The impact of capital endowment on smallholder farmers' entrepreneurial drive in taking advantage of small-scale irrigation schemes: case studies from Makhathini and Ndumo B irrigation schemes in KwaZulu-Natal, South Africa

By

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Dedication

My late father, Thembinkosi Joachim Hadebe

Declaration

I, Nolwazi Hadebe, declare that

1. The research reported in this thesis, except where otherwise indicated, is my original research,

2. This thesis has not been submitted for any degree or examination at any other university,

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As the candidate's supervisor, I, Prof Edilegnaw Wale Zegeye, agree to the submission of this thesis;

Signed _____ Date_____

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Abstract

Smallholder irrigation has been taken across the developing countries as a means of poverty reduction. However, irrigation schemes have failed to meet these goals for various technical and institutional reasons. The South African government has invested a significant amount of funds into projects that are meant to link smallholder farmers into commercial agricultural market value chains. Despite this huge investment on smallholder irrigation infrastructure, the performance of South African smallholder farmers remains unsatisfactory. Smallholder farming has shown very little change in the number of farmers actively participating in commercial agricultural markets. This study was started with the identification of several barriers to the development of agricultural businesses at small production scale. One of the key challenges is the misconception related to visualising smallholder farmers as homogeneous. Many studies in the development economics literature have shown that they are diverse in terms of preferences, resource endowments, capabilities, entitlements, constraints, and opportunities.

Given this reality, considering them as a homogenous unit is inaccurate and it hinders the process of action, research and development for policy and management interventions. For farmers to survive the increasingly competitive environment they operate in, it is imperative that they possess entrepreneurial skills. The purpose of this study, therefore, was to evaluate the impact of the capital endowment on on-farm entrepreneurial skills to take advantage of small-scale irrigation schemes and enhance rural livelihoods. The first objective of this study was to evaluate the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship in Makhathini and Ndumo B irrigation schemes. This was done using descriptive analysis, Analysis of Variance (ANOVA), Principal Component Analysis (PCA) and two-limit Tobit regression. The second objective of the study was to examine the impact of on-farm entrepreneurship and capital endowment on enabling small farmers to productively use the scheme infrastructure. This was done using ANOVA and a one-limit Tobit regression estimation of cabbage production function. Production functions were estimated to find out the impact (at the margin) of on-farm entrepreneurship on the productivity of individual farmers in each category of the respondents. Cobb-Douglas production functional form was chosen for this analysis.

A stratified random sampling technique was used to obtain a sample comprising of 114 scheme irrigators, 46 independent irrigators, 24 home gardeners, 15 community gardeners, and 22 non-irrigators in Makhathini and Ndumo B irrigation scheme areas. The results suggest that the number of days the farmer was available for labour per week, level of education, distance of household to the irrigation scheme, total size of land operated, crop income, number of years the household had been receiving child grant and recipient of foster child grant were all statistically significantly different within farming groups. The on-farm entrepreneurship competency index generated using PCA was dominated by motivated farmers who perceived their farms as a means of making a profit and ambitious farmers who also understand how to motivate people. The econometric models revealed that the estimated coefficients for farmer gender, farming experience, education level, psychological capital, scheme irrigators, main occupation and irrigation scheme distance from homestead statistically and significantly explained on-farm entrepreneurship competencies.

The coefficient estimates of training related to agricultural land preparation, household size, farming experience, cabbage total variable costs, credit, cabbage gross margin and on-farm entrepreneurship were all statistically significant in explaining the variations in cabbage yield. Scheme irrigators produced the highest mean cabbage and bean yields. However, these yields were well below the recommended commercial targets. Scheme irrigators had the lowest levels of entrepreneurial competency. Thus, government's exclusive focus on infrastructural investment, with no due consideration of the human and social dimensions of collective management of the schemes, has to be revisited. Moving forward, the key to unlocking the potential of small-scale irrigation schemes is a holistic approach, not just focusing on infrastructure but placing the human aspect right at the centre. With male farmers being more entrepreneurially skilled than female farmers, entrepreneurial skills training needs to target women.

To improve the economic performance of small farm enterprises, an assessment of the goals and aspirations of current and potential female farmers should be made. The better-educated farmers had lower levels of on-farm entrepreneurship skills. This could be because the younger generation, often better educated, had very little interest in farming as a career. Government initiatives in promoting agriculture and campaigns together with universities can shape public perceptions and make agriculture more appealing to the youth. Therefore, government investment in smallholder irrigation for rural poverty reduction should continue but the sector

has to be made more appealing for the youth. Improving the ICT infrastructure in the rural areas and enhancing the role of this technology in agriculture could be one of the focus areas of the intervention package as the youth are attracted to ICTs. The study recommends the continuation of investments in smallholder irrigation provided that a more holistic approach is taken that accounts for small farmer heterogeneity and the complexity of their farming systems. Both institutional (functional) and human-centred aspects of sustainability of small-scale irrigations schemes, has to be the key area of focus to improve their governance. It is important to note that capital endowment of any kind is not effective in isolation. What is needed is a policy environment enabling and inducing on-farm entrepreneurship in rural areas. The effectiveness of such policies, in turn, depends on the availability of capital assets (especially psychological capital) and capabilities.

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List of Acronyms

ABCD	Asset-Based Community Development
BEE	Black Economic Empowerment
CBOs	Community-based organisations
CES	Constant elasticity of substitution
COGTA	Cooperative Governance and Traditional Affairs
COMBUD	Computerised Enterprise Budget
DfID	Department for International Development
DoA	Department of agriculture
FAO	Food and Agriculture Organization of the United Nations
GM	Gross Margin
HDI Human	Development Index
IDC	Industrial Development Corporation
MAFISA	Micro Agricultural Financial Institutions of South Africa
MDGs	Millennium Development Goals
MIS	Makhathini Irrigation Scheme
NEF	National Empowerment Fund
NIS	Ndumo- B Irrigation Scheme
NYD	National Youth Development
PCA	Principal Component Analysis
SA	South Africa

SEDA	Small Enterprise Development Agency
SEFA	Small Enterprise Finance Agency
SIS	Smallholder Irrigation Scheme
SL	Sustainable Livelihoods
SLF	Sustainable Livelihoods framework
UNDP	United Nations Development Programme

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CHAPTER 1. INTRODUCTION

1.1. Background

Irrigation farming plays an important role in food production and food security in the world today. About 30% of the world's food production comes from 18% of the total cultivated land under irrigation (FAOSTAT, 2012). Poverty alleviation and ensuring household food security are central policy goals in developing countries, particularly in sub-Saharan Africa. The general agreement is that investment in smallholder irrigation schemes continues to be a viable and important strategy for achieving improved agricultural production, household food security and rural poverty reduction in the developing world (Kumar, 2003; Hussain and Hanjra, 2004; Gebregziabher *et al*., 2009;You *et al.,* 2009; Bacha *et al*., 2011; Sinyolo *et al.,* 2014a). The challenge is to what extent this expectation has been met, especially the institutional and governance issues in the collective management of the schemes (Muchara *et al*., 2014; Sinyolo *et al.,* 2014b).

As reported by Svendsen *et al.* (2008), the average rate of expansion of irrigated area over the past 30 years was 2.3% in both Sub-Saharan Africa and all of Africa. Total irrigated land in Africa is estimated to be about 12.2 million hectares and six countries, namely Egypt, Madagascar, Morocco, Nigeria, South Africa and Sudan account for nearly 75% of this total irrigated land. The 1.3 million hectares of irrigated land in South Africa constitute about 11% of the total irrigated land in Africa (FAOSTAT, 2012). It would appear that the potential for irrigation development for Africa, and in particular for Sub-Saharan Africa is large, given existing water resources. As well as the high value of irrigated agriculture on the continent coupled with the large number of rural poor that could benefit from productivity boosting as a result of irrigation investment (You *et al.,* 2011).

However, Africa faces complex challenges relating to irrigation. These challenges have been linked to low levels of expertise, knowledge, and capacity to develop and manage irrigation; the absence of an adequate policy and strategic planning framework (You *et al*., 2011). Empirical research identifies several barriers to the development of agricultural businesses at small production scale; lack of capital, limited access to markets, distribution channels and business support, shortage of experience, inadequate legislation and isolation from learning centres. The other challenges include the often poor yield performance of previous irrigation development

and the need for continued support for recurrent costs from the public sector; relatively high costs of conventional irrigation development, farmer practices and increasing competition over water (Crosby *et al.,* 2000; McElwee, 2005; *You et al.,* 2011).

Africa's agricultural productivity is the lowest in the world. This is partly due to the under-utilization of irrigation in Sub-Saharan Africa. Previously low food prices, limited government commitment, poor rural infrastructure, diets fixed to crops with low water requirements, and low population densities have all contributed to high costs and low levels of irrigation in Sub-Saharan Africa. Nevertheless, these trends have been changing and investments on irrigation have increased significantly (You *et al.,* 2011).

Poverty alleviation and ensuring household food security in rural areas are major objectives for the establishment of smallholder irrigation in South Africa (SA) (Denison and Manona, 2007). Most smallholder irrigation schemes were developed during the early apartheid era. They cover approximately 47000 ha and account for about four percent of irrigated areas in SA. It is estimated that about 250000 rural black people are dependent at least partially for a livelihood on such schemes. Irrespective of such a relatively small contribution, it is believed that those schemes could play a crucial role in rural development (Bembridge, 2000).

While smallholder irrigation accounts for a small proportion of irrigated area in South Africa, it remains important and has become national public interest in recent years (Denison and Manona, 2007). The importance arises primarily from its location in the rural areas, where poverty and food insecurity are concentrated. Approximately half the country's population lives in rural areas, and poverty rates are higher there (Perret, 2002).

Owing to the historical design, most areas where smallholders and subsistence farmers farm are less productive than other parts of the country particularly due to insufficient resources and erratic and unreliable rainfall in these areas. Additional challenges such as lack of skills and empowerment in managing surface runoff, deep drainage and evaporation coupled with poor technological skills in relatively simple skills such as water harvesting techniques among the farmers further limit water availability. Soil degradation is another characteristic of South African smallholder farms. Soil degradation including soil fertility has been described as one of the key constraints that contribute to poor productivity especially in communal areas of South Africa based on impractical policies such as the 'betterment planning' which led to crowding and thus adversely affecting food security (Thamaga-Chitja and Morojele, 2014).

For the purpose of this study smallholder irrigation schemes (SIS) refers to schemes developed in the former homelands of South Africa (SA). Additionally, it refers to schemes initiated by previously disadvantaged farmers or development agencies in resource-poor areas as well as schemes which are greater than 5 ha in size (Denison and Madonna, 2007). Smallholder irrigation schemes include farmers who use shared or individual water sources. The farmers own small plots that are subdivided and sometimes fragmented (Maepa *et al*., 2014).

These schemes are under local responsibility, controlled and operated by the local people in response to their felt needs, and using a level of technology which they can operate and maintain effectively. Over the years, many SIS have been established in South Africa in order to gain accessibility to productive land and increase production in the different regions of the country (Fanadzo, 2013). Evidence suggest that in 2010 there were 302 SIS in South Africa, with a command area of 47 667 ha. Not all 302 SIS were operational in 2010 and not all operational schemes were fully functional. A majority of the schemes have collapsed or are utilised well below their potential (Van Averbeke *et al.,* 2011).

Theoretically, the benefits of irrigation are realized through improvements in agricultural productivity per unit area and spin-offs in overall agricultural production, employment and wages, incomes, consumption, food security and overall socioeconomic welfare. These benefits tend to be interconnected and reinforce the impacts of each other (Hussain and Hanjra, 2004). Irrigation enables smallholders to adopt more diversified cropping patterns and to switch from low-value subsistence production to high-value market-oriented production. Irrigation investments act as production and supply shifters, and have a strong positive effect on growth, benefiting populations in the long-run (Bacha *et al*., 2011; Gebregziabher *et al*., 2009; and Hussain and Hanjra, 2004).

Despite increased public interest, generally, smallholder irrigation schemes in South Africa have performed poorly and have not delivered on their development objectives of increasing crop production and improving rural livelihoods. The poor performance of many SIS in terms of productivity and economic impact has been largely attributed to socio-economic, political, climatic, and design factors, as well as lack of farmer participation (Fanadzo *et al*., 2010a).

Irrigation succeeds only when complementary inputs and rural services are available even in cases when supported by national agencies. Thamaga-Chitja1 and Morojele (2014) propose the need for projects that support smallholder farming to go beyond identification of physical and natural assets. Fanadzo *et al.* (2010b) recommend that appropriate crop production approaches, including farmer training, be considered alongside all other issues during revitalisation of small-scale irrigation schemes to improve performance. Siyolo *et al.* (2014a) found that the welfare of the irrigators was better than that of non-irrigators. However, poverty indices indicated that poverty is prevalent for both groups, but is more pronounced among non-irrigators.

Consequently, significant efforts are required to develop irrigation and further ensure that irrigation realizes its full potential for poverty eradication, food security, and economic growth. Irrigation is an important medium for promoting increased productivity, only if investments in irrigation are properly targeted and accompanied by improvements in other agricultural inputs. In this manner, institutional settings, extension and management systems, availability of complementary inputs, and the involvement of farmers in the design and management of irrigation systems are likely to determine final system performance infrastructure (Sikelwa and Mushunje, 2013; You *et al*., 2011). In addition to this governments have recognized the need for a more entrepreneurial culture in the farming business (McElwee, 2006). According to Smit (2004) cited in McElwee (2006), entrepreneurship has become probably the most important aspect of farming and will increasingly continue to be so.

