still benefit or have access to a resource without paying for it or contributing to its maintenance (Ostrom, 1990). This is known as the 'free rider' problem and it reduces the collective benefit of the resource. Noting this challenge, Ostrom proposes an approach that promotes the use of collective action institutions or cooperatives that are organized and managed by the resource users. Game theory models in her book showed that the collective benefit of using a common pool resource are optimized when the users define, enforce and self-monitor compliance to the rules and regulations of managing the resource (Ostrom, 1990). If these conditions are not met, an optimal solution is close to impossible.

The main challenges for smallholder irrigation in SA are scheme level institutional failures affecting access to water, and the non-availability of markets for irrigation water (Muchara *et al.*, 2016). Together with poor record keeping and lack of water measurement devices in most schemes, irrigation water valuation is close to impossible (Lange and Hassan, 2007; Young and Loomis, 2014; Muchara *et al.*, 2016). As a result, in the absence of credible water value estimates, there are little or no incentives for

changing irrigation practices and efficient utilization of water. Ray (2011, p64) states that ‘a farmer who pays next to nothing for water has no incentive to use it efficiently’. This has negative implications on smallholder irrigation transformation.

Thus, to address this challenge, Schur (2000) suggests the use of economic incentives to improve the allocation of water resources. The scarcity of irrigation water must be reflected in the market thereby inducing the incentive to use it more efficiently (Ray, 2011). This will contribute to sustainable use of water resources. Due to the non-availability of water markets in smallholder agriculture, several approaches are used to elicit the economic value of irrigation water. These include direct (stated preference) and indirect (revealed preference) methods (Young and Loomis, 2014). Direct techniques obtain preferences directly through interviewing individuals on their WTP for a good or a service obtained (e.g., contingent valuation method (CVM) and choice experiment method (CEM)). Indirect techniques, on the other hand, depend on observed market behaviour and data (e.g., residual valuation, hedonic pricing, production function, and demand function approach) to infer an economic value of water. Past studies on irrigation water valuation in SA (e.g. Speelman *et al.*, 2011; Muchara *et al.*, 2016) have used mostly the residual valuation approach. However, the use of this or any other revealed preference methods is problematic because markets for some key inputs such as land in smallholder agriculture are non-existent. In such cases, it is recommended to use the stated preference approaches, i.e., the CVM or CEM.

Compared to the CVM, the CEM has several advantages that make it more appropriate for use in the smallholder irrigation sector (see Section 5.2.1 for more details). Most importantly, the approach can model the heterogeneity in smallholder preferences given the nature of irrigation water management and use. Ostrom and Benjamin (1993) outline several key aspects or design principles of farmer-led irrigation schemes which are important in assessing their preferences to manage and WTP for irrigation water. These include collective action arrangements, the proportional equivalence between benefits and costs (one who use more pays more), and defined boundaries for irrigation water use (e.g., how to deal with other uses of irrigation water). Such aspects should be considered when deriving irrigation water values. This information is essential for

policy given the current debates on the revision of the water use pricing strategy in SA, the shift towards the commercialization of smallholder irrigation agriculture, and efficient and sustainable utilization of scarce water resources. Given the increasingly important climate change issues, it will also form part of the climate change policy.

1.3 Objectives of the study

Enhancing the contribution of the smallholder agricultural sector to rural economies and livelihoods requires an in-depth understanding of the smallholder farmer. This understanding entails greater knowledge on smallholder decisions and behaviour which is important for agricultural policy and development. Thus, the research aims to contribute to knowledge on strategies for moving towards appropriate entrepreneurial development pathways in smallholder irrigation. It achieves this by focusing on four critical aspects, i.e., the relevance of the entrepreneurship concept, farmer heterogeneity, aspirations in irrigation and preferences for irrigation water management. The study uses case studies of communities in and around selected irrigation schemes in KwaZulu-Natal to arrive at its conclusions. The specific objectives of the study are to:

a. assess the validity and applicability of the mainstream concept of entrepreneurship in smallholder irrigation farming in SA and identify avenues of adaptation to make it relevant;
b. identify sources of smallholder heterogeneity and farmer typologies in smallholder irrigation, accounting for PsyCap;
c. examine aspirations of smallholder farmers to expand irrigation crop production; and
d. assess farmer preferences for managing irrigation water resources and their WTP for irrigation water.

1.4 The data: cross cutting processes for the empirical chapters

1.4.1 Description of the study area

The study was conducted in two sites with rural farmers in and around two irrigation schemes (Makhathini and Ndumo-B) in Jozini. Jozini is a local municipality in uMkhanyakude district, in the northern part of KwaZulu-Natal Province, SA (Figure 1.1). The study forms part of a Water Research Commission project titled "Water use productivity associated with appropriate entrepreneurial development paths in the transition from homestead food gardening to smallholder irrigation crop farming in KwaZulu-Natal Province (K5/2278/4)". Selection of the study sites followed a three-step process involving first the identification of all smallholder irrigation schemes in the province, the selection of six schemes for further assessment and then ranking of the selected schemes based on some certain pre-specified criteria. The criteria focused on factors such as irrigation area, the number of beneficiaries, the presence of out-of-scheme irrigators, operational status, opportunities for entrepreneurial development, infrastructure and public services and agro-ecological conditions.

Jozini covers 3,057km^2 of land and borders Mozambique to the north, Swaziland to the west and four other local municipalities to the east and south. It is predominately rural but has four semi-formalized towns that act as tertiary centres. The municipality has a population size of 186,502, 72% of which is under the age of 29 years. The gender structure shows more females (54%) than males and the differences are quite apparent in the 20-64 years age range. Education levels are low with 13.5% of the population having no schooling while only 2% have a post-grade 12 qualification. Poverty levels are quite high with 43% households reporting no income in the last census (Jozini Local Municipality, 2015). Both, the education and poverty levels resemble those of the district and the province.

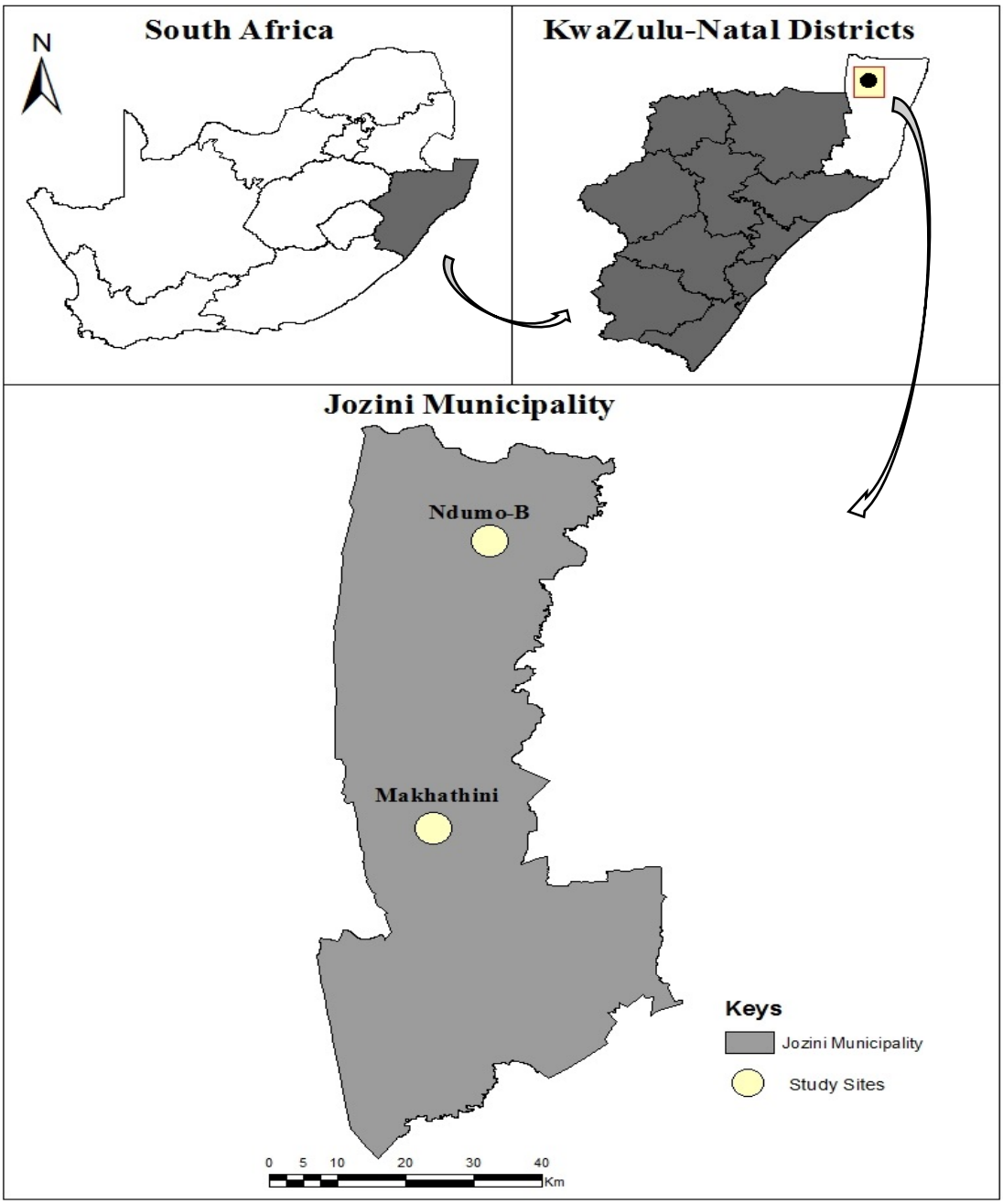


Figure 1.1. Map of the study area

The municipality is predominately rural with agriculture as one of the two dominant economic activities, the other being eco-tourism (Jozini Local Municipality, 2015). The general livelihoods resemble a mixed farming system, i.e., farmers are engaged in either crop farming (rainfed and irrigated) or livestock production or both. The most common livestock is cattle which has significant cultural and economic value to both communities. Land is held on a 'permission to occupy' (PTO) (only use rights) basis

granted by the traditional authorities. This means it cannot be transferred or sold, although, in practice, informal land transactions (leasing and renting) do exist. In both sites, farmers sell most of their produce locally through hawkers at lower prices compared to market rates. Despite being connected to the major input and output markets through a well-developed network of gravel and tarred roads, the transaction cost of accessing high value produce markets is quite high. These markets are in cities at least 300km away.

Irrigation farming is mostly along the Pongola river floodplain which cuts across from the south moving north of the municipality. Smallholders further away from the floodplain practice rainfed agriculture. However, due to drought and inconsistent rainfall, irrigation farming has assumed greater importance in the municipality. Irrigation is conducted both in schemes and outside. Three types of smallholder irrigators engage in irrigation outside of the schemes. These include independent irrigators, homestead gardeners and community gardeners (see Section 1.4.2 for more details). Scheme irrigation is mainly through two major schemes, i.e., Makhathini and Ndumo-B.

Makhathini irrigation scheme (MIS) is in the central part of the municipality, near Jozini town. It covers an estimated 4,500 ha of irrigated land with a potential to expand to 15,000 ha. It has a total of 1,481 smallholders farming as individuals (21%) or part of cooperatives (79%). Management is by Mjindi Farming Private Limited, a state-owned entity, which holds the water permit for the scheme. The scheme is serviced by a 34km canal carrying water from the Jozini dam, drawn by six pump stations. The average land holding per farmer or cooperative is 10ha. Within cooperatives, the average land holding ranges from 0.2 – 1.5 ha per farmer depending on the number of farmers in each cooperative. The major crop in the scheme is sugarcane, followed by maize, cabbages, and beans, respectively. However, none of the farmers operating in cooperatives are growing sugarcane. The scheme also serves the surrounding communities with water for irrigation, domestic use, and livestock. Farmers not in the scheme, through agreements with Mjindi Farming, can extract water from the canal for independent irrigation.

Ndumo-B irrigation scheme (NIS) is approximately 80km from Jozini town, in the northern part of the municipality near the Swaziland border. It is relatively small compared to MIS and covers 500 ha of land. Unlike MIS, it is managed and operated by two cooperatives. At the time of the survey, only a part of the scheme with 21 members was operational (200 ha). The average land holding per farmer is approximately 10 ha. Farmers grow mostly horticultural crops. Water is drawn from the Pongola river using an electric pump and brought to the plots using pipes. Irrigation is by overhead sprinklers and draglines. In both schemes, there is currently no volumetric water charging systems at the farmer level.

1.4.2 Types of smallholder irrigators in the study community

a) Scheme irrigators

These are smallholders engaging in farming activities inside the MIS and NIS. Their main objectives in farming are both income generation and subsistence, although some do farm only for the market.

b) Independent irrigators

Independent irrigators constitute smallholders outside of the irrigation schemes who irrigate as individuals. Their location is usually around an irrigation scheme or near a water source. Two key aspects distinguish independent irrigators from homestead or community gardeners. They are highly mechanized and use pumping systems such as electric or diesel water pumps to extract water from rivers or dams. Their major motivation in irrigation is income generation, and they are more resourced compared to homestead and community gardeners.

c) Home gardeners

These are smallholders who irrigate small homestead gardens. The gardens are located at or near the homestead and vary in size, but most are less than 0.2 ha. Their source of water is usually tap water, and they use the bucket system for irrigation. Activities in home gardens are usually dominated by vegetable crops, mostly for subsistence purposes.

d) Community gardeners

Community gardeners are not significantly different from home gardeners except in terms of their management, location and water source. A community garden is communally owned by a group of individuals who share the same vision and objective. They are located away from the homesteads along a river or near a water source. The plot sizes per farmer are small, less than 0.2 ha to as little as 100 square metres. However, the garden itself could be more than half a hectare. The system of irrigation is the bucket and the main purpose for farming is subsistence although some do sell their produce. Despite group ownership, each farmer is responsible for his/her plot and output.

1.4.3 Sampling and data collection

Data collection was conducted in April 2016 over a two-week period through a semi-structured questionnaire (see Appendix B). Six trained enumerators administered the questionnaire. A total of 328 questionnaires were completed. Three considerations motivated the sampling approach for the study. These are the existence of different types of smallholder irrigators in SA (Van Averbeke, 2008) and the fact that irrigation schemes also benefit other farmers outside the schemes. The other consideration was the need to align the study with the government's objective of expanding the operation of existing schemes and establishing new ones. Thus, the sample was stratified to include scheme irrigators, farmers irrigating out of the schemes (independent irrigators, homestead gardeners, and community gardeners) and rainfed farmers around the two schemes. Table 1.1 shows the distribution of the study sample.

Table 1.1. Study sample distribution by location, gender and farmer category

	Female	**Male**	**Ndumo B**	**Makhathini**	**Total**
Scheme irrigators	68	41	25[2]	84	109
Independent irrigators	33	37	50	20	70
Home gardeners	44	14	10	48	58
Community gardeners	36	10	12	34	46
Rainfed farmers	32	13	15	30	45
Total	**213**	**115**	**112**	**216**	**328**

Source: Survey data, 2016

[2] More farmers were found in the scheme since others were renting part of the land

Another consideration in sample size determination was adequacy of data for the proposed methods of empirical data analysis, i.e., Principal component analysis (PCA), Cluster analysis (CA), Heckman two-step sample selection model and the multinomial and mixed logit models for the CEM. For PCA, the study adhered to the recommended ratio of observations to variables (at least 10:1) (Costello and Osborne, 2005). For CA, the literature shows no rule of thumb in sample size determination but recommends that one has to ensure a balance between the data dimensionality and the number of cases to be grouped (Dolnicar, 2002). The Heckman two-step model uses probit regression in the first step and the Ordinary Least Squares (OLS) regression in the second step. Thus, the study adhered to the ten observations per parameter rule of thumb for maximum likelihood estimators (Long and Freese, 2014) which is also sufficient for an OLS regression. The sample size was not a major issue with the empirical models used in the CEM because the structure of the choice experiment resulted in 6540 observations, a large enough sample for that analysis (refer to Section 5.3.2). Thus, the sample of 328 was sufficient for the proposed empirical methods of data analysis.

To complement the questionnaire survey, a total of four focus group discussions were also held with groups of farmers, i.e., scheme irrigators (2) and independent irrigators and home gardeners. Each discussion comprised of between 12-20 farmers. A set of questions or checklist were used in guiding the discussions (see Appendix C).

1.5 Outline of the thesis structure

The rest of the thesis comprises five chapters, four which are empirical, followed by the closing chapter presenting the conclusions and recommendations of the study. Chapter 2 presents a critical analysis and synthesis of the validity and applicability of the mainstream concept of entrepreneurship to smallholders. It uses insights from the literature and evidence from the study through focus group discussions and descriptive analysis to support its arguments. In the end, the chapter suggests ways of redefining the entrepreneurship concept to account for heterogeneity and complexity of smallholder farming. Considering the heterogeneity in smallholders, Chapter 3 focuses on farmer typology formulation, accounting for psychological capital and discusses the implications of these typologies for entrepreneurship development. It employs PCA and

CA, in complementarity, to reduce the dimensionality of variables used in the analysis and then group the resulting factors into homogenous farmer typologies. The chapter applies the modified SLF that integrates PsyCap as the sixth livelihood capital to formulate smallholder farmer typology. Characterization of the farmer typologies based on selected entrepreneurship indicators follows, to determine implications of farmer heterogeneity on entrepreneurial development.

Given SA's policy focus on irrigation farming as a key driver for rural transformation, Chapter 4 empirically assesses factors influencing farmer aspirations to expand irrigation farming. This is meant to produce evidence on opportunities and constraints for expanding irrigation farming. The chapter uses the Heckman two-step selection approach to model farmer aspirations to expand crop irrigation as a two-stage decision involving willingness and ability/capacity to expand. Chapter 5 employs the CEM to determine farmer preferences in managing irrigation water resources and their WTP for the water. It focuses on three attributes, i.e., institutional arrangements in the management of water resources, cropping patterns (irrigation intensity) and multiple uses of irrigation water. The final chapter, Chapter 6, discusses the conclusions, policy recommendations and suggestions for further research.

CHAPTER 2. TOWARDS REDEFINING AND MAKING RELEVANT ENTREPRENEURSHIP TO SMALLHOLDERS

2.1 Introduction

The chapter challenges the fundamentals of the concept of entrepreneurship in relation to smallholders. It contributes to the growing literature on entrepreneurship through examining the validity and applicability of the mainstream concept of entrepreneurship in the context of smallholder farming, with empirical evidence from SA. The chapter uses insights from the literature and empirical findings to validate the presented arguments.

Regarding the structure of the chapter, Section 2.2 presents a brief discussion of the mainstream definitions of entrepreneurships, and principles therein, to pave the way for identifying the challenges and redefining the concept to make it speak to smallholders. Section 2.3 gives an analysis of the relevant lessons for consideration when applying the mainstream entrepreneurship concept to smallholders, while Section 2.4 suggests ways of redefining the concept for smallholders focusing on what should happen and the policy implications. A summary of the chapter is given in Section 2.5 while the conclusions and policy/research implications are contained in the final chapter of the thesis.

2.2 Entrepreneurship definitions

There is no single definition of entrepreneurship agreeable to all scholars. This is a testimony to the multidimensionality of the concept. Each scholar is focusing on certain elements or dimensions, and no one is capturing all that everyone agrees on. Table 2.1 presents a sample of some of the definitions which encapsulate most of the facets of the concept of entrepreneurship. Even though no claim can be made for exhaustively presenting the definitions, no aspect of the concept is left untouched and no additional definition can bring more features of the concept than those discussed below. Likewise, the definitions also represent all aspects of agripreneurship, which as noted earlier in Section 1.1, simply means entrepreneurship in agriculture.

Table 2.1. Entrepreneurship: a sample of mainstream definitions

Source	Definition
Oxford English Dictionary (1989)	'The activity of making money by starting or running business, especially when this involves taking financial risk'
Wikipedia	Entrepreneur - a loanword from French, first used in 1723 – qualities of leadership, initiative, and innovation in new venture design.
Schumpeter (1934)	Creative destruction, i.e., willingness and ability to convert a new idea into a successful innovation, e.g., destroying old and creating new combinations of products, services, markets, organizations, and production methods. The entrepreneur is a change agent (Schumpeter, 2005).
Rukuni (2011)	Seeing and exploiting opportunities (unmet market needs or gaps) where others do not, the courage to act, do new things never tried before, and being innovative and creative.
Herrington (2011, p116)	'Starting a new business venture using limited resources'.
Maluleke (2016)	It is about risk-taking, innovation, seizing opportunities, efficiency, profitability and corporate citizenship.
Singh (2013, p14)	'An entrepreneur is an individual who recognizes an opportunity or unmet need and takes risk to pursue it'.
Dollinger (2008)	Management and utilization of resources to create innovative economic organization for profit or growth in a risk and uncertain environment.
European Commission (2003, p7)	'A mindset and process to create and develop activity by blending risk-taking, creativity, and innovation with sound management, within a new or existing organization'.
Frederick and Kuratko (2010, p11)	'Dynamic process of vision, change, and creation'.
Allen (2015)	A mindset that is opportunity focused, innovative, risk-taking and growth-oriented.

Almost all of the definitions are derivatives of neoclassical economic thinking. They are based on the ideology that entrepreneurs are rational in their decisions, and their ultimate objective is profit maximization. More arguments against the rational choice theory in relation to smallholders are presented under Section 4.2.2. Though there is no universally agreed-upon definition of entrepreneurship (Maluleke, 2016), some salient features of the concept can be derived from the preceding definitions. The traits of an entrepreneur, accordingly, are:

- Risk-taking, tolerance for failure, being determined and persistent,
- Seizing an opportunity,

- Proactive, curious, hardworking, strong drive to achieve, independent, self-confident, positive attitude (Singh, 2013)
- Problem solving,
- Innovation or creativity - working on new, not already existing goods or services,
- Value addition, efficiency, and profitability – to be at a competitive edge,
- Embracing change/growth – entrepreneurs are not necessarily sources of change but managers of change in terms of exploiting the opportunities that change creates (Singh, 2013),
- Internal locus of control, self-reliance and motivation, and
- Visionary and goal oriented– an entrepreneur must visualize where the business is destined.

The summation of the various entrepreneurship definitions emphasizes both creation and implementation of new ideas with the objective of converting an existing gap to a business idea and mobilizing resources including skills, self-reliance, motivation and the foresight. Accordingly, this requires a 'mindset' ready to engage and withstand the challenges that come with the entrepreneurial process. However, given the limited willingness and ability to meet the above features, it is clear that not all people can be entrepreneurs. Likewise, not every business owner is an entrepreneur, but all entrepreneurs are business owners (Maluleke, 2016). Starting a business is neither a necessary nor sufficient condition for entrepreneurship (Singh, 2013). The following section discusses the broad aspects of the mainstream entrepreneurship concept in relation to smallholder farming and draws lessons for redefining it to pave the way for cultivating entrepreneurship and to make it relevant to smallholders.

2.3 Applying the entrepreneurship concept: does it speak to smallholders?

2.3.1 Entrepreneurial traits and values

Entrepreneurship is associated with people endowed with certain unique personality characteristics and attributes that differentiate them from the rest (Frederick and Kuratko, 2010). While some of these attributes are innate, others are learnt, formally

and/or informally. Such qualities include having the instinctive ability to identify an opportunity and act on it, a strong drive for independence and success, self-confidence /reliance (internal locus of control), risk-taking propensity, vision, and the ability to inspire or motivate others, among others (McElwee, 2006; Vesala *et al.*, 2007; Phelan and Sharpley, 2012). Most of these qualities emanate from the cognitive ability of individuals which is observed through the state of their positive PsyCap, their mindset. That is why, it is argued here, the concept of positive PsyCap endowment (Luthans, 2004; Luthans *et al.*, 2007; Luthans *et al.*, 2010; Simons and Buitendach, 2013; Luthans *et al.*, 2015) and behavioural economics (Dawnay and Shah, 2005; Ariely, 2008; Etzioni, 2011; Wilkinson and Klaes, 2012; Baddeley, 2017) will remain the key resources to explain one's endowment with entrepreneurial spirit.

a) Risk-taking propensity (calculated risk)

The risk-taking propensity is a critical trait distinguishing entrepreneurs from general managers and is used to judge the existence of entrepreneurial behavior in the literature (McElwee, 2008; Díaz-Pichardo *et al.*, 2012; Phelan and Sharpley, 2012). Successful entrepreneurs inevitably take risks that result in benefits (Maluleke, 2016). Sources of risk for entrepreneurs in smallholder agriculture are related to volatile market prices, unpredictable weather conditions, financial uncertainities, changing policy and regulations, pests and diseases and unknown outcomes of new technologies or practices (Kahan, 2013; Adesina *et al.*, 2014; Harvey *et al.*, 2014). Some of the risks such as weather changes are due to factors that are uncontrollable to the smallholder. However, others exist because smallholders are bounded in their rationality due to imperfect information and their limited capacity to evaluate and process that information timeously (Boahene, 1996). This complicates decision making, and when farmers fail to deal with this complexity, most become risk averse.

There is evidence that smallholders are generally risk averse (Dillon and Scandizzo, 1978; Binswanger, 1981; Bardsley and Harris, 1987). Field observations and focus group discussions with the sampled farmers also suggest the same. Primarily, this is understandable given the prevalence of poverty, limited access to information, lack of capacity to absorb potential shocks and farming being the primary source of livelihoods.

For smallholders, taking risks and trying out new technologies/new crops is tantamount to gambling with their livelihoods. Analysis of cropping patterns of the sampled farmers shows their unwillingness to take risk and the lack of ability to absorb risk. There are limited farming activities in high-value crops and markets. Although there are several reasons for this, risk aversion is one of them. Most smallholders are sticking to producing traditional horticultural crops such as green maize, cabbages, green beans, tomatoes, and spinach. Few are willing to diversify into high-value crops such as chillies, paprika, turnip, lettuce, and cucumbers (see Figure 2.1). Farmers' past negative experiences (own experience or others) with production, post-harvest handling, and marketing of high-value crops, and lack of information on markets standards and prices make them more risk averse. The challenges are made worse due to institutional, agroecological and smallholder behavioral factors.

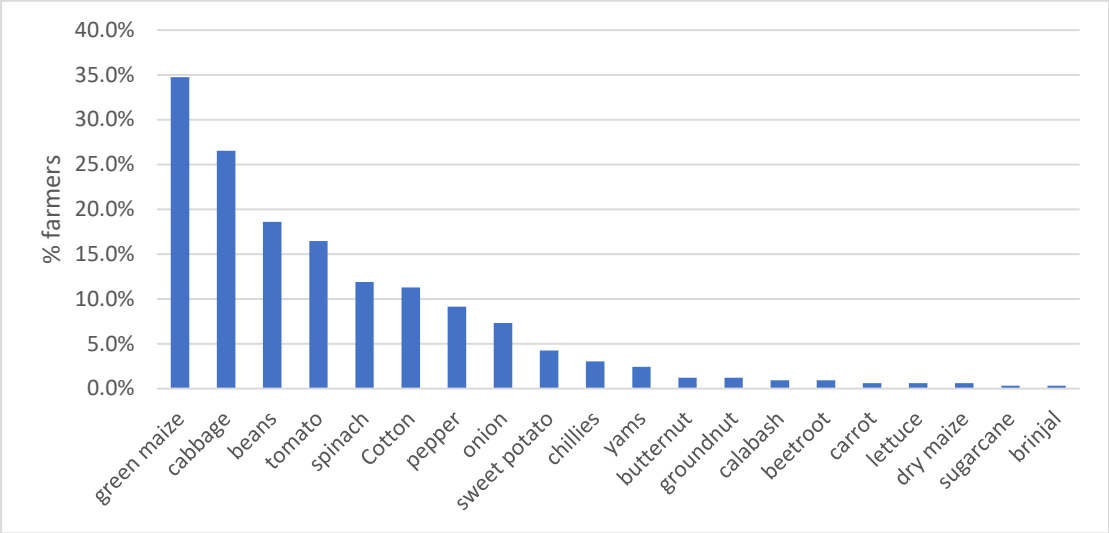


Figure 2.1. Crops grown by the sampled farmers (N=328)

Source: Survey data, 2016

Smallholder low-risk propensity is also evident in their borrowing behaviour. A third (33%) of the sampled farmers do not actively seek for credit because of fear of getting indebted. Such smallholders are afraid that they may not be able to produce enough for loan repayment. Kahan (2013) identified this as a financial risk since it comes because of money borrowed to finance the farm business. Boussard (1992) indicates that

borrowing is a risk for smallholders because they are poor. He concludes that such risk tendencies are deterrent to investment which is important in entrepreneurship.

b) External, not internal locus of control and self-reliance

The traditional entrepreneurship concept stipulates that entrepreneurs should have an internal locus of control. Individuals with an internal locus of control are more likely to be entrepreneurial than those without (Bradstock, 2006; Vesala *et al.,* 2007). These are people who perceive that the outcome of an event is within their control. Such individuals are more likely to be self-reliant, depending on themselves and their resources to meet their own needs. However, it seems most smallholders in SA have an external rather than internal locus of control. An external locus of control is associated with individuals who have the belief and attitude that someone else, particularly, the government is responsible for their success or failure. Such views show a 'culture of dependency' among black South Africans (Preisendörfer *et al.,* 2012). These attitudes are entrenched by an apartheid and post-independence government system that nurtured a mentality that government is responsible for everything (Preisendörfer *et al.,* 2012).