However, developing entrepreneurial and organisational competency of farmers has proven to be a problematic and difficult process. The issue of the extent at which such competency can be passed on arises. Furthermore, how these skills can be learnt and developed and more importantly how farmers can be encouraged to recognise the necessity of developing these entrepreneurial skills and treat farming as a business. Moreover, the creation of a new business based on the perception of opportunity, the work that is required for progressing from an idea to a concrete and valuable proposal, and obtaining the resources necessary haven proven to be difficult tasks. Consequently, educational processes are required for farmers to develop such competence (Díaz-Pichardo *et al.,* 2012**)**.

Among the developing countries which are included in the Global Entrepreneurship Monitor (GEM), South Africa has the weakest performance when it comes to entrepreneurship and business start-ups. The number of entrepreneurs per 100 adults amounts to about a third of the

number in Thailand, the leading country in the GEM index (Herrington and Kew, 2013).The South Africa GEM country report associates the weak entrepreneurship performance to four factors: the high transaction cost of tax compliance, in particular for young firms, weak support structures, in particular business development services which are not accessible or suffer from low quality, inadequate support structures for informal businesses and insufficient access to credit, in particular micro-finance (Foxcroft *et al.,* 2002; Herrington and Kew, 2013).

In the case of smallholder farmers what hinders the process of action, research and development for entrepreneurship policy interventions are to visualise smallholder farmers as a homogeneous group (McElwee, 2006). Theory suggests that farming is not a homogeneous sector and it operates in a complex and multi-faceted environment. This is particularly the case for smallholder farming, where farmers and the farming systems vary. To visualise smallholder farmers as a homogeneous group is inaccurate and hinder the process of policy development. For farmers to survive the extremely competitive environment they operate in, it is imperative that they possess entrepreneurial skills (Vesala *et al*., 2007).

1.2. Study motivation

Schumpeterian tradition has had the greatest influence on the contemporary entrepreneurship literature. The differentiating feature from Schumpeter is that entrepreneurship is viewed as a disequilibrating phenomenon rather than an equilibrating force (Schumpeter, 1954). Schultz, 1990; Kirzner, 1997 and Rosen, 1997 all regard market disequilibrium as a necessary condition for entrepreneurship**.** The argument is that entrepreneurship is about change and entrepreneurs are the agents of that change; entrepreneurship is thus about the process of change (Schumpter, 1954). Change is only introduced to the model through the talented, imaginative, bold, resourceful innovator, who does this by 'carrying out new combinations' (Audretsch, 1995**;** MCcaffrey, 2009).

Despite the disbelief in farmers as business owners or entrepreneurs, they do own a business. However, this business is not of a conventional type. Farm businesses seldom can be opened, closed, relocated and re-opened with the ease of many non-farm retail and service businesses. Agricultural business is risky with unstable incomes. Farm economics differ from most other businesses (McElwee, 2008a; Richards and Bulkley, 2007). Without a risk-taking attitude, a farmer is not able to realise business opportunities. Farmers lacking specific personal qualities and attitudes hinder the development of entrepreneurial skills. Some of these skills are

encompassed by the motivation to learn, self-reflection, and attitude toward feedback (de Wolf and Schoorlemmer, 2007).

The South African government has invested significant amounts of funds into projects that will successfully link smallholder farmers into commercial agricultural markets (DoA, 2013). Despite the enormous amounts of investments by government institutions, the performance of South African smallholder farmers remains unsatisfactory. There has been an insufficient change in the number of farmers actively participating in commercial agricultural markets (Muchara *et al.*, 2014). The participation of smallholder farmers directly and actively in marketing is important to produce agricultural entrepreneurs who are competitive, self-reliant and able to grow the business to a higher level in the future (Hussin *et al.*, 2012).

Improvement of entrepreneurial skills in agriculture is an important condition to generate sustainable rural development (de Wolf and Schoorlemmer, 2007). If entrepreneurship is an instrument for improving the quality of life for families and communities, and for sustaining a fit economy and environment, fostering entrepreneurship skill must be regarded as an urgently needed development component. Consequently is important to analyse to what extent farmers are progressive, forward looking and willing to diversify their occupations (Chandramouli *et al.,* 2007).

Applying the thought and practice of entrepreneurship in the field of agriculture generates increased agricultural productivity, creation of new business ventures, the creation of employment, innovative products and services, development of rural areas and increased wealth. The argument is that developing entrepreneurs in agriculture will in addition to creating employment opportunities for rural youth, control migration from rural to urban areas and reduce the pressure on urban cities. Entrepreneurship is not only an opportunity but also a necessity for improving the production and profitability in agriculture and aligned sectors (Bairwa *et al.,* 2014**)**.

Traditionally, entrepreneurship research has primarily been concerned with the start-up of new firms or existing firm levels (Schendel, 1990; Sexton and Landström, 2000). Empirical research has focused mainly on the innovative activity contributed by relatively large firms. The smallest firms have received relatively less attention and quantification. Most of the suggestions which have been made about the causes of innovative activity have been based on observing the behaviour of larger firms (Zoltan and Audretsch, 1988). Within the field of agriculture, little is

known concerning smallholders' agricultural decision-making or profitability throughout the season from a business perspective. Smallholder and subsistence agriculture remain on the sidelines as far as statistics are concerned. Smallholders are often regarded as constituting a homogeneous group, loosely classified by asset endowment and contrasting with large-scale producers (FAO, 2014).

Each step of establishing a business for entrepreneurs is a difficult process and consists of a variety of repetition and frustration. The traditional human, social, natural, financial and physical capital forms of capital commonly discussed as setbacks to the sustainable livelihood framework are insufficient in overcoming obstacles and recovering from the setbacks. Therefore, in attempts to better understand the people element of entrepreneurship, recognition of psychological capital (self-confidence, optimism, hope, and resilience) can prove to be very valuable. Each component of psychological capital may impact an individual's ability to cope with smallholder farming challenges. Psychological capital can help to reinforce the methodology foundation of the study of entrepreneurship and has strong explanatory power for the related issues of entrepreneurial process and a better predictive index of venture performance (Ming and Zuguang, 2013).

This study argues that entrepreneurial outcome is a multi-dimensional construct that has been measured and operationalized in various ways. However, literature has failed to produce ways that are suitable for agriculture and more specifically, smallholder farmers. The public sector agricultural extension has tended to be biased in research favouring more commercial farmers and simple yield maximisation rather than a range of choices more relevant to smallholder farmers. The study will attempt to fill knowledge gaps in smallholder farmer entrepreneurship literature. This will be done by integrating psychological capital into the sustainable livelihoods analysis, different to previous studies. This is done in attempts to demonstrate the value of psychological capital within the domain of on-farm entrepreneurship, where physical, human, financial, natural and social forms of capital have historically received much greater attention. The aim was to also investigate the degree to which capital assets and institutions influence on-farm entrepreneurship of smallholder irrigation. Furthermore, the degree to which on-farm entrepreneurship influences small farmers to productively use small-scale irrigation schemes.

1.3. Study objectives

The general objective of this study is to analyse the impact of the capital endowment on on-farm entrepreneurial skills to take advantage of small-scale irrigation schemes. The specific objectives include:

1. To evaluate the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship, and
2. To examine the impact of on-farm entrepreneurship and capital endowment on enabling smallholder farmers to productively use small-scale irrigation schemes.

1.4. Organisation of the study

The thesis is organised into six chapters. The first chapter has introduced and motivated the research problem and the objectives of the study. The second chapter will present the literature on the role of capital endowment in rural entrepreneurship spirits of smallholder irrigation schemes. The third chapter introduces the study area, the conceptual framework and the empirical models used. The fourth chapter presents the first set of results, which is a focus on the descriptive evaluation of capital asset endowment of Makhathini and Ndumo B scheme irrigators, independent irrigators, home gardeners and non-irrigators. The chapter also generates the entrepreneurship index and estimates the determinants of entrepreneurship. Consequently, the impact of capital endowment on rural entrepreneurship in smallholder irrigation schemes is also examined in this chapter. Chapter five is a display of the main findings of the study concerning on-farm entrepreneurship and its link to the productive use of small-scale irrigation schemes. The conclusions drawn and policy recommendations made are presented in the final chapter

CHAPTER 2. LITERATURE REVIEW

2.1. Introduction

The emergence of the free market economies globally has resulted in the development of a new spirit of enterprise and the increased individual need for responsibility for running their own businesses. Market liberalisation and multi-functionality are developments that have encouraged farmers to become more entrepreneurial and to re-consider their identities and roles as farmers (Morgan *et al*., 2010). The empirical literature indicates that farmers' entrepreneurship development has been globally recognised as key to increasing farm and national incomes and eventually improved household livelihoods. In the last few years, farmers, agricultural businesses, researchers and governments have recognized the need for a more entrepreneurial culture in the farming business (Lutalo and Lange, 2011; McElwee, 2006).

The next section describes the main concepts used in this study. This chapter defines entrepreneurship in the context of farming and presents literature on measuring entrepreneurship. It further presents an overview of entrepreneurship in South Africa, on-farm entrepreneurship, and synthesises the linkages between on-farm entrepreneurship, capital endowment and smallholder irrigation schemes. Factors that influence on-farm entrepreneurship of smallholder irrigation are also discussed. Furthermore, evidence from other studies is presented.

2.2. Defining entrepreneurship

A lot of scholarship has been dedicated to defining the concept of entrepreneurship. The lack of consensus can be attributed to the fact that entrepreneurship is not neatly contained within any single academic domain. However, numerous disciplines have contributed their perspectives on the concept of entrepreneurship, including psychology. A disagreement exists in the literature on the topic of agriculture being a suitable sector in which to study the ways that entrepreneurial competence can be characterized and identified, how it develops and how it can be promoted (Lans, 2009).

A comprehensive definition of entrepreneurship in general and farmer entrepreneurship, in particular,, remains nonconcrete. Many studies of farm business processes are resistant to considering farmers as entrepreneurs. This reluctance comes from the existing views of farmers,

particularly under state subsidy systems and as having been separated from the normal market process (Gasson and Errington, 1993). Additional reluctance originates from farmer identities that are formed primarily as producers rather than as business people (Van der Ploeg, 2003; Juma and Spielman, 2014). Bauernschuster *et al.* (2010) argue that African farmers, in particular,, do not fit the modern characterization of an entrepreneur. The argument is that they are often viewed as independent producers who operate outside the formal markets by consuming what they produce.

The opposing argument is, farmers are not just users of technologies developed elsewhere but they perform entrepreneurial functions that involve the transformation of knowledge into goods and services (Juma and Spielman, 2014). Contrary to popular perceptions, farmer entrepreneurship is equivalent to all those activities which help farmers adjust to a free market economy (Richards and Bulkley, 2007). Beell and Rehman (2000) confirm that in order to fully understand the concept of entrepreneurship one needs to pay careful attention to farmers' attitudes and motivation in an increasingly competitive business environment. Vesala *et al.* (2007) assert that a major challenge for the agricultural sector is to enable farmers to develop their entrepreneurial skills.

Zmija (2001) quoted in Mcelwee (2006), marked entrepreneurship as the progressive modernization of agriculture connected with multifunctional rural development. Dollinger (2003) defines entrepreneurship as the creation of an innovative economic organization for the purpose of growth or gain under conditions of risk and uncertainty. The definition, however, assumes that all farmers are engaged in farming for financial gain or growth which is not always the case. In addition, Gray (2002) defines an entrepreneur as an individual who manages a business with the intention of expanding the business and with the leadership and managerial skills necessary for achieving those goals. This growing body of literature has derived its inspiration from the work of Joseph Schumpeter.

According to Schumpeter (1951), the entrepreneur is an agent of change who disturbs the equilibrium of the steady state. In many societies, most of the markets are inefficient, thus providing entrepreneurs with opportunities of creating wealth by exploiting those inefficiencies. Even when markets are in equilibrium, human nature combined with the search for profit, technological progress, and advances in knowledge eventually destroy the equilibrium, in a process of creative destruction (Cuervo, 2005; Olawale and Garwe, 2010). It is innovation that is

needed to disrupt equilibrium, also labelled ‘creative destruction’. This is a pervasive concept in complexity economics which is economics articulated in a more general way. It demonstrates an economy perpetually inventing itself, perpetually open to response, creating novel structures and possibilities for exploitation, and (Arthur, 2013).

Schumpeter (1951) recognized that entrepreneurs seek to profit through innovation and transforming the static equilibrium into a dynamic process of economic development. This results in changing the patterns of production by utilising an innovation or new pattern of production (Schumpeter, 1951). This instinctive shift occurring in the economy is from a managerial to an entrepreneurial economy (Beatty, 1998). Furthermore, innovations do not appear independently of one another but in swarms or clusters (Harvey *et al.,* 2010). Schumpeter (1951) portrayed the entrepreneur as a ‘leader motivated by the urge of act who performs the entrepreneurial function of carrying out new combinations’. From the resource base view, the entrepreneur will successfully compete as he or she develops, and will maintain unique capacities that allow him or her to take advantage of opportunities and neutralise risks (Barney, 1991; Schumpeter, 1934).

Hebert and Link (1989) define an entrepreneur as “someone who specialises in taking responsibility for and making judgmental decisions that affect the location, form and use of goods, resources or institutions.” Apart from having high scores on entrepreneurial characteristics, farmers need also to have the ability for effective fulfilment of tasks as an entrepreneur. These are called competencies (Bergevoet *et al.,* 2005). Entrepreneurship is the pursuit of opportunity irrespective of limited resource conditions. These conditions are responsible the formation of entrepreneurial motivation, the advance of the entrepreneurial process and the achievement of entrepreneurial goals. (Ming and Zuguang, 2013).