Discussions held with smallholders in Makhathini and Ndumo-B confirm this assertion. Most farmers are concerned about what the government has done, failed to do or can do for them. Seldom are discussions about what they can do for themselves using the resources and assets they are endowed with to maintain their livelihoods. Most think that they are entitled to government support/public resources and these resources are unlimited/available always unconditionally. For example, during a group discussion, using an analogy, one farmer said that when someone buys a car, it comes with a service plan. They suggested that similarly, the government should also provide the cost for operation and maintenance for the installed irrigation infrastructure. With such a locus of control, smallholders are not inclined to look for and act decisively to utilize available opportunities and would not act in the manner expected of an entrepreneur. The results show that about 33% of the smalholders in Makhathini and Ndumo-B are unwilling to pay for irrigation water and their major reasons are that the resource should be free of charge, or it is the government's responsibility (Figure 2.2).

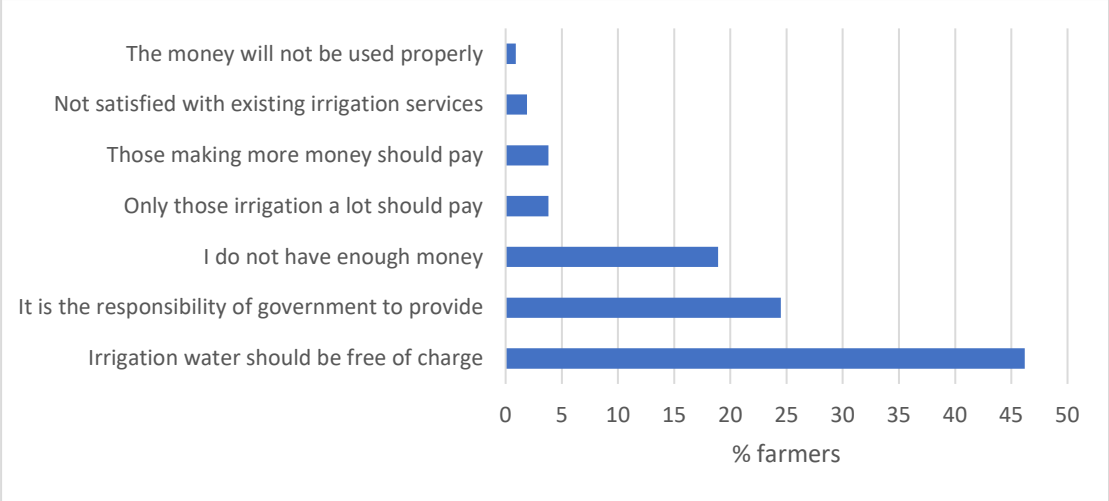


Figure 2.2. Reasons for farmers' unwillingness to pay for water (N=106)

Source: Survey data, 2016

Given the potential benefits from the use of irrigation water, it is only rational that users pay for the water and maintenance of the irrigation infrastructure to continue enjoying the benefits in the future. This is also necessary to make the system sustainable. However, due to the entrenched dependency, entitlement and expectation mindset, this is not happening. Moreover, the lack of cost recovery and maintenance plans, and the lack of transfer of ownership and management to the smallholders at scheme level worsens the situation. These entrenched attitudes and behaviours can be explained using behavioral economics principles which say that habits are important, long lasting and hard to change, i.e., the frequency of past behaviour influences current behaviour (Dawnay and Shah, 2005). Thus, farmers' attitudes and behaviours could be a result of the unintended negative impact of many years of the social grants programme on agricultural entrepreneurship (Sinyolo *et al.*, 2017). The demonstration knock-on effect of the social grant programme, be it positive/negative, is long lasting and difficult to change. Similarly, years of failure or dissatisfaction with production or income levels from farming can have the same negative effect on farmers' behavior and attitudes.

c) Motivation for entrepreneurship

Mainstream entrepreneurship thinking suggests that entrepreneurs have a motivation that drives them to engage in the entrepreneurial process. Motivation is the driving

force between intention and action taken by entrepreneurs (Renko *et al.*, 2012; Zimmermen and Chu, 2013). This driving force for entrepreneurial spirit is, however, missing among smallholders. Half of the sampled farmers (50%) revealed that they are into farming not because they have chosen to be but because they have no other option (s). Such farmers have no belief that farming provides opportunities for productive employment and wealth creation. This will naturally affect the effort they put into this activity as a means of maintaining their livelihood. Further analysis shows that 71% of the smallholder income is unearned, i.e., most of their living is coming through no effort (Table 2.2). The unearned income (social grants and remittances) is reducing recipient households' entrepreneurship drive and incentives to engage in income generating activities. In their study, Sinyolo *et al.* (2017) found that social grants which accounted for 50% of rural household income were negatively affecting on-farm entrepreneurship.

Table 2.2. Estimated farm and non-farm income sources (N = 328)

Income source	**% households**	**Mean (Rand)**	**Std. dev**	**% of Total income**
Remittances	21	1,988	6,971	7%
Arts and craft	6	205	1,298	1%
Permanent employment	3	1,120	9,270	2%
Casual employment	10	523	2,072	3%
Social grant	88	19,645	21,322	63%
Net crop income	63	9,803	34,382	23%
Livestock sales	14	619	2,671	2%
Earned income		12,269	36,851	29%
Unearned income		21,646	22,731	71%

Source: Survey data, 2016

Thus, if most of their living is coming through no effort how can smallholders be self-confident let alone entrepreneurial? How can incentives work? How can they believe that their destiny is in their hands? How can they consider themselves as farmers, mobilize resources and exert the necessary effort? How can they have an internal locus of control? People are inclined to put more effort in a given income source if it is important to their livelihood and if they can affect the outcome. Unfortunately, for most

smallholders in SA, this source is not agriculture, and hence there is no motivation to engage in entrepreneurship in farming.

The conclusion from the analysis under this section is that most smallholders exhibit tendencies that are not in harmony or compatible with the entrepreneurial traits and values expected of the mainstream entrepreneur. They fail to meet the attributes of the mainstream entrepreneur listed under Section 2.2.

2.3.2 Indigenous knowledge, not mainstream innovation theory

The idea that entrepreneurship is associated with innovation was first advanced by Schumpeter (1934) in his Theory of Economic Development. He posits that economic development emanates from innovation, i.e., the creation or introduction of new products or combinations in the economy. He stated that individuals who bring about innovation through creative destruction are known as entrepreneurs. However, his discussions on innovation refer more to commercial or industrial applications of the concept which are more mainstream and do not fit the African smallholder (Juma and Spielman, 2014).

However, smallholders can be innovators in their own right (Sanginga, 2009; Lorentzen, 2010; Juma and Spielman, 2014). Nonetheless, unlike the Schumpeterian entrepreneur, their innovation is neither motivated by value creation nor profit but by the need to mitigate or cope with several challenges in farming, in what Lorentzen (2010) calls ‘scarcity induced innovation’. They innovate in their efforts to address various survival and livelihood challenges on-farm. This kind of innovation is the result of ‘indigenous knowledge’. Indigenous knowledge is ‘local knowledge that is unique to a given culture or society’ (Agrawal, 1995, p416). The knowledge is relevant to its owners, policy makers, and local and international development agents (FAO, 2009). It has the potential to result in economic and social transformation (Briggs, 2005).

Indigenous knowledge is the basis of how most smallholders, in their bounded rationality, make important farming decisions on soil fertility management, water conservation, environmental management, among others that affect entrepreneurship

(Briggs, 2005; Sen, 2005; Oliver *et al.*, 2012). Unlike in mainstream entrepreneurship discussions, such innovation is not necessarily intentional but is produced through trial-and-error processes learnt from generation to generation (Briggs, 2005). However, the challenge is that it tends to be local and hence its transferability and replicability beyond the local context is often limited (Sen, 2005). It is also largely undocumented (Lorentzen, 2010) and under-appreciated (QUNO, 2015). Nevertheless, it has positive benefits associated with increases in yield, reduced costs on herbicides and possible multiplier effects on other farm enterprises, that aids on-farm entrepreneurship (Kamau and Almekinders, 2009). For example, in Makhathini, farmers use indigenous knowledge in pest management, controlling pests affecting their cabbage crop, where commercial herbicides have failed. They mix a detergent (sunlight liquid), garlic, chillies and water, and use it to spray their crop. Others grow some herbal plants around the crop whose strong scent drives away pests. This has improved the quality of their produce, and hence the price fetched in the market. Therefore, the definition of entrepreneurship for smallholders has to encompass indigenous knowledge.

2.3.3 Endowment with the business mindset

When the entrepreneur is also running and managing the business, then it is important that they possess capabilities that enable them to manage it properly. Smallholders in sub-Saharan Africa need to be more business minded (Conway *et al.*, 2014). The business mindset of an entrepreneur is reflected in their management style. In their argument for European farmers, Carter and Rosa (1998) argue that farmers are primarily business owners and their farms can be characterized as businesses. However, such a thesis does not hold for most smallholders in Africa. In mainstream neoclassical economics, a business involves an organization or entity that creates or produces goods and services exchanged for money (Osterwalder *et al.*, 2005). It is a separate entity from the family. However, smallholder farms are family farms not distinct from family operations. Farming is a way of life, not a business. For example, results show that half of the farmers (50%) do not often distinguish farm operations from family activities. This is similar to the Indian smallholder sector where agriculture is also considered as a family tradition, not enterprise or business, the majority of the farmers practicing what their forefathers or their neighbours practiced (Bhardwaj and Singh, 2015). If

motivation is subsistence-related, then it is hard to separate the family operations from the farming operations. This would require a mindset change which takes time.

Table 2.3. Smallholder objectives in farming (N=327)

Objective	Scheme irrigators	Independent irrigators	Home gardeners	Community gardeners	Rainfed farmers	Total
Income generation	41.3	29.0	25.9	17.4	53.3	34.3
Food self sufficiency	18.3	37.7	34.5	52.2	31.1	31.8
Food sufficiency and income generation	36.7	27.5	32.8	30.4	15.6	30.3
Food sufficiency and employment creation	2.8	2.9	3.4	0.0	0.0	2.1
Income and employment creation	0.9	2.9	3.4	0.0	0.0	1.5
Total	100	100	100	100	100	100

Pearson Chi-square = 36.7, P-value = 0.002

Source: Survey data, 2016

Insights from the sampled farmers in Makhathini and Ndumo-B (Table 2.3 above) show that nearly a third of the smallholders engage in farming for subsistence purposes while a slightly higher proportion are purely driven by the need to earn income. The remainder is mainly smallholders who farm for both income and food self-sufficiency objectives. Other studies in Eastern Cape and Limpopo provinces (Muchara *et al.*, 2014a; Denison *et al.*, 2015) show similar results. Moreover, the culture of record keeping inherent in mainstream businesses is almost non-existent or rudimentary at best. For example, only 39% of the smallholders keep records of their operations and transactions, albeit rather inconsistently. It will, therefore, remain difficult to trace their operations, estimate costs and revenues to figure out whether or not they are making a profit.

The above results confirm that profit maximization is not always the primary objective of most smallholders. Sometimes, the farmers exhibit satisficing behaviour which is contrary to the ideals of mainstream entrepreneurship. This behaviour is explained by applying heuristics (rules of thumb) (Simon, 1959) and the theory of human motivation,

the so-called Maslow's Hierarchy of Needs (Maslow, 1943). The theory of satisficing behaviour states that the motive to act stems from one's drive and the action is terminated when that drive is satisfied, not maximized. Beyond these satisficing levels (or needs), the farmers are reluctant to exert more effort to reach higher levels, choosing to stick to their traditional ways instead (Kahan, 2012). Almost 40% of the sampled smallholders put more weight on short-term profits compared to long-term benefits.

In their study, Ligthelm (2013) described satisficing behaviour as 'unproductive entrepreneurship' which is mainly concerned about survival and not growth. Bromley (1982) also found the same behaviour among small American farmers. The theory of human behaviour says the most basic level of needs must be met before the individual will strongly desire the secondary or higher level needs (Maslow, 1943). Given that most of the smallholders in SA are poor, their behaviour is thus in line with this theory. The satisficing mindset is against and not in line with the ideals of mainstream business thinking, i.e., seizing opportunities, creatively destroying the *status quo* and taking calculated risks.

2.3.4 The entrepreneurial environment

Entrepreneurs need a supportive environment to achieve their entrepreneurial ambitions. In the introduction of Schumpeter's book, John Elliot indicated the importance of providing funding in the success of entrepreneurs (Schumpeter, 1934). Furthermore, entrepreneurship is induced by well-developed information services, transport infrastructure, and markets. However, the entrepreneurial environment is different for the smallholder in sub-Saharan Africa. It is characterized by the several challenges facing smallholders outlined earlier in the first chapter and stringent requirements of commercial agri-food chains (consistency in supply, homogeneity and quality of produce) that affect the performance of smallholders (Salami *et al.*, 2010; Fanadzo, 2012; Jordaan *et al.*, 2014). The lack of a supportive institutional environment is often blamed for low productivity in smallholder agriculture in Africa (Djurfeldt, 2013). Thapa and Gaiha (2014) state that removing market failures, institutional gaps and policy distortions will make the small farmer more competitive.

The results from the sampled farmers confirm the above. Only 38% of the sampled farmers reported accessing credit (either loans or input grants), and of these, only 19.2% got that credit through the commercial banks. This is mainly because most smallholders in SA do not meet the banks' 10 ha cut-off to receive production financing (Denison *et al.*, 2015) and their land cannot be used as collateral due to lack of tenure security. Informal institutions such as savings clubs *(stokvels),* friends and relatives and money lenders *(amatshonisa)* are the major sources of funding (68%), albeit at high-interest rates (20-30% per month). Denison *et al.* (2015) also showed similar results in Limpopo Province. These results demonstrate the failure by commercial banks to penetrate the rural markets and their reluctance to learn how to do business with the poor (Rukuni, 2011) while government support programmes through different agencies have failed to effectively benefit smallholders due to poor management and inefficiencies (Herrington, 2011).

Analysis of market access suggests a limited participation of smallholders in profitable input and output markets. Lack of transport or high transport cost is the major constraint. Such challenges make it difficult to promote entrepreneurship among smallholders and put farmers at the lower end of the bargain. Thus, 48.3% of the farmers were not satisfied with income from farming. Salami *et al.* (2010) find similar problems for small farmers in East Africa. Thus, such is the environment common to smallholders which do not conform to the mainstream entrepreneurship ideals or principles.

2.4 Redefining entrepreneurship for smallholders: a behavioural approach

Given the above analysis, the study identifies the following key imperatives/tenets that should be given attention in future efforts to promote and improve the relevance and applicability of the entrepreneurship concept to smallholders in SA and beyond. These include integration of PsyCap and behavioural economic principles to explain and adapt on-farm entrepreneurship in the context of smallholders, nurturing local indigenous knowledge, embracing heterogeneity, the multi-purpose of smallholder farming and the creation of an enabling environment that cultivates smallholder entrepreneurial spirit.

2.4.1 Integration of psychological capital

Positive PsyCap should be at the centre of defining and characterising entrepreneurship in smallholder agriculture. This section is meant to motivate why and how this can be done.

The ability to identify unmet demand in the market, take that as a business opportunity and integrate that into one's livelihood strategy is an important character of an entrepreneur (Shane and Venkataraman, 2000). This ability is a function of one's PsyCap endowment, a concept so far neglected in the sustainable livelihoods literature. PsyCap is a state of mind of an individual at a given time (Seligman, 2002). It is about the individual mindset that enhances or hinders willingness and ability to take advantage of opportunities (like irrigation schemes) despite the prevailing constraints. PsyCap goes beyond the 'human capital (what you know)' and 'social capital (whom you know)' to 'who you are and more importantly what you intend to become' (Avolio and Luthans, 2006). If individuals are endowed with positive PsyCap, their entrepreneurial drive is enhanced, and they will most likely develop the tenacity necessary to go through the entrepreneurial process (Hmieleski and Carr, 2008).

PsyCap is multi-dimensional and made up of four constructs, i.e., confidence, optimism, hope and resiliency (Luthans, 2004; Luthans *et al.*, 2007; Luthans *et al.*, 2015). *Confidence* is the belief in oneself's ability to accomplish one's goals. Having confidence motivates one to invest more time and persevere even in the face of challenges (Luthans *et al.*, 2007). *Optimism* depicts a scenario where one looks forward to a positive, meaningful and desirable future. It is defined either as an explanatory style (Seligman, 1998) or an expectancy perspective (Carver *et al.*, 2010). As an explanatory style, optimistic persons 'attribute positive events to personal, permanent, and pervasive causes and interpret negative events in terms of external, temporary, and situation-specific factors' (Luthans *et al.*, 2007, p90-91). Using the expectancy perspective, optimistic people are those that expect a desirable result from putting more effort and hence would continue to work hard even when faced with difficulties (Carver *et al.*, 2010). *Hope* is about the willpower to accomplish something and the ability to generate alternative routes to achieve one's goals (Luthans *et al.*, 2007). Luthans *et al.*

(2010, p45) describe a hopeful person as 'one who proactively generates one or more pathways to goal accomplishment in a given situation'. *Resiliency* is the ability to adjust or adapt in the face of hardships or risk that allows one to quickly bounce back and move ahead (Masten and Reed, 2002). For smallholders, their mindset is the single most important factor that dictates their entrepreneurial spirit. Creating a conducive environment, access to new technologies, market access and access to finance, though necessary, will not sufficiently create agripreneurs unless smallholders have a mindset which says, 'I can do it' and 'I am ready to face the challenges'.

2.4.2 Fostering an environment that cultivates positive PsyCap and entrepreneurial spirit

The redefinition of entrepreneurship in smallholder agriculture is incomplete without a concerted effort to create an environment that cultivates smallholders' positive PsyCap and the entrepreneurial spirit. The idea is to make farmers more optimistic, resilient, hopeful and confident in themselves and enable them to consider farming not just as a way of life but also as a business. This is only possible if policies, institutions, and services are well-prepared to support the entrepreneurial smallholders who can embrace new ideas and take advantage of opportunities.

Transformation is required in several areas such as agricultural extension services (that includes training on the importance of: managing a small farm as a business, record keeping, distinguishing family and farm operations, and collective action organisations). For example, how well prepared are agricultural extension services in the country to support a business-oriented smallholder? Are commercial banks ready and do they have the willingness, ability and mechanisms for working with smallholders? Are high-value food markets, currently dominated by commercial farmers, prepared to integrate small farmers into the market? How well serviced are the rural communities with road infrastructure, communication, and electricity, among other services that foster entrepreneurial development.

Collective actions in the above areas will offer more opportunities to the entrepreneurial smallholders to explore and implement their ideas. Platforms that foster social networking and interactive learning among farmers, their communities, and the various

stakeholders should also be promoted as vital tools for developing and nurturing positive PsyCap and the entrepreneurial spirit of smallholders.

2.4.3 Integration of behavioural economic principles

Behavioural economics principles should be integrated into the definition of entrepreneurship in smallholder agriculture since smallholder on-farm decisions are of behavioural nature and not maximizing profit.

Neoclassical economics is concerned with the immediate effect that does not last long and asserts that humans are rational and maximize their self-interest. It assumes that individuals have perfect information on the choices and the alternatives that are available to them and have the ability to make logical calculations (Goodwin *et al.*, 2009; Soukup *et al.*, 2015). Behavioural economics, the study of how real people make choices (Lambert, 2006), on the other hand, is concerned with explaining 'irrational' behaviour and long lasting behavioural change to make people comply with policies/rules. It is a field concerned with the psychology of economic decisions that 'seeks to use inputs from psychology to obtain an enhanced understanding of, and/or an improved ability to predict behaviour in respect of areas that have normally been viewed as the preserve of economics' (Earl, 2005, p911).

Unlike neoclassical economics, behavioural economics teaches us that economic agents care not just about outcomes but also how outcomes came to be (Bohnet and Zeckhauser, 2004). According to behavioural economics, individual tastes, preferences, choices, and judgments are not a matter of dispute, nor can they be deemed rational or irrational (Wilkinson and Klaes, 2012). Nobel Prize winners in economics who challenged the neoclassical economics paradigm and brought behavioural economics as a subject of its own right include Herbert Simon (1955) and Tversky and Kahneman (1974). Behavioural economics provides more realistic psychological, social and emotional foundations of 'irrational' decision making behaviour; it does not replace/abandon neoclassical rational choice/equilibrium models (Wilkinson and Klaes, 2012). It enhances the functionality of neoclassical economics and offers answers in areas that would have otherwise been taken as beyond economics or

mistakes in conventional economics (Earl, 2005). There is evidence which increasingly shows that agriculture research focusing on smallholders is now integrating insights from behavioural economics to explain the behaviour of small farmers (see Duflo *et al.*, 2008; Poole and de Frece, 2010; Timmer, 2012; Shaba *et al.*, 2017).

The key lessons from behavioural economics summarized by Dawnay and Shah (2005) and relevant to smallholder behaviour include:

- *People's behaviour is influenced by how others behave or act towards their behaviour* (Jackman, 2015).

  This implies that encouragement and appreciation of farmers' efforts through recognition or awards can be used as a strategy to boost their entrepreneurial spirit. Where there are strong networks and high level of mutual trust (social capital), other people's behaviour may be important in influencing others. This is important to technology adoption and the promotion of indigenous knowledge systems among smallholders.
- *Habits are important, long lasting and hard to change*

  This has both positive and negative implications for on-farm entrepreneurship development. On the positive, it means if smallholders get used to earning their livelihood through their own effort, such a culture will last longer and permeate to the younger generations. In addition, any policy that positively affects smallholder behaviour will create a new social norm that is long lasting, and which needs little enforcement. However, because old habits die hard (Thornton, 2013), on the other hand, it means more effort is needed to change any negative behaviours that work against on-farm entrepreneurship, e.g., the dependency syndrome.
- *People are motivated to do what is 'right', not necessarily maximizing profit*

  This entails adopting a different approach to promoting entrepreneurship among smallholders. As explained earlier, smallholders do not maximize (Etzioni, 2011) but optimise and satisfice. Emphasis should be put on the benefits of entrepreneurship in supporting livelihoods and survival strategies rather than profit maximization.

- *Self-expectations influence one's behaviour, making their decisions in line with their values and commitments*

  Thus, if building the positive PsyCap endowment of smallholders has potential to positively influence their entrepreneurial spirit (their desire for entrepreneurship), this will also be reflected in their entrepreneurial decisions and behaviour.
- *People put undue weight on recent events and too little on far-off ones*

  This means assisting smallholders to work through their immediate challenges can be a strong incentive for unlocking entrepreneurship. This is especially important for smallholders as their behaviour by and large is as behavioural economics suggests. According to Lambert (2006), 'there is a fundamental tension in humans between seizing available rewards in the present and being patient for more rewards in the future.
- *People need to feel involved and effective to make change*

  Information and incentives are not enough (Thornton, 2013). Telling smallholders what to do undermines local knowledge and works against entrepreneurship development in smallholder agriculture. Rural development strategies should build on what smallholders know/have and make them believe that their destiny is in their own hands, rather than ridiculing local endowments and starting from a scratch (see the study by Chiangmai (2017)).
- *A small number of influential people can have a big impact* (Gladwell, 2006)

  Since all smallholders cannot be entrepreneurs, there is a need to focus on the few successful and entrepreneurial farmers so that their success can influence the rest and get scaled-up and multiplied

Application of these lessons to agricultural policy supporting the transformation of smallholder farming offers better chances of success for smallholder entrepreneurial development. The behavioural approach will require a paradigm shift and will result in a long lasting and positive culture of entrepreneurship among smallholders and hence improve the performance and value contribution of smallholder agriculture to the rural economy in SA. The analysis given on page 30 Section 2.3.1(c) and the analogy by one smallholder explained in Section 2.3.1(b) show that some of the behaviours of the

sampled farmers and their responses are by and large in line with the predictions of behavioural economics.

2.4.4 Nurturing and integrating local/indigenous knowledge

Indigenous knowledge can result in local level farmer-led innovations that are important to smallholders. Innovations can be in the form of a product, or a new way of doing things (Schumpeter, 1934) and indigenous knowledge is more of the latter. It is prudent that entrepreneurship in smallholder agriculture embraces farmers as individuals endowed with indigenous knowledge relevant to deal with the day to day challenges of the sub-sector. Recognizing and embracing local knowledge in farming paves the way for deliberate research and documentation, nurturing and sharing of this knowledge to benefit both local and other smallholders facing similar challenges. Without support, this critical part of smallholder farming will remain obscured and local, and its benefits will never permeate through to the broader agricultural sector.

Both government and private sector support are critical to growing and preserving indigenous knowledge. It is advisable to recognize that some local innovations have the potential to grow into business ideas. This is evident through the current support and effort by the National Research Foundation and to promote research, development and scaling-up of indigenous knowledge systems in Southern Africa (SANbio Network, 2012; National Research Foundation, 2017). Hence, agricultural policies should embrace the use of indigenous knowledge systems in farming and also protect farmers through the generation of sufficient patents. The existing legislation in South Africa, the Intellectual Property Laws Amendment Act of 2013 and the Protection, Promotion, Development and Management of Indigenous Knowledge Systems Bill, 2014, do provide the protection of indigenous communities in the commercialization of indigenous knowledge (Government Communications, 2015). Thus, these should be used as the foundation for development of agricultural policies that support the development and commercialization of indigenous knowledge in smallholder agriculture. To improve the sustainability of the farmer-led local innovations, partnerships between farmers and the private sector should be encouraged (Rajalahti *et*

al., 2008). Government's role in such arrangements is to ensure that farmers' interests are well represented and protected.

2.4.5 Embracing heterogeneity and the multi-purpose nature of smallholder farming

Entrepreneurship in smallholder farming should recognize that smallholders are highly heterogeneous. Besides their livelihoods assets, this heterogeneity is also reflected in their preferences (Wale and Yalew, 2007). Embracing this heterogeneity allows the recognition that smallholders are at different levels of their entrepreneurship spirit and not all farmers are highly entrepreneurial. Chapter 3 of the thesis will provide empirical evidence on smallholder heterogeneity and its implication on on-farm entrepreneurship.

Entrepreneurship in smallholder agriculture should also accommodate the multi-purpose nature of smallholder farming. Satisfying household subsistence requirements is a primary and one of the most fundamental objectives of smallholder farming. It is thus, unrealistic to expect that smallholders just focus on market-oriented production. Since the household is the central decision-making unit, entrepreneurship training should help entrepreneurial farmers with knowledge on how to separate family and farm decisions. Nurturing a culture of business-minded thinking and planning among such farmers and the audacity to follow through those plans should be a priority for agricultural extension services.

2.4.6 Redefining the entrepreneurial smallholder

Given the above analysis and synthesis, the remaining question is how one should define on-farm entrepreneurship in such a way that it informs policy and impacts the way farmers think and decide with the ultimate objective of reducing rural poverty on the ground?

Using the concept of PsyCap and drawing from behavioural economics, this study redefines an entrepreneurial smallholder as an individual who is willing and able to do whatever he/she can and take advantage of available opportunities with what he/she has given the prevailing constraints. Someone who can see a constraint as a challenge rather

than a problem. When one views a constraint as a problem, he/she is more pessimistic (negative) and this normally leads to stress, anxiety, fear, anger, depression, and resentment. However, if one sees a constraint as a challenge, he/she is more optimistic (positive) driven by hope and enthusiasm. A problem is of permanent in nature while a challenge is transient. An entrepreneurial smallholder is someone who takes a constraint as a challenge resorting to own initiatives, seeing opportunities, not a problem which is difficult to deal with, hindering the achievement of a desirable objective. It takes someone who is willing to challenge him/herself to come up with contextually relevant solutions to the prevailing challenges. An entrepreneurial smallholder is one who internalises challenges, rather than externalising them. One who has an internal locus of control.

Entrepreneurship in smallholder agriculture is thus defined as the willingness and ability of an individual or group of farmers to take advantage of available opportunities and resources (including indigenous knowledge), given the prevailing constraints. The concept is taken as a continuum recognizing that smallholders can be at different levels of the entrepreneurial ladder. The definition advances the idea that entrepreneurship for small farmers is first a function of the PsyCap endowment before anything else. Emphasis should be put on the ability to solve problems on an ongoing basis as critical to operating the farm as a business. The PsyCap concept and behavioural economics can be used to identify smallholders with better or poor entrepreneurial spirit.

2.5 Summary

The chapter set to assess the validity and applicability of the mainstream concept of entrepreneurship to smallholders. This emanates from the thesis that smallholders and their context do not conform to the common neoclassical paradigm underpinning the mainstream concept of entrepreneurship. The findings agree with this hypothesis and show the divergence of the neoclassical definitions with smallholders in areas such as risk-taking propensity, the locus of control, motivation, innovation, endowment with a business mindset and the entrepreneurial environment. Smallholders are generally risk-averse having an unwillingness to diversify into new/unfamiliar crop enterprises and to take agricultural related debt. Due to poverty, their capacity to absorb risk is limited.

Most of them have an external and not internal locus of control, unable to look for and act, using whatever resources at their disposal, to utilize available opportunities. In SA, smallholder entrepreneurial motivation in farming is missing, with most of their livelihoods derived from non-farm unearned income, mainly social grants and remittances. The findings also show that smallholders do not conform to the mainstream entrepreneurship paradigm on innovation but rely more on indigenous knowledge, which is seldom recognized nor supported. Their practices do not reflect the ideas behind conventional businesses, hardly ever distinguishing between farm and family operations and with poor record keeping. They also seldom focus on profit maximization with the majority exhibiting satisficing behaviour.

To make entrepreneurship more relevant to smallholders, the study suggests a paradigm shift that puts smallholder behaviour at the centre underpinned by the concept of PsyCap and behavioural economics principles. The farmers' mindset is identified as one critical resource that determines smallholders' farming decisions and behaviour and hence entrepreneurial spirit. Besides the integration of PsyCap and behavioural economic principles, the study also suggests the need to recognize, embrace and nurture indigenous knowledge as an important aspect of smallholder farming. It indicates that policies and strategies promoting entrepreneurial development should identify with small farmer heterogeneity and multi-purposes of smallholder farming. There is also a need to foster an environment that cultivates PsyCap endowment and the entrepreneurial spirit of smallholders. In the end, the study proposes a contextualized definition of an entrepreneur and entrepreneurship that is more relevant to smallholders. The conclusions and policy implications of this chapter are contained in Chapter 6 of the thesis.

CHAPTER 3. FARMER TYPOLOGY FORMULATION: IMPLICATIONS FOR ON-FARM ENTREPRENEURIAL DEVELOPMENT[3]

3.1 Introduction

The chapter uses PCA and CA to empirically develop farmer typologies in and around smallholder irrigation schemes. The typologies are analysed to inform policy recommendations relevant for on-farm entrepreneurship development. The study demonstrates how PsyCap can be introduced to farmer typology formulation, an aspect that eluded past farm typology research.

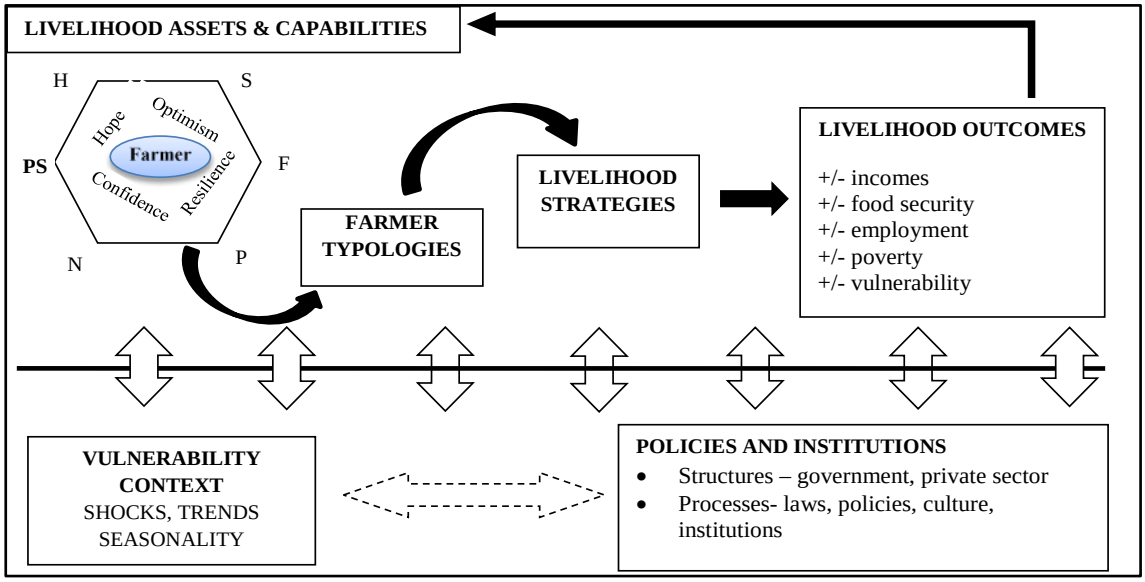
The rest of the chapter is structured as follows: Section 3.2 discusses the conceptual framework of the study followed by the research methodology in Section 3.3. Section 3.4 presents and discusses the empirical results while Section 3.5 provides the implications of the findings for entrepreneurial development. The summary then follows in Section 3.6. The conclusions and policy implications are part of Chapter 6.

3.2 Conceptual framework

The conceptual framework of the study is based on the modified SLF (Figure 3.1) which integrates the PsyCap denoted by *PS* as the sixth livelihood capital. This is meant to explain diversity among farmers brought about by differences in individual mindsets. In the past, heterogeneity among small farmers has been attributed to differences in indigenous knowledge, farm management practices and other resource endowments (Wale and Yalew, 2007; Muthamia *et al.*, 2011). However, there is no literature to explain differences normally observed among smallholders working in the same village, having a similar resource endowment and faced with similar institutional and infrastructural constraints. It is the view of this study that variations in PsyCap endowment can explain these differences. Indeed, Liu and Liu (2016) posit that

[3] This chapter resulted in the following publication: Chipfupa U and E. Wale, Farmer typology formulation: implications for on-farm entrepreneurial development. *Development in Practice* (*forthcoming*).

farmers' different perceptions and attitudes towards their lives, affects their livelihood strategies and outcomes. PsyCap emanates from the literature on positive organizational behaviour with firm foundations from the social cognitive theory (Luthans *et al.*, 2007). PsyCap can help to explain differences in the farmers' ability to take advantage of opportunities when they arise; the dependency tendencies observed among some smallholders; different levels of confidence in agriculture as a sustainable livelihood strategy; and the farmers' varying abilities to cope with different challenges.



Notes: H, S, F, P, N, and PS, refer to human, social, financial, physical, natural and psychological capital, respectively.

Figure 3.1. PsyCap in the modified Sustainable Livelihoods Framework

Source: Adapted from Dorward (2001)

Section 2.4.1 in the preceding chapter gave a detailed description of PsyCap as a concept. It mentions that PsyCap is mainly associated with four constructs, i.e., confidence, hope, optimism, and resilience (Luthans *et al.*, 2015). Individuals who have self-confidence persevere even when faced with difficulties and those who are optimistic take these obstacles as opportunities to think differently (Simons and Buitendach, 2013). They always bounce back, and through hope, they generate different pathways to accomplish goals (Simons and Buitendach, 2013). When resources are limited and, individuals are faced with risky decisions, those with positive PsyCap are in a better position to make effective decisions and employ more resilient adaptation

strategies. Positive PsyCap is, therefore, an important means to manage and utilize all the other forms of resources effectively.

3.3 Empirical approach

There are several approaches used in farm typology research such as expert knowledge, participatory rankings, and multivariate statistical methods. The multivariate methods include multi-dimensional scaling, multiple correspondence analysis, multiple factorial analysis, canonical discriminant analysis, PCA and CA. The most common techniques are PCA and CA. The ability of PCA to reduce several variables of data into smaller and manageable dimensions (Hair *et al.*, 2010) has resulted in its wide application to complement CA in farm typology formulation (e.g. Bigodeza *et al.*, 2009; Goswami *et al.*, 2014). Thus, this study employs PCA to reduce the dimensionality of variables of interest and then CA to group the different types of farmers into relatively homogenous clusters. The process follows three steps, i.e., first PCA is conducted on PsyCap measures to determine the PsyCap dimensions, and in the second step, PCA is conducted on all variables that measure household livelihood assets including the PsyCap dimensions. The factors derived in the second step are then used as inputs in the cluster analysis.

3.3.1 Principal component analysis

PCA was used to transform the variables of interest and create a set of new variables, known as principal components (PC). According to Jolliffe (2002), these new variables are uncorrelated and ordered so that the first few retained components explain most of the variation present in the original variables. The relationship of the PCs to the original variables can be expressed as follows:

$$PC_1 = a_{11}X_1 + a_{12}X_2 + ... + a_{1n}X_n \quad (3.1)$$

$$PC_m = a_{am1}X_1 + a_{am2}X_2 + ... + a_{amn}X_n \quad (3.2)$$

where a_{mn} represents the weight for the m^{th} PC and the n^{th} variable.

To ensure that the data was sufficient to measure common factors of interest, i.e., all aspects of a household livelihood, the study adopted the modified sustainable livelihoods approach in designing the questionnaire. Data on all six livelihood assets, including PsyCap, were collected. Pre-testing of the questionnaire improved the quality and reliability of the data. Moreover, the Kaiser-Maier-Olkin (KMO) and Bartlett's Sphericity test were used to check the appropriateness of the data for conducting a PCA. Also, a correlation matrix helped to assess the level of correlation among variables while the anti-image SPSS output assisted in checking variables with a very low measure of sampling adequacy. The Kaiser criterion which recommends retaining factors with eigenvalues > 1 was used as the criterion for the factor retention decision. Varimax rotation was used to make the solutions more interpretable.

3.3.2 Cluster analysis

Clustering was conducted in two stages, i.e., hierarchical followed by K-Means clustering. Agglomerative hierarchical clustering using the Ward method and Squared Euclidean distance was used to determine the number of clusters. The Ward method was preferred because of its ability to produce clusters proportionally equal to each other (Hair *et al.*, 2010). A decision on the number of clusters was reached using the dendrogram generated as part of the output file (see Figure A1 in Appendix). After determining the number of clusters, the extracted factors from PCA were subjected to a K-Means clustering process. In deciding on the final clusters, a balance was struck between achieving a simple structure and maintaining some level of homogeneity within the groups (Hair *et al.*, 2010).

3.3.3 Measurement of psychological capital

The approach to measuring PsyCap in this study follows work by Luthans *et al.* (2007) which has been successfully applied in several other studies, e.g., Luthans *et al.* (2010) and Simons and Buitendach (2013). They developed a PsyCap questionnaire (PCQ) measure with 24 Likert scale questions measuring the four PsyCap constructs, six questions for each. In this study, the PCQ was adapted to suit the context of smallholders. Farmers were asked 12 five-point Likert scale questions *(1 = strongly*

disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree), three for each PsyCap construct. The questions were meant to solicit farmers' view regarding themselves, how they rate themselves in relation to each question. A reliability test (Cronbach alpha = 0.75) showed that the variables were acceptable measures of PsyCap. Table 3.1 presents the questions asked under each construct and the average scores for the sample.

Table 3.1. PsyCap construct measurements

Psychological constructs	**Mean**	**Std. Dev**
Confidence		
I am confident in farming as a way of life (CONF_AGRIC)	4.38	0.58
I am confident in myself as a farmer (CONF_FR)	4.13	1.06
I have the power to affect the outcome of my farming (POWER)	3.92	1.08
Optimism		
I am optimistic about the future of agriculture in my area (OPTI_FR)	4.10	1.02
I do not give up easily (DNT_GIVE_UP)	4.06	1.03
I would not be farming if there was a better alternative source of income (ALTER_INC)	3.19	1.49
Hope		
I have hope that the quality of work will get better (HOPE_LIFE)	4.12	0.98
I am willing to forgo a profit opportunity in the short-run in order to benefit from potential profits in the long-run (LONG_FOCUS)	3.76	1.19
I am willing to try new ideas even without full knowledge about the possible outcomes (TRY_IDEAS)	4.13	0.74
Resilience		
I am able to cope with shocks such as drought and other natural disasters (COPE_SHK)	3.64	1.14
I am willing to take more risks (RISK_TAKE)	3.52	1.22
Government is responsible for the wellbeing of rural households (GOVT_RESP)	2.12	1.14

Source: Survey data, 2016

3.3.4 Other variables used in the farmer typology formulation

Table 3.2 shows other variables that were used in the formulation of the farmer typologies. The variables represent the rest of the household livelihood assets. Income from crop (INC_IRR_CRPS and INC_DRY_CRPS) and livestock (INC_LVSTK) variables represents the net income received from sales of crops and livestock in the past 12 months before the survey. The dependency ratio (DEP_RATIO) was adjusted

for chronically ill members within the productive age range (15-64 years). The total land operated (LAND_SIZE) is an average for all farmers. Membership to social networks (SOC_NETWKS) includes cooperatives and other social groups. The results of the analysis are discussed in the next section.

Table 3.2. Variables used in farmer typology determination

Variables	Description	Mean	Std. Dev
GENDER_FR	Gender of houshold head (1 if male, 0 otherwise)	0.35	0.48
AGE_FR	Age of a household head in years	48.82	11.95
EDU_LEVEL	Years of schooling of the household head	4.28	4.50
DEP_RATIO	Adjusted dependency ratio	0.85	1.02
INC_SOCIAL	Social grant income (ZAR‘000)	19.66	21.31
INC_IRR_CRPS	Irrigated crop income (ZAR‘000)	8.88	30.38
INC_DRY_CRPS	Rain-fed crop income (ZAR‘000)	0.92	4.00
INC_LVSTK	Livestock sales income (ZAR‘000)	0.62	2.67
INC_OTHER	Other non-farm income (remittances, formal and informal employment, arts and crafts) (ZAR‘000)	3.84	11.56
ACC_CREDIT	Access to credit (1 if Yes, 0 otherwise)	0.38	0.49
SAVINGS	Have savings (1 if Yes, 0 otherwise)	0.59	0.49
HHLD_ASSETS	Household assets value (ZAR‘000)	54.93	133.05
LAND_SIZE	Total land operated (in hectares)	1.41	2.68
SOC_NETWKS	Membership to social networks (1 if Yes, 0 otherwise)	0.77	0.42

Source: Survey data, 2016

3.4 Results and discussion

3.4.1 Socio-demographic characteristics

Most respondents were female which resembles the sex structure of the district and province. Their ages range from 15-75 years, and only 15.2% are below the age of 35 years. This shows the limited participation of young people in smallholder agriculture. Several other studies have reported young people’s lack of interest in farming as an occupation (e.g. White, 2012; Swarts and Aliber, 2013). For young people, agriculture is often seen as outdated, unprofitable and hard work (Agriculture for Impact, 2014). The respondents’ mean years of schooling is 4.3 indicating low levels of education. Census 2011 results show that uMkhanyakude district has the second highest

population without schooling (25%) in the province (Statistics South Africa, 2014b). The results also show a relatively high proportion of adults of working age in smallholder households capable of supporting the young and elderly. Only 21.6% households have a dependency ratio greater than 1. However, mean ratio for the sample is higher than the national and provincial averages of 0.53 and 0.59, respectively (Statistics South Africa, 2015). This show that the sampled smallholder households are more economically burdened compared to the average household at national or provincial level.

3.4.2 Psychological capital dimensions

PCA on the PsyCap measures yielded three PsyCap dimensions (Table 3.3). The first dimension (*positive PsyCap*) has positive loadings on most PsyCap measures, and a negative loading for farmers view regarding the government's responsibility for their wellbeing. It represents farmers who are independent, full of confidence, optimistic, hopeful about life, forward looking and resilient.

Table 3.3. PsyCap dimensions

	Components		
PsyCap measures	**D1**	**D2**	**D3**
CONF_AGRIC	0.259	**0.500**	**-0.429**
CONF_FR	**0.871**	0.167	0.007
POWER	**0.618**	**0.459**	-0.015
OPTI_FR	**0.813**	0.232	0.004
DNT_GIVE_UP	**0.846**	0.180	0.046
ALTER_INC	0.004	**0.809**	0.095
HOPE_LIFE	**0.845**	0.142	0.038
LONG_FOCUS	**0.427**	-0.085	**0.590**
TRY_IDEAS	-0.084	0.157	**0.778**
COPE_SHK	**0.486**	0.133	-0.068
RISK_TAKE	**0.461**	**0.619**	0.053
GOVT_RESP	**-0.568**	0.161	-0.282
% variation	36.50	14.23	10.32
Cumulative % variation	36.50	49.72	**60.04**

Notes: KMO value = 0.88; Barlett's test of sphericity significant at 1%; only factors with loadings > 0.4 included in the explanation of the results.

Source: Survey data, 2016

The second dimension (*resilient, optimistic and confident*), has positive loadings on four measures and represents farmers who are resilient, optimistic and confident in farming and their power to affect their success in farming. Their resilience emanates from them willing to take more calculated risks than the other farmers. The third dimension (*venturesome and future-oriented*) has positive loadings on two measures for hope and a negative loading on confidence in farming. It represents farmers who are venturesome and forward-looking but lack confidence in farming as a way of life. The three PsyCap dimensions are included as variables in the PCA for all household livelihood assets, results of which are presented in Section 3.4.3 below.

3.4.3 Livelihood asset dimensions

PCA on the livelihood assets resulted in eight livelihood assets dimensions (Table 3.4). Only three of these dimensions (LD5, LD7, and LD8) have high and positive loadings on the PsyCap measures. LD1 (*mixed farming)* represents farmers engaged in both crop irrigation and livestock farming, endowed with physical assets. LD2 (*elderly and limited education*) represents elderly and less educated farmers. LD3 (*land endowment and rainfed farming*) represents farmers with larger land holdings and dependent on rainfed agriculture as a source of livelihood. LD4 (*social grant reliance and economic burden*) represents households with many dependents who rely mostly on income from social grants.

LD5 (*financial endowment, resilient, optimistic and confident)* represents farmers well-endowed with financial assets who are resilient, not afraid to take calculated risks, optimistic and confident. LD6 (*income diversification*) represents farmers who have diversified income sources. LD7 (*positive PsyCap*) represents farmers well-endowed with all aspects of PsyCap and do not rely much on income from rainfed farming. LD8 (*cautious, short-term focus and social capital endowment*) represents farmers who are short-sighted and not willing to try new ideas without much information but are endowed with social capital. These farmers could be members of social networks but their level of participation as ordinary members does not allow them to benefit from the social capital within the network.

Table 3.4. Household livelihood asset dimensions

	Component							
	LD1	**LD2**	**LD3**	**LD4**	**LD5**	**LD6**	**LD7**	**LD8**
GENDER_FR	0.385	-0.065	0.394	-0.226	-0.118	-0.234	0.380	-0.035
AGE_FR	0.008	**0.873**	0.103	0.089	0.015	0.070	0.028	0.014
EDU_LEVEL	0.008	**-0.857**	0.084	-0.025	-0.028	0.130	0.050	0.042
DEP_RATIO	-0.059	-0.035	-0.051	**0.861**	-0.115	-0.050	0.045	-0.061
INC_SOCIAL	0.045	0.216	0.191	**0.639**	0.243	0.032	0.001	0.140
INC_IRR_CRPS	**0.741**	0.010	-0.017	-0.076	0.096	-0.033	0.066	-0.168
INC_DRY_CRPS	-0.087	-0.062	**0.667**	0.065	-0.031	-0.107	**-0.424**	-0.048
INC_LVSTK	**0.786**	-0.018	0.060	0.031	-0.077	-0.025	-0.028	0.093
INC_OTHER	-0.088	-0.046	-0.034	-0.078	-0.063	**0.870**	-0.006	0.016
ACC_CREDIT	-0.021	0.106	0.051	0.008	**0.641**	-0.130	-0.061	-0.048
SAVINGS	0.176	-0.168	-0.037	0.117	**0.656**	0.288	0.021	0.018
HHLD_ASSETS	**0.451**	0.050	0.203	0.116	0.147	0.391	-0.038	0.167
LAND_SIZE	0.157	0.086	**0.773**	0.063	0.009	0.115	0.111	0.107
SOC_NETWKS	0.194	0.004	-0.306	0.147	-0.259	0.032	-0.324	**0.551**
POS_PSYCAP	0.006	-0.020	-0.054	0.085	-0.058	0.000	**0.837**	0.026
RES_OPTI_CONF	-0.141	0.108	-0.297	-0.130	**0.430**	-0.320	-0.029	0.134
VENT_FUTURE	0.096	0.031	-0.148	0.022	-0.087	-0.023	-0.124	**-0.842**
% variation	11.59	10.47	8.53	7.60	6.93	6.61	6.17	5.98
Cumulative % variation	11.59	22.06	30.59	38.19	45.12	51.73	57.90	**63.88**

Notes: KMO = 0.55; Barlett's test of sphericity significant at 1%, only factors with loadings > 0.4 included in the explanation of the results.

Source: Survey data, 2016

3.4.4 Farmer typology classifications

Hierarchical and K-Means clustering, conducted on the eight livelihood assets dimensions, demonstrated that with 9 clusters, farmers could be grouped into reasonably homogeneous groupings. The 9-cluster solution also made sense given the prior knowledge of the farmers. However, in the solution, four clusters had very low observations (≤4) assigned to them. According to Hair *et al.* (2010), such observations are outliers and thus should be discarded. A one-way ANOVA was used to check the validity of the clustering process and the reliability of the created clusters (see Table A5 in Appendix). All dimensions were statistically significant ($p < 0.01$) in determining the clusters. Figure 3.2 shows the final cluster centres for the five remaining clusters.

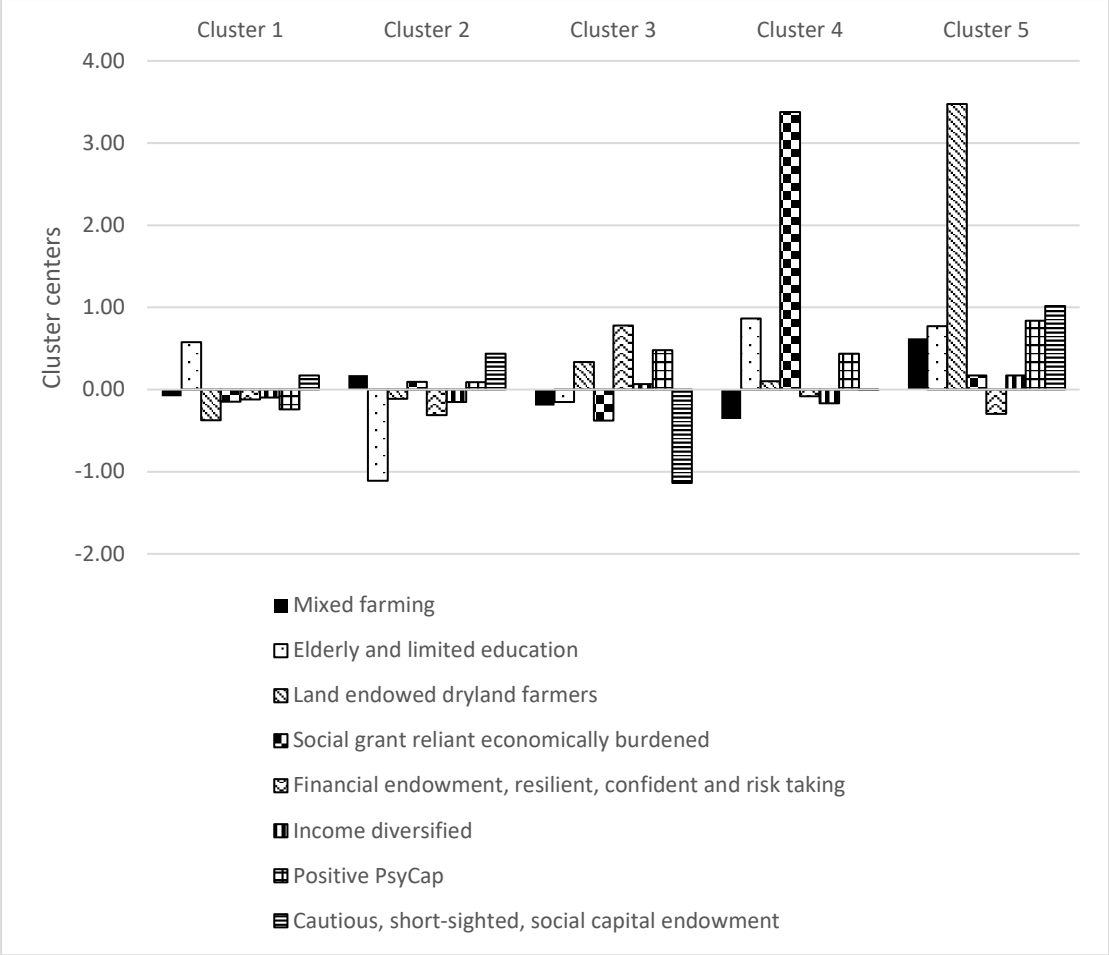


Figure 3.2. Final cluster centres from CA

Source: Survey data, 2016

The empirically identified clusters in Figure 3.2 above represent five farmer typologies among small farmers in and around Makhathini and Ndumo-B irrigation schemes. The typologies are named based on the dominant characteristics given by the final cluster centres. The results show that PsyCap is an important characteristic in describing all the farmer typologies. Farmer typology 1 (*elderly and uneducated*) has the largest membership (48.1%). It is made up of elderly farmers with limited access to formal education. Their PsyCap endowment is limited by the lack of hope, i.e., the willpower to continue working hard. Farmer typology 2 (*cautious and short-sighted farmers*) constitutes the second largest group (26.1%). It is characterized by farmers who are not hopeful, i.e., they are short-sighted and not willing to explore new ideas. They are

mostly likely engaged in mixed farming and are endowed with both physical and social capital.