The idea of considering farmers as innovators is not a new concept. An extensive analysis of farming as a business would prove that it is the nature of farming to innovate. The capacity of individuals to innovate is influenced by individual’s interpretation of their own surrounding environment, the challenges of that environment and the creativity and commitment they resist the challenges with (Juma and Spielman, 2014).

Kumar (2012) argues that there are two elements of entrepreneurship. The first is the managerial skills needed to start and run a profitable farm business. The second is an entrepreneurial spirit.

Faris (1991) hold the view that entrepreneurs are born with specific entrepreneurial qualities and that is not only something that one can learn. The opposing arguments are the notion that individuals can develop entrepreneurial skills through life experiences, and through the entrepreneurial process itself. The empirical findings of Lazenby and Machaba, (2011) support the observation that a university degree is not necessarily an essential ingredient for being successful entrepreneurs. A high number as 80% of a convenience sample of 100 small business owner managers of respondents did not have a university degree, although were running profitable businesses. Timmons (1999) holds a balancing argument with the view that entrepreneurship is a combination of both talent and skills; it is the opportunity coupled with the needed resources and applied with the entrepreneurial mindset.

2.3. Measuring entrepreneurship: evidence from the empirical literature

Policy-makers are particularly interested in the determinants and impacts of entrepreneurship on a country's economic development. It is a priority that they know what encourages entrepreneurial activity and the effects as well as the spill-overs it causes (Ahmad and Hoffman, 2008). The assumption is that policies are driven by certain goals related to entrepreneurship and policy-makers need indicators to inform them how these policies affect entrepreneurship and achieve the goals (Avanzi, 2009).

Contextually relevant measurement and evaluation of performance is critical in entrepreneurship research. Without adequate means of measuring performance, theory development is hindered. It also becomes difficult to develop useful recommendations for entrepreneurs (Murphy *et al.,* 1996). Researchers have attributed the contradictory findings to the determinants and impacts of entrepreneurship to the lack of conceptual clarification and the use of single and divergent measurements. (Audretsch, 2003).

Audretsch*, et al.* (2002) and Carree *et al.* (2001) used a measure of business ownership rates to reflect the degree of entrepreneurial activity. This measure is defined as the number of business owners in all sectors excluding agriculture, divided by the total labour force. This method combines all types of heterogeneous activity across a broad spectrum of sectors and contexts into one measure. The variable measures the stock of businesses and not the start-up of new ones and neglects the agriculture sector.

Self-employment data can be used across countries when collected from standardized sources but is not a correct measure of entrepreneurship. The lack of distinction between self-employment/opportunity[1] and necessity entrepreneurship[2] in developing countries leads to a very different mean of self-employment than in developed countries. However, self-employment serves as a good proxy for entrepreneurial activity. A majority of self-employed persons do not create new businesses. Many people who create new businesses are still considered by the Census Bureau as "wage employed" because wage employment is their primary source of income (Yakova, 2007).

An alternative measure of entrepreneurship highlights the change linked to innovative activity for an industry. This measure incorporates indicators of the numbers of patented inventions, new product innovations introduced into the market, research and development activities. Other measures of entrepreneurial activity focus only on the criterion of growth. The most frequent measures of entrepreneurship performance have been income, wages, survival, innovation, and productivity. Other performance measures that have been used include profitability and satisfaction of business owners and employees. At the unit of observation of the individual, the most typical performance measure has been individual earnings (Audretsch, 1995).

The Global Entrepreneurship Monitor (GEM) project is the most comprehensive effort to produce data and policy-relevant information that can be comparable across countries. It collects data on early-stage entrepreneurship. Start-up activity is measured by counting the proportion of the adult population that is currently engaged in the process of creating a business. New firm activity is measured as the proportion of the adult population that is currently involved in operating a business of less than 42 months. However, the GEM is likely to overestimate early-stage entrepreneurship activities in cases where, respondents have taken steps to form a business but fail to this may not materialize for several years (Desai, 2009).

Lundstrom and Stevenson (2001) followed the model of the Global Entrepreneurship Monitor (GEM) study (Reynolds *et al*., 2000) by defining and measuring entrepreneurship as "mainly people in the pre-start-up, start-up and early phases of business" A restriction of this approach is

[1] Opportunity entrepreneurs are individuals who start a business in order to pursue an opportunity (Buang, 2012).

[2] Necessity entrepreneurs are individuals in developing countries who start small enterprises out of necessity. While they range from street sellers to educated hopefuls with little access to formal employment (Buang, 2012).

that it restricts entrepreneurial activity to the process of the firm start-up. Furthermore, all the above-mentioned measures focus primarily on corporate entrepreneurship, ruling out agriculture and smallholder farmers (Lundstrom and Stevenson, 2001).

For the entrepreneur, identity problems arise from farmers' position in the market and in their relationship with customers. This is especially evident when farmers' customer base consists of a single big company such as a dairy or a slaughter house. The experience of a sense of control, which is considered to be characteristic for an entrepreneur, is restricted in this kind of customer relationship (Vesala and Peura, 2005). Reviews of studies on farmers' entrepreneurial behaviour show a mixed result in which farmer identity, farm business processes and entrepreneurship are dealt with in a number of different ways (Vesala and Pyysiainen, 2008; McElwee, 2005; 2006; Morgan, 2010). Carter (2001), and Yakova (2006) all show that farmers do identify themselves as entrepreneurs or that at least it is possible for farmers to have an entrepreneurial identity. However, some studies question the strength of this identity among farmers (Phelan *et al.,* 2012).

McElwee (2008a) suggests that networking, innovation, risk taking, team working, reflection, leadership and business monitoring are fundamental to developing and improving the farm business. Correspondingly, Morgan *et al*. (2010) give emphasis to what is described as higher order skills, namely, creating and evaluating a business strategy, networking and utilizing contacts, and recognizing and realizing opportunities. McElwee (2008b) alludes that 'farmers are business people in the sense that they run businesses but in practice they do not necessarily have well-defined business skills'.

The Principal Components Analysis (PCA) has been used extensively to construct different indices by different researchers (eg.Filmer and Pritchett, 2001; Manyong *et al.*, 2006; Vyass and Kumaranayake, 2006; Achia *et al.*, 2010; Howe *et al.*, 2012; Muchara *et al.*, 2014; Sinyolo *et al.*, 2014 b). Following these studies, PCA was used to create a multi-criteria entrepreneurship index by merging the entrepreneurship indicators and determining the appropriate weights. Empirical evidence on factors that determine on-farm entrepreneurship fall short and are limited. As far as the author's knowledge goes, none of the previous studies fully captures the totality of on-farm entrepreneurship, as this study attempts to do in later chapters.

2.4. Rural entrepreneurship in the context of smallholder agriculture

It is imperative that we distinguish between rural and corporate (urban) entrepreneurship. Urban entrepreneurs are more likely to start new businesses because of their networking opportunities. Hence, leaving out the environment could lead to insignificant or misleading results, impacting entrepreneurship initiatives (Freire-Gibb and Nielsen, 2011). The background and profile of an individual, his or her self-perception, cultural traditions, social and institutional structures can strongly influence his or her willingness and capacity to learn and develop entrepreneurial and organisational competency (Pyysiäinen *et al*., 2006; Rudmann *et al*., 2008; Vesala *et al*., 2007).

Rural entrepreneurship can be defined as new ventures that happen to be created in rural regions as a result of an intervention, such as a tax subsidy to attract businesses into an area or through the in-migration of city dwellers that then start businesses. It can also be described as a start of new enterprises that result from the unique endowments in rural regions that are not present in metropolitan areas. Such businesses are likely to involve agriculture (Lee and Phan, 2008). Integrating agricultural training with enterprise training can help smallholders to manage and market their farm production more effectively, to take advantage of new agricultural opportunities. Enterprise training can help farmers take and manage the risks involved in introducing progressive production technologies (Hussin *et al.,* 2012).

In the more recent years; research on rural economic development has focused on the role of entrepreneurs. Consequently, a growing literature is now emerging on rural entrepreneurship and, in particular, on the role of business enterprise characteristics and the range of skills regarded as critical to the success of farm enterprises (Crommie, 2000). Several countries in sub-Saharan Africa have emphasised the importance of employment in rural areas as a way of reducing rural poverty and food insecurity. Since most of the production in rural areas is conducted by smallholder farming households, the belief is that production plays an important role in rural livelihood strategies (Mtashe 2009).

Free food distribution or hand-out often creates a dependency syndrome which hinders the process of successfully implementing a commercial model and developing sustainable solutions to developmental problems (Manje and Snalgrove, 2010). The dependency syndrome due to food aid is regular among smallholder farmers and seldom witnessed with the large-scale commercial farmers (Isenman and Singer, 1977). Sharaunga and Wale, (2013) found that, in addition to the disincentive effects of food aid, agricultural policies including price controls and

sustained reliance on imported cereals were also undermining incentives to sustain local agricultural production.

The smallholder farmers' entrepreneurial behaviour is further shown to be influenced by the degree to which it is possible to integrate farming activity and products within a rural economy. This integration can be stimulated by those aspects of rural economies that add value to the farm and the farmer's resources. Entrepreneurial activity by smallholder farmers is directly affected by general rural development that may provide opportunities for those farmers who are capable and motivated to realise them. Challenges often result in increased marketing and transaction costs, which motivate the failure by farmers to meet market demands for quality, quantity. Timeliness research indicates that the difficulty in accessing market information and lack of bargaining power reduces producers' likelihood of participating in remunerative markets (Mabuza *et al*., 2014).

Low productivity coupled with inefficient production costs pose barriers in attempts to access the supermarket sector. Farmers face pressure due to low offer prices which could be related to their small scale size of operations and the supermarkets' dominant position resulting from their market shares. In addition, limitations in terms of knowledge and experience in business management, marketing, planning and entrepreneurship also prevent smallholder farmers from operating in a more commercial business world (Hussin *et al.,* 2012).

In certain circumstances, smallholder farmer entrepreneurship is constrained and narrowly expressed whilst in others there is space and opportunity to develop multiple entrepreneurial activities. These activities have significant demands on the farmer's entrepreneurial skills Farmers' entrepreneurial skills, therefore, are formed by the kind of socio-economic development and by the institutional support that is apparent in rural economies, as well as by personal, locational and physical factors (Morgan *et al*., 2010).

Entrepreneurship is a key factor for the survival of small-scale farming in the dynamic and increasingly complex global economy. Farmer-entrepreneurs need to view and treat their farms as businesses (McElwee, 2006). However, this entails various inherent constraints including smallholder farmers' mindsets, lack of distinction between family and farm operations, and absence of records (Audretsch 2009).

Rural livelihoods are very different from urban ones. Seasonality brings predictable cycles of hard work and under-employment, full and empty storerooms. It also brings low food prices when the harvest has been reaped and high prices when the crops are still in the field. Farmers face food crises, usually triggered by adverse weather conditions. Poor smallholders with only a little land and struggling to afford seeds and fertiliser face persistently low yields and chronic hunger (Devereux, 2013).

Rural communities and economies face incomparable, and very particular, social and economic challenges and opportunities. The understanding of these factors contributing to rural sustainability is often rooted in 'hard' quantitative performance indicators (Díaz-Pichardo *et al.,* 2012). Van Niekerk *et al*. (2011) attributed smallholder farmers not developing to inadequate farming systems, poor market access, inadequate financial assistance, poor support services, insufficient training and, a lack of water and associated infrastructure.

Farmers are "innovative reservoir in agricultural communities and potential sources of entrepreneurship" (Alsos *et al*., 2003). Development agencies see rural entrepreneurship having employment potential whereas farmers favour it as a way of improving earnings. Rural women identify entrepreneurship as creating employment possibility near their homes, which promotes independence (Chandramouli *et al*., 2007; Carr, 2008). The contribution of farmers to rural business development can go beyond the operation of their farm businesses, but also in their ability and propensity to start additional non-farm businesses (Carter, 1998).

The distinction between high-potential and low-potential areas in the transition toward commercialization is no longer restricted to the physical land capabilities of an area or region. It is the ability of the wider rural sector to adapt to change that proves to be crucial (Devereux, 2013). The farmers' skills can engage the farm to a greater or lesser extent with the wider rural economy (Morgan *et al*., 2010). The lack of adequate start-up finance is one of the most prominent impediments to people seeking to create their own businesses in rural areas (Robinson *et al.*, 2004; Sarasvathy, 2004; Ulrich, 2006). Rural farmers face strict credit scoring methodologies and regulations, complex documentation procedures and long waiting periods when they apply for funding (Robinson *et al.,* 2004).

Rural businesses face challenges that are not often experienced by those in urban settings. Apart from gaps present in telecommunications and transportation networks, social services and other standard business infrastructure, the owners themselves are often lacking in the necessary skills

and capabilities required for business start-up and operations (Lyons, 2002). Rural people lack knowledge, awareness and understanding of startup financing possibilities, personal savings, and credibility and collateral securities for debt financing, business experience and skills. This explains the common trend in rural areas where the market for products is too low to encourage expansion of entrepreneurial activities. For the market that exists, products are sold at a very low price to benefit the majority of the poor who live in rural areas. This limits entrepreneurs from exploiting some opportunities in rural areas (Ngorora and Mago, 2013).