Farmer typology 3 (*financial capital and PsyCap endowed farmers*) (19.5%) is characterized by farmers with savings and access to credit. The farmers are highly endowed with PsyCap and thus have high levels of confidence, optimism, resilience, and hope. Farmer typology 4 (*social grant reliant farmers*) (3.8%) is made up of mostly elderly farmers with a high number of dependents, who rely heavily on social grants from the government. This typology is also characterized by farmers with positive PsyCap. Farmer typology 5 (*land endowed rainfed farmers)* (2.5%) has land endowed rainfed farmers practicing mixed farming. Most are cotton farmers contracted to Makhathini Cotton Company. They are mostly elderly with limited formal education. Some of the farmers exhibit positive PsyCap, while others are cautious and short-term focused in their approach to farming. Results also show significant gender differences ($p < 0.01$) in the farmer typologies. Farmers in typologies 1 (75%) and 4 (83%) are mostly female, while all farmers in typology 5 are male. Typologies 3 and 4 are 55% and 58% female, respectively.

Results in Table 3.5 show that for all the typologies except typology 5, the farmers are predominately situated in Makhathini. Ndumo-B has more rainfed farmers around the irrigation scheme compared to Makhathini since the scheme can only accommodate a few farmers, while the rest scramble for land along the Pongola river for irrigation. Most farmers in Ndumo-B are predominately in typology 1 (38.7%), followed by typology 3 (28.3%) and typology 2 (26.4%). For Makhathini the pattern is slightly different. Most farmers in that area are in typology 1 (52.8%), followed by typology 2 (25.9%) and typology 3 (15.1%). Anecdotal evidence suggests that Ndumo-B farmers are more successful than Makhathini farmers and this could explain why the proportion of farmers in typology 3 is higher than that of typology 2 in the area. The Pearson Chi-square value generated as part of the results in Table 3.5 is significant at 1% showing heterogeneity in farmer typologies in the study areas.

Table 3.5. Distribution of farmer typologies by study area

Area	Typo 1	Typo 2	Typo 3	Typo 4	Typo 5	Total
Ndumo-B	41 (38.7; 26.8)	28 (26.4; 33.7)	30 (28.3; 48.4)	2 (1.9; 16.7)	5 (4.7; 62.5)	106
Makhathini	112 (52.8; 73.2)	55 (25.9; 66.3)	32 (15.1; 51.6)	10 (4.7; 83.3)	3 (1.4; 37.5)	212
Total	153	83	62	12	8	318
% of Total	48.1	26.1	19.5	3.8	2.5	100
χ	13.8	p=0.008				

Note: numbers in parentheses are row and column percentages, respectively

Source: Survey data, 2016

Results in Table 3.6 show significant differences between the farmer typologies in relation to the farmer categories. Scheme irrigators have the highest proportion of farmers in typologies 1, 2 and 3, and second highest in typology 5. Independent irrigators are joint highest in typology 4, and second highest in typology 2 and 3. Home gardeners constitute the second highest percentage of farmers in typology 1 while community gardeners are fourth in most typologies except typology 5. Rainfed farmers constitute most farmers in typology 4 and 5.

Table 3.6. Distribution of farmer typologies by category of sampled farmers

Farmer category	Typo 1	Typo 2	Typo 3	Typo 4	Typo 5	Total
Scheme irrigators	51 (48.6; 33.3)	27 (25.7; 32.5)	23 (21.9; 37.1)	2 (1.9; 16.7)	2 (1.9; 25)	105
Independent irrigators	30 (44.1; 19.6)	20 (29.4; 24.1)	15 (22.1; 24.2)	3 (4.4; 25.0)	0 (0.0; 0.0)	68
Home gardeners	32 (58.2; 20.9)	13 (23.6; 15.7)	8 (14.5; 12.9)	2 (3.6; 16.7)	0 (0.0; 0.0)	55
Community gardeners	23 (50.0; 15.0)	13 (28.3; 15.7)	8 (17.4; 12.9)	2 (4.3; 16.7)	0 (0.0; 0.0)	46
Rainfed farmers	17 (38.6; 11.1)	10 (22.7; 12.0)	8 (18.2; 12.9)	3 (6.8; 25.0)	6 (13.6; 75)	42
Total	153	83	62	12	8	318
X	32.5	p=0.009				

Note: numbers in parentheses are row and column percentages, respectively

Source: Survey data, 2016

Results also show that most of the smallholders in all farmer categories are classified as typology 1 farmers. To the extent that some typology 5 farmers are scheme irrigators shows the existence of farmers practicing both irrigation and rainfed farming. This is a common strategy used by smallholders in SA to adapt to the adverse impacts of climate change (Ndhleve *et al.*, 2017).

The findings compare well with other studies. Denison and Manona (2007a) and Denison *et al.* (2015) used case studies to describe farmer typologies in and around smallholder irrigation schemes in SA. Although using a different approach, some of their typologies compare well to those found in this study. For example, 'the food producer' is similar to typology 1 and 4, 'the food and cash farmer' to typology 3, while 'the business farmer' can be likened to typology 5 (see also Table 3.7). Moreover, Denison *et al.* (2015) also found similar results which show that most 'food producers' were female while 'business farmers' were male.

3.4.5 Characterization of farmer typologies

Table 3.7 presents results that help in understanding the characteristics of the farmer typologies in terms of on-farm entrepreneurship. Results show no statistically significant difference in market participation between the farmer typologies, i.e., farmers who sold crops or livestock in the previous 12 months. A high proportion of farmers (at least 75%) in all the typologies participated in crop produce markets, with typology 5 having the highest proportion compared to the other groups. Selling livestock was low across all typologies. The highest proportion of livestock sales is observed in typology 5 and is lowest in typology 3. However, results show heterogeneity in the extent or level of market participation between the typologies. Mean net crop income per year (irrigated plus rainfed) show that the level of participation in crop produce markets is greatest for typology 5 followed by typology 3 and lowest in typology 4. Similarly, annual livestock sales reflect heterogeneity in the level of participation in livestock markets. Farmer typology 5 has the highest annual livestock sales, while typology 4, recorded the lowest average sales.

Table 3.7. Characteristics of farmer typologies based on selected entrepreneurship related indicators

Indicator	**Typo 1** *(elderly and uneducated)*	**Typo 2** *(cautious and short-sighted farmers)*	**Typo 3** (*financial capital and PsyCap endowed farmers*)	**Typo 4** (*social grant reliant farmers*	**Typo 5** (*land endowed rainfed farmers)*	**Sig.**
Sold crops in the previous year (%)	76.5	75.9	75.8	75.0	100.0	0.642
Sold livestock in the previous year (%)	11.1	18.1	4.8	8.3	25.0	0.112
Irrigated income/yr (ZAR)	6,122	6,402	13,102	1,617	16,010	0.003
Rainfed income/yr (ZAR)	318	497	556	2,135	4,648	0.000
Livestock sales/year (ZAR)	226	1,315	126	13	2,750	0.000
Distance to nearest town (min)	35.6	34.8	37.2	44.6	34.4	0.574
Market transport problems (%)	69.5	67.1	75.8	83.3	65.5	0.000
Land owned (ha)	0.9	1.4	1.9	2.0	15.6	0.000
Membership to cooperatives (%)	82.4	79.5	11.7	90.9	62.5	0.000
Have savings (%)	51.0	62.7	75.8	58.3	50.0	0.017
Accessing to credit (%)	39.2	22.9	58.1	33.3	37.5	0.001
Trained in commodity marketing (%)	38.6	33.7	29.0	16.7	25.0	0.410
Trained in produce processing (%)	37.9	32.5	32.3	25.0	25.0	0.761
Trained in bookkeeping (%)	24.2	16.9	17.7	8.3	25.0	0.488

Source: Survey data, 2016

Heterogeneity is also observed in three other market access related factors, i.e., distance to market, transport challenges and membership to cooperatives. Farmer typology 4, followed by typology 3, has the highest average distance to the nearest town, and percentage of farmers who encounter transport challenges in marketing. Typology 5 has farmers with the lowest mean distance to the markets and with transport problems. Despite, apparent market access problems, typology 4 has the highest percentage of farmers who are part of cooperatives, followed by typologies 1, 2, 5 and 3. The results suggest that members of typology 3 are largely independent farmers because only a small percentage of them are members of cooperatives.

The results on savings and access to credit show statistically significant differences across the farmer typologies. Typology 3 has the highest proportion of farmers with savings and access to credit compared to the other farmers. Access to credit is low (below 50%) in all the other four typologies, with typology 2 having the lowest percentage of farmers with access to credit. No heterogeneity is observed regarding entrepreneurship skills training. Entrepreneurship skills training is low across all the typologies (below 50%). Typology 1 and 2 have the highest proportion of farmers trained in processing and commodity marketing, respectively, while typology 4 has the lowest percentage of farmers receiving all forms of entreprenuership skills training.

Overall, the results reveal that entrepreneurship development in smallholder irrigation requires a greater understanding of the farmers involved and the linkages between farming practices and level of entrepreneurial activity *vis a vis* the constraints currently being faced by each typology of farmers. The observed heterogeneity in on-farm entrepreneurship between the farmer typologies reflects one or a combination of entrepreneurship related factors, existing in one group and not the other. For farmer typologies 1 and 2, their inability to participate more in markets is related to their PsyCap endowment. Yes, they do have other challenges such as inadequate land and lack of access to capital and entrepreneurial skills but addressing these without first dealing with their inherent psychological problems, will not yield much results. This confirms Preisendörfer *et al.* (2012) notion of adopting a mindset approach in efforts to enhance entrepreneurship among black South Africans. For typology 3, the situation is different. Access to financial resources removes some of the major bottlenecks to smallholder farming and allow farmers to acquire appropriate inputs, timeously conduct farm operations and hire needed labour. Regarding PsyCap, the farmers are confident, optimistic, hopeful and resilient. However, their major drawback is a lack of entrepreneurial skills. This supports findings by Khapayi and Celliers (2016) that entrepreneurship skills are important in successful farming business.

By definition, typology 4 farmers are economically burdened. Thus, despite their PsyCap endowment, their limited participation in markets is a result of several other factors including distance from the nearest markets, transport challenges, lack of access to financial resources and limited entrepreneurship skills. Moreover, just like typology

1 and 2, membership to cooperatives is not aiding much with regards to access to markets. The results confirm the current debate on the impact of cooperatives in SA and findings that, in their current form, they are one of the causes of the poor performance of the land reform programme (Binswanger-Mkhize, 2014). The major challenges to on-farm entrepreneurship for typology 5 is limited access to financial resources and training in entrepreneurship skills. Lack of access to finance is one of the major obstacles to entrepreneurship (Patgaonkar, 2010). However, for some farmers in this typology, some aspects of their PsyCap, especially those related to hopefulness, need boosting for them to succeed in farming.

3.5 Implications for on-farm entrepreneurship development

Overall, capacity building on farm business management skills is critical for the transformation of smallholder irrigation. However, beyond this, specific policy focus and support is needed in areas such as access to markets, access to financial resources and PsyCap endowment. Hazell and Rahman (2014) gave similar conclusions by indicating that some assistance policies and interventions should be different depending on the farmer typology. For typologies 1, 2 and 4, support is needed for improving access to markets for produce. This can be done through empowering smallholders to demand the right market information, and programmes that promote linkages to high value markets. This should be coupled with crop management advice to ensure that the quality of crops produced meets the required market standards. In a different typology study, Torero (2014) reached similar conclusions and reiterates the need to have functional rural markets. Moreover, cooperatives can be supported to play a more active role in ensuring market access as shown in other countries. Although cooperatives *per se* did not improve market access for banana farmers in Kenya, Fischer and Qaim (2012) conclude that their role in linking farmers with high value markets and information is crucial for farmers to remain competitive.

Given the scale of production, resource endowment and the current competition in the markets, the farmers' greatest opportunity exists in their numbers. According to the 'fortune at the bottom of the pyramid' notion, smallholders could be poor individually, but they are collectively endowed with a fortune that can be exploited (Prahalad, 2005).

However, this demands a paradigm shift regarding the formation and management of cooperatives to reverse the current negative tag and enhance their role in the transformation of SA's smallholder farming. Ostrom (2011) emphasizes that developing trust and enhancing knowledge will improve collective action in irrigation.

Approaches to the financing of smallholder irrigation farming should be revisited, especially for typologies 1, 2, 4 and 5. Linking access to small loans financing to proof of permanent employment, ownership of a regularly serviced bank account and in the case of commercial banks, collateral, might not be appropriate for most smallholders. Due to climate and markets risks, yields vary considerably from one season to another and prices are not guaranteed. This, coupled with a lack of business track record (Diagne and Zeller, 2001), makes it difficult for smallholders to service debt. There is a need to develop financing models that resonate with the situation of smallholders, i.e., that account for smallholder typologies. This means financial services and products should be context specific. Success stories from Latin America show that it is possible to design farmer context-specific financial products that enhance small farmers' access to standalone credit and value chain finance (International Finance Corporation., 2014).

Efforts to support on-farm entrepreneurship development for farmers in typologies 1 and 2 are negatively affected by low PsyCap endowment. The challenge with a low PsyCap endowment is that it is entrenched and hence difficult to address with short-term and isolated actions. However, efforts should be made to improve PsyCap endowment of farmers through training, mentoring and exchange visits meant to motivate or inspire farmers to become more entrepreneurial. This conclusion is in line with a study by Narayanan *et al.* (2016) which showed that psychological correlates (self-esteem, self-efficacy and proactive attitude) are significant in influencing agri-preneurship among rural women entrepreneurs in India.

3.6 Summary

Heterogeneity in smallholders is a reality that makes 'one size fits all' interventions inappropriate and unproductive. Accounting for it is important for entrepreneurial development in smallholder irrigation. Moreover, the failure to account for PsyCap as

a key livelihood asset in the SLF meant that past farm typology studies were unable to capture heterogeneity introduced by differences in the PsyCap endowment among farmers. Thus, the chapter sought to develop typologies of farmers in smallholder irrigation, demonstrate how PsyCap can be accounted for in farmer typology formulation, and use the findings to inform on-farm entrepreneurship development.

The study demonstrates the practicality of measuring and integrating PsyCap in farmer typology formulation. The dominance of the PsyCap variables in defining the identified typologies shows its importance and the need to give it more attention in future similar studies. The results of the PCA and CA highlight the complexity introduced by the heterogeneity of smallholders. The study identifies five farmer typologies in smallholder irrigation, i.e., elderly and uneducated, cautious and short-sighted, financial capital and PsyCap endowed, social grant reliant, and land endowed rainfed farmers. Heterogeneity among the different farmer typologies is observed in PsyCap endowment, the extent of market access, participation in cooperatives and access to financial resources. Overall, the results confirm the need for farmer specific packages of support focusing on access to finance, market access, collective action and nurturing of positive PsyCap endowment. Blanket strategies are only relevant when addressing common challenges such as lack of entrepreneurial skills.

CHAPTER 4. EXPLAINING SMALLHOLDERS' ASPIRATIONS TO EXPAND IRRIGATION CROP PRODUCTION

4.1 Introduction

The chapter presents empirical methods and results on factors influencing smallholders' aspirations to expand irrigation farming with a focus on aspirations to expand land under irrigation. It uniquely employs the Heckman's two-step selection approach to model farmer aspirations. The premises behind this approach emanates from the hypothesis that farmers' aspirations to expand their irrigation activities are a two-stage decision process allowing those not interested to self-select out of the process. The chapter also recognizes that aspirations only make sense when they are achievable, recognizing willingness in the first step and ability in the second step decision. The findings of the chapter are used to draw implications and recommendations for improving rural livelihoods and economies through irrigation expansion.

The chapter is structured as follows. Section 4.2 presents the conceptual framework of the study. Section 4.3 provides the research methodology which discusses the analytical framework for measuring farmer aspirations and the empirical model used. Section 4.4 presents the results and discussions followed by a summary of the chapter in Section 4.5. Conclusions and recommendations are given in Chapter 6.

4.2 Conceptual framework

4.2.1 Defining farmer aspirations to expand irrigation farming activities

Aspiration is defined as 'hope and ambition to achieve something' (Oxford English Dictionary, 1989). 'Something' could refer to anything that is of value to the aspirant such as income, education, wealth and social status, among others. The definition is linked to words like 'mental capacity', 'will' and 'inclination'. It shows the level of willingness and desire to improve one's future situation. Aspirations are more future focused and hence are more concerned with satisfaction in the future (Ray, 2006; Bernard *et al.*, 2014). Explaining smallholders' aspirations can serve as an input to find

the way out of the vicious circle of rural poverty if realizing the aspirations contributes to poverty reduction. If decision makers thoroughly understand development linked aspirations of rural communities and why they are not achieved, it will make it easy to formulate strategies that enable such communities achieve them. It will also enable them identify the enablers, areas of disconnect and mechanisms of scaling-up the impacts. The study by Dalton *et al.* (2016) demonstrates that enhancing aspirations is a sufficient condition for escaping the poverty trap. The literature also shows that aspirations should be large enough to motivate a change in behavior but not too high to frustrate an individual (Ray, 2006; Genicot and Ray, 2017). In other words, to be of practical relevance, they should be within the means of the aspirant, i.e., accounting for resource endowments, capabilities, and institutional constraints.

The study of aspirations is embedded within literature in sociology, psychology, and economics. It is formulated around several theoretical models such as the aspirations-based learning (Karandikar *et al.*, 1998; Bendor *et al.*, 2001), reinforcement-based learning (Börgers and Sarin, 2000), occupational choice models (Mookherjee *et al.*, 2010) and aspirations-based theory of poverty traps or individual behavior (Ray, 2006; Genicot and Ray, 2017). The SLF (see Section 3.2) is also key to understanding the capability dimensions of aspirations. This study resonates with aspiration-based theories on individual behavior. It postulates that, like any other individual, smallholders have an 'aspiration window' and 'aspiration gap'. The aspiration window is defined as a cognitive space where they derive their aspirations from the achievement and lives of their peers. By observing the performance and lives of other farmers in scheme irrigation or with more irrigable land, smallholders in rainfed agriculture, food gardening or even some scheme irrigators formulate aspirations in their minds regarding their willingness to expand or transform into irrigation farming activities. The aspiration window is affected by opportunities and constraints facing each farmer which are bound to be different due to heterogeneity in socioeconomic, psychological and institutional factors. The farmers' 'aspiration gap' (Ray, 2006), in relation to the expansion of irrigation activities, is defined as the difference between the irrigable land they currently possess and the total which they aspire to put under irrigation farming. Genicot and Ray (2017) posit that it is this gap and not aspirations as such that will ultimately influence their future behavior and the outcome.

4.2.2 Factors influencing farmer aspirations

Arguments in the literature are that the rational choice theory is not sufficient to explain farmers' behavior or choices (Prendergrast *et al.*, 2008; Hallam *et al.*, 2012). Smallholders' rationality in decision making is bounded by uncertainty. Smallholders find themselves in a world of imperfect information characterized by both ambiguity and uncertainty (Wale, 2012). They lack perfect information on the choices and the alternatives that are available to them (Wani *et al.*, 2009). Their risk preferences are affected by several factors such as resource constraints, market imperfections and differences in access to support institutions (Mendola, 2007). Even when information is available, Wale (2012) posits that it is difficult for farmers to understand and process all the important information due to the limited human cognitive capacity. Thus, in this state of limitation, farmers make decisions influenced by one's goals, experiences and social networks (Wale, 2012; Bernard *et al.*, 2014). The decisions will differ depending on how one views the world, interprets his/her surroundings and understands him/herself (Gentner and Stevens, 2014).

In the light of the above, factors that influence farmers' aspirations to expand irrigation farming are classified into two categories, i.e., internal and external factors (Ray, 2006; Mekonnen and Gerber, 2016) (Figure 4.1). Internal factors are those that are not quantifiable and relate to the personal attributes of a farmer such as self-efficacy, perceptions, and entrepreneurial spirit. They define an integral part of the PsyCap of a human being (Luthans *et al.*, 2015) (the concept of PsyCap is explained in detail in Chapter 2). External factors are largely observable and relatively easy to measure. They include farmer characteristics (e.g., age, gender, experience, education), household factors (e.g., assets, social networks, income, and membership to cooperatives) and institutional factors (e.g., access to markets, credit and extension services).

The effect of gender on farmer aspirations is context-specific, depending on the structure of gender norms and relations in a community (Leavy and Smith, 2010). While the study by Kibirige (2013) did not show any influence of gender on farmer goals, Kosec *et al.* (2012) found that men have significantly higher aspirations than women. Similarly, the effect of age is also context-specific. While age was not associated with

aspirations of farming households in rural Pakistan (Kosec *et al.*, 2012), it had a significant impact on socially oriented goals (collective action, common purpose, trust and cultural norms and values) of farmers in Eastern Cape, SA (Kibirige, 2013). Aspirations are also influenced by education levels of farmers (Kosec *et al.*, 2012; Kibirige, 2013; Mekonnen and Gerber, 2016) and their experiences. Individual experiences determine personal desires and standards of behaviour (Ray, 2006). How people perceive their past successes and failures also influence their aspirations (Gutman and Akerman, 2008).

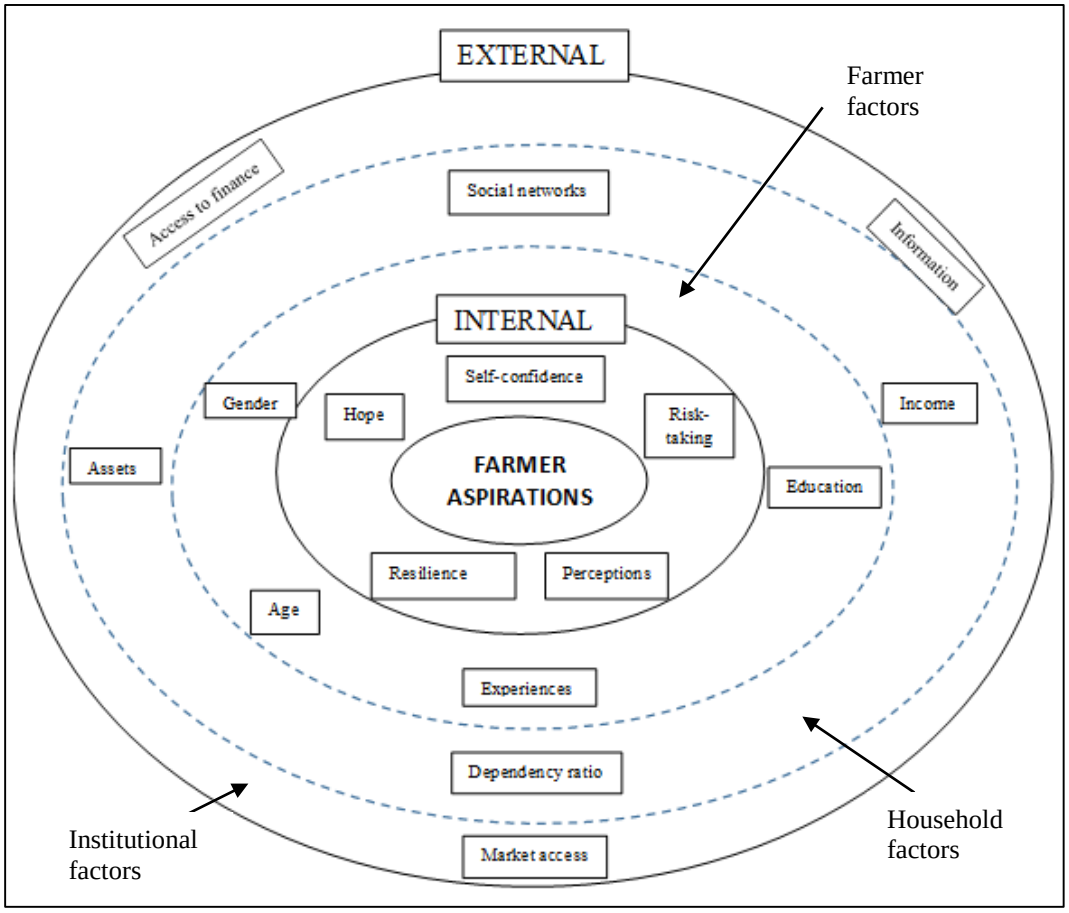


Figure 4.1. Factors influencing farmer aspirations

Source: Author's compilation drawing from the literature

Access to resources is one of the key factors that influence farmer aspirations (Gutman and Akerman, 2008; Kibirige, 2013; Bernard *et al.*, 2014; Mekonnen and Gerber, 2016). More access boosts the ability to achieve one's aspirations. Low aspirations or

aspiration failure is associated with poverty (Kibirige, 2013; Dalton *et al.*, 2016; Mekonnen and Gerber, 2016). Poor people lack the capacity to aspire, i.e., they lack resources and capabilities to invest and achieve their aspirations (Appadurai, 2004). This is particularly true for smallholder households where ownership of important farming assets might enhance a farmer's ability to expand irrigation farming activities.

As discussed earlier in this section, endowment with PsyCap and access to social capital also influence farmers' aspirations to expand irrigation farming activities. Farmer heterogeneity in perceptions and attitudes on several issues, e.g., social support and land tenure security, often result in different livelihood strategies and outcomes (Liu and Liu, 2016). These views are largely influenced by their socio-cultural context and positive PsyCap endowment (Zafirovski, 2013). Evidence from the literature suggests that positive PsyCap, especially self-confidence, increases farmer aspirations (Leavy and Smith, 2010; Kosec *et al.*, 2012; Kibirige, 2013).

Social networks do influence aspirations through the 'peer or demonstration effect', i.e., through observation of the experiences and achievements of others (Ray, 2006; Leavy and Smith, 2010; Bernard and Taffesse, 2012). The implication is that through kinship networks, farmers can either be motivated or demotivated with the experiences of other people in their community. Posel and Rogan (2017, p18) concluded that aspirations in SA are 'stimulated by the relative success of others'. Schaefer and Meece (2009) showed that social influences affect self-confidence while Ray (2006) indicates that through collective action they enhance sharing of information, with major implications on one's aspirations.

The study could not find any literature on the relationship between aspirations and access to markets or credit. However, smallholders with access to markets are expected to have higher aspirations to expand their farming activities. If farmers can see the unmet market demands for agricultural products that they can produce, they will aspire to expand their enterprises. Similarly, access to production credit will leverage farmers' ability to operate an increased land area.

4.3 Research methodology

4.3.1 Measurement of farmers' aspirations for irrigation expansion

Aspirations are attitudinal and endogenous (Mekonnen and Gerber, 2016; Genicot and Ray, 2017). Thus, it is not possible to directly observe and measure them. In the past, different approaches have been used to measure aspirations. Knight and Gunatilaka (2012) were more focused on assessing one aspect of people's aspirations, i.e., income aspirations, and hence they used a single dimension indicator. However, most studies use proxy indicators of several dimensions of people's aspirations in life (e.g. health, income, educational and social status aspirations) and then develop an aggregated and weighted index to derive a single proxy as an aspiration indicator (Beaman *et al.*, 2012; Kosec *et al.*, 2012; Bernard and Taffesse, 2014). Kibirige (2013) used a different approach by employing factor analysis to define four dimensions of farmers with different aspirations.

This study assesses aspirations for irrigation expansion only and not the broad spectrum of all smallholder aspirations in farming or life. Thus, it uses a single dimension aspiration indicator but adopts a slightly different approach to its measurement, informed by Bernard and Taffesse (2014). In relation to aspirations to expand irrigation farming activities, what matters most is to assess both farmers' willingness and ability to expand. Thus, the study adopted a two-step approach to assessing aspirations to expand irrigation farming activities. The first step (dependent variable denoted by SELECT) assesses farmers' interest (willingness) to expand irrigation faming activities with a simple "yes" or "no" question while the second step assesses their ability to expand or achieve their aspirations. Ability to expand land under irrigation (ASPIRE) was measured by obtaining the additional irrigable land that farmers want for expansion, after considering their capacity. Farmers were asked the following questions:

a) Would you be in interested in expanding your farming operations, i.e., adding small-scale irrigation plots to your current gardening and rainfed farming operations or increasing your plots in the irrigation scheme? 1=Yes 0= No

b) If “Yes”, considering your capacity (resources endowments and capabilities), by how much, in terms of land in hectares, would you want to expand your farming operations?

Smallholders interested in expansion constituted 91% of the sample population. However, 80% of these cited different capacity challenges as holding them back from expansion. Nonetheless, considering their current capacity, the mean land one aspires to expand with is 5.9 ha and is higher for community gardeners, rainfed farmers and home gardeners compared to independent and scheme irrigators. At present, mean irrigable land holding is 1.05 ha (scheme irrigators - 1.3 ha, independent irrigators - 1.7 ha, home gardeners - 0.6 ha and community gardeners - 0.6 ha) which is slightly lower than the 1.5 ha reported by Denison and Manona (2007b). Land utilization is 92% which means most of the farmers are fully utilizing the available land, implying that land is the single most constraint and there is no much room for expansion on current land holdings.

4.3.2 The empirical model to explain farmers' aspirations to expand crop irrigation farming

The study used the Heckman two-step sample selection model to evaluate factors determining aspirations of farmers to expand crop irrigation farming activities. The model is more suitable for this study compared to other corner solution models such as the Tobit and the Double Hurdle. This is because the dependent variable is censored in such a way that there is potential for selectivity bias. In such limited dependent variables, censoring at zero results in a non-random sample whose estimation causes bias due to the correlation of the error term with the independent variables (Vance, 2009). The use of the Tobit or Double Hurdle models, with such data is not possible because the dependent variable (outcome variable), i.e. ‘amount of land a farmer wants to expand’ exhibits incidental truncation for those farmers who are not interested in expansion. The unobserved zeros make it impossible to use corner solution models (Ricker-Gilbert *et al.*, 2011). However, the two-step estimator developed by Heckman (1979) can address this bias. Heckman’s approach first estimates a probit model for selection and then introduces a correction factor, the Inverse Mills Ratio (IMR),

calculated from the probit model into the second stage. The second stage estimates an OLS only on the non-censored observations.

The selection equation shown as (Eq4.1) models the farmers' interest in expanding irrigation farming activities, i.e.

$$W = \alpha' Z_i + u_i \tag{4.1}$$

where W denotes farmers' willingness to expand irrigation farming operations, Z_i represents the explanatory variables, α' is the associated vector of coefficients and u_i is the error term which is normally distributed. After obtaining the predicted values from the probit (Eq4.1), the second stage estimates the farmers' ability to achieve their aspiration through an OLS regression (Eq4.2) of the amount of land (in hectares) a farmer wants to expand with (L_i) and explanatory variables X_i. L_i is only observed if W=1.

$$E(L_i \mid W_i = 1, X_i) = \beta' X_i + E(\varepsilon_i \mid W_i = 1) = \beta' X_i + E(\varepsilon_i \mid u_i > \alpha' Z_i) \tag{4.2}$$

where L_i is the dependent variable, and β' is the associated vector of parameter estimates of explanatory variables (X_i). Let ρ represent the correlation between the error terms of Eq4.1 (u_i) and Eq4.2 (ε_i). If the error terms have a bivariate normal distribution (Greene, 2012), the expected value of ε_i conditional on u_i is given as:

$$E(\varepsilon_i \mid u_i > \alpha' Z_i) = \rho \sigma_\varepsilon \sigma_u \left[\frac{\phi(\alpha' Z_i)}{\Phi(\alpha' Z_i)} \right] \tag{4.3}$$

where σ_ε and σ_u are the error variances of the probit and OLS models. According to Greene (2012), when using probit to estimate the selection equation, σ_u is assumed to be 1. The term in brackets at the right side of Eq4.3 represents a correction factor known as the Inverse Mills Ratio (IMR). It is estimated by dividing the normal density function, ϕ, by its cumulative function, Φ. Inserting the IMR (λ_i) in Eq4.2 above controls for any selection bias and the outcome equation becomes:

$$E(L_i \mid W_i = 1, X_i) = \beta' X_i + \rho \sigma_\varepsilon \lambda_i \tag{4.4}$$

The coefficient of the IMR is the error covariance, and if significant, it shows the presence of selection bias (Cameron and Trivedi, 2010).

There are two estimation options for the Heckman model in Stata 13, i.e., the maximum likelihood and the two-step estimations (StataCorp, 2013). Attempts to estimate the model through maximum likelihood estimation were made but they did not yield any result and hence the estimation of the two-step model instead. The two-step model relaxes the bivariate normality assumption and hence is more robust but might be less efficient (Cameron and Trivedi, 2010). One challenge that was noted with the Heckman model is the potential of multicollinearity between the IMR and the independent variables of the model (Belsley *et al.*, 2005; Bushway *et al.*, 2007). Thus, the Variance Inflation Factor (VIF) and condition number were calculated to check for multicollinearity in the outcome equation. The average VIF for the explanatory variables was 1.22, well below the critical value of 10 (Gujarati and Porter, 2009) and the condition number was 30.19 which is just at the acceptable threshold of 30 (Belsley *et al.*, 2005). Thus, there were no problems of multicollinearity among the explanatory variables.

The Breusch-Pagan-Godfrey test was conducted on the outcome equation to check for the presence of heteroskedasticity. This test was significant at $p < 0.01$ indicating that coefficients from the outcome equation might be biased. To overcome heteroskedasticity, the same equation was reestimated with robust standard errors. The results from both estimations are presented. Furthermore, due to the potential endogeneity between the dependent variable in the outcome equation and the proxy indicator for household income invested in agriculture (Knight and Gunatilaka, 2012; Kosec *et al.*, 2012), the Durbin-Wu-Hausman test recommended by Davidson and MacKinnon (1993) was performed to test for endogeneity. The results show an insignificant test result (F-statistic = 0.17; $p = 0.67$), and hence the study rejects the hypothesis that there is endogeneity between land that a farmer wants for expansion and the expenditure income ratio.

a) Marginal Effects

The interpretation of the marginal effects from the Heckman model is not always straight forward, especially for the outcome equation that has variables that also appear in the selection equation (Vance and Buchheim, 2005). For the outcome equation, the effect of the explanatory variables on L_i takes two forms, i.e., the direct effect of the X_i

on the mean of L_i and the indirect effect if the explanatory variable also appears in the selection equation. Following Sigelman and Zeng (2000), this effect is given by:

$$\frac{\partial E(L_i \mid W > 0, x)}{\partial X_i} = \beta_k - \alpha_k \rho \sigma_\varepsilon \lambda(\lambda + \alpha' Z) \tag{4.5}$$

where β_k gives the effect of the respective explanatory variable on the amount of land a farmer wants for expansion and $\alpha_k \rho \sigma_\varepsilon \lambda(\lambda + \alpha' Z)$ is the effect of the change in the explanatory variable on the probability of having an interest in expansion. The Stata estimation used in this study internally addresses this issue.

4.3.3 Explanatory variables included in the regression

Table 4.1 below describes all the explanatory variables that were used in the analysis. The table also shows the descriptive results for farmers interested and not interested in expanding land under crop irrigation activities. The explanatory variables were selected from the literature presented in section 4.2.2 above. The dependency ratio (DEP_RATIO) was adjusted for chronically ill members within the productive age range (16-65). Travelling time to the nearest town (MKT_TOWN) was used as a proxy for market access. Perceptions of local or social conflicts (LOC_SOC) show farmers' answers to whether they agree or disagree that local and political conflicts are a farming constraint. The scheme dummy (SCHEME_DM) captures differences between smallholders irrigating in the irrigation schemes versus all the other farmers. The rainfed farmer dummy (LAND_DRY_FR) is a farmer typology variable showing mostly male farmers in rainfed farming. The correlation coefficient between this variable and gender was not statistically significant and very low (chi-value = 0.019). The details of this typology are provided in Section 3.4.4. The dummy for the objective in farming (OBJ_FARM) shows differences between subsistence farmers and those whose main objective is producing for the market.

Farming expenses to income ratio (FM_EXP_RATIO) is a proxy of the proportion of annual household income invested in agriculture. The argument is that aspirations to expand irrigation farming activities are likely to be affected by household income that is invested in agriculture and not income per se. Household physical capital assets value

(LOG_HHASSETS) is the log of the total value of assets owned by a household and includes livestock, farming equipment, and other physical assets. POS_PYSCAP is the principal component index for positive PsyCap. Details of how this PsyCap dimension was obtained are provided earlier in Section 3.4.2. Smallholders with positive PsyCap are self-driven, ambitious, resilient and risk-taking.

After a certain age, old people are more likely to abandon many of their aspirations (Schwandt, 2016). This means the relationship between aspirations and age could be non-linear. However, this was not the case in this study. There were no statistically significant differences in interest to expand land under irrigation ($p = 0.320$) and also the land that one wishes to expand with ($p = 0.914$) between smallholders 64 years and below and those above. An attempt to include the square of age in the model also confirmed this, the coefficients of both age and age square had the same signs. This just demonstrates the importance of irrigation farming to rural livelihoods. Once irrigation land has been allocated, *ceteris paribus*, its use rights remain within the family from one generation to the other. Hence, the square of age was excluded from the independent variables of the model.

Table 4.1. Description of explanatory variables used in the Heckman two-step selection model

Variables	**Description**	**+/-**	**Not interested (n=31)**		**Interested (n=297)**		**Total**	
Continuous variables			*Mean*	*St.dev*	*Mean*	*St.dev*	*Mean*	*St.dev*
AGE_FR	Age of household head (years)	+	51.00	13.20	48.68	11.77	48.90	11.91
EDU_LEVEL	Education level (years of schooling)	+	3.77	4.60	4.33	4.50	4.28	4.50
DEP_RATIO	Dependency ratio	-	0.71	0.54	0.87	1.06	0.85	1.02
LOC_SOC [a]	Perceptions on local or social conflicts (1-5 Likert scale)	+/-	3.35	1.45	3.33	1.34	3.33	1.34
FM_EXP_RATIO	Ratio of farming expenses to total income	+/-	0.11	0.20	0.16	0.24	0.15	0.24
LOG_HHASSETS	Log of physical capital asset value	+	3.85	1.14	4.15	0.77	4.12	0.81
MKT_TOWN	Travelling time to nearest town (minutes)	-	41.84	25.35	35.57	19.09	36.16	19.80
POS_PSYCHO	PC index for positive psychological capital	+	-2.33	0.72	0.24	0.65	0.00	1.00
Dummy variables								
LOCATION	The area under study (1 if Makhathini and 0 otherwise)	+/-	0.87	0.34	0.64	0.48	0.66	0.47
GENDER	Gender (1 if male and 0 otherwise)	+/-	0.10	0.30	0.38	0.49	0.35	0.48
ACC_CREDIT	Access to credit (1 if yes and 0 otherwise)	+/-	0.35	0.49	0.38	0.49	0.38	0.49
LAND_SEC	Insecure land ownership constraint (1 if yes and 0 otherwise)	-	0.48	0.51	0.54	0.50	0.53	0.50
MEM_COOP	Membership to a cooperative (1 if member and 0 otherwise)	+	0.81	0.40	0.66	0.47	0.67	0.47
MEM_SOC_GRP	Membership to other social groups (1 if member and 0 otherwise)	+	0.47	0.51	0.53	0.50	0.52	0.50
SCHEME_DM	Scheme irrigation dummy (1 if scheme irrigator and 0 otherwise)	-	0.29	0.46	0.34	0.47	0.33	0.47
OBJ_FARM	Objective in farming dummy (1 if objective is food self-sufficiency and 0 otherwise)	-	0.39	0.50	0.31	0.46	0.32	0.47
LAND_DRY_FR	Land endowment farmer typology dummy (1 if land endowed farmer typology and 0 otherwise)	+/-	0.19	0.40	0.09	0.29	0.10	0.31

[a] Likert scale measurement: 1- strongly disagree, 2- disagree, 3- neutral, 4- agree and 5- strongly agree

Source: Survey data, 2016

4.4 Heckman two-step selection model results and discussion

Table 4.2 presents the empirical results from the Heckman two-step regression model. The Wald test is significant at $p < 0.01$ showing that the explanatory variables are jointly explaining the variance in the model well. There were no problems of multicollinearity among the explanatory variables. Following preliminary analysis in Section 4.3.1 above, an assumption was made in this study that the farmers' interest (or willingness) to expand (first stage decision) was taken without much consideration of one's capacity. Hence, the explanatory variables in the selection equation exclude most indicators for resource endowment or farmer capabilities. However, following the SLF and work by Luthans *et al.* (2015), these variables are included in the outcome equation which is a proxy for farmers' ability to achieve their aspirations of expanding land under irrigation farming activities.

a) Determinants of farmers' aspirations to expand irrigation crop farming activities

Five factors significantly affect smallholders' aspirations to expand. PsyCap (POS_PSYCAP) has a positive statistically significant effect on aspirations for expansion. Farmers with positive PsyCap endowment are 9% more likely to be interested in expanding. The results are similar to conclusions of most aspiration studies that show that aspirations in life are associated with self-confidence (Gutman and Akerman, 2008; Leavy and Smith, 2010). Self-confidence is critical in defining the entrepreneurial characteristics of a farmer. It is the belief in one's own capability to perform the roles and tasks of an entrepreneur (Pyysiäinen *et al.*, 2006, p7). Farmers who are confident in themselves have the belief that they can succeed in whatever situation and this acts as a motivation to aspire for more in life. This highlights the importance of building positive PsyCap for effective smallholder agricultural transformation.

Table 4.2. The Heckman two-step selection model results

	Probit regression		**OLS regression**		
	Coef.	**Marginal effect**	**Coef.** *(normal std. err)*	**Coef.** *(robust std. err)*	**Marginal effect**
	SELECT		ASPIRE	ASPIRE	
LOCATION	-0.286 (1.583)	-0.006	-0.291 (0.712)	-0.291 (0.740)	-0.196
GENDER_FR	1.395 (1.110)	0.027	1.035 (0.684)	1.035 (0.653)	0.697
AGE_FR	-0.042 (0.045)	-0.001	0.046 (0.032)	0.046 (0.031)	0.031
EDU_LEVEL	0.088 (0.106)	0.002	0.060 (0.082)	0.060 (0.070)	0.040
ACC_CREDIT	2.247[c] (1.353)	0.044	-0.541 (0.636)	-0.581 (1.209)	-0.364
LOC_SOC	-0.785 (0.490)	-0.015	0.926[a] (0.239)	0.926[a] (0.278)	0.624
MEM_COOP	-0.152 (1.057)	-0.003	-0.175 (0.685)	-0.175 (0.826)	-0.118
MEM_SOC_GRP	2.469[c] (1.514)	0.048	0.364 (0.650)	0.364 (0.666)	0.245
MKT_TOWN	-0.065[c] (0.034)	-0.001	-0.029[c] (0.017)	-0.029[c] (0.015)	-0.020
POS_PSYCAP	4.653[b] (2.006)	0.090	0.146 (0.540)	0.146 (0.542)	0.098
LAND_SEC	-1.898[c] (1.080)	-0.037			
OBJ_FARM	0.718 (1.247)	0.014			
DEP_RATIO			0.091 (0.296)	0.091 (0.322)	0.061
FM_EXP_RATIO			-0.581 (1.358)	-0.541 (0.668)	-0.392
LOG_HHASSETS			0.947[b] (0.417)	0.947[b] (0.461)	0.638
SCHEME_DM			0.279 (0.702)	0.279 (0.887)	0.188
LAND_DRY_FR			1.910[c] (1.076)	1.910 (1.191)	1.287
Mills_lambda			-1.621 (2.480)	-1.621 (1.540)	
_cons			-2.809 (2.655)	-2.809 (2.831)	
Rho			-0.314		
Sigma			5.161		
Observations			**324**		
Wald chi2 (15)			**39.8[a]**		

In parenthesis are standard errors; [a, b, c] significant at the 1%, 5% and 10%, respectively

Source: Survey data, 2016

Access to credit (ACC_CREDIT) significantly influences farmers' aspirations to expand. Farmers with access to credit are 4% more likely to be interested in expansion compared to those without access. Other studies also emphasize the importance of access to credit to financing and growth of smallholder farming (Poulton *et al.*, 2006; Sinyolo *et al.*, 2016). As noted earlier in Section 2.3.4, most credit in the study area is accessed from informal savings and lending clubs and loan sharks at very high interest rates. This makes it expensive and beyond the reach of many smallholders and thus affecting farming operations.

Membership to other social groups (MEM_SOC_GRP) has a positive statistically significant impact on farmers' interest in expansion. Members of other social groups are approximately 5% more likely to aspire to expand their farming activities. These groups include religious associations, burial societies and savings clubs which are mostly dominated by women. Social networks are sources of inspiration, knowledge sharing and support for farmers and are important in smallholder farming. Leavy and Smith (2010) state that the extent of social-embeddedness will affect aspiration formation. This reinforces the need to support institutions that promote social interactions and learning in the communities such as farmer associations and cooperatives.

Land security constraints (LAND_SEC) have a negative statistically significant influence on farmers' aspirations to expand. Farmers facing land tenure security constraints are 4% less likely to be interested in expansion compared to those without such constraints. Earlier results in Table 4.1 show that the mean for LAND_SEC is 0.53 which means that there are differences in the level of tenure security for the sampled farmers. There are two reasons why some farmers felt insecure. At the time of the survey there were discussions by the authorities (traditional leadership and the scheme board of trustees) on land reallocations in Makhathini Irrigation Scheme on the grounds of fairness. This meant that some of the PTO rights could be revoked and the most affected would be farmers not originally from Jozini area but holding PTO rights in the scheme. Secondly, some of the sampled farmers are using rented/leased land from those holding the PTO rights. Frequent disputes regarding land use decisions and sometimes payments occur between the two parties. Thus, land insecurity, whatever source, works

against the transformation of smallholder irrigation farming. There is a need for investing more time in building mechanisms for resolving land-related disputes. Ostrom and Benjamin (1993) indicated that the chances of farmer-managed irrigation schemes enduring without such conflict resolution mechanisms are close to none.

The travelling distance to the nearest town/market (MKT_TOWN) has a statistically significant negative effect on farmers' interest in expansion, i.e., the further away farmers are from the nearest town or market, the more unlikely they will aspire to expand their farming activities. Kosec *et al.* (2012) showed similar findings of the association of higher farming aspirations with improved communication and transport links with other localities. Pender and Gebremedhin (2006) showed that improved road infrastructure and access to towns has significant impact on input use and crop productivity. Irrigation expansion requires enhanced access to inputs, information and support services while, on the other hand, the increased marketable surplus should be matched by better access to high value markets. This requires an improvement in the road infrastructure and transport support services linking the smallholder irrigation farming communities to the nearest towns. Hence, the Agri-Parks programme coordinated by the Department of Rural Development and Land Reform could be integrated within the irrigation expansion programme and support the development of rural infrastructure that enhance access to both input and output markets by rural farmers.

b) Determinants of farmers' ability to achieve their aspirations

The estimation of the outcome equation with robust standard errors shows three factors affecting the ability to achieve farmer aspirations to expand. Interpretation of the results from the outcome equation with heteroscedastic properties would have erroneously made the land endowed farmer typology variable significant. The conditional marginal effects calculated at the means for the outcome equation in Table 4.2 show the impact of the explanatory variables on the amount of land a farmer wants for expansion after correcting for the representativeness of the sample.

Local or social conflicts regarding access to productive resources (LOC_SOC) have a positive and statistically significant impact on land that a farmer wants for expansion. Given that expansion could entail allocation of land on newly established irrigation schemes, farmers experiencing local conflicts regarding access to productive resources, especially irrigable land, are more inclined to favour the irrigation land expansion programme. This demonstrates that irrigable land is a scarce resource that should be equitably and sustainably managed for the greater good of all in the rural communities.

Physical assets ownership (LOG_HHASSETS) also has a positive and statistically significant impact on the farmers' ability to achieve their aspirations. Farmers with more physical assets such as livestock and farming equipment, among others, want to expand with more land than those without assets. Livestock assets can be sold to meet immediate household needs including acquiring of inputs or other agricultural related investments (Rumosa-Gwaze *et al.*, 2009; Chaminuka *et al.*, 2014). This is critical since additional financial resources are required for expansion, and the sale of livestock can generate the much-needed income for such investments. Kosec *et al.* (2012) show similar results that advance the thesis that wealthier people can invest to achieve their aspirations which is not the case for poor households. Furthermore, cattle also act as a source of draught power and together with ownership of farming equipment, it enhances the farmer's ability to operate bigger land sizes. Thus, building the household's resource base increases the chances of realizing their aspirations for expansion.

Access to markets does not only influence farmers' interest to expand but also their ability to achieve their aspirations. The coefficient of travelling time to the nearest town/market (MKT_TOWN) has a significant negative impact on the farmers' ability to expand. A one-minute increase in travelling time to the nearest town results in a 0.02 ha decrease in the land that a farmer wants for expansion after correcting for selection. Market access can act as an incentive for farmers to aspire to increase land under production (Van der Heijden and Vink, 2013; Sinyolo *et al.*, 2016). In the study areas, limited access to markets has resulted in the loss of produce and value and consequently, reduced land under production.

Though not significant in the outcome equation, access to credit affects the selection and outcome decisions differently. While it positively influences farmers' interest in expansion, it has a negative impact on farmers' ability to achieve their aspirations. Most of the credit is for consumptive purposes and is available at very high interest rates as indicated earlier under Section 2.3.4. At face value, such credit seems cheap since payment is in very small installments over a longer period. However, in the long term farmers can be trapped in a vicious cycle of debt which increases their vulnerability and reduces their ability to achieve their aspirations to expand. Thus, policy should promote the development of rural financial markets with linkages to the wider financial economy. These markets should improve access to affordable, agricultural production credit, not easy consumption credit which depletes farmers' resources.

4.5 Summary

Exploring opportunities and constraints to expand irrigation farming activities in and around the schemes is vital for unlocking on-farm entrepreneurship in SA. Aspirations of farmers affect their decisions and behaviour regarding the expansion of smallholder irrigation activities. Aspirations-based theories of individual behaviour and the SLF are important in understandings aspirations and their capability dimension. The chapter aimed to determine factors that influence the aspirations of smallholders to expand irrigation farming activities using the Heckman two-step sample selection model. Aspirations for expansion are modelled as a two-stage decision process involving willingness to expand in the first stage and ability to achieve those aspirations in the second stage.

The results show five factors that affect smallholders' willingness to expand irrigation farming activities. PsyCap, access to credit and social networks positively influence smallholders' willingness to expand irrigation farming activities while land security concerns and travelling time to nearest town/market negatively affect the same. The results also show three determinants of smallholders' ability to achieve their aspirations on expansion, i.e., local or social conflicts, asset ownership and travelling time to nearest town/market. Local or social conflict and asset ownership positively influence the capacity to achieve aspirations to expand while travelling time to nearest market

has a negative effect. Overall, the study reveals important findings critical for the rural development policy. Conclusions and policy implications of these findings are contained in Chapter 6.

CHAPTER 5. SMALLHOLDER WILLINGNESS TO PAY AND PREFERENCES IN MANAGING IRRIGATION WATER: A CHOICE EXPERIMENT APPROACH

5.1 Introduction

The chapter assesses smallholders' preferences in managing irrigation water resources and their WTP for irrigation water. Preferences in managing irrigation water are assessed from three angles, i.e., water management, multiple uses of water and cropping patterns. These represent the institutional arrangements in irrigation water management, other possible uses of irrigation water and the demand for irrigation water. The chapter introduces a relatively new approach to irrigation water valuation in SA, the CEM.

Regarding the structure of the chapter, Section 5.2 presents details of the methods of data analysis, i.e., why the CEM is preferred, the theoretical framework and the design of the choice experiment. Presentation and discussion of the results then follow in Section 5.3. The last section provides a summary of the chapter while the conclusions and recommendations are part of Chapter 6.

5.2 Research methodology

5.2.1 Why the CEM?

The CEM model has several advantages over the other stated preference methods such as the CVM. As noted in Section 1.2.4, it is a better method, especially when considering heterogenous preferences for a given good. The approach can model heterogeneity in irrigation water services and show farmer preferences through estimation of the implicit prices of those services. Abu-Zeid (2001) indicates that this is important as it leads to higher water use efficiency. Moreover, unlike the CVM, the choice experiment asks several preference questions, and thus, it often requires a small sample of data to achieve similar accuracy in water valuation estimates (Barton and

Taron, 2010). The CEM overcomes biases associated with the 'warm glow' effect[4] and strategic positioning by respondents often encountered in CVM (Birol *et al.*, 2006). This is because the values for the resource are already stated in the choices, and the respondent is not required to indicate any values. Due to the design of the choice experiment, the respondents are also familiar with the attributes including the price or cost of the resource. For these reasons, the method was adopted in this study.

The application of the CEM to irrigation water valuation is relatively new, with only a few studies (e.g. Kunimitsu, 2009; Barton and Bergland, 2010; Bhaduri and Kloos, 2013). However, the method has been widely used in the past across different studies that seek to determine non-market values, particularly for environmental goods. For instance, Jaeck and Lifran (2009) used CEM to determine the sensitivity of farmers to payment of agro-environmental services while Kragt and Bennett (2008) derived non-market values attached to different attributes of a catchment area using CEM. CEM has also found use in pastoral studies such as the study by Ouma *et al.* (2006) on the economic values of preferred traits in breed improvement programmes whilst in technology adoption studies (such as Asrat *et al.*, 2010; Lambrecht *et al.*, 2013), CEM is applied to explore how technology traits affect farmers' adoption decisions of improved crop varieties. These studies show the strength of the CEM approach in determining the WTP for services derived from a given resource such as irrigation water.

5.2.2 Theoretical framework of the CEM

The theoretical foundation for choice modelling, the random utility model, is used to analyse the farmer's utility maximization problem (McFadden, 1973). It is founded on Lancaster's characteristics theory which indicates that it is not the good but the attributes it possesses that determine its value to a consumer (Lancaster, 1966). The decision maker is the only one with knowledge of this utility. What the researcher observes are the different levels of the attributes and not the utility of the decision maker (Train, 2009). The study assumes that smallholders WTP for irrigation water is

[4] Warm glow effect occurs in the CVM when respondents express positive WTP for a good or service because it makes them feel good that they are doing something that is socially right (Birol *et al.*, 2006).

determined by the utility they derive from the use of that water. The utility depends on their preferences for the various factors which impact on irrigation water use. At any one time, given a set of alternatives, rational farmers choose an alternative that gives them the highest utility.

To illustrate this, if a farmer's utility depends on a choice made from a given choice set (*J*) of irrigation water use options (explained in Section 5.2.3), the utility function for the farmer is given by:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad j = 1, 2, \ldots\ldots, J \qquad (5.1)$$

where, for any farmer *i*, a given level of utility *U* is associated with alternative choice *j*. The utility function for each farmer has two parts, i.e., an observable part (*V)* as well and an unobservable part (*ε). V* is assumed to be a linear function of the attributes and any socio-economic characteristics of the farmer such as gender, income and resource endowment. The exact estimation of the model depends on the assumptions made about the probability distribution of ε_{ij}. If ε_{ij} is independent and identically distributed with extreme value distribution, one should estimate the conditional logit model (Greene, 2012). In this model, the probability of individual farmer *i* choosing alternative *j* can then be expressed as:

$$P_{ij} = \frac{\exp(V_{ij})}{\sum_{j=1}^{J}\exp(V_{ij})} = \frac{\exp(\beta' X_{ij})}{\sum_{j=1}^{J}\exp(\beta' X_{ij})} \qquad (5.2)$$

where X_{ij} are all the observed factors and β' represents parameters obtained from the model. If there are *m* attributes, V_{ij} is expressed as:

$$V_{ij} = \beta_0 ASC + \beta_1 X_{1j} + \beta_2 X_{2j} + \beta_m X_{mj} \qquad (5.3)$$

where β_m is the coefficient of attribute X_m. The *status quo* or current situation is represented by *ASC* which is a dummy variable with 1= choice of current status and 0= any other alternative. The inclusion of the *status quo* provides an opt-out choice for those farmers not interested in any of the suggested alternatives.