Lack of confidence and assertiveness also affect rural entrepreneurship (Hookoomsing and Essco, 2003). In addition to poor perseverance, lack of management skills, lack of technical skills and risk aversion also, influence rural entrepreneurship. Poor or lack of networking also affects rural entrepreneurship (Ozgen and Minsky, 2007). This causes rural entrepreneurs to be isolated from viable linkages in urban areas. In as much as rural areas are rich in social capital, there is a need to be able to link with other entrepreneurs other than those in rural areas. Rural networking may lead to direct support in terms of raising funds, inter-trading, cooperative efforts, leadership and entrepreneurship development (Hookoomsing and Essco, 2003).

Governments, support organizations, communities and individuals are turning to entrepreneurship and small business development as a means for economic development in relatively disadvantaged areas. However given the key differences in the rural context, a business education framework for this group must meet the unique needs of rural entrepreneurs to ensure relevance and applicability and to achieve individual and economic development goals Business training and skills development are necessary to ensure businesses survive (Siemens, 2012).

2.5. Entrepreneurship in smallholder agriculture

Of the developing world's three billion rural people, over two-thirds reside on small farms of less than two hectares; there are nearly 500 million small farms. These people include half of the world's undernourished people (Hazell *et al.,* 2007). The Census of Commercial Agriculture (2008) reflects a 31% decline in the number of farmers since 1993 in SA, resulting in the industry being left with fewer than 40 000 farms. Stimulating agricultural growth is "vital for stimulating growth in other parts of the economy" and smallholders are at the core of this strategy (World Bank, 2007).

Smallholder farmers are often characterized as forming part of the 'rural poor', together with subsistence producers. The emphasis is often on commonalities rather than differences in assets, income or investment. Frequently neglected in literature are the dynamics of change and the underlying processes which clarify why some producers are more commercially orientated than others. Smallholder farmers are faced with unequal access to natural resources, infrastructures like storage facilities and rural roads, credit availability, the right technology, knowledge and skills, and markets. Low levels of human capital are witnessed mostly in terms of nutritional, health and educational inadequacies (Chitja and Morojele, 2014).

Groenewald (1993) argues that the entrepreneurship lacking in much of African agriculture cannot be all attributed to the irrational behaviour of farmers but partially to the lack of economic opportunities. International experience shows that crops mostly grown by commercial or large estate farming can be adapted successfully by smallholder farmers, provided that the right institutions and policies are in place (Nowata and Norris 2014).

Different categories of smallholder farmers face widely different sets of issues and constraints to market participation (FAO, 2013). Irrespective of support, smallholder farmers who lack commercial skills and assets may not be able to participate effectively in market development processes. Markets are changing rapidly and offering a new environment for smallholders and the potential for greater profits. Well-functioning agricultural markets can enable farming households to increase their incomes. For smallholders, however, the potential benefits are neutralized by higher entry costs and the risks of marginalization. In addition to other forces working against the smallholder farmer is the shift toward consumer-driven markets as part of market liberalization and globalization. The smallholder farmer is increasingly being forced to compete in markets that demand much more in terms of quality and food safety (Hazell *et al.,* 2007; Randela, 2008). These changes offer new opportunities while simultaneously presenting serious threats to smallholder farmers (IFAD, 2001).

Agriculture in Africa is undergoing a transformation, which brings opportunity and potential for growth together with uncertainty and problems. Southern African agriculture is in a state of transition, in attempting to balance rapid social, political and economic changes and population growth. However, the periods given to African farmers and governments for this transition are often unrealistically short. The goal deadlines are repeatedly being moved, together with shifting

policies and prices. This further weakens the stability which is needed to enable farmers to invest in long-term sustainability (Whiteside, 1998).

Entrepreneurs are critical for the spirit and creativity they bring. They are best prepared to realize the goals of rural economic development. Entrepreneurship is synonymous with risk, often coupled with learning curves and high failure rates. The farmers who venture off towards commercially-oriented production without success will need to bear the cost (IFAD, 2001). Entrepreneurs must be prepared, however, to acknowledge that some of the most well thought out and executed plans could still not be successful (Fal, 2013).

This is when the spirit of resilience becomes useful. Davidson (2000) viewed resilience as the phenomenon of recovery from a prolonged or severe adversity, or from an immediate danger or stress. Resilient people are expected to adapt successfully even though they experience risk factors that are against good development. Risk factors are related to poor or negative outcomes. In some cases, investors actively seek individuals who have failed, learned from their failures and are willing to try again. The fear of failure among existing and aspirant farmer entrepreneurs restricts them from taking calculated risks to start and expand their businesses (De Hoe, 2014).

The entrepreneurship of smallholder farmers is determined by characteristics of the population, including the demographic composition, educational levels, incomes levels and degree of unemployment, and cultural norms. Institutional factors include access to finance, administrative burdens, and the degree of taxation. In particular, the resources and capabilities of individuals along with their attitudes towards entrepreneurship are key factors in influencing entrepreneurship. Both cultural and institutional factors assist in the shaping the supply of entrepreneurial activity (Whiteside, 2008).

Smallholder farming is often considered too small to be viable enterprises. Smallholders are usually viewed as beneficiaries, and not as equal partners, in development projects. However, they are a heterogeneous group with different forms of production ranging from subsistence to part-time/diversified farms or self-sufficient commercial enterprises and conducting a variety of initiatives and innovations. Characterizing smallholders as largely engaged in unviable subsistence activity leads to treating them as welfare groups. Heterogeneity among farmers and their conditions means that subsistence farmers have a more difficult path to entrepreneurship as compared to those closer to commercialization (Omah *et al.,* 2013).

Encouraging entrepreneur farmers to thrive in developing countries can be achieved by managing incentives and rapidly changing agri-food systems. Good domestic markets are a favourable condition for business-minded farmers who recognize market opportunities. Complex land ownership rights are a persistent disincentive. What also serves as a hurdle is the culture of youthful aspiration to move away from the farms, who are not inspired to be enterprising farmers (Jayne *et al.,* 2010; Maepa *et al.,* 2014). Specific programs need to be targeted to youth. It is important to support young entrepreneurs and encourage them to see the vibrant business opportunity in smallholder farming. However it also important to simultaneously enable an environment for experienced farmers to be entrepreneurial and connect to value chains (IFAD, 2001; Brooks *et al.,* 2013).

Market intermediaries can play a significant role in stimulating entrepreneurship among smallholders. There is incentive all along the value chain to engage with smallholders. This incentive can translate into flows of inputs to production, technical assistance, credit, or even business training. This has been shown to be a promoter for entrepreneurship among farmers. Innovative partnerships and business models arise together with contract farming relationships. Governments are essential to value chain development; from attracting local investment to setting quality standards, building capacity, and developing infrastructure (IFAD, 2OO1; Fal, 2013).

Value chains are often introduced at the national government level. For donors and development organizations, creating an environment of vibrant economic growth is vital for inspiring entrepreneurship along the value chain. (IFAD, 2001) To preserve the balance of incentive and investment, government or donor interventions should correspond with market forces and work through the private sector to avoid distorting markets. A government program to provide free tractors will put the tractor supplier out of business. Markets should, therefore, be supported and private sector activity encouraged (Onumah *et al.,* 2007).

2.6. The role of physical, financial and natural capital to on-farm smallholder entrepreneurship

Land tenure arrangements form an additional obstacle together with the lack of productive assets and factor markets. These obstacles prevent entrepreneurial development. Furthermore, tenure and size relationships are inseparable with the latter largely being a function of entrepreneurial ability. Technological advancement has repeatedly been proven to be a major tool to economic

development and including agricultural development. However, it requires the development of methods and techniques. Entrepreneurs adopt new technology provided that they perceive it to be advantageous. The advantage could be in terms of a higher expected income or reductions in its variability (Groenewald, 1993).

Future agricultural development will depend on numerous interconnected factors. These factors include the acceptance of the smallholder farmer as an entrepreneur, the development needs, improved access to product and factor markets, improved infrastructure and the choice of appropriate technology (Groenewald, 1993; Van Zyl *et al*., 1993).

Land tenure reform may be regarded as a necessary tool, although not a sufficient condition for agricultural progress. Individual tenure does not suggest that every farmer should own all or a portion of the land he occupies. Owner-occupation according to Groenewald (1993) has nowhere in the developed or developing countries proven to be a necessary condition for the development of entrepreneurship. The answer to tenure problems lies in the conversion from traditional communal to individual tenure. Smallholder farmers could lease land from traditional owners on either a short term or long term basis. Furthermore, farmers can be allowed to lease to traditional land use rights from each other. Flexibility, mobility and efficiency will be enhanced by providing transferable lease contracts. This would lead to the development of a land market and a financial value to land market without getting rid of communal ownership in favour of private tenure (Cousins, 2007; Groenewald, 1993).

Farmers in various parts of Sub-Saharan Africa have insufficient access to markets for their products. Road infrastructure and distances from markets are major bottlenecks. Entrepreneurial activities in agricultural production and marketing can only occur if they are made profitable. Smallholder farmers operate in a small restricted environment which is encompassed by limited mobility. Limited access to factor markets causes prices of production factors to be high, resulting in little incentive for commercial production and limited scope for wealth creation. This eventually impeded entrepreneurial spirits (Groenewald, 1993; Lahiff, and Cousins, 2005).

From the review of empirical studies, weak institutional and organisational arrangements and poor crop management practices by farmers seem to be the major factors leading to under-performance of most SIS (Fanadzo, 2013). Additional concerns associated with smallholder irrigation include lack of investment, a focus on food consumption that prevent commercial production, lack of provision of financial services like credit, difficulties in water allocation,

distribution and charging, difficulties in organising maintenance, inadequate extension, lack of markets and lack of entrepreneurial and managerial skills (Tafesse, 2003; Makombe *et al*., 2007).

Capital assets are required to improve smallholder irrigation performance (Namara *et al.,* 2010). Access, control, and ownership of land, labour, finance, and social capital enable people to create stable and productive lives. However, relatively little is known about how agricultural development is constrained by the differential access to and control over the assets (Meinzen-Dick *et al*., 2011; Muchara *et al.,* 2014).

The endowment of physical resources on agricultural land (e.g. irrigation infrastructure, machinery, and equipment) has a major influence on business performance and diversification. In the case of pressurised watering systems, it can significantly improve the effectiveness of water application and, therefore,, the productivity of crops. In addition, using spare capacity of physical assets can reduce the costs and risks associated with diversification (Díaz-Pichardo *et al.,* 2012). A critical challenge for the agricultural sector consists of facilitating farmers' development of entrepreneurial and organisational capacities and attitudes. This requires economic support and a greater emphasis on education and training (McElwee, 2006). Research on the development of entrepreneurial and organisational competency in farmers is notably scarce in emerging economies (Diaz- Pichardo *et al.*, 2012).

The lack of financial support is a major obstacle to many farmers who are expanding production or diversifying into new high-value enterprises. Farmers who are starting new enterprises often face difficulty raising investment capital. The lack of title deeds inhibits farmers from accessing finance and thus cannot invest in other forms of capital (Kahan, 2012 and Kruntz, 2001). This further limits their ability to take up new opportunities that arise, inhibiting development of entrepreneurial behaviour. Access to credit contributes to training which should enhance entrepreneurial capacity. However, after completing training, some farmers discover they do not have funds to implement their new ideas (Kahan, 2012). The next sub-section discusses a review of the literature on the role of human, social and psychological capital to on-farm smallholder entrepreneurship.

2.7. The role of human, social and psychological capital to on-farm smallholder entrepreneurship

For as long as people have managed physical, financial and natural resources, they have engaged in collective action to access, manage and utilize these resources. However, development assistance has not paid enough attention to how social and human capital affects their engagement with these resources and the development outcomes. Social capital has been applied in a variety of contexts. The nature of the role and application of social capital in an entrepreneurial context has not been extensively explored. Social capital consists of relations of trust, reciprocity, common rules, norms and sanctions, family, networks and connectedness in institutions (Piaza-Georgi, 2000; Pretty and Ward, 2001; Anderson and Jack, 2002).

Increasing empirical evidence suggests that families play an important role in the venture creation process and thus deserve greater consideration in the entrepreneurship literature (Aldrich and Cliff, 2003). Many studies in the past indicate that, during the start-up process, family plays an important role in the mobilization of financial resources, the provision of human resources and physical resources in the form of space in the family household (Aldrich and Langton 1998; Steier and Greenwood, 2000).

The concept of human capital refers to individuals' knowledge (indigenous and otherwise), skills and abilities that allow for changes in action and the outcome(s) of the action. Skill is related to ability and the capacity to act, and may be claimed only when it is employed in practice. The level of a farmer's entrepreneurial skills can be linked to the farmer's relative economic independence. It may also reflect their ability to respond to developments in agricultural policy and regulation, and to be more responsive to markets (Vesala and Pyysiainen, 2008). Given that the entrepreneurial process is inherent to continuous mistakes and learning on the part of the entrepreneurs, it is critically important for researchers to understand what factors trigger entrepreneurial learning. Equally important is how exactly entrepreneurs learn, and what conditions determine how much they can learn from a given experience (Minniti and Bygrave, 2001).

Human capital theory suggests that knowledge provides individuals with increases in their intellectual abilities, leading to more productive and efficient potential activity (Coleman, 1988). Therefore, where there are opportunities for new economic activities, it is the individuals with more quality human capital that would be better at identifying them. Once involved in the

entrepreneurial process, such individuals would be better enabled to successfully exploit opportunities (Davidsson and Honig, 2002).