However, if the error terms are correlated and not identically distributed, the independence from irrelevant alternatives (IIA) assumption of the conditional logit model is violated (Hausman and McFadden, 1984). The likelihood of this happening is high in the presence of heterogeneity in farmer preferences and socioeconomic factors. In such situations, estimating the conditional logit would result in biased estimates. The recommendation is to use the mixed logit, a less restrictive model that allows random taste variation and correlation in the error terms (Train, 2009; Greene, 2012). In this study, after estimating the conditional logit model, a test for the IIA assumption using the Hauseman-McFadden test was conducted. The significant test results meant that the IIA assumption did not hold and hence the mixed logit model was estimated.

In the mixed logit model, the probability *P* of individual farmer *i* choosing alternative *j* then becomes:

$$P_{ij} = \int \left(\frac{\exp(\beta' X_{ij})}{\sum_{j=1}^{J} \exp(\beta' X_{ij})} \right) f(\beta) d\beta \qquad (5.4)$$

where $f(\beta)$ is the distribution function for β and X_{ij} is a vector of observed variables. In the estimation of the mixed logit, the non-price attributes were randomized while the cost attribute was treated as non-random (Layton, 2000; Lee *et al.*, 2014). This was a preferred option because it allowed the distribution of the WTP to be the same as that of the attribute (Scarpa *et al.*, 2008), making it easier to compute WTP estimates.

5.2.3 The design of the choice experiment

Three critical steps are followed when designing a choice experiment. First, is the establishment of attributes of interest, then assigning levels and finally, the design of the choice sets (Mangham *et al.*, 2009; Johnson *et al.*, 2013). How each step is conducted has implications for the validity and credibility of the results. In this study, complementary processes were followed to identify and assign levels to attributes of irrigation water in the target communities. The processes include literature review (including policy documents), in-depth discussions with farmers, field observations and key informant interviews with relevant stakeholders. For selection, an attribute had to be relevant to the agricultural policy direction in SA, hold significant value to the

smallholders in relation to the payment of water and have literature which supports its importance. This process resulted in four attributes (Table 5.1)

Table 5.1. Attributes used in the choice experiment[5]

Attribute	Level	Expected impact on choice
Membership to an organization governing water use	- Yes - No (*status quo*)	+
Multiple uses of irrigation water	- Irrigation only (*status quo*) - Irrigation and domestic use - Irrigation and livestock - Irrigation, domestic and livestock use	+
Number of crops per season	- One crop per season (*status quo*) - Two crops per season - Three crops per season - Four and above crops per season	+
Annual payment for irrigation water (ZAR)	- 2,500/ha (*status quo*) - 3,000/ha - 5,000/ha - 7,000/ha	-

Source: Survey data, 2016

The attribute 'membership to an organization governing water use' represents institutional arrangements in the irrigation schemes and knowledge on collective water management. Water governance and management of irrigation schemes are key aspects of sustainable management and success of smallholder irrigation in SA (Muchara *et al.*, 2014b). Currently, water management is implemented through cooperatives or a third-party institution managing the irrigation schemes on behalf of farmers. According to the National Water Act of 1998 (Department of Water and Sanitation, 1998), the water allocation rights are obtainable by any individual or organization drawing water from a

[5] A combination of the attribute levels with *status quo* in parenthesis represents the opt out scenario used in the study. It is assumed that in the absence of institutional challenges farmers in both schemes will face the same water charges. In the absence of any other information, the same *status quo* is also used for out-of-scheme farmers.

surface or groundwater resource. However, resource poor farmers are encouraged to form cooperatives to assist them, not only in water management but also access to information, finance and high value markets.

The attribute ‘multiple uses of irrigation water’ represents the possibility of using irrigation water for other uses other than irrigation. The lack of consideration of the different uses of irrigation water results in undervaluation and inefficient allocation of the resource (Meinzen-Dick and Van Der Hoek, 2001). The current water pricing policy (see Department of Water and Sanitation (2015)) does not consider these other different dimensions in irrigation water valuation. Currently, 20% of the sampled smallholders use irrigation water solely for irrigation purposes while the remaining majority use it also for other purposes (watering of livestock and/or domestic/household use). Though not desirable, since access to water is a human right, authorities indicate that it is possible to fence off the canal or use a pipe system that prevents access outside of the schemes.

The attribute ‘number of crops per season’ characterizes the demand for irrigation water by each farmer, i.e., irrigation intensity. Farmers growing more crops (multiple crops or more quantities of the same crop) are more likely to use more water per season, yet they pay the same amount of annual water fees per hectare. Currently, some scheme irrigators voiced their concerns with the non-volumetric charging system and believe that even in the absence of water meters, those growing more crops should pay more for water.

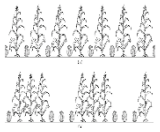
The attribute ‘annual payment for irrigation water per ha’ includes both raw water fees and water service charges (electricity and maintenance) paid by smallholders to access irrigation water. Raw irrigation water is subsidized, with farmers paying minimal fees or nothing at all. However, to some extent, they contribute to the maintenance of water infrastructure and pumping charges. Those from MIS currently pay a subsidized charge of approximately ZAR2,500/ha/year. The charges include raw water and other related services (electricity and water infrastructure maintenance). Smallholders from NIS pay almost three times (ZAR7,200/ha/year) more since they cater for the full cost of water

provision. Though they have no charge for raw water, their electricity bill translates to an average of approximately ZAR600/ha/month.

In designing the choice sets, the study aimed to achieve a balance between statistical efficiency of the design and response efficiency. Statistical efficiency refers to 'minimizing the confidence intervals around parameter estimates in a choice model' while response efficiency deals with the 'measurement error resulting from respondents' inattention to the choice questions or other unobserved, contextual influences' (Johnson *et al.*, 2013, p6). Statistically efficient designs are orthogonal (levels of each attribute are statistically independent of each other), balanced (each attribute level appears in equal proportion across choices) and minimize overlap (repeating of the attribute level with a choice set) (Ryan *et al.*, 2012). Due to the practical impossibility of presenting the full set of choices ($128\,(2\times4^3)$), a fractional factorial design was adopted in the study (Kuhfeld, 2010).

The orthogonal design option in IBM SPSS v 24 (IBM Corp, 2016) was used to generate a choice set of 16 alternatives. Pairwise correlation coefficients of the attributes showed that the choice set met the orthogonality criterion and was also balanced. To increase response efficiency, a compromise was made on the minimum overlap condition. Johnson *et al.* (2013) state that overlap improves response efficiency by reducing the cognitive burden of evaluating huge attribute differences in a short space of time. However, this was kept to a minimum to limit the negative impact on the design efficiency. Of the 16 alternatives, one was similar to the *status quo* scenario (see Table 5.2) and hence was dropped from the list because it did not add any new information. The remaining list of 15 alternatives was divided into five choice sets of four alternatives including the opt out choice. Pretesting results showed that smallholders could respond to these with minimum difficulties. The literature suggests a practical limit of 18 choice sets of two that an individual can respond to with no difficulties (Mangham *et al.*, 2009).

Table 5.2. Example of a choice set employed in the study

Attributes		Option 1	Option 2	Option 3	Status quo
	Membership to a water organization	No	No	Yes	No
	Multiple uses of water	Irrigation only	Irrigation, domestic and livestock	Irrigation and domestic use	Irrigation only
	Number of crops per season	Three crops per season	Two crops per season	At least 4 crops per season	One crop per season
	Annual payment of water (ZAR/ha)	7000	3000	2500	2500
Please tick only one		☐	☐	☐	☐

Source: Survey questionnaire, 2016

5.3 Results and discussion

5.3.1 The comparative descriptive results

Table 5.3 shows the characteristics of the respondents in respect of the demographics and other variables related to the attributes used in the choice experiment. Comparison by farmer category shows statistically significant differences in the number of crops grown per season, cattle ownership, multiple uses of irrigation water and interest in collective water management. Non-scheme irrigators grow more crops per season while rainfed farmers own approximately three times the number of cattle compared to the other farmers. Evidence of multiple uses of irrigation water is higher among farmers outside compared to those in the schemes. Interest in collective water management is also higher among farmers outside of the schemes compared to those inside. This is because smallholder farmers in the schemes have negative experiences with collective water management. Non-compliance by some members result in consequences that affect even those who are compliant. For example, the failure by some to pay for water use charges often leads to the disconnection of electricity or water which affects everyone.

Table 5.3. Demographic and other characteristics of the sample farmers

	Scheme irrigators (n=109)	**Non-scheme irrigators** (n=174)	**Rainfed farmers** (n=45)	**P-value**	**Makhathini** (n=216)	**Ndumo-B** (n=112)	**P-value**	**Total** (N=328)
Gender *(% female)*	62.4	64.6	71.1	0.59	75.5	46.4	**0.00**	64.9
Age of farmer (years)	47.6 *(1.2)*	49.2 *(0.9)*	50.2 *(1.8)*	0.36	49.1 *(12.6)*	48.4 *(10.7)*	0.61	48.8 *(0.66)*
Number of years in formal school	4.8 *(0.4)*	4.1 *(0.4)*	3.8 *(0.7)*	0.30	43 *(4.5)*	4.3 *(4.6)*	0.99	4.3 *(0.3)*
Number of crops	1.3 *(0.1)*	1.8 *(1.0)*	1.1 *(0.3)*	**0.00**	1.4 *(0.7)*	1.7 *(1.0)*	**0.00**	1.5 *(0.1)*
Number of cattle	5.3 *(1.2)*	4.6 *(0.7)*	14.8 *(5.5)*	**0.00**	6.3 *(19.1)*	6.0 *(11.1)*	0.80	6.24 *(0.9)*
Estimated income from crop farming (ZAR '000)	15.3 *(5.2)*	7.5 *(1.3)*	5.4 *(1.4)*	0.12	4.9 *(0.6)*	19.2 *(5.3)*	**0.00**	9.8 *(1.9)*
Membership in a cooperative *(% members)*	64.2	67.8	73.3	0.54	72.9	56.8	**0.00**	67.4
Interested in being part of an institution governing water *(% interested)*	59.0	68.2	66.7	**0.07**	64.6	65.7	0.29	65.0
Other uses of irrigation water:								
Livestock watering (%)	55.6	80.6	70.5	**0.00**	62.8	86.9	**0.00**	70.8
Domestic use (%)	59.3	81.2	70.5	**0.00**	65.6	86.9	**0.00**	72.4
Construction (%)	52.8	78.2	68.2	**0.00**	61.4	82.2	**0.00**	68.3

Note: Parenthesis(.) are standard errors

Source: Survey data, 2016

Regarding differences across the study areas (Makhathini and Ndumo-B), statistically significant differences are observed in gender, the number of crops grown per season, crop income, membership to cooperatives and multiple uses of water. Makhathini had more female respondents and a higher proportion of farmers in cooperative membership compared to Ndumo-B. However, Ndumo-B farmers grow, on average, more crops per season and obtain approximately four times the crop income of Makhathini farmers. Furthermore, Ndumo-B has a higher proportion of farmers who use irrigation water for other purposes.

5.3.2 The results of the choice experiment

The study estimates the empirical models using a dataset of 6450 $(327 \times 5 \times 4)$ observations. Each farmer had five choices from choice sets containing four options. Out of the 328 questionnaires completed one had incomplete information and hence was dropped. The estimation was conducted in STATA 13 (StataCorp, 2013). To reduce simulation errors in parameter estimates, 100 Halton draws were used in the mixed logit estimation. For ease of analysis and interpretation of results the attribute 'multiple uses of water' was transformed into a dummy variable with 1 representing the use of irrigation water for more than just irrigation and 0 otherwise. An interaction term was then introduced to test the effect of cattle ownership on the multiple uses of water and hence WTP. After estimating the conditional logit, the results of the Hauseman-McFadden test showed statistically significant differences between parameters of a model estimated with a full set of alternatives versus models with subsets of the alternatives (Table 5.4). This suggests a violation of the IIA assumption and hence the decision to estimate the unrestricted mixed logit model. The log-likelihood, Bayesian Information Criterion (BIC), and Akaike Information Criterion (AIC) values also confirmed that the mixed logit, which allows heterogenous preferences, is the better model compared to the conditional logit.

Table 5.4. Test for the IIA assumption

Hauseman-Macfadden test	Chi-square	P-value
Exclude Option 1	43.7	0.000
Exclude Option 2	168.8	0.000
Exclude Option 3	222.3	0.000
Exclude Option 4	31.0	0.000

Source: Survey data, 2016

Table 5.5 presents the results of the mixed logit models estimated with and without interaction terms. As noted earlier in Section 5.2.2, the dependent variable is the farmer's choice of irrigation water use options. The results of the two models are similar and the signs of the coefficients are as expected except for the 'membership to a water governing institution' attribute. The results suggest that the coefficient of the membership attribute does not statistically significantly affect choices. This shows that

smallholders do not see the water use benefits or costs of engaging in collective water management arrangements. The other three attributes have a significant impact on choices. The negative coefficient of the attribute water fees shows that higher fees reduce the probability of a farmer selecting an expensive option. Both coefficients of the number of crops per season and multiple uses of irrigation water positively influence the choice of an option. This means all farmer categories prefer the option of growing more crops and are willing to pay more for increased irrigation intensity. The results confirm findings from other studies that identified the importance of recognizing multiple uses of irrigation water (e.g. Meinzen-Dick and Van Der Hoek, 2001; Boelee *et al.*, 2007) in water valuation. The negative sign of the ASC coefficient shows that farmers prefer the alternatives that offer different combinations of water services compared to the *status quo*. Only 20% of the farmers prefer the *status quo* situation.

Table 5.5. Mixed logit estimation results for all farmers (n=327)

	MXL Simple		***MXL with interactions***	
CHOICE OPTION	***Coef.***	***Std. Err.***	***Coef.***	***Std. Err.***
Attributes				
ASC	-0.586[a]	0.190	-0.554[a]	0.190
Membership to water organization	-0.053	0.083	-0.046	0.083
Number of crops	0.354[a]	0.062	0.358[a]	0.063
Multiple uses	1.098[a]	0.216	0.959[a]	0.224
Water fees	-4.81×10^{4}[a]	2.48×10^{5}	-4.34×10^{4}[a]	2.97×10^{5}
Multiple uses × no. of cattle			0.035[b]	0.015
Water fees × gender			-1.94×10^{4}[a]	5.17×10^{5}
Water fees × crop income			1.52×10^{9}	9.54×10^{10}
Standard Deviation				
Membership to water organization	0.170	0.219	0.126	0.242
Number of crops	0.712[a]	0.074	0.733[a]	0.075
Multiple uses	2.763[a]	0.210	2.686[a]	0.207
Number of observations	6540		6540	
LR $chi^2(4)$	541.7		529.7	
Prob > chi^2	0.000		0.000	
Log likelihood	-1777.8		-1763.9	
AIC	3571.6		3549.8	
BIC	3625.9		3624.5	

Note: The results of the conditional logit which are different from those in Table 5.5 are presented in Table A.6 in Appendix**;** [a, b, c] significant at the 1%, 5% and 10%, respectively

Source: Survey data, 2016

The study tests the effect of gender differences on the WTP through an interaction term of water fees and gender. The results show a negative coefficient for the 'fees and

gender' interaction term suggesting that being male negatively affects choices resulting in a lower WTP for irrigation water compared to females. Women farmers in the study community generally place a higher significance on crop farming compared to men, most of whom prefer the culturally valued livestock production. The SOFA Team and Doss (2011) made similar conclusions for women in sub-Saharan Africa, and this could explain their higher WTP for irrigation water.

The study also tests the hypothesis that higher crop income increases farmers' WTP for water using an interaction term between water fees and crop income. The results indicate that the potential for higher income earnings from crop production increases farmers' WTP. Thus, improving the productivity of agricultural enterprises and ensuring profitable markets for the marketable surplus will positively impact farmers' effective demand and hence their WTP for irrigation water. Similar results were also obtained in a study conducted in China where income had a positive and significant effect on WTP for irrigation water (Tang *et al.*, 2013). The coefficient of the interaction term between cattle ownership and the 'multiple uses of water' attribute is statistically significant and positive. This shows that farmers with larger stocks of cattle have a higher probability of choosing the multiple uses attribute and are willing to pay more for water. These farmers are typically benefiting from the complementarity of crop-livestock integration. Cattle is the single most important livestock enterprise in SA's rural communities.

The standard deviations of the 'number of crops' and 'multiple uses of water' attributes are statistically significant ($p < 0.01$) showing heterogeneity in farmers' preferences for these attributes. The magnitudes of the mean and standard deviation show further information on the proportion of smallholders with a negative or positive preference of an attribute. Following Hole (2007), the proportions are given by $100 \times \Phi\left(-b_x / s_x\right)$, where b_x and s_x are the mean and standard deviation of the x^{th} coefficient, while Φ is the cumulative standard normal distribution function. The results show that 69% of the smallholders prefer to use irrigation water for many more purposes and 65% prefer to grow more than one crop. Adding interaction effects to the model has no significant effect on the proportion of farmers with such preferences.

5.3.3 Preferences in managing irrigation water across farmer categories

The results in Table 5.6 show heterogeneity in preferences between the different category of farmers and study areas. The coefficient of the attribute 'multiple uses of water' is positive but significant only for the scheme and non-scheme irrigators. However, the coefficient of the interaction term between the attribute 'multiple uses of water' and 'the number of cattle owned' is statistically significant only for rainfed farmers. This means, due to the value that rainfed farmers place on their livestock, multiple uses of irrigation water are important only as they relate to the livestock enterprise. As shown in the descriptive results, rainfed farmers own more cattle compared to the other farmers. The coefficient of the interaction variable 'water fees and crop income' has a significant positive influence on choices and the WTP for non-scheme irrigators only. This suggests that higher income from crops will enhance the ability to pay for irrigation water among farmers irrigating outside of the schemes.

Regarding spatial differences, the cattle ownership effect on multiple uses of water, and hence choices is statistically significant for Makhathini and not Ndumo-B area. This suggests that integrating livestock with crop production will enhance smallholder ability to pay for irrigation water in Makhathini. The impact of gender and crop income on water fees and hence the ability to pay for irrigation water is statistically significant for Ndumo-B and not Makhathini. This means female smallholders in Ndumo-B are more price sensitive compared to men and have a lower WTP. Despite women valuing smallholder agriculture more than men, other factors make those in Ndumo-B more economically vulnerable and hence could face challenges paying for irrigation water. Sharaunga *et al.* (2016) report that women in SA are disproportionately economically disempowered compared to their male counterparts. The significance of the coefficient of 'water fees and crop income' interaction term for Ndumo-B shows that increased productivity and profitable markets for the marketable surplus will have more impact on smallholder WTP in this area and not Makhathini.

Table 5.6. Mixed logit estimation results for different farmer categories and study areas

CHOICE OPTION	Scheme irrigators (n=109)		Non-scheme irrigators (n=173)		Rainfed farmers (n=45)		Makhathini (n=215)		Ndumo-B (n=112)	
Attributes	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
ASC	-0.410	0.312	-0.565[b]	0.268	-0.695	0.554	-0.802[a]	0.232	0.181	0.354
Membership to water organization	-0.216	0.152	0.088	0.116	-0.121	0.275	-0.104	0.102	0.028	0.155
Number of crops	0.365[a]	0.121	0.349[a]	0.080	0.321[c]	0.195	0.165[b]	0.081	0.741[a]	0.104
Multiple uses	0.657[c]	0.404	1.339[a]	0.317	0.684	0.660	0.662[b]	0.292	1.693[a]	0.401
Water fees	-3.21×10^{4}[a]	5.10×10^{5}	-0.001[a]	4.33×10^{5}	-3.80×10^{4}[a]	7.86×10^{5}	-3.72×10^{4}[a]	3.60×10^{5}	-0.001[a]	6.53×10^{5}
Multiple uses × no. of cattle	0.037	0.027	0.041	0.026	0.037[c]	0.020	0.027[b]	0.013	0.035	0.023
Water fees × gender	-1.85×10^{4}[b]	8.91×10^{5}	-1.61×10^{4}[b]	7.11×10^{5}	-0.001[a]	2.13×10^{4}	-3.91×10^{5}	6.20×10^{5}	-2.86×10^{4}[a]	9.29×10^{5}
Water fees × crop income	9.44×10^{10}	1.23×10^{9}	5.27×10^{9}[a]	1.81×10^{9}	-5.92×10^{8}	4.26×10^{8}	-1.95×10^{9}	3.06×10^{9}	2.45×10^{9}[b]	1.17×10^{9}
Standard deviation										
Membership to water organization	-0.460	0.353	-0.040	0.244	-0.557	0.527	-0.234	0.384	-0.049	0.269
Number of crops	0.898[a]	0.149	0.596[a]	0.092	0.854[a]	0.240	0.789[a]	0.098	0.560[a]	0.120
Multiple uses	2.673[a]	0.364	2.598[a]	0.267	-3.119[a]	0.640	-3.201[a]	0.312	2.092[a]	0.304
Number of observations	2180		3460		900		4300		2240	
LR $chi^2(4)$	213.0		225.5		88.0		447.5		80.6	
Prob > chi^2	0.000		0.000		0.000		0.000		0.000	
Log likelihood	-600.3		-916.8		-219.9		-1172.1		-553.0	

Note: [a, b, c] significant at the 1%, 5% and 10%, respectively

Source: Survey data, 2016

5.3.4 Farmers' WTP for different attributes

Since the water fees coefficient is taken as non-random, the WTP distribution takes the same form as that of the non-price attributes. According to Scarpa *et al.* (2008), the mean and standard deviation of the WTP can thus be given by the mean and standard deviation of the attribute scaled by the inverse of the price coefficient. For a given attribute, the ratio of the attribute to the price coefficient also represents the marginal WTP for a change in the attribute values (Lee *et al.*, 2014). Following Bech and Gyrd-Hansen (2005), the coefficient of the dummy attributes' in the equation, e.g. 'multiple uses of water', is multiplied by two. The equation is slightly adjusted to incorporate the interaction effects associated with the price or non-price attributes (Giergiczny *et al.*, 2012; Bhaduri and Kloos, 2013). For example, computing the WTP for the attribute multiple uses of water should include two terms in the numerator, i.e., *multiple uses* and *multiple uses*×*no_cattle*. The denominator, which will be the same for all attributes, should include three terms, i.e., *water fees*, *water fees*×*gender* and *water fees*×*crop_income*.

$$WTP_{multiple\_uses} = -\frac{2\beta_{multiple\_uses} + \beta_{multiple\_uses \times no\_cattle}}{\beta_{fee} + \beta_{fees \times gender} + \beta_{fees \times crp\_income}} \tag{5.5}$$

Table 5.7 presents the mean WTP for the different water related services, estimated from the model with interaction effects. The negative WTP values show the lack of willingness to pay for that attribute. The bigger the number the more unwilling are the farmers to pay for the attribute.

The results suggest that farmers value the additional benefits derived from the use of irrigation water for other purposes more than the other attributes. Membership to an organization that governs water is the less valued of the three, for the reasons explained earlier. The heterogeneity in preferences is observed through different WTP estimates for the attributes. Non-scheme irrigators are willing to pay ZAR1,213 more than what scheme irrigators are willing to pay for additional uses of irrigation water while those in Ndumo-B are willing to pay more compared to Makhathini for the same attribute.

Table 5.7. Mean WTP estimates for irrigation water*

	Mean WTP					
	Pooled sample (n=328)	**Scheme irrigators (n=109)**	**Non-scheme irrigators (n=173)**	**Rainfed farmers (n=25)**	**Makhathini (n=215)**	**Ndumo-B (n=112)**
Membership to water organization	-145.3 *(199.8)*	-854.7 *(910.0)*	250 *(56.8)*	-217.3 *(499.1)*	-504.5 *(569.9)*	62.5 *(55.9)*
Number of crops per season	569.8 *(1165.7)*	722.1 *(1775.1)*	497.8 *(851.3)*	287.2 *(764.6)*	401.6 *(1919.7)*	836.9 *(631.9)*
Multiple uses of water	3108.1 *(4274.3)*	2671.0 *(5286.3)*	3884.0 *(3710.5)*	1259.7 *(2793.7)*	3288.1 *(7791.2)*	3863.3 *(2362.5)*

Note: * estimates in South African Rand; figures in parenthesis (.) are standard deviations of mean WTP

Source: Survey data, 2016

The results also suggest that farmers growing more crops (multiple and/or more of the same) are willing to pay extra for the use of more water, and the WTP is higher for scheme irrigators and Ndumo-B compared to other farmers. This finding suggests that irrigation water pricing should reflect irrigation intensity leading to efficient water allocation outcomes, an argument also put forward by Giraldo *et al.* (2014). Although the initial cost might end-up being prohibitive to resource poor farmers (Abu-Zeid, 2001), volumetric water pricing remains the best option for improving efficient utilization of water in smallholder irrigation. Despite facing frequent crop failures, the low rainfed farmers' WTP values across all attributes is an indication of their negative valuation and perceptions on irrigation water payment compared to the other smallholders. Payment for water is a new phenomenon to such farmers, most of whom have never paid for water before. Their attitudes to irrigation water payment are thus bound to be different from the rest of the farmers. More awareness creation on water scarcity and the importance of efficient and sustainable utilization of water is required for this group.

5.4 Summary

Water valuation is an important step to address market failure in irrigation water, value the resource and induce efficient utilization of the resource in the smallholder irrigation sector. Water scarcity threatens agricultural production and productivity and therefore, endangers food security, the capacity of smallholder agriculture to create employment,

and rural livelihoods. The objective of the chapter has been to assess farmers' preferences in managing irrigation water resources and determine their WTP for irrigation water using the CEM. It contributes to the debate on irrigation water pricing for resource-poor farmers and improving efficient utilization of water resources. The chapter focuses on three attributes of primary importance in managing irrigation water, i.e., water management, multiple uses of water and cropping patterns. While the other two were significant in influencing WTP, membership to water governing institutions did not.

The results show that smallholders prefer the alternative choices of managing irrigation water compared to their current situation. They are willing to pay more to produce more valuable crops, implying that irrigation water use charges should reflect irrigation intensity and the benefits that farmers derive. The farmers' WTP for additional uses of irrigation water is high, confirming why it is important to consider multiple uses of irrigation water for efficient allocation and improved water management. Ignoring this value results in the undervaluation and unsustainable utilization of the resource. Improving agricultural production and productivity, with market access, will improve farmers' willingness and ability to pay for irrigation water. If smallholder agriculture is made profitable, which is a big if, farmers are willing to pay for water used in agriculture. The study also reiterates the importance of smallholder agriculture to women. Thus, enabling women farmers to be productive has positive implications for efficient and sustainable utilization of irrigation water. The details of the conclusions and policy implications of this chapter are contained in the following chapter.

CHAPTER 6. CONCLUSIONS, RECOMMENDATIONS AND FUTURE RESEARCH DIRECTIONS

6.1 Recapping the purpose of the research

Smallholder irrigation provides a strategy for improving rural livelihoods and reducing rural poverty in SA. Irrigation reduces risks to climate change, improves production and productivity, and makes it possible for smallholders to produce throughout the year. The expansion of smallholder irrigation is thus identified in the National Development Plan 2030 as critical to creating employment, increasing incomes and food security in SA. However, despite the investments made so far, the literature shows that the performance of smallholder irrigation in SA is poor. The sector has failed to make a meaningful contribution to food security and employment creation. This poor performance has been attributed to, among other factors, the failure of existing agriculture development programmes to develop the human and social capital to effectively manage the schemes, engage in productive agriculture and participate in high value markets. Inevitably, this has led to the inability to take advantage of the huge potential and opportunities presented by smallholder irrigation to transform rural economies.

Thus, the government policy for smallholder irrigation is now focused on entrepreneurship development as the appropriate strategy to improve the performance of smallholder irrigation. For this strategy to be successful, more understanding is needed on the relevance of the mainstream concept of entrepreneurship to smallholders, implications of farmer heterogeneity, especially differences in PsyCap endowment, aspirations of farmers to expand irrigation farming, and management and efficient utilization of irrigation water resources. This improved understanding is critical for unlocking entrepreneurship in smallholder irrigation and for the rural transformation agenda.