Agricultural growth, as well as entrepreneurship, is constrained by the absence of appropriate technology and related tacit knowledge[3]. Tacit knowledge refers to know-how, the often non-codified components of activity (Davidsson and-and Honig, 2002). The know-how consists of the explicit type[4] of information normally conveyed in procedures, processes, policies, formal written documents and educational materials. These constraints have resulted in misguided perception concerning appropriateness and a bias favouring large farmers among agriculturalists (Groenewald, 1993).

One way to overcome some of the constraints the smallholder farmers may face is to acquire knowledge and resources by outsourcing knowledge existing outside their own farm. Prior studies have shown that an entrepreneur's personal network allows access to resources that are not possessed internally (Liao and Welsch, 2005). Social capital may also help with the entrepreneurial exploitation process, by providing and distributing critical information and other essential resources. Social capital assists emerging entrepreneurs as individuals by exposing them to new and different ideas and global views. Entrepreneurs frequently make decisions as a result of associations based on friendship or advice often consisting of social capital based on weak ties (Davidsson and Honig, 2002).

Previous knowledge plays a critical role in intellectual performance. It assists in the integration and accumulation of new knowledge, as well as integrating and adapting to new situations. This network of resources and information may represent a rich source of explicit and implicit knowledge, experience and privileged access to physical resources. Such networks may offer a solution to the limitations of the infinite supply of internal resources for the new or growing venture (Anderson and Jack, 2002). Solving complex problems and making entrepreneurial decisions requires combining both tacit and explicit knowledge, as well as social structures and belief systems. Therefore, farmers may be able to increase their knowledge as a result of formal education, such as university education, informal education and non-formal education, such as adult education (Davidsson and Honig, 2002).

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[3] Tacit knowledge can be expanded through an individual's experiences (Scar, 2012).

[4] Explicit knowledge can be learned from books or other similar sources (Scar, 2012).

Social networks are regarded as critical for opening up entrepreneurial possibilities, providing access to useful, reliable, exclusive and less redundant information. It is increasingly recognized that interpersonal relationships have a crucial role to play in the success of individuals (Anderson and Jack, 2002). Although an entrepreneur is regarded as an individualist, there is sample evidence that entrepreneurship is, in fact, socially embedded in network structures (Casson and Guista, 2007).

Understanding how collective action can help address the inefficiencies, coordination problems or barriers to market access is particularly important (Markelova *et al.*, 2009). Farmers in SIS have previously acted in isolation of each other, with beneficiaries seeking support from separate projects and programmes. In the former homelands, a number of SIS were planned and established following a centralised estate design whereby control over farming activities and decision making was strictly enforced by central management with minimal or no input from farmers (Sikelwa and Mushunje, 2013). According to this study, this then resulted in high levels of dependency among farmers in the schemes and poor performance when farmers were left to manage the schemes on their own. Research conducted elsewhere in sub-Saharan Africa has shown that SIS can succeed if farmers participate in the planning, design and management (FAO, 2012).

Successful farmer-entrepreneurs are technically competent, innovative and plan ahead. They can manage their farm businesses through the stages of enterprise development from establishment and survival to rapid growth and maturity (McElwee, 2005). The results of a study conducted by Davidsson and Honig (2002) suggest that entrepreneurs would be well advised to develop and promote networks.

Research has demonstrated that individuals who are high in psychological capital tend to attract other like-minded persons to them, which in turn, increases the likelihood of creating long-lasting friendships and networks (Fredrickson, 2001). These strong emotional connections with both their work and individuals within their social networks help those rich in psychological capital to broaden their emotional capacity. This then enables them to be particularly resilient to stress and other health disorders (Fredrickson and Levenson, 1998), and to thrive in situations in which others may find to be overwhelming (Corey *et al.,* 2003).

Psychological capital, which focuses on who individuals perceive themselves to be, is a particularly important individual characteristic for smallholder farmers to possess in leading

their farms through the entrepreneurial process. It empowers the capability to persevere through uncertain conditions and to bounce back from failure. Psychological capital tends to be self-perpetuating. As individuals accumulate psychological capital, they tend to form a reputation for mental power that attracts to them individuals and situations that reinforce this capacity within them (Fredrickson, 2001). Smallholders who build psychological capital should not only increase their general level of well-being but also tend to develop the tenacity necessary to endure through the entrepreneurial process. Considering the increased emotional demands involved in leading new ventures within dynamic industries (Hmieleski and Ensley, 2007; Hmieleski and Carr, 2008)

2.8. State of entrepreneurship in South Africa

South Africa has the lowest Total Entrepreneurship Activity (TEA) rate of any developing country; this means that entrepreneurial activity on a range of measures is extremely low (Foxcroft *et al.,* 2002). South Africa's early-stage entrepreneurial rate is 7.8% which is significant below the average of 13% of other middle to low income countries (Herrington *et al.,* 2008). Studies in Global Entrepreneurship Monitor (GEM) over the years have conclusively shown that the low level of early stage entrepreneurial activity in South Africa is shaped by low levels of education, social and entrepreneurial factors that do not encourage entrepreneurship as a career path of choice; a lack of access to finance, particularly in the micro-financing arena and a difficult regulatory environment (Herrington *et al.,* 2009.)

South Africa's market dynamics is cited as one of the most constraining factors for entrepreneurship by 29% of GEM's national experts. The aggregated mean score for market dynamics of 2.81 suggests that the country's market shifts in demand and supply do not change dramatically enough. The more dramatic and frequent the market's shifts, the more opportunities there are likely to be because of thriving competition and innovation. South Africa's market dynamics score may help to explain in part why the country's rate for perceived opportunities of thirty-six percent is below the average for efficiency-driven countries of forty-one percent (Fal *et al.*, 2010).

Development of economy of any nation depends primarily on the important role played by entrepreneurs. The role played by such entrepreneurs is crucial to the developing economy of a country like South Africa. South Africa has displayed a nation- wide effort to support entrepreneurship, which is apparent through the Black Economic Empowerment (BEE) policies

and other similar types of initiatives (Fal *et al.*, 2010) The South African agricultural sector strategy aims to integrate the majority of subsistence farmers into the commercial agricultural economy. However, despite such efforts, the entrepreneurial spirit is not as set in motion as it should be. (Foxcroft *et al.,* 2002).

Given the failure of the formal and public sector to absorb the growing number of job seekers in South Africa, increasing attention has focused on entrepreneurship and new firm creation and its potential for contributing to economic growth and job creation (Herrington *et al.,* 2009). Despite the importance placed on promoting entrepreneurship and the abundance of resources committed to encouraging entrepreneurial activity, policymakers have primarily been operating without the benefit of substantive research findings (Dennis, 2000).

Several government institutions support entrepreneurial development, including the Small Enterprise Development Agency (SEDA), the Small Enterprise Finance Agency (SEFA), the National Empowerment Fund (NEF), the Industrial Development Corporation (IDC), the National Youth Development Agency (NYDA), the Land Bank, and the Micro Agricultural Financial Institutions of South Africa (MAFISA). These institutions are supported by various NGOs, a number of which are initiatives from foreign countries that support business creation in developing countries. However, many of these programmes are strongly criticised by the recipients as well as by experts, for reasons such as bureaucracy, inefficiency, high-interest rates and limited access (GEM, 2011).

The Small Business Development Corporation (1996) cited in Ladzani and van Vuuren (2002) reported that up to fifty percent of the small businesses started in South Africa eventually fail. The general perception amongst entrepreneurs is that access to capital is a major inhibitor to entrepreneurial growth and activity. The general misconception is that this is a result of the scarcity of funds available to funding institutions. The issue is not so much a lack of access to capital but the stringent and lengthy process required to access funding. This is intensified by the general lack of awareness about the procedures and the courses of action involved in gaining equity funding. This leaves entrepreneurs under-prepared and under-researched. Unprepared applicants often end up frustrated and disappointed with the process. Therefore, discovering the factors that motivate the individual to embark on an entrepreneurial career becomes important in stimulating entrepreneurship. (Fal *et al.,* 2009).

Entrepreneurship is the solution to many social problems South Africa faces at present. The longer it takes to fully adopt a culture of entrepreneurship the longer it will take to see the benefits of democracy. A significant amount of resources has been dedicated to stimulating small business development in South Africa by providing financial incentives, creating infrastructure and deregulating restrictive legislation. Despite this effort, an estimated 10 million South Africans still do not have access to transportation and are thus restricted in their physical movements (Fal e*t al.,* 2009; Mitchelle, 2004).

Mobility increases peoples' exposure to new concepts and ideas. Consecutively, exposure to new concepts and ideas drives one's sense of experimentation and innovation. The latter is critical to entrepreneurship development (Fal *et al.,* 2009; Sorensen and Sharkey, 2014).

2.9. Summary

Market liberalisation and multi-functionality are developments that have encouraged farmers to become more entrepreneurial and to re-consider their identities and roles as farmers. Empirical literature suggests that farmers' entrepreneurship development is crucial to improved household livelihoods. The growing body of entrepreneurship literature has derived its inspiration from the work of Joseph Schumpeter. According to Schumpeterian theory, the entrepreneur is an agent of change who disturbs the equilibrium of the steady state. Entrepreneurship is the pursuit of opportunity irrespective of limited resource conditions. The most frequent measures of entrepreneurship performance have been income, wages, survival, innovation, and productivity. Other performance measures that have been used include profitability and satisfaction of business owners and employees. The measures of entrepreneurship tend to focus on big non-agricultural firms, by and large neglecting the agricultural sector.

It has been suggested that networking, innovation, risk taking, teamwork, reflection, leadership and business monitoring are fundamental to developing and improving the farm business. Emphasis has also been put on what is described as higher order skills, namely, creating and evaluating a business strategy, networking and utilizing contacts, and recognizing and realizing opportunities. The notion is that farmers are business people in the sense that they run businesses but in practice they do not necessarily have well-defined business goals.

Farmers in various parts of Sub-Saharan Africa have insufficient access to markets for their products. Road infrastructure and distance are major bottlenecks. The endowment of physical

resources on agricultural land (e.g., irrigation infrastructure, machinery, and equipment) has a major influence on business performance. A critical challenge for the agricultural sector consists of facilitating farmers' development of entrepreneurial and organisational capacities and attitudes. This requires economic support and a greater emphasis on education and training.

Empirical evidence on factors that determine on-farm entrepreneurship, fall short and are limited. There is not much research done on the entrepreneurial spirit of smallholder farmers. Entrepreneurial activity by farmers is directly affected by general rural development that may provide opportunities for those farmers who are capable and motivated to realise them. In certain circumstances farmer entrepreneurship is constrained and narrowly expressed whilst in others there is space and opportunity to develop multiple entrepreneurial activities.

Human capital theory suggests that knowledge provides individuals with increases in their intellectual abilities, leading to more productive and efficient potential activity. Social networks are regarded as critical for opening up entrepreneurial possibilities, providing access to useful, reliable, exclusive and less redundant information. Understanding how collective action can help address the inefficiencies, coordination problems or barriers to market access is particularly important. Psychological capital empowers entrepreneurs with the capability to persevere through uncertain conditions and to bounce back from failure. Psychological capital tends to be self-perpetuating.

South Africa has the lowest Total Entrepreneurship Activity (TEA) rate by any standard. Global Entrepreneurship Monitor (GEM) studies over the years have shown that the low level of early stage entrepreneurial activity in South Africa is created by low levels of education, social and entrepreneurial factors that do not encourage entrepreneurship as a career path of choice, lack of access to finance and a difficult regulatory environment.

Several government institutions support entrepreneurial development, including the Small Enterprise Development Agency (SMEDA) and others. A significant amount of resources has been dedicated to stimulating small business development in South Africa by providing financial incentives, creating infrastructure and deregulating restrictive legislation. Despite this effort, an estimated 10 million South Africans still do not have access to transportation and are thus restricted in their physical movements.

Literature defining entrepreneurship is mostly limited to commercial corporate firms. Empirical evidence on factors that determine on-farm entrepreneurship is limited. As far as the author's knowledge goes previous studies that fully captures the totality of on-farm entrepreneurship fall short. With South Africa already having the lowest Total Entrepreneurship Activity (TEA) rate by any standard. It is imperative that we distinguish between rural and corporate (urban) entrepreneurship. The role of the farmer in African developing countries is changing. Farmers need to be more entrepreneurial and develop new skills and functional capabilities in order to be competitive. The reviewing of literature that has been done in this chapter attests to the necessity and motivation of this study. The following chapter will present methodological approaches that were used in this study. The study area is described in short before discussing data collection procedures and methods. Thereafter the conceptual framework is discussed, followed by the analytical models that were used in this study.

CHAPTER 3. RESEARCH METHODOLOGY

3.1. Introduction

This chapter introduces the methodological approaches that were used in this study. The study area is briefly described before discussing data collection procedures and methods. The conceptual framework is then discussed, followed by a close look at the analytical models that were used in this study. Finally, the empirical methods that include PCA and Tobit regression model are presented.

3.2. Study area description

The Makhathini and Ndumo B irrigation schemes are located in the Jozini local municipality under the Umkhanyakude District of KZN. The municipality is one of five local municipalities within Umkhanyakude District Municipality. It is located in the Northern KZN, near borders of Swaziland and Mozambique. Jozini Municipality covers 32% (3057 km^2) of the total area of 13859 km^2 of UMkhanyakude District Municipality. With the population of 207, 250 people and 38,530 households, it is the most populated municipality within Umkhanyakude District. The large area of Jozini jurisdiction falls under the ownership of Ingonyama Trust and some areas are privately owned by individuals and others owned by State. The current land ownership, which lacks security of tenure, is one of the reasons why it is very difficult to control development in the Municipal area of jurisdiction.

Significant portions of Jozini formed part of the former KwaZulu which tended to be historically neglected in terms of economic development. Most of the areas are also rural and associated with a lack of development, poverty and poor service provision. The district is characterised by high levels of unemployment and poverty. More than 70% of the population survives on less than R800 per month and 82.95% of households live below the poverty line (Cooperative Governance and Traditional Affairs (COGTA), 2011). The sanitation backlog is one of the major infrastructural challenges facing the municipality, with Jozini and uMhlabuyalingana being the most affected.The municipality is isolated from the rest of KwaZulu-Natal. The majority of the population has little to no formal skills which limit the job opportunities that they can pursue and also limits the types of jobs/development that can be created in the area. There are relatively low socio-economic levels therefore, there is a strong dependency on social grants.

The geographic area encompassed by the Umkhanyakude District Municipality (UDM) has the potential to supply the total subtropical fruit and winter vegetable market consumed by KZN. Much of this market is currently supplied from outside of the province. This potential arises from a combination of level and fertile floodplains for its three major rivers, an abundance of irrigation water, in spite of indifferent quality and a hot, dry climate (DoA, 2013).

3.2.1 Makhathini Irrigation Scheme

Mjindi Farming is employed by KZN Department of Agriculture and Environmental Affairs to manage and maintain Makhathini Irrigation Scheme (2500ha). Mjindi Farming plays a critical managerial role, supplying and charging for irrigation water and electricity distributed to individual farmers or groups. The irrigation scheme spills over into a portion of KwaJobe Tribal Authority area, resulting in some overlap with farmers falling under the Big 5 False Bay area of jurisdiction. The pattern of farming within the Jozini area is closer to commercial and semi-commercial farming relative to the pattern of subsistence and small-scale farming practiced not only in the rest of Umkhanyakude but also throughout the rest of KZN. The land and water in MIS have been allocated in blocks of 10ha and 20 ha to each farmer. This is regarded as a huge step in changing new farmer perceptions of land usage for crop production. On the contrary, the popular practice throughout SA is 12 to 20 people organising themselves as a co-op and then each planting their own small plot within a one or two ha communal garden.

3.2.2 Ndumo B -Mnotophansi – Co-op

The Ndumo B Irrigation Scheme (NIS) consists of recipients of the second 500 ha farm, situated south of the Ingwavuma River. This is approximately 80 km away from the MIS in Jozini. The Mnotophansi Co–op is an enterprising, growing group of 19 farmers and has been quoted as one of the Makhathini success stories (Phipson, 2012). The group farms 200 ha irrigated by over 350 kW of electric pumps drawing water from the Phongolo River. Some of the Furrow irrigation has been replaced by overhead sprinklers and draglines. The scheme could expand irrigation with the remaining 300 ha of land.

However, to achieve this, new markets will need to be found since the local market is virtually saturated. Each member farms his own block. Implements and equipment are communally owned as a separate business and then leased out to members. Soil and crop husbandry is of a high standard. The NIS grows and markets a full range of vegetables, using their own transport.

3.3. Data collection methods

Data were collected over a period of three months in 2014-2015 by six enumerators who spoke fluent Zulu, the local language. The questionnaires were pretested and enumerators trained in data collection methods and on the contents of the questionnaire before going for the survey. A sample of 12 farmers was interviewed in different blocks of the Makhathini and Ndumo B irrigation scheme during questionnaire pre-testing. Questions that were ambiguous and culturally sensitive during questionnaire pre-testing were amended following the pre-test. The sampling procedure and data collection tools that were used are discussed below.

3.3.1 Data collection instruments

Primary data were collected using structured questionnaires, key informant interviews and focus group discussions. Information on basic farmer characteristics and other social demographics, as well as capital endowment, was collected using the questionnaire. The questionnaire also included measures of capital endowment such as the household assets, livestock, and type of houses; the level of farming experience and training, sources of income, the farmers' perception of who they are i.e. psychological capital. Furthermore, the questionnaire sought to obtain farmers' perceptions of their own entrepreneurial spirits. This was done to create an on-farm entrepreneurship index for the two irrigation schemes in the Jozini area. The same questionnaire was used for irrigators, non-irrigators, independent irrigators and home gardeners but with more focus on irrigation schemes.

A portion of the questions was specific to each particular group. The skills and competencies around which the questionnaire was constructed were adapted from multiple sources of literature. Similar to Vesala and Vesala (2010) the study approached the issue of farmers' changing role from a social psychological perspective by utilizing the concept of identity. The use of self-assessed competencies is justified seeing that farmers themselves have a better understanding of their own entrepreneurial capability and skills set (Rudmann, 2008; Vesala and Pyysiäinen, 2008; Morgan *et al.*, 2010). More importantly, the farmer's viewpoint is critical in studying entrepreneurship because farmers make their production and business decisions based on their views (Morgan *et al.*, 2010). McElwee (2005) argues that entrepreneurship in farming can best be understood if the farmers are asked how they perceive themselves, i.e., the extent to which farmers see themselves as entrepreneurs. The success of a small business depends on the initiatives of the individual entrepreneur to create a viable business (Mitchelle, 2004).

3.3.2. Sampling procedure and sample size

A stratified random sampling technique was used to select the respondents. Following the key informant interviews and focus group discussions, farmers were categorized into four groups: irrigators, non-irrigators, independent irrigators and home gardeners. A list of the irrigating farmers and co-ops in the case of Makhathini Irrigation Scheme was obtained from extension officers. The reason for stratification according to the irrigation system or lack thereof was to capture the developmental paths constraints and challenges of progressing to the next level in each category. It has been insisted that the effectiveness of smallholder agriculture can be enhanced if the rural households advance from subsistence production to market-oriented or commercial smallholder production (Tshuma, 2012; DAFF, 2013). There was a limited list for non-irrigators; therefore, the non-irrigators, and independent irrigators, as well as home gardeners that were interviewed, were identified during the survey.

3.4. Conceptual framework

One of the extremely challenging socio-economic problems facing South Africa is how a large number of smallholder farmers could be assisted in establishing viable rural livelihoods (Kirsten and Van Zyl, 1998). Smallholder irrigation farmers rely on a variety of assets to achieve their livelihood outcomes, which can be analysed using the sustainable livelihoods framework (SLF) (Ahmed *et al*., 2008). Through the use of the SLF one is able to identify ways of enhancing livelihoods, strengthening asset bases and reducing vulnerability (De Satgé and Holloway, 2002; Ahmed *et al*., 2008).

The concept of Sustainable Livelihood (SL) is an attempt to go beyond the conventional approaches to poverty eradication. The SLF acknowledges that a specific livelihood encompasses more than just income, but includes social institutions such as family and community, gender relations, illiteracy, lack of social services and property rights other variables influencing the strategies adopted by rural households (Ellis, 1998; Krantz, 2001). It starts from an analysis of people's strengths, opportunities and constraints rather than needs, seeking to build on existing poverty reducing potential and emphasising the issue of sustainability (Hasnip, 2011).

Development interventions based on a sustainable livelihoods and asset-based (ABCD) analysis aim to make livelihoods sustainable and to strengthen people's ability to cope with crisis (Nel,

2015). ABCD approach encourages awareness and mobilisation of the assets and strengths in communities – a component not emphasised in the SL approach. ABCD approach complements and provides a richer description to the SL framework. Both the SL and ABCD approaches emphasise not what people lack, but rather how they cope and survive, in spite of constraints, lacks and shocks (Emmett, 2000). The study builds on an integrated SL/ABCD theoretical framework and practice model to analyse the impact of capital endowment on on-farm entrepreneurial skills to take advantage of small-scale irrigation schemes.

Ellis (1998) suggests that the phenomenon of livelihood diversification among rural households is as a process by which a diverse portfolio of activities and social support capabilities are strategies chosen for better living standards. Capabilities indicate what people can do or be to help them access assets. Once the contribution of assets, activities and capabilities have been assessed, it is also required to explore the vulnerability context in terms of the trends, shocks and stresses in which the assets, activities and capabilities exist (Chambers and Conway, 1992).

Community-based organisations (CBOs), institutions and all relevant role players in the community are the ones that decide on livelihood strategies and respective outcomes of these strategies. When capital assets, activities and capabilities can be converted into sustainable strategies, the result is positive livelihood outcomes, such as increased incomes (Nel, 2015).

Farming activities form an important part of these strategies as the majority of rural people are either directly or indirectly linked to agriculture (Pauw, 2007). Farming households in South Africa's rural areas typically pursue different livelihood strategies on the basis of the availability of natural, physical, human and financial capital available to them. These are also largely dependent on biophysical and socio-economic circumstances (Matshe, 2009; Monana *et al.,* 2010).

The SLF ensures a holistic analysis of the smallholder farmer assets and their operating environment (Muchara *et al.,* 2014). Adequate ownership of livelihood capital assets is vital for pursuing a range of livelihood opportunities (Matshe, 2009). This framework suggests that an adequate ownership of all forms of human, social, physical, natural, financial is essential for pursuing a range of livelihood opportunities, and is a key determinant of livelihood performance (Ashley and Carney, 1999; Krantz, 2001; Rakodi 1999). This study integrates psychological capital to this framework.

Understanding the nature and complexity of capital asset constraints and how they can possibly be alleviated can assist in improved market access strategies (Mabuza *et al.*, 2013). According to Barret (2008), private asset accumulation, public infrastructure and services are necessities for smallholders to escape from subsistence production and produce a marketable surplus. In addition, they lack reliable market information as well as information on potential exchange partners (Ouma *et al.,* 2010). The majority of f=smallholder farming households do not possess the level of assets required to protect themselves from market, natural, political and social shocks (Mabuza *et al.,* 2013)

To influence changes in the poverty outcome for smallholder farmers one needs to take into account a framework that considers the relationship between internal and external influences on the households to their livelihood outcomes (Matshe, 2009). The use of natural and physical capital varies considerably both within and among countries (FAO, 2004). The rural poverty reduction depends on increasing yields in agriculture, creating growth linkages in rural non-farm sectors (Matshe, 2009).

Carter (1994) suggest that certain financial market disadvantages may declare small farms non-competitive. Regardless of small-scale farming strategy holding considerable potential from an efficiency perspective, its implementation has still proven to be difficult. Critical policy issues, such as resolving the usually constrained access of small farmers to credit markets cannot be ignored. In countries like South Africa, where markets facing smallholder farmers for any combination of labour, land, credit, land rental, insurance, etc., are generally imperfect or give rise to real economies of scale over the short-term. These economies of scale are only temporary, and the outcome of deliberate elimination of, or restrictions on, the markets. (Kirsten and Van Zyl, 1998).

The use of more than one livelihood strategy can be represented as a result of the failure of agriculture to provide a sufficient livelihood for a substantial proportion of rural dwellers. However, smallholders with low levels of livelihood assets could steadily be propelled towards more mainstream market exchange as assets can serve as collateral, households with sufficient assets can exploit investment, and agricultural expansion opportunities can more effectively generate cash income (Kirsten and Van Zyl, 1998). It is imperative that for policy makers understand what type of livelihood diversification is being observed. Consequently designing policies that address cash constraints for further development where appropriate (Matshe, 2009).

This implies that local governments have an important role to play in contributions to the creation of an enabling environment access to markets, access, access to knowledge, access to infrastructures such as fences and boreholes, support to agricultural processing and access to credit. The underutilised potential, within rural areas could be realised by addressing critical aspects of smallholder farmer livelihood (Kirsten and Van Zyl, 1998). Agricultural innovation has to be approached in an integral way, part of a general process of change towards sustainability. A transformation from low-value subsistence production to high-value market-oriented production is a key driver of income diversification and risk management which is crucial to entrepreneurship development (Scar, 2012). Figure 3.1 sketches the important inter-linkages among capital endowment and entrepreneurship using the sustainable livelihood framework and asset-based analysis.