The study was conducted on smallholders in and around Makhathini and Ndumo-B irrigation schemes in Jozini, KwaZulu-Natal, SA. The specific objectives of this study have been to (i) assess the validity and applicability of the mainstream concept of

entrepreneurship in smallholders in SA and identify avenues of adaptation to make it relevant; (ii) to identify sources of smallholder heterogeneity and farmer typologies in smallholder irrigation accounting for PsyCap; (iii) examine the aspirations of smallholder farmers to expand irrigation crop production; and (iv) assess farmer preferences for managing irrigation water resources and their WTP for irrigation water. The conceptual imperative of the study is mainly based on understanding smallholder choices, behaviour and decision making.

The rest of this chapter presents the conclusions in Section 6.2, followed by recommendations in Section 6.3. Section 6.4 discusses the future research possibilities, drawing from the knowledge gap identified in the literature and field work experiences.

6.2 Conclusions

6.2.1 Redefining and making relevant entrepreneurship to smallholders

Entrepreneurship is an important concept in smallholder agriculture but should be conceived differently to make it relevant to this sector. The study sought to validate the applicability of the mainstream concept of entrepreneurship to smallholder agriculture with a focus on smallholder irrigation. The findings show that smallholders and their context do not conform to the common neoclassical paradigm underpinning the mainstream concept of entrepreneurship. However, this does not mean small farmers cannot be entrepreneurial, but it highlights the need to redefine the concept for application in their context. For smallholders, entrepreneurship is a mindset referring to the question of taking one's destiny in their hands. Government and other stakeholders can only provide seed funding and support. In the long-term, smallholders must handle their farming activities in their own hands, collectively or individually.

In the quest for improving the performance in smallholder irrigation, a paradigm shift is, therefore, required to which the concept of PsyCap and lessons from behavioural economics are found to be of special relevance. The farmers' mindset is one critical resource that determines farming decisions and behaviour and hence entrepreneurial spirit. Although changing small farmers' mindset takes time, it is the primary step for

unlocking on-farm entrepreneurship. Taking this approach, the study proposed a definition of entrepreneurship applicable to smallholders. The definition emphasizes the need for entrepreneurial smallholders to internalize rather than externalize their challenges, resorting to own initiatives for solutions, even in the face of constraints.

The critical synthesis and analysis also revealed the importance of indigenous knowledge and embracing the heterogeneity and multi-purpose nature of smallholder farming to better cultivate on-farm entrepreneurship. Smallholders need to develop and apply a business mindset to their farming operations. Moreover, the existing income structure (ratio of earned to unearned income) and support environment does not foster the growth of positive PsyCap and entrepreneurial spirit. To enhance entrepreneurship in smallholder agriculture and improve the performance of smallholder irrigation these issues must be dealt with as critical elements of the transformation agenda.

6.2.2 Farmer typologies and implications for entrepreneurial development

The conclusions for this part of the study are two-fold, i.e., those focused on farmer typology formulation as a methodology and the ones for policy and entrepreneurial development. First, the study illustrated how a seemingly different concept from another discipline could be adopted, adapted and used to enrich agricultural economics research. This research separates itself from most studies that rely on the conventional SLF to come up with indicators used in the development of farmer typologies. The introduction of a sixth livelihood capital, the PsyCap, made it possible to capture salient features of each smallholder, otherwise missed by the generic SLF literature. The fact that PsyCap was one of the dominant characteristics defining each typology testify to its importance and the need to give it more attention in smallholder farming research. The research can be replicated in any setting. The measures of PsyCap can be adapted to suit the context of any study. However, for credible results, the process should ensure the consistency of the adapted measures as proxies of the different dimensions of PsyCap.

Secondly, the findings highlight the complexity introduced by the heterogeneity of smallholders. The results show the existence of five farmer typologies in smallholder

irrigation in SA, i.e., elderly and uneducated, cautious and short-sighted, financial capital and PsyCap endowed, social grant reliant, and land endowed rainfed farmers. Heterogeneity is observed in aspects such as PsyCap endowment, the extent of market access, participation in cooperatives and access to financial resources. However, no differences exist in entrepreneurial skills which are relatively low across all farmers. This implies that homogenous policies and strategies, i.e., 'one size fits all,' are not entirely appropriate in rural development. However, defining and implementing heterogenous policies and strategies is complicated. Nevertheless, recognizing heterogeneity in smallholders will enhance the impact of rural development policies and programmes. To the extent possible, whenever capacity exist, efforts should be made to implement tailor-made policies and strategies. However, careful targeting is needed to ensure that any benefits accruing to the other groups of farmers should not take away from the benefits meant for the primary target group.

The findings also confirm the importance of access to finance, education and training, and market access as critical to early stage entrepreneurship development in SA. Collective institutions such as cooperatives, if supported and transformed in the way they function, are vital instruments for enhancing smallholder linkage and participation in high value markets.

6.2.3 Explaining smallholders' aspirations to expand irrigation activities

Expanding smallholder irrigation is vital to the growth of the agricultural sector, promotion of smallholder businesses and enhancement of rural livelihoods. Understanding farmer aspirations for irrigation expansion and their ability to achieve those aspirations is thus a critical part of realizing transformation in the smallholder agriculture sector. There are several opportunities and constraints to irrigation expansion and hence to unlocking on-farm entrepreneurship among smallholders in SA. Building positive PsyCap will enhance farmer aspirations to expand irrigation farming. The poverty of this livelihood asset has negative implications for on-farm entrepreneurship development. Improving access to credit is also important for the expansion of irrigation farming. However, rural financial markets are currently dominated by informal institutions that offer credit at very high interest rates. These

informal institutions (stokvels and loan sharks) are seldom linked to the broader economy and hence are difficult to control or manage.

Smallholders have limited capacity to invest to realize their aspirations in irrigation expansion, and hence on-farm entrepreneurship. Expanding irrigation farming activities will increase production and other related costs. Thus, building the household physical capital base, i.e., livestock and agricultural-related assets, can thus assist farmers to overcome this challenge and make better use of irrigation schemes. Improving smallholder access to markets is also critical in the expansion of smallholder irrigation. Access to both input and output markets through improved linkages between rural communities and towns will increase input usage, land under production and ultimately yields. This demands an investment in the road and transport infrastructure servicing the rural communities. Land tenure security is also important to the expansion of irrigation farming. Mechanisms for resolving land-related conflicts within schemes should instil confidence in farmers' land holding and use rights. Closely related is the need to build a strong social capital base to support smallholders in rural areas. Continued support for institutions that promote social interaction and learning in the communities such as farmer associations and cooperatives is vital. In sum, the government should move away from exclusive focus on investment in physical irrigation infrastructure and work on other complementary institutions, services and inputs, engaging other stakeholders.

6.2.4 Smallholder WTP and preferences in managing irrigation water

Regarding farmers' preferences in managing irrigation water resources and their WTP for irrigation water, the study demonstrated the applicability of the CEM to irrigation water valuation in SA. Thus, it adds to knowledge on the increasing importance of the approach in modelling heterogenous preferences in irrigation water management and use. Findings contribute to the debate on irrigation water pricing for resource-poor farmers and improving efficient utilization of water resources. The WTP for production of more valuable crops implies that irrigation water use charges should reflect irrigation intensity and the benefits that farmers derive. This will also contribute to curbing over-irrigation by some smallholders. In respect of water management, the study showed that

smallholders do not view collective water management as important. This suggests that the benefits or costs of collective water management accruing to the smallholders are negligible. Thus, there is a need to interrogate the current role of collective institutions charged with the management of water in the irrigation schemes.

Improving smallholder production and productivity, with market access will improve farmers' willingness and ability to pay for irrigation water. Thus, policies that promote on-farm entrepreneurship and enhance the profitability of smallholder irrigation will increase farmers' WTP for water, which in turn, will contribute to sustainable utilization of the resource. For smallholders to contribute to costs of irrigation water (electricity, maintenance and cost recovery), they must farm profitably because that enables them to pay. However, improving market access remains a major challenge in smallholder farming which requires a concerted effort from all stakeholders. The study also revealed that smallholders are willing to pay for additional uses of irrigation water, confirming why it is important to consider multiple uses of irrigation water for efficient allocation and improved water management. Ignoring the value of irrigation water to other uses such as livestock and domestic use could lead to the undervaluation and unsustainable utilization of the resource. The importance of agriculture to women smallholders is a critical aspect of the management and utilization of irrigation water. Women farmers are willing to pay more for irrigation water compared to men. Thus, empowering women has positive implications on irrigation water use.

6.3 Policy and farm management implications

Given the findings of the study, several recommendations for policy and farm management implications are made. With regards to the validity and applicability of the concept of entrepreneurship to smallholder agriculture, there is a need to take a psychological and behavioural approach to make it relevant for smallholders. To enhance the chances of achieving the objectives set in the National Development Plan 2030 as related to smallholder agriculture, policies and programmes supporting the transformation of smallholder irrigation should redefine entrepreneurship in the context of smallholders. To this end, Chapter 2 of this thesis has provided the foundation. Support programmes should encourage and reward effort and hard work instead of a

culture of dependency. Smallholders should know that they are the primary and most important agents of change in their lives and be proactive in seeking solutions to address existing challenges. It is also recommended that indigenous knowledge should be recognized and embraced as a form of innovation important to smallholder farming. There is also a need to make concerted efforts to change smallholder income structure, i.e., their livelihoods should rely more on earned income and not social grants. For them to put more effort into farming or for any incentives to work, the contribution of agriculture as a source of income should increase.

The importance of PsyCap in explaining heterogeneity in farmer typologies, aspirations and the entrepreneurial spirit of smallholders is quite evident from the findings. It is, therefore, recommended that PsyCap be identified as a key livelihood asset that should be nurtured among smallholders. Entrepreneurial characteristics are built around the notions of self-confidence, optimism, hope, and resilience. Without such characteristics, it is hard to promote the management of small farms as businesses. An environment should be created where smallholders' PsyCap and entrepreneurial spirit can flourish or grow. Efforts should also be made to boost PsyCap through integrating character building programmes in agricultural extension services. This can be done through training, mentorship and peer support programmes.

Smallholders have limited access to credit. Moreover, the current rural financial markets composed of unregulated informal institutions, are making smallholders more vulnerable by extending short-term consumption credit at exorbitant interest rates. Therefore, it is recommended that policies should promote the development of rural financial markets that are linked to the wider financial economy. These markets should improve access to affordable agricultural production credit. This can be done through mechanisms that directly extend and link credit to markets for inputs and outputs. In this regard, value chain financing (VCF) is an option for improving smallholder access to finance. Since VCF is more suited for high value chains, promotion of production of high value crops among smallholders in the irrigation schemes should be a priority. Reforming existing government credit programmes is another option. Reforms, for example in programmes such as the Micro Agricultural Financial Institutions of SA,

should ensure that there is no political interference or nepotism and that only deserving smallholders benefit.

To increase the ability of smallholders to achieve their aspirations to expand irrigation farming activities, support for livestock production and mechanization should be part of the smallholder irrigation revitalization programme. Livestock sales can help enhance farmers' financial capacity while proper mechanization ensures that farmers increase the scale of their production.

With regards to improving smallholder access to markets, irrigation expansion should be integrated within existing value chain development programmes such as Agri-Parks. There is a need to invest in the development of road and transport infrastructure that link rural communities to input and output markets in towns. While policy can create an enabling environment for farmers to participate in high value markets, smallholders have a responsibility in the development of a mutual relationship of trust between them as the sellers and the buyers in the market. Professionalism is required in the handling of contracts. Smallholders should improve their production techniques and adhere to industry standards which allow consistent production and delivery of high-quality produce that can compete in both the local and regional markets. They should utilize their numbers to leverage their bargaining power in price and contract negotiations. All this demands that smallholders organize themselves and work together. Organized and well managed clusters of smallholders can also increase their competitiveness in the market by reducing transaction cost in both input and output markets. The clusters can also be an enforcement mechanism or interface between smallholder and government, financial institutions or other agribusinesses. In this regard, the role of cooperatives as collective action institutions remains critical in transforming smallholder irrigation.

Regarding irrigation water charges and irrigation intensity, it is recommended that the water pricing policy shifts from the current average charge per hectare to a volumetric charging system, particularly at the scheme level. The government should fund the initial meter installation costs with a cost recovery plan that expects farmers to contribute towards this cost over time. The current subsidies in irrigation water pricing designed to support the participation of resource poor farmers in irrigation should be

maintained. In this way, sustainable utilization of water resources is enhanced while not derailing the rural development agenda. To increase smallholder WTP for irrigation water, institutions governing the management of water resources should be more transparent and accountable, communication between farmers and management committees should be enhanced while rules and regulations governing water use should be reviewed to ensure that they strongly deter non-compliance.

In respect of multiple uses of irrigation water, there is a need to recognize this reality for sustainable management and use of irrigation water. The design and management of irrigation water systems can integrate these other uses. For example, the design of water canal infrastructure can be done to accommodate livestock watering. This will reduce the damage of the water infrastructure thereby averting a common source of conflict between scheme irrigators and livestock owners, and also reducing maintenance cost. With regards to gender, empowering women farmers enhances the efficient and sustainable utilization of irrigation water. Thus, development policies should seek to redress gender imbalances that disproportionately disempower women, e.g., in access to resources including land or agricultural input and output markets, which might affect their ability to pay for irrigation water.

6.4 Future research possibilities

The study was limited in that it was conducted in only two areas in the same municipality. It will be interesting to check if the main conclusions on redefining entrepreneurship and PsyCap and its implications on entrepreneurial development in smallholder irrigation are reflective and representative of the situation of most smallholders in SA. In this regard, future research should test the validity and relevance of the contextualized definition of entrepreneurship proposed in the study under different locations and contexts. There is a need to link the level of entrepreneurial spirit among smallholders and their PsyCap endowment with the proportion of earned income, land utilization and income diversification. The argument is that those smallholders who earn the larger portion of their income, or utilizing their land at its full capacity or diversifying their income sources are expected to be more entrepreneurial.

Future research should also consider conceiving entrepreneurship differently by introducing social entrepreneurship. The focus will be how the promotion of the bottom of the pyramid social entrepreneurial spirit development in South Africa can address challenges of food insecurity, poverty and unemployment.

The approach to measuring PsyCap used in the study is based on self-reported answers obtained from farmers through likert-scale type questions. This methodology is limited in that it depends on how truthful farmers are in their answers. The responses are susceptible to bias since people can modify their answers because they do not want to appear less intelligent, unwise or less successful. This is called the Hawthorne effect and is a common challenge encountered in social sciences research. The alternative for future research is to use revealed preferences approach which will indirectly infer a farmer's level of self-confidence, optimism, hopefulness and resilience. Behavioral economists and psychologists can assist in developing these questions which will enhance the credibilty of the results.

The study showed the limited participation of young people in smallholder farming. Yet, they are the hope of the nation, and the future of agriculture depends on their enthusiasm and participation in commercialized agriculture. The introduction of PsyCap and behavioral economic principles to future research to explain smallholder behaviour can help understand what influences the involvement of young people. This should result in recommendations regarding the required policy changes in education, agriculture, and other economic policies meant to improve their participation.

The study demonstrated the possibility of measuring farmers' aspirations and using these to understand smallholder behaviour and decisions. Its focus, however, was on only one form of smallholder aspirations, i.e., aspirations to expand irrigation farming activities. Future research can expand this study and look at the broader spectrum of farmer aspirations and how they influence other important farming aspects such as crop productivity, land use decisions, water productivity and on-farm entrepreneurship. Given the conclusions made above regarding access to credit, it is imperative that future studies address several issues. These include the impact of consumption credit on the

growth of smallholder farming and the possibility of regulating informal institutions offering this credit. The major question is how to incentivize these institutions to shift focus to the provision of affordable production credit.

A more difficult question for future research regarding irrigation water pricing is the possibility of integrating other irrigation water uses into the water pricing system. The opportunity cost of ignoring the multiple uses of irrigation water is too high, especially in the presence of growing water scarcity. Not accounting for these other uses in irrigation water values results in the unsustainable utilization of irrigation water and threatens the future livelihoods of many rural people. The study also recommends that future research should conduct a proper cost benefit analysis on the volumetric water charging at farmer level in the schemes. This will assist policy makers in planning for a smooth shift in the water pricing strategy.

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APPENDIX A: TABLES AND FIGURES

Table A.1. Communalities from PCA on PsyCap measures

PsyCap Measures	Initial	Extraction
CONF_AGRIC	1.000	0.502
CONF_FR	1.000	0.787
POWER	1.000	0.593
OPTI_FR	1.000	0.714
DNT_GIVE_UP	1.000	0.751
ALTER_INC	1.000	0.664
HOPE_LIFE	1.000	0.736
LONG_FOCUS	1.000	0.538
TRY_IDEAS	1.000	0.637
COPE_SHK	1.000	0.259
RISK_TAKE	1.000	0.598
GOVT_RESP	1.000	0.428

Source: Survey data, 2016

Table A.2. Communalities from PCA on household livelihoods assets dimensions

Livelihood asset measures	Initial	Extraction
GENDER_FR	1.000	0.573
AGE_FR	1.000	0.786
EDU_LEVEL	1.000	0.763
DEP_RATIO	1.000	0.769
INC_SOCIAL	1.000	0.574
INC_IRR_CRPS	1.000	0.598
INC_DRY_CRPS	1.000	0.655
INC_LVSTK	1.000	0.638
INC_OTHER	1.000	0.779
ACC_CREDIT	1.000	0.448
SAVINGS	1.000	0.588
HHLD_ASSETS	1.000	0.464
LAND_SIZE	1.000	0.671
SOC_NETWKS	1.000	0.630
POS_PSYCAP	1.000	0.716
RES_OPTI_CONF	1.000	0.442
VENT_FUTURE	1.000	0.765

Source: Survey data, 2016

Table A.3. PsyCap measures inter-item correlation matrix

PsyCap Measures	GOVT_RESP	CONF_AGRIC	CONF_FR	OPTI_FR	COPE_SHK	HOPE_LIFE	DNT_GIVE_UP	ALTER_INC	RISK_TAKE	LONG_FOCUS	POWER	TRY_IDEAS
GOVT_RESP	1.000											
CONF_AGRIC	0.034	1.000										
CONF_FR	-0.410	0.324	1.000									
OPTI_FR	-0.363	0.343	0.766	1.000								
COPE_SHK	-0.136	0.122	0.368	0.349	1.000							
HOPE_LIFE	-0.413	0.275	0.735	0.690	0.311	1.000						
DNT_GIVE_UP	-0.357	0.238	0.757	0.650	0.421	0.717	1.000					
ALTER_INC	-0.039	0.195	0.147	0.194	0.100	0.169	0.152	1.000				
RISK_TAKE	-0.250	0.267	0.446	0.429	0.342	0.400	0.516	0.375	1.000			
LONG_FOCUS	-0.261	-0.080	0.291	0.294	0.164	0.338	0.348	0.049	0.142	1.000		
POWER	-0.248	0.329	0.548	0.565	0.267	0.561	0.557	0.263	0.533	0.212	1.000	
TRY_IDEAS	-0.051	-0.066	0.038	0.033	-0.030	0.004	0.007	-0.026	0.017	0.175	0.003	1.000

Source: Survey data, 2016

Table A.4. Livelihood measures inter-item correlation matrix

Livelihood measures	GENDER_FR	AGE_FR	EDU_LEVEL	DEP_RATIO	INC_SOCIAL	INC_IRR_CRPS	INC_DRY_CRPS	INC_LVSTK	INC_OTHER	ACC_CREDIT	SAVINGS	HHLD_ASSETS	LAND_SIZE	SOC_NETWKS	POS_PSYCAP	RES_OPTI_CONF	VENT_FUTURE
GENDER_FR	1.00																
AGE_FR	-0.01	1.00															
EDU_LEVEL	0.08	-0.55	1.00														
DEP_RATIO	-0.15	0.07	-0.03	1.00													
INC_SOCIAL	-0.03	0.22	-0.11	0.25	1.00												
INC_IRR_CRPS	0.19	0.03	0.03	-0.05	-0.02	1.00											
INC_DRY_CRPS	0.04	0.02	0.03	0.02	0.08	-0.04	1.00										
INC_LVSTK	0.20	0.00	0.02	0.00	0.02	0.39	0.03	1.00									
INC_OTHER	-0.15	-0.01	0.16	-0.02	-0.03	-0.03	-0.02	-0.01	1.00								
ACC_CREDIT	-0.06	0.09	-0.08	-0.01	0.08	0.05	0.01	-0.02	-0.07	1.00							
SAVINGS	-0.02	-0.05	0.06	0.01	0.10	0.08	-0.03	0.06	0.08	0.14	1.00						
HHLD_ASSETS	0.14	0.04	0.01	-0.01	0.21	0.15	0.04	0.22	0.12	-0.04	0.15	1.00					
LAND_SIZE	0.22	0.13	0.01	0.03	0.15	0.11	0.29	0.18	0.04	0.04	0.03	0.20	1.00				
SOC_NETWKS	-0.08	0.00	-0.01	0.05	0.04	-0.06	-0.02	0.10	0.05	-0.03	-0.01	0.07	-0.09	1.00			
POS_PSYCAP	0.15	-0.01	0.03	0.05	-0.01	0.04	-0.14	0.04	0.02	-0.02	-0.01	-0.03	0.04	-0.05	1.00		
RES_OPTI_CONF	-0.12	0.02	-0.11	-0.07	0.03	-0.05	-0.05	-0.09	-0.11	0.06	0.03	-0.06	-0.19	-0.04	0.00	1.00	
VENT_FUTURE	0.04	-0.02	-0.05	-0.03	-0.08	0.04	0.01	-0.03	-0.04	0.00	-0.04	-0.06	-0.12	-0.11	0.00	0.00	1.00

Source: Survey data, 2016

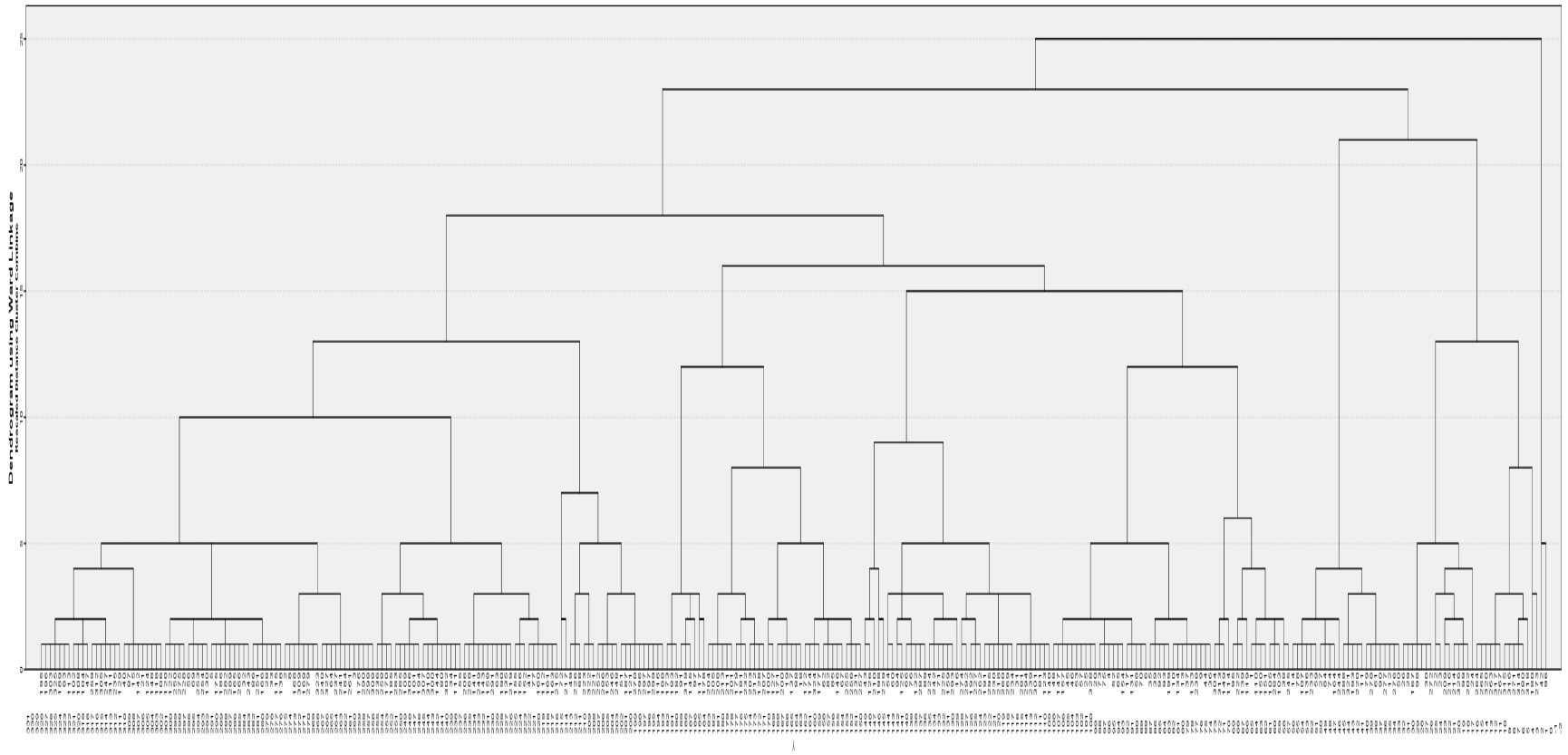


Figure A.1 Dendrogram generated through hierarchical clustering

Source: Survey data, 2016

Table A.5. ANOVA results from CA

	Cluster		Error		F	Sig.
	Mean Square	**df**	**Mean Square**	**df**		
Mixed farming	23.23	8	0.44	317	52.90	0.000
Elderly and limited education	21.61	8	0.48	317	45.03	0.000
Land endowed rainfed farmers	28.05	8	0.32	317	88.38	0.000
Social grant reliance and economic burden	19.23	8	0.54	317	35.61	0.000
Financial endowment, resilient, optimistic and confident	6.34	8	0.87	317	7.32	0.000
Income diversification	26.41	8	0.36	317	73.59	0.000
Positive PsyCap	10.36	8	0.76	317	13.56	0.000
Cautious, short-term focus and social capital endowment	14.56	8	0.66	317	22.13	0.000

Source: Survey data, 2016

Table A.6. Conditional logit results

Attributes	**Coef.**	**Std. Err.**
ASC	0.253[b]	0.139
Membership to WUA/water institution	-0.010	0.072
Number of crops	0.275[a]	0.036
Multiple uses	0.836[a]	0.118
Water fees	-3.31×10^{4}[a]	1.99×10^{5}
Number of obs		6540
LR chi2(4)		435.9
Prob > chi2		0.000
Log likelihood		-2048.6
AIC		4107.3
BIC		4141.2

Note: [a, b, c] significant at the 1%, 5% and 10% respectively

Source: Survey data, 2016

APPENDIX B: STUDY QUESTIONNAIRE

University of KwaZulu-Natal

The information to be captured in this questionnaire is strictly confidential and will be used for research purposes by staff and students at the University of KwaZulu-Natal working on a project **"Linking small-scale irrigation schemes with appropriate on-farm entrepreneurial development paths"**. There is no wrong or right answer to these questions. You are free to be or not part of this survey and you can withdraw from the survey anytime you feel like doing so. However, your cooperation is greatly appreciated.