Key

H = Human Capital S = Social Capital N = Natural Capital P = Physical Capital

F = Financial Capital Ps = Psychological Capital

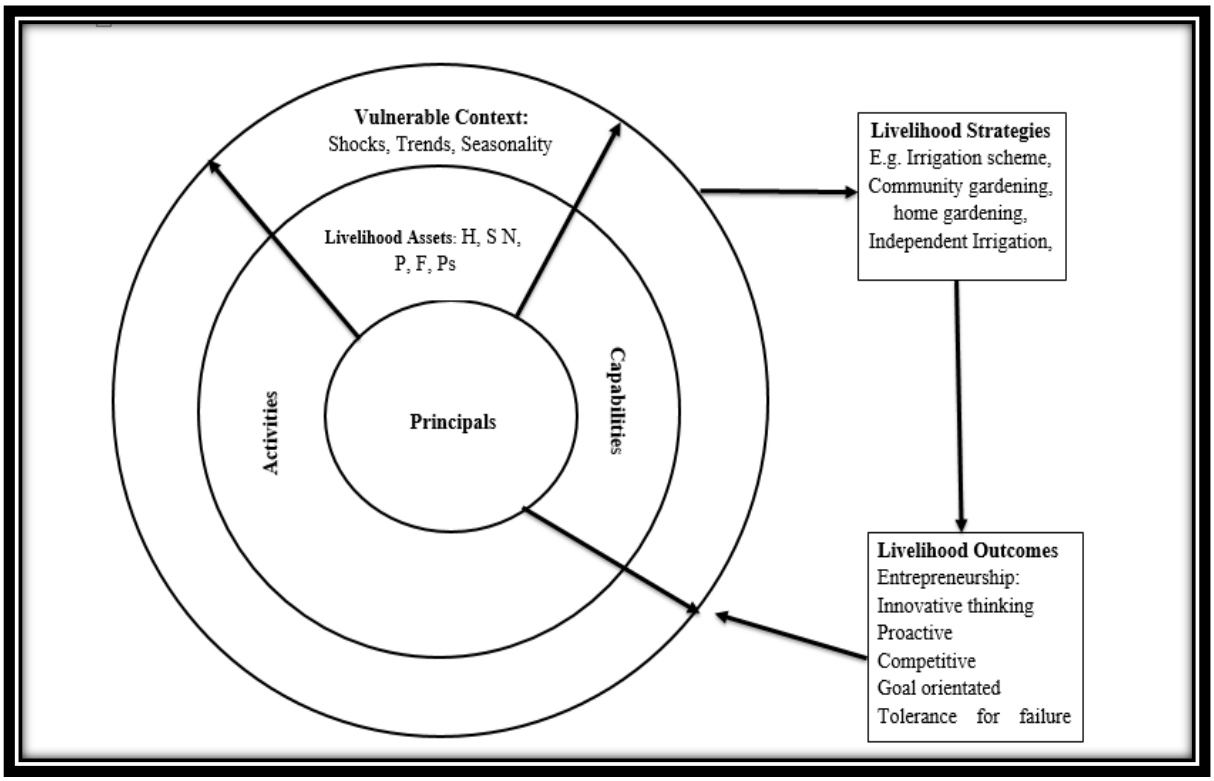

Figure 3.2. The integrated SL/ABCD framework

Source: Adapted from DfID (2001) and Nel (2015)

The acceptance of entrepreneurship as a central development force by itself will not lead to the rural development and the advancement of rural enterprises. What is needed in addition is an environment enabling entrepreneurship in rural areas. The existence of such an environment largely depends on policies promoting on-farm entrepreneurship. The effectiveness of such policies, in turn, depends on the availability of capital assets and capabilities to make use of them. It is important to note that all six forms of capital or determinants of entrepreneurial skills are not effective in isolation. They need to be integrated into thought and in action (Tyson *et al.,* 1994), for which psychological capital is the key.

Entrepreneurship is a socio-economic phenomenon that is influenced by multiple factors. An effective entrepreneurial culture embodies new ideas and creativity, risk taking capacity, capacity to accept and learn from failure, and a continuous change management process (Daily *et al*., 2002). Correspondingly, irrigation schemes and irrigated farm enterprises are a complex interaction of physical, social and economic factors that can best be understood within an integrated systems framework (Bembridge, 2000).

Traditionally, financial and tangible assets such as plant and equipment have received most of the attention. Informed irrigation scheme managers and policy makers now recognize the importance not only of tangible assets, data, and physical resources but also of this intangible human capital. The "human" referring to the people working at all levels of an organization, and the economic term "capital" referring to the resources withdrawn from consumption that is invested for future anticipated returns (Dennison and Monana, 2007; Mwendera and Chilonda, 2013).

De Lange *et al.* (2000) observed that research and expenditure on irrigation schemes tended to focus mainly on infrastructure which repeatedly proved to be ineffective. This is mainly because the human capital was not developed to effectively utilize and maintain the infrastructure (Fanadzo, 2013). This further highlighted the importance of human capital. According to Schumpeter (1942), human capabilities are even more critical when a society is engaged in creative economic responses. To Schumpeter (1942), the quality of human resources was critical to the execution of the entrepreneurial function.

In addition to their personal characteristics, smallholder farming entrepreneurs also need a range of competencies and abilities that can be learned or developed through training and experience, with the active support of extension officers and other stakeholders. An essential part of any

competency is knowledge which allows farmers to make informed choices. It puts farmers in a favourable position to compare the costs and benefits of the current practices being used with alternatives (Kahan, 2012; Kelley *et al.,* 2012).

It is also important to note that each farmer handles knowledge in a distinct way. Most traditional farmers tend to hang on to the knowledge they learned from their fathers (Kahan, 2012). Investments made into the scheme have a direct relationship to infrastructure. The ability to manage and maintain physical, financial and natural capital is strongly linked to local endowment of social, human and psychological capital. Communities with a greater access to assets are likely to have greater success in maintaining irrigation infrastructure (Dakhli and De Clercq, 2004; Kahan, 2012).

The foundation of farm-based businesses is land and water. Despite the desire to irrigate or produce as much as possible over the short-term, the successful farmer-entrepreneur is conscious of the value of the land that lies in its ability to continue producing profitably for generations. Sustaining land and water is a key element of the long-term success of the farm business. Most importantly, a farmer-entrepreneur is forward thinking and plans to be in business for a long time (Carsrud and Brännback, 2009; Kahan, 2012).

Irrigation plays a central and dynamic role in the improvement of rural livelihoods, but it is often characterised by inefficient water use, high capital and recurrent cost, lack of sustainability and inequity in the distribution of land. Tekana and Oladele (2011) suggest that the higher educational, income and socioeconomic status of the farmers and the availability of men on the scheme, the higher the household welfare**.** They further suggest that the availability of financial and human capital also contributes to a higher household welfare. Moreover, female-headed households often have a poor endowment to welfare enhancing resources. A majority of what is known about entrepreneurs, their background, motivation for starting a business and business problems faced by them are based on studies of male entrepreneurs (Mitchell, 2002).

However, despite all these conditions being met, poor farmers continue to fail to make sales to distant markets, due to market imperfections or high transaction costs.. Improvement in the management of irrigation water could provide some indirect benefits to the landless poor and would provide substantial benefits to poor smallholders (Hussain *et al.,* 2004). In summary, it is the whole set that matters for effective poverty reduction and not only the supply of water in irrigation schemes (Sinyolo *et al.,* 2014a).

Being an entrepreneur has been paralleled in literature to a way of life and a way of looking at the world. Entrepreneurs take pleasure in independence and freedom. Even when farmer-entrepreneurs work independently in free markets they do not work alone in isolation. They operate in a complex, dynamic environment and social network. They are part of a larger collection of people including other farmers, suppliers, traders, transporters and processors, each of whom has a role to play in the value chain (Coleman, 1988 and Kahan, 2012). Corman *et al.* (1996) suggest that business operations require managerial skills while being an entrepreneur in their view requires innovation and other skills.

Literature indicates that individual's psychological ability is a very important originator to the success of knowledge integration and knowledge sharing. It goes beyond human capital which is 'what you know' and the social capital of 'who you know'. It is more directly concerned with 'who you are' and more importantly 'who you are becoming' which inevitably determines access to other forms of capital (Luthans *et al.,* 2004). It is, therefore, imperative to assess the psychological capital of smallholder farmers. Entrepreneurs are passionate about growing their business and possess the qualities of a positive psychological capital (Kahan, 2004 and McElwee, 2005).

3.5. Empirical methods of data analysis

Different econometric models were used to achieve the specific objectives of this study. Table 3.1 gives the specific objectives and the corresponding analytical methods that were used.

Table 3.1 Study objectives and methods of data analysis

Objective	**Data analysis method**
To evaluate the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship, and	Principal Components Analysis (PCA) Two-Limit Tobit regression model
To examine the impact of on-farm entrepreneurship and capital endowment on enabling small farmers to productively use small-scale irrigation schemes.	Analysis of Variance (ANOVA) One-Limit Tobit regression model

3.5.1. Descriptive statistics

Descriptive analysis for all the variables was carried out as a first step in the data analysis. The descriptive analysis involved looking at means, frequencies and standard deviations of the variables. The t-test was used to make comparisons between irrigators, independent irrigators, non-irrigators and home gardeners with respect to relevant continuous variables, and the $\chi 2$-test was used to test the degree of association between the irrigation access variable and other relevant categorical variables.

3.5.2. Principal Components Analysis (PCA)

An empirical framework based on the entrepreneurial skills of farmers allows the researcher to investigate how farmers identify and develop their own skills and roles both in relation to immediate physical, social, economic and institutional environments (Morgan *et al.,* 2010).PCA was first used to combine socioeconomic indicators into a single index (Boelhouwer and Stoop, 1999). However, due to the inappropriateness of simple aggregation procedures, Lai (2003) modified the United Nations Development Programme (UNDP), Human Development Index (HDI) by using PCA to create a linear combination of indicators of development.

Several researchers have increasingly used PCA, since the late 1990s, to compute various composite socioeconomic indices (Antony and Rao, 2007; Fukuda *et al.,* 2007; Fotso and Kuate-defo, 2005; Havard *et al.*, 2008). It has been used to construct an asset-based poverty index which determines the socio-economic status of households (Filmer and Pritchett 2001; Vyass and Kumaranayake 2006; Achia *et al.,* 2010; Howe *et al.,* 2012). Following the same logic, PCA is used in this study to create a multi-criteria on-farm entrepreneurship index.

PCA was used to generate the entrepreneurship index, and this index was, in turn, used as a dependent variable in the Tobit regression model to determine the effect rural endowment has on the entrepreneurship level of the farmers' irrigation schemes. These different analytical techniques are explained in detail in the following sub-sections. From an initial set of 45 (See appendix A) which was cut down to 28 correlated entrepreneurship skills, motivations, self-efficacy, competencies and attributes were identified. The PCA created uncorrelated five components, where each component was a linear weighted combination of the initial skills or attributes. Only the factor scores (eigenvectors) of the first principal component (PC1) were used to construct the entrepreneurship index.

The aim was to create a single measure of on-farm entrepreneurship for farmers in the irrigation schemes. PCA is a powerful and relatively simple technique for extracting hidden structures from possibly high-dimensional datasets (Achia *et al*., 2010). Suppose we have a dataset with a high number of variables (i.e. indicators) for various observations. One can think that these indicators are measuring the same object or episode from different perspectives so all of them contain common information about the object. PCA is an orthogonal transformation of the coordinate system in which we describe our data. The new coordinate values by which we represent the data are called principal components. It is often the case that a small number of such principal components is enough to account for most of the structure in the data. These are sometimes called factors or latent variables of the data (Tabachnick and Fidell, 1983).

There are alternatives to PCA such as correspondence analysis, multivariate regression or factor analysis. Cortinovis *et al*. (1993) used correspondence analysis to derive an asset-based poverty index. However, the analysis can only be used for categorical data (nominal and ordinal); continuous data would need to be reorganized into ranges. With multivariate regression, dimensionality reduction is accomplished by simply choosing which variables to leave out, at the expense of ignoring some dimensions of the data (Aicha *et al*., 2010).

Factor analysis has a similar aim to PCA, in terms of expressing a set of variables into a smaller number of indices or factors. However, the difference between the two is that while there are no assumptions associated with PCA, the factors derived from factor analysis are assumed to represent the underlying processes that result in the correlations between the variables (Aicha *et al.,* 2010). The choice between using PCA and factor analysis to solve for multicollinearity also depends on the researcher's own assessment of the fit between the common factor model, the data set and the goals of the research (Tabachnick and Fidell, 1983).

For this study, which aimed at formulating an on-farm entrepreneurship index, PCA was deemed the better choice. The alternative, factor actor analysis is more suitable when the aims of the study are to obtain hypothetical solution uncontaminated by unique and error variability as opposed to an empirical summary of results Compared with other statistical alternatives, PCA is computationally easier, can use the type of data that can be more easily collected in household surveys, and uses all of the variables in reducing the dimensionality of the data (Jobson, 1992).

PCA is concerned with explaining variability. If the variables are in different units the operations involving the trace of the covariance matrix will have no meaning and the correlation matrix will

be used. If the variables are in the same units taking into account the logs of the variables, the covariance matrix must be used (Jackson, 1991).

Suppose we have a set of N variables, a_{*1j} to $a_{*N\,j}$, representing the possession of N picket scale of an entrepreneurial trait by each farmer. Principal components start by specifying each variable normalized by its mean and standard deviation: for example, $a_{1j} = (a_{*1}j - a_{*1}) / (s_{*1})$, where a_{*1} is the mean of a_{*1j} across all farmers and s_{*1} is its standard deviation.

These selected variables are expressed as linear combinations of a set of underlying components for each farm household j:

$$a_{1j} = v_{11} \times A1j + v_{12} \times A_{2j} + ... + v_{1N} \times A_{Nj} \qquad ... j = 1,...J$$

$$a_{Nj} = v_{N1} \times A_{1j} + v_{N2} \times A_{2j} + ... + v_{NN} \times A_{Nj}\,, \quad (1)$$

Where the As are the components and the vs are the coefficients on each component for each variable (and do not vary across farmers). Because only the left-hand side of each line is observed, the solution to the problem is indeterminate.

Principal components overcome this indeterminacy by finding the linear combination of the variables with maximum variance—the first principal component A_{1j}— and then finding a second linear combination of the variables, orthogonal to the first, with maximal remaining variance, and so on. Technically, the procedure solves the equations $(R - \lambda nI)vn = 0$ for λ_n and v_n, where R is the matrix of correlations between the scaled variables and v_n is the vector of coefficients on the n^{th} component for each variable. Solving the equation yields the characteristic roots of R, λ_n (also known as eigenvalues) and their associated eigenvectors, v_n.

The final set of estimates is produced by scaling the v_ns so the sum of their squares sums to the total variance, another restriction imposed to achieve determinacy of the problem. The "scoring factors" from the model are recovered by inverting the system implied by Eq. (1), and yield a set of estimates for each of the N principal components (Armeanu and Lache, 2008).

$$A_{1j} = f_{11} \times a_{1j} + f_{12} \times a_{2j} + ... + f_{1N} \times a_{Nj} \qquad ... j = 1,...J$$

$$A_{Nj} = f_{N1} \times a_{1j} + f_{N2} \times a_{2j} + ... + f_{NN} \times a_{Nj}. \qquad (2)$$

The first principal component, expressed in terms of the original (un-normalized) variables is, therefore, an index for each entrepreneur based on the expression:

$$A_{1j} = f_{11} \times (a^*_{1j} - a^*_1)/(s^*_1) + ... + f_{1N} \times (a^*_{Nj} - a^*_N) / (s^*_N) \qquad (3)$$

Given that the PCA generated entrepreneurship index is censored at its minimum and maximum values (Manyong *et al.*, 2006; Muchara *et al.*, 2014), the 2-limit Tobit model (Greene, 2003; Long and Freese, 1997; Wooldridge, 2002) was estimated to investigate the determinates of on-farm entrepreneurship in taking advantage of smallholder irrigation schemes. Since entrepreneurship can also be influenced by the individual's farming experience, education levels, these variables and others mentioned below in Table 3.2 were included in the model. Using the index generated by PCA as the dependent variable, the Tobit regression model was estimated as follows: $Y^*i = \beta_0 + \beta_{xi} + \varepsilon_i$ [1]. Where Y^*_i is the unobservable latent on-farm entrepreneurship index of household *i*; x_i is a vector of household characteristics; β and ε_i residual term.

3.5.3. Tobit regression model

Given the right- and left-censoring at minimum (σmin) and maximum (σmax) score, respectively, in the use of a PCA-generated on-farm entrepreneurship index as a dependent variable (Manyong *et al.,* 2006), a two -limit Tobit regression was estimated. As noted by Wooldridge (2002), traditional methods of regression are not suitable for censored data, since the variable to be explained is partly continuous and partly discrete. In this situation, ordinary least squares (OLS) analysis might have generated biased and inconsistent estimates of the model parameters. Therefore, the Tobit regression model was estimated to investigate the impact of capital endowment on unlocking on-farm entrepreneurship in irrigation schemes. Table 3.2 lists the variables used in the two-limit Tobit regression.

Table 3.2 Two-limit Tobit regression variables

Variable	Variable description	
Dependent variables		
Entrepreneurship Index	Entrepreneurship index generated through PCA	
Independent variables		Hypothesized Effect
X_1= Household size	Number of household members that stay in the household	+
X_2= Age	Farmer's age (years)	+
X_3 =Farmer gender	Farmer gender: 1=Male 0 = Female	+
X_5 =Education	Farmer education level	+
X_6 =Main occupation of respondent	1= Fulltime farmer 0=Otherwise	+
X_7= Marital Status	Farmer marital status: 1= married 0=Single	-
X_8 =Farming Experience	Farmer's years of experience in farming	+
X_9= Agriculture marketing training	1=Training received by the farmer relating to agriculture product marketing 0=None	+
X_{10}= Product pricing training	1=Training received by the farmer relating to farm product pricing 0= None	+
X_{11}=Credit	1= Credit take in the last 12 months 0= No credit	+
X_{12}= Irrigation distance(minutes)	Walking distance between household and the nearest irrigation scheme in minutes	–
X_{13}=Total Land Operating (ha)	Average land farmer is operating under	+
X=$_{14}$Type of Farmer	1=Independent irrigator 0= otherwise 1=Community gardener 0=otherwise 1=Home gardener 0=otherwise 1=Non- irrigator 0= otherwise	
X_{15} =Social grant	Average amount being received per household per month	-
X_{16} =Livestock Value	Average livestock value per household (Rands)	+
X_{17} =Crop Income	Average income received per year (Rands)	+
X_{18}=Psychological capital	Psychological capital score derived from the PCA	+

3.4.3.1 Terminology

Household size: This is the number of household members that stay in the household for 4 or more days per week as seen in table 3.2.

Age: This refers to a number of years the farmer has lived in according to the farmers' own knowledge. No documentation was provided to demonstrate the age given by farmers. Older farmers are expected to be on-farm entrepreneurial as seen in table 3.2.

Farmer gender: This dummy variable refers to the gender of the respondent. It is expected that male farmers are more on-farm entrepreneurial than females as seen in table 3.2.

Education: This variable refers to the highest of grades in formal schooling the farmer has attained. Farmers who have attained higher grades are expected to be on-farm entrepreneurial as seen in table 3.2.

Main occupation of respondent: This variable captures whether the farmer is a full-time farmer or a part-time farmer. It is expected that full-time time farmers are more entrepreneurial, as seen in table 3.2.

Marital Status: This dummy variable refers to the of the farmer marital status. Married farmers are expected to more entrepreneurial than single farmers, as seen in table 3.2.

Farming Experience: This variable refers to the number of years the farmer has invested in farming,given to researchers by the farmer interviewed, as seen in table 3.2. It is expected that farmers who have accumulated longer years in experience in farming will be on-farm entrepreneurial.

Agriculture commodity marketing training: This is training received by farmers on marketing agriculture produce. Farmers who have received this training are expected to be more on-farm entrepreneurial than those who did not, as seen in table 3.2.

Product Pricing training: This is training received by farmers on the pricing of agriculture produce. Farmers who have received this training are expected to be more on-farm entrepreneurial than those who did not, as seen in Table 3.2.

Credit: This dummy variable account for farmers who had taken credit within 12 months prior the questionnaire was administered. Farmers who had taken credit are expected to be more on-farm entrepreneurial than those who did not, as seen in Table 3.2.

Irrigation distance (minutes): This referred to the amount of time it took the farmer to walk from homestead to nearest irrigation scheme, as seen in table 3.2. It is expected that the farmers residing further away from irrigation schemes are less on-farm entrepreneurial.

Total Land Operating (ha): This referred to the total number of hectares of land the farmer was currently operating, consisting of both irrigated and dry land. It expected that the farmers with larger hectares of land are on-farm entrepreneurial, as seen in Table 3.2.

Type of Farmer: The smallholder farmers in the sample were dived into five groups, namely scheme irrigator, independent irrigator, community gardener, home gardener and non- irrigators. These groups were entered into the model as dummy variables. To avoid the dummy variable trap, scheme irrigator was used as a reference for the other type of farmers, as seen in Table 3.2.

Independent irrigator is expected to be more on-farm entrepreneurial relative to other group of farmers. The assumption is that the independent irrigator has more psychological capital and, therefore,, more entrepreneurial.

Social grant: This variable is the average social grant received by household per month. It is calculated by averaging monthly income from child support grant, child grant, old persons grant, disability grant, foster child grant and care dependency grant. It is expected that farmers belonging to a household with higher social grant monthly income are not on-farm entrepreneurial, as seen in Table 3.2.

Livestock Value: This value was estimated according to market rand value farmers perceived their livestock to be. It is the average livestock value per household. The livestock accounted for consisted of cows, calves, oxen, sheep and goats. Farmers with a higher value of livestock are expected to be on-farm entrepreneurial, as seen in Table 3.2.

Crop Income: This variable is the estimated gross income farmers received for crop produced in 2015. This was estimated using knowledge provided by the farmer. Farmers with higher gross crop income are expected to be on-farm entrepreneurial, as seen in Table 3.2.

Psychological capital: This variable was created using optimism, resilience, confidence and hope PCA scores calculated from a psychological capital section of the questionnaire (See Table 4.5 and Appendix E). It is expected that farmers with larger psychological capital are on-farm entrepreneurial, as seen in Table 3.2.

3.5.4. Production function

A production function was estimated for the major crops to find out the marginal effect entrepreneurship will have on the crop productivity of individual farmer. The specification of the production function used is of the Cobb-Douglas type. In the analysis of policies affecting factor returns, such as taxes on capital and labor income, the Cobb-Douglas specification may be too restrictive. The alternative, constant elasticity of substitution (CES) function has also been criticized as being unjustifiably restrictive. However, the study continues using the Cobb-Douglas in spite of its drawbacks because the additional costs and parameter uncertainties from the use of the CES are not outweighed by its benefits (Miller, 2008). It was used in this study because of because of its theoretical appropriateness, seemingly good empirical fit across many

data sets and suitability when dealing with small farms (Ajibefun *et al.,* 2002; Aihonsu and Sunmola, 1999).

Its general form is specified in semi-log linear form as follows:

$$LnY = \alpha + \beta_1 LnZ_{1i} + \beta_2 LnZ_{2i} + ... + \beta_{15} LnZ_{11} + e_i ....$$

Where: Y = cabbage heads/ha *Z* represents cabbage production inputs by the $_i$th farmer, $\beta_1 \ldots \beta_{15}$ are the regression parameters to be estimated and Ln is natural logarithm.

Crop yield densities typically possess a degree of negative skewness as plants are biologically limited upward by a maximum yield, but can be negatively impacted by adverse weather, such as drought (Belasco and Gosh, 2008). Censored regression models, such as Tobit, have been used to model the outcome of an optimization problem for which there is a corner solution (Wooldridge, 2002). Negative skewness occurs whenever production is tightly controlled so that the left tails of some resource availability distributions are thin **(**Tumusiime *et al.,* 2011**)**. Given the non-normality nature of cabbage yield, the one-limit Tobit regression model was estimated to measure on-farm entrepreneurship link to crop productivity in Table 3.3 below

One-limit Tobit regression specification:

$$Y = Y^* = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \ldots\ldots\ldots + \beta_{15} Z^2_{15} + \mu \quad If\ Y^* > 0\ EY = 0\ if\ Y \leq 0$$

Where *Y* is the cabbage heads/ha and *Y** is the latent variable; β are unknown parameters.

The parameters represent the elasticity of production with respect to the corresponding input and are constants and μ is a disturbance term. Table 3.3 below lists and explains the variables used in the one-limit Tobit regression.

Table 3.3 One- limit Tobit regression variables

Dependent Variables		
Cabbage Yield (heads/ha)	Calculated using cabbage heads per hectare	
Independent Variables	**Variable description**	**Expected relationship**
Z_1 = Household size	Number of household members that stay in the household for 4 or more days per week	+
Z_2 = Age	Farmer's age (years)	+
X_3= Education level	The number of grades attained in formal schooling	+
Z_4 = Farmer experience	Number of years in farming	+
Z_5= Total land operating	Total hectares of land farmer is operating on	+
Z_6= Gross margin	Cabbage gross margin, Rands/ha(2015)[Gross margin data allow analysing relationship between revenue and yield and identifying the critical level of yield when farm profitability is negative.]	
Z_7= total cabbage variable cost per ha	Estimated Rands/ha cost of cabbage production per year (2015)	+
Z_8=Cabbage Price	Price of cabbage head in Rands	+
Z_9= Type of farmer	1= Scheme Irrigator 0= Not scheme irrigator	+
Z_{10}= On-farm entrepreneurship index	Calculated using PCA	+
Z_{11} = Credit taken in the last 12 months	1=credit 0=No credit	-
Z_{12}= Training received by the farmer relating land preparation	1= Training relating to land preparation 0= None	+
Z_{13} =Training received by the farmer relating agricultural commodity marketing	1= Training relating to agricultural commodity marketing 0= None	+
Z_{113} = Farmer gender	1=Male 0= Female	+
	ei = Robust error term α & β are parameters that were estimated	

3.6. Summary

This chapter presented the methodological approaches that were employed in this study undertaken in Makhathini and Ndumo B irrigation schemes. Data were collected over a period of three months in 2014-2015 by six enumerators who spoke fluent Zulu, the local language. The questionnaires were pre-tested and enumerators trained in data collection methods and on the contents of the questionnaire before going for the survey. Information on basic farmer characteristics and other social demographics, as well as capital endowment, was collected using the questionnaire. The conceptual framework used in the study merges the sustainable livelihoods framework (SLF) with asset-based community development (ABCD). Through the use of the SLF one is able to identify ways of enhancing livelihoods, strengthening asset bases

and reducing vulnerability. The SLF ensures a holistic analysis of the smallholder assets and their operating environment. The ABCD approach encourages awareness and mobilisation of the assets and strengths in communities, an aspect not considered in the SLF approach. ABCD approach complements and provides a richer description to the SLF framework. This study integrates psychological capital to this framework. PCA was used to generate the on-farm entrepreneurship index, and this index is, in turn, used as a dependent variable in the two-limit Tobit regression model to examine the effect capital endowment has on the on-farm entrepreneurship. Following the estimation of the two-limit Tobit regression model, a production function of the major crop (cabbage) was estimated to examine the impact of on-farm entrepreneurship on crop productivity in each category of respondents. Cobb-Douglas production functional form will be chosen for this analysis because of its theoretical appeal and suitability when dealing with small farms. The following chapter will present socio-demographics of sample size and the empirical results of 2- Limit Regression model and discussion thereof.

CHAPTER 4. SOCIO-DEMOGRAPHIC CHARACTERISTICS AND MEASURING ON-FARM ENTREENEURSHIP

4.1. Introduction

The results presented in this chapter seek to achieve the first objective of the study, which is to evaluate the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship in irrigation schemes. This is achieved using descriptive analysis and Analysis of Variance (ANOVA). Principal component analysis is used to create an on-farm entrepreneurship