Would you like to participate in this survey? 1 = Yes 2 = No

Date		Respondent Name	
Village name		Ward No.	
Type of farmer		Irrigation scheme and Block No.	
Questionnaire No.		Enumerator	

Farmer type: 1 -Scheme irrigator 2-independent irrigator 3-homestead gardener 4- community gardener 5- Rainfed farmer

A. HOUSEHOLD DEMOGRAPHICS

	Question	**Response**
A1	Gender of farmer *1= male 2=female*	
A2	Marital status of farmer *1=Single 2= Married 3= Divorced 4= Widowed 5=Cohabiting*	
A3	Age of farmer (years)	
A4	Relationship of the farmer with the household head *1=self 2=spouse 3=child 4= relative 5=other (please specify)*	
A5	Level of education of farmer (highest grade attained)	
A6	Household size (total number of household members)	
A7	Number of household members below 15 years	
A8	Number of household members 65 years and above	

	Question	Response
A9	Number of household members chronically ill	
A10	Main occupation of the respondent	
A11	Number of years of experience in farming?	
A12	Number of years the farmer has been involved in irrigation farming?	
A13	Does the household have anyone below the age of 35 with agricultural related tertiary qualification? *1=Yes 0= No*	

Note: A10. *1=Fulltime farmer 2=Regular salaried job 3=Temporary job 4=Self-employed 5=Student 6= Others (please specify)* ……..

B. INCOME AND CREDIT

Complete the following questions on access to government social support grants and income sources

B1. Are any of your household members receiving a government grant? *1=Yes 0= No*

If yes, complete the table below

Grant	**B2.** Number of people receiving	**B3.** Number of years receiving grant/ since which year
a. Child grant		
b. Old persons grant		
c. Disability grant		
d. Foster child grant		
e. Care dependency grant		

Note: Foster grant is support given to a family that is looking after a child not theirs, in their home

Complete the table below on sources of household income

	B4. Source of income *1=Yes 0= No*	B5. Average income each time (Rands)	B6. How many times do you receive this income per year? E.g. once, 2, 3 or 4 times, per year, etc.	B7. Major uses of income *(indicate at most two)*
a. Remittances				
b. Arts and craft				
c. Permanent employment				

	B4. Source of income *1=Yes 0= No*	B5. Average income each time (Rands)	B6. How many times do you receive this income per year? E.g. once, 2, 3 or 4 times, per year, etc.	B7. Major uses of income *(indicate at most two)*
a. Remittances				
d. Temporary employment				
e. Welfare grant				
f. Crops - irrigated				
g. Crops – rain-fed				
h. Livestock				
i. Other (please specify)				

Note: B7. *1=food and groceries 2=agricultural inputs 3=school fees and supplies 4=health-related expenses 5=transport 6=other (specify)*

B8. Do you have any form of savings? *1=Yes 0 =No*

B9. If yes to **B8,** which type of saving? *1=Formal 2= informal (i.e. stokvel) 3=both*

B10. Have you ever taken credit or used any loan facility in the past 12 months? *1=Yes 0=No*

B11. If yes to **B10** what was the main source of credit/loan? *1=Relative or friend 2=Money Lender 3= Savings club (e.g. stokvel or Internal savings and lending schemes) 4= Input supplier 5=Output buyer 6=Banks 7=Government 8=Microfinance institutions 9=Others (please specify……..*

B12. If No to **B10,** please specify the reason(s) for not taking and/or using credit (multiple answers possible*). 1= The interest rate is high 2= I couldn't secure the collateral 3= I have got my own sufficient money 4= It isn't easily accessible 5= I do not want to be indebted 6=Other, please specify……*

B13. If you took credit or loan what was the purpose of the loan/credit? *(multiple answers possible) 1=Family emergency 2=Consumption 3=Agricultural purposes 4=Other (specify)……*

B14. Were you able to pay back the loan/credit in time? *1=Yes 0=No*

Complete the following table on ownership and access to assets (If yes to B15 please skip to B17)

Assets	**B15.** Own the asset individually *1=Yes 0=No*	**B16.** Own asset as a group *1=Yes 0=No*	**B17.** Current value of asset (s)(Rand)	**B18.** Have access to asset through hiring and borrowing? *1=Yes 0=No*
a. Cell phone				
b. Radio				
c. Television				
d. Personal computer				
e. Fridge/freezer				
f. Bicycle				
g. Motorcycle				
h. Trailer/cart				
i. Water tank				
j. Motor vehicle in running order				
k. Generator				
l. Water pump				
m. Plough				
n. Planter, harrow or cultivator				
o. Wheelbarrow				
p. Tractor				
q. Other (please specify)				

Complete the table below on livestock ownership

Type of livestock	**B19.** Number owned	**B20.** Current value **per unit** (Rand)
a. Cows		
b. Calves		
c. Oxen		
d. Sheep		
e. Goats		
f. Domestic chickens		
g. Others (please specify)		

C. CROP PRODUCTION AND MARKETING

Land ownership and tenure issues

Land type	**C1.** Type of ownership *1=Traditional 2=Rented 3=Borrowing 4=Other (specify)*	**C2.** Total area (ha)	**C3.** Area under use (ha)
a. Homestead garden			
b. Rainfed (Field crops)			
c. Community garden (your portion)			
d. Irrigation plots (inside the scheme)			
e. Irrigation plots (outside the scheme)			
f. Total			

C4. Generally, are you satisfied with the present security of ownership of the land you are using?

1=Very unsatisfied 2=Unsatisfied 3=Neutral 4=Satisfied 5=Very satisfied

C5. Do you find it difficult to make land use decisions due to the current land ownership system?

1= Yes 0= No

C6. If Yes, please give details

_____

_____

Complete table for crops grown in 2015 **(**Please indicate units of produce for each crop)

Crop	**C7.** Water source *1=irrigation 2=rain-fed 3=both*	**C8.** Area under production (ha)	**C9.** Quantity harvested (units/ha)	**C10.** Quantity sold	**C11.** How many times did you sell?	**C12**. Average selling price per unit	**C13.** Market outlet	**C14.** Market distance from farm
Maize								
Cabbage								
Other								
Other								
Other								

Note: C13. *1=Farm gate 2=Hawkers 3=Local shops 4=Shops in town 3=Contractors Roadside 5=small informal agro-dealer 6=large agro-dealers 7=Others (specify) 99 = N/A*

C15. Do you sell some of your produce collectively or as a group? *1=Yes 0=No*

C16. What is the walking distance to the nearest (a) **road** (minutes) ____(b) **town** (minutes)_____

Complete the following table for production inputs used for each crop in 2015 *(for fertilizer, agro-chemicals and manure please indicate type)*

Crop	**Inputs**	**Unit**	**C17.** Quantity/Number	**C18.** Cost per unit (R)	**C19.** Total Cost (R)
Maize	a. Seeds				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure				
	e. Herbicides				
	f. Pesticides				
	g. Tractor/ ox				
	h. Transport cost				
Cabbage	a. Seeds/ seedlings				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure				
	e. Herbicides				
	f. Pesticides				
	g. Tractor/ox				
	h. Transport cost				
Other (specify)	a. Seeds				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure				
	e. Herbicides				
	f. Pesticides				
	g. Tractor/ ox				
	h. Transport cost				
Other (specify)	a. Seeds				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure				
	e. Herbicides				
	f. Pesticides				
	g. Tractor/Ox				
	h. Transport cost				
Other (specify)	a. Seeds				
	b. Basal fertilizer				
	c. Top fertilizer				
	d. Manure				
	e. Herbicides				
	f. Pesticides				
	g. Tractor/Ox				
	h. Transport cost				

C20. Did you use any recycled seed for any of the crops grown? *1=Yes 0=No*

C21. If No to **C20**, why are you not using improved seeds? _____

_____

Complete the following table for **hired labour** for each operation per crop (whenever applicable)

Crop	**C22.** Ploughing/ Land preparation		**C23**. Planting		**C24**. Weeding		**C25**. Fertilizer application		**C26.** Watering		**C27**. Crop spraying		**C28**. Pest control		**C29.** Harvesting		**C30.** Packaging		**C31**. Marketing	
	days	people	days	people	days	people	days	people	days	people	days	people	days	people	days	people	days	people	days	people
Maize																				
Cabbage																				
Other																				
Other																				
Other																				

On average how much did you pay your hired labour per day?

	C32. Ploughing/Land preparation	**C33.** Planting	**C34**. Weeding	**C35**. Fertilizer application	**C36**. Watering	**C37**. Crop spraying	**C38**. Pest control	**C39**. Harvesting	**C40**. Packaging	**C41**. Marketing
Labour rate per day **(Rand)**										

Complete the following table for **family labour** for each operation per crop (whenever applicable)

Crop	**C42**. Ploughing/ Land preparation		**C43**. Planting		**C44**. Weeding		**C45**. Fertilizer application		**C46**. Watering		**C47**. Crop spraying		**C48**. Pest control		**C49**. Harvesting		**C50**. Packaging		**C51**. Marketing	
	days	people	days	people	days	people	days	people	days	people	days	people	days	people	days	people	days	people	days	people
Maize																				
Cabbage																				
Other																				
Other																				
Other																				

C52. What are your average working times in hours for family labour in the field per day?_____hour per day

C53. Are there times in the production season when hired labour is not available? *1=Yes 0=No*

C54. If yes to **C53**, which months in the season is hired labour not available or difficult to find?
1=Dec-Mar 2=Apr –July 3=Aug-Nov

To what extent do you consider the following as constraints to your farming operations?
1 =Strongly disagree 2=Disagree 3= Neutral 4 = Agree 5 = Strongly agree

Farming constraints	**C55.** Response
a. Lack of access to inputs is a constraint	
b. Large (unaffordable) increase in input prices is a constraint	
c. Limited or lack of farming knowledge and skills is a constraint	
d. Lack of access to adequate land is a constraint	
e. Insecure land ownership is a constraint	
f. Lack of financial resources	
g. Too high labour cost is a constraint	
h. High pump and maintenance cost is a constraint	
a. Unavailability or lack of access to adequate water is a constraint	
b. Water distribution network is a constraint	
i. Lack of adequate storage facilities for vegetables or fresh produce is a constraint	

Farming constraints	**C55.** Response
j. Poor output prices is a frequent challenges	
k. Limited access to market information is a constraint	
l. Lack of access to transport services for marketing agricultural produce is a constraint	
m. Poor quality of the agricultural extension service	
n. Local or social conflict- resource use related	
o. Political conflict – local government and traditional leadership related	
p. Irrigation scheme is far away from my home	
q. Stray animals destroy my crops in the field	

C56. To what extent are you satisfied with your current level of crop production? *1=Very unsatisfied 2=Unsatisfied 3=Neutral 4=Satisfied 5=Very satisfied*

C57. For 1 or 2 what are the most important reasons for dissatisfaction?_____
_____
_____

C58. To what extent are you satisfied with your current level of income earned from farming operations? *1=Very unsatisfied 2=Unsatisfied 3=Neutral 4=Satisfied 5=Very satisfied*

C59. For 1 or 2 what are the most important reasons for dissatisfaction?_____
_____

C60. Do you obtain livestock feed from crop residues? *1=Yes 0=No*

C61. Which crops do you mostly use as livestock feed?_____

D. SKILLS AND TRAINING

Complete table on your skills rating and training in the following areas

Skills	**D1.** Have you ever been trained *1=Yes 0=No*	**D2.** Do you currently need training in any of these areas *1=Yes 0=No*
a. General crop/vegetable production		
b. Land preparation		
c. Fertiliser application		
d. Herbicide application		
e. General irrigation practices		
f. Irrigation scheduling and water management		
g. Agricultural commodity marketing		
h. Packaging of fresh produce		
i. Processing of farm produce		
j. Pricing of products including negotiation of prices		
k. Business planning		
l. Budgeting/ Bookkeeping		
m. If other (please specify)		

D3. Are you able to utilize any of the skills learnt from above training or any other irrigation production related training you have received before? *1=Yes 0=No*

D4. If you are not able to utilize any of the skills learnt, why is it so?_____

_____

_____

D5. Do you have a business plan for your farm? *1=do not have (never developed one) 2=do not have (tried to develop one but could not) 3=have a written business plan 4=have a business plan conceptualized in my mind*

D6. If **D5 is 4**, what stops you from having written business plan?_____

E. WATER AVAILABILITY AND IRRIGATION

E1. How far away is your household to the irrigation scheme? (walking minutes)_____

Ask questions in table to only scheme irrigators (E2-E5)

	Questions	**Response**
E2	What is your position along the main distributary canal? *1=Head 2=Middle 3=Tail*	
E3	On average, how many days per week do you irrigate your crops? (indicate number)	
E4	On average, how many irrigation hours do you do per day (this week)?	
E5	Amount paid for water fee during this season (Rand /ha/year or per month)	

E6. What type of irrigation system are you using for crops grown? *1=Sprinkler 2=Flood irrigation 3=bucket system 4=Center pivot 5=other (specify)*_____

E7. What is the maximum amount of money you are willing to pay for water per hectare of irrigated land? (Rand/ha/year)

E8. If maximum amount is zero, why don't you want to pay anything? (Circle answers)

1*=Irrigation water should be provided free of charge* ***2****=I am not satisfied with the existing irrigation service* ***3****=I do not have enough money* ***4****=I know that the money will not be used properly* ***5****=It is the responsibility of the government to provide* ***6****=Only those irrigating a lot should pay* ***7****=Only those that are making more money should pay* ***8****=Other reasons, specify*_____

E9. How often do disputes (conflicts) occur among farmers or between blocks on water issues?
1 = Never 2 = Occasionally 3= I don't know 4 = Often 5 = Very Often

E10. If your answer is 4 or 5, what are the main reasons for water related disputes?_____

_____

Indicate and rank importance of irrigation/ canal water uses? *1=unimportant 2=moderately unimportant 3=neutral 4= important 5= very important*

Uses of irrigation/ canal water	**E11.** Use water for that purpose *1= Yes 0= No*	**E12.** Rank Importance
a. Crop irrigation in the scheme		
b. Crop irrigation outside of the scheme		
c. Livestock watering		
d. Domestic use (laundry, cooking, bathing, drinking)		
e. Construction (house or brick making)		
f. Other (specify)		

F. PSYCHOLOGICAL CAPITAL

F1. What are your main reasons for farming? *1=Have sufficient food to feed my family 2=Earn an income from sale of crops 3= Create employment for myself and family members 4= Create employment for people in community 5= Leisure 6=Other (specify)* _____ ***(multiple answers possible)***

F2. Do you distinguish (separate) your farming operations from family operations?
1=Always 2=Often 3=Sometimes 4=Rarely 5=Not at all

F3. Do you keep records of all your farming activities?
1=Always 2=Often 3=Sometimes 4=Rarely 5=Not at all

F4. In what form do you practice farming? *1=As an individual OR household 2=As member of informal group 3=As member of cooperative 4=other (please specify)* _____

Complete the table on selected farmer attitudes
1= Strongly disagree 2= Disagree 3=Neutral 4= Agree 5= Strongly agree

Farmer attitudes	**F5.** Response
a. The social grant is sufficient money to maintain the household	
b. The government is responsible for the wellbeing of rural farming households	
c. I am confident in farming as a way of life	
d. I am confident in myself as a farmer	
e. I am optimistic about the future of agriculture in my area	

Farmer attitudes	**F5.** Response
f. I am able to cope with shocks such as drought and other natural disasters (resilience)	
g. I have hope the quality of life will get better	
h. I enjoy new challenges and opportunities	
i. I don't give us easily	
j. I would not be farming if there was a better alternative source of income	
k. I am willing to take more risk than other farmers in my community	
l. I am willing to forgo a profit opportunity in the short-run in order to benefit from potential profits in the long-run	
m. I have power to affect the outcome of my farming	
n. I trust other farmers	

Please let us know your views as regards the following small-scale irrigation issues:

1 =Strongly disagree 2 =Disagree 3 =Neutral 4 =Agree 5 =Strongly agree

Farmer views	**F6.** Response
a. There are no available plots in irrigation schemes	
b. There is a lot of red tape involved in land allocation in irrigation schemes	
c. Being a member of an irrigation scheme deprives one of individual decision-making powers	
d. Being a member in a group of farmers limits members' flexibility in terms of irrigation	
e. Irrigation schemes are too far from homestead	
f. There is a lot of free riding in collective irrigation schemes	
g. Illegal use of water is a major concern for irrigation schemes managed collectively	
h. Lack of enforceable rules in collectively managed irrigation schemes is a challenge	
i. Not many are interested to take responsibility in collective management of the schemes	
j. Not many are interested to pay towards cost recovery	
k. Not many are interested to contribute to maintenance costs	

Complete following questions regarding interest to expand irrigation farming operations

F7. If an opportunity arises, are you interested in expanding your farming operations, i.e. moving into small-scale irrigation (including increasing plots in the irrigation schemes)
1= Not interested at all 2=disinterested 3=Neutral 4=Interested 5=Very interested

If answer is 1 and 2 please go to F12, otherwise continue

F8. If **'interested'**, considering your capacity (resource endowments and capabilities), by how much, in terms of land in hectares, would you want to expand your farming operations? ___**hectares**

F9. If you interested in expanding farming operations, what are the factors holding you up?
*1=financial constraints 2=land availability and security constraints 3=Lack of access to inputs and machinery 4= Water availability constraints 5= Market constraints 6= Local and political constraints 7=Other (specify)*_____ ***(multiple answers possible)***

F10. If you are interested in expanding farming operations, would you like to irrigate? 1 = individually or 2 = collectively

F11. What are the reasons for your answer in **F10**?_____

_____

F12. If you are not interested at all, answer in **F7** is **1** or **2**, why?_____

_____

F13. Do you see yourself as a potential commercial farmer one day? *1=Yes 0=No*

F14. How interested are you in being part of a collective institution governing water use?
1=Not interested at all 2=disinterested 3=Neutral 4=Interested 5=Very interested

F15. If 1 or 2 in **F14**, why?_____

F16. How interested are you in taking part in training in collective management of irrigation scheme?
1=Not interested at all 2=disinterested 3=Neutral 4=Interested 5=Very interested

F17. If 1 or 2 in **F16**, why?_____

Complete table on the entrepreneurship characteristics of the farmer

1=Strongly disagree 2= Disagree 3=Neutral 4= Agree 5= Strongly agree

Entrepreneurial Characteristics	**F18.** Response
a. I like being my own boss	
b. I produce mainly for the market	
c. I produce mainly for household consumption	
d. I view my farm as a profit making business	
e. I know what and when resources and materials are needed and where to get them	
f. I am passionate about my farm business	
g. I always look for better and profitable ways to run farm operations	
h. I deal with problems as they arise rather than spend time to anticipate them	
i. I work long and irregular hours to meet demands/ deadlines	
j. I have the ability to inspire and energize others	
k. I am able to manage myself and my time	
l. I always take responsibility for solving problems that I face	
m. I am willing to cooperate with others and network	
n. I possess persuasive communication and negotiation skills	
o. I have the ability to set goals and set new ones once attained	
p. I am very competitive in nature	
q. I am always willing to learn new things	
r. I am very hands-on	
s. I welcome failures from which I am able to learn	
t. I am willing to try new ideas even without full knowledge about the possible outcome	
u. I seek information that will help with tasks I am working on	
v. I weigh my chances of succeeding or failing before I decide to do something	
w. If one problem is persistent, I try alternative approaches to address it	
x. I am keen to take advantage of new farm business opportunities	
y. I possess the bookkeeping skills (business skills) important for managing my finances	
z. I think having a business plan is important for my farming operations	
aa. I am able to emotionally cope when faced with a problem	

G. SOCIAL CAPITAL

Are you a member of any of the following groups?

Group	**G1.** Membership *1=Yes 0=No*
a. Local producers group/ cooperative	
b. Secondary cooperative/ Group for marketing crop produce	
c. Social groups (church or burial society)	
d. Institution governing water use e.g. Mjindi	
e. Others (please specify)	

G3. Can you rank the following sources of information relevant for your farming activities, based on how you have used them in the past year (e.g. where to sell, market prices, *etc*.)
1=unimportant 2=moderately unimportant 3=neutral 4= important 5= very important

Information Source	**G4.** Rank of source of information
a. Extension officers	
b. Media (newspapers, radio, TV)	
c. Internet (emails, websites, etc)	
d. Fellow farmers	
e. Community meetings	
f. Irrigation / Scheme committees	
g. Cooperative leaders	
h. Traditional leaders	
i. Non-governmental organizations (NGOs)	
j. Private organizations	
k. Phone (sms, text)	
l. Other (please specify)	

H. CHOICE EXPERIMENT QUESTIONS

To enumerator:

Please read the choice scenario to the respondent and make sure that the respondent gives attention to your description before you go to the questions.

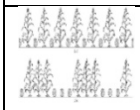
The aim of this experiment is to investigate the willingness of farmers to pay for water in small scale irrigation, accounting for differences in number of crops one can cultivate in a season, governance of irrigation water and multiple uses of irrigation water? Now we ask you to consider these attributes or issues and the cost of water associated with each choice set. There are no wrong or correct answers. What is required is the priority that you place for different options provided. Please choose your preferred option and mark it as if it is the only choice you make. Please consider all the options carefully. Just a reminder that there are three important aspects to consider plus the associated cost. These are **membership to a cooperative in the scheme**, **multiple uses of irrigation water** and **number of crops one can grow per season**. Don't hesitate to ask for further clarifications. In case you change your mind, feel free to go back and change your previous choice(s).

Given the increasing expansion of small-scale irrigation agriculture, increased demand for water resources, persistent droughts and the need to ensure that water will be available even for future agriculture use:

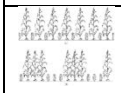
Suppose the government has an intention to take measures that ensure that small-scale farmers are charged for water and its related services according to the different possible uses of irrigation water, number of crops you can grow per season and participation in collective management structures that govern water use in the scheme at different prices per ha per year. You are kindly requested to consider the different choices and select the one that will suit you for each set of choice cards.

For each choice set from the four alternatives below, mark the alternative you prefer.

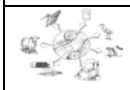
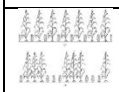
CHOICE SET 1

Attributes	**Option 1**	**Option 2**	**Option 3**	**Status quo**
 Membership to a cooperative	No	Yes	Yes	**No**
 Multiple uses of water	Irrigation and domestic use	Irrigation, domestic and livestock	Irrigation and livestock	**Irrigation only**
 Number of crops per season	One crop per season	One crop per season	One crop per season	**One crop per season**
 Annual payment of water/**ha/yr**	3000	7000	5000	**2500**
Please tick only one				

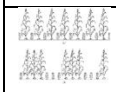
CHOICE SET 2

Attributes	**Option 1**	**Option 2**	**Option 3**	**Status quo**
 Membership to a cooperative	No	No	Yes	**No**
 Multiple uses of water	Irrigation only	Irrigation, domestic and livestock	Irrigation and domestic use	**Irrigation only**
 Number of crops per season	Three crops per season	Two crops per season	At least 4 crops per season	**One crop per season**
 Annual payment of water/**ha/yr**	7000	3000	2500	**2500**
Please tick only one				

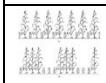
CHOICE SET 3

Attributes	**Option 1**	**Option 2**	**Option 3**	**Status quo**
 Membership to a cooperative	No	No	No	**No**
 Multiple uses of water	Irrigation and livestock	Irrigation and livestock	Irrigation and domestic use	**Irrigation only**
 Number of crops per season	At least 4 crops per season	Two crops per season	Three crops per season	**One crop per season**
 Annual payment of water/ **ha/ yr**	7000	2500	5000	**2500**
Please tick only one				

CHOICE SET 4

Attributes	**Option 1**	**Option 2**	**Option 3**	**Status quo**
 Membership to a cooperative	No	Yes	Yes	**No**
 Multiple uses of water	Irrigation, domestic and livestock	Irrigation, domestic and livestock	Irrigation and livestock	**Irrigation only**
 Number of crops per season	At least 4 crops per season	Three crops per season	Three crops per season	**One crop per season**
 Annual payment of water/**ha/yr**	5000	2500	3000	**2500**
Please tick only one				

CHOICE SET 5

Attributes	**Option 1**	**Option 2**	**Option 3**	**Status quo**
 Membership to a cooperative	Yes	Yes	Yes	**No**
 Multiple uses of water	Irrigation only	Irrigation and domestic use	Irrigation only	**Irrigation only**
 Number of crops per season	At least 4 crops per season	Two crops per season	Two crops per season	**One crop per season**
 Annual payment of water/ **ha/ yr**	3000	7000	5000	**2500**
Please tick only one				

In general, what considerations did you take when you were making your choices? ***(multiple answers possible)***

		H21. Consideration *(tick applicable)*
a	I exclusively choose the cheapest alternative	
b	I find cultivating large number of crops per season is important and choose such attribute among the alternatives	
c	I find membership to a cooperative is important and choose such attribute among the alternatives	
d	I find multiple uses of irrigation water is important and choose such attribute among the alternatives	

APPENDIX C: FGD CHECKLIST

Focus group discussion checklist of guiding questions

1. What do you do farming? How important is farming compared to other sources of income?
2. Which farming enterprises or crops have significant contribution to the livelihoods of farmers?
3. What are the most important challenges that farmers face in farming? Natural hazards? How do you cope with challenges?
4. Where do farmers access the different inputs required for producing the above crops? Mention the agro-dealers?
5. Do you use hired labour and if yes, how accessible is hired labour for your operations?
6. How do farmers sell their produce? Individually? Cooperatives or Associations? Contracts? What are the common marketing channels? Any challenges in marketing?
7. Are you interested to be part of a small-scale irrigation scheme? If Yes, Why? If No, Why not? If you are interested why have you not moved into irrigations plot?
8. Are you interested in collective management of water in the irrigations schemes?
9. Would you be prepared to pay for water use in the irrigations scheme? If Yes, Why? If No, Why not?
10. Have you ever experienced any conflicts related to water use? What were the points of conflict?
11. What would you recommend should be done to ensure that homestead/ independent irrigators also participate in small-scale irrigation in the schemes?

For scheme irrigators only

1. How much are farmers paying for water? Are the fees paid monthly? Yearly? Or at what interval?
2. Are farmers charged based on the amount of water they use or a flat rate? If flat rate, how are farmers over-irrigating monitored?

3. What are the farmers' opinions on the water charging system?
4. Are most farmers willingly paying water fees? Please explain? What could make farmers not pay their water fees?
5. Who is responsible for maintenance of irrigation infrastructure in the scheme?
6. What is the farmers' contribution in the maintenance of irrigation infrastructure?
7. What is the water use/ sharing arrangement?
8. Are there any conflicts that arise between farmers regarding water use/ sharing? If Yes, what are those conflicts and what are the causes?
9. What is the source for water used for irrigation? What are the other major competing uses of water from the same source?
10. Do farmers recognize that water is a scarce resource? What do you think needs to be done so that farmers can realise that water is a scarce resource?

APPENDIX D: ETHICAL CLEARANCE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

18 June 2015

Mr Unity Chipfupa 215079790
School of Agricultural, Earth & Environmanrtal Sciences
Pietermaritzburg Campus

Dear Mr Chipfupa

Protocol reference number: HSS/0601/015D
Project title: The role of small-scale irrigation schemes in finding appropriate entrepreneurial development paths

Full Approval – Expedited Application

In response to your application received on 27 May 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol have been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....
Dr Shamila Naidoo
On behalf of Dr Shenuka Singh (Chair)
Humanities & Social Sciences Research Ethics Committee

/pm

Cc Supervisor: Professor WE Zegeye
Cc Academic Leader Research: Professor Onisimo Mutanga
Cc School Administrator: Ms Marsha Manjoo

APPENDIX E: TURNITIN REPORT

Final thesis

ORIGINALITY REPORT

4%	2%	2%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	edepot.wur.nl Internet Source	<1%
2	www.wider.unu.edu Internet Source	<1%
3	Handbook of Climate Change Adaptation, 2015. Publication	<1%
4	Shawn Bushway. "Is the Magic Still There? The Use of the Heckman Two-Step Correction for Selection Bias in Criminology", Journal of Quantitative Criminology, 03/27/2007 Publication	<1%
5	www.econ.cam.ac.uk Internet Source	<1%
6	www.thecroc.com Internet Source	<1%
7	Van Averbeke, W, J Denison, and PNS Mnkeni. "Smallholder irrigation schemes in South Africa: A review of knowledge generated by the	<1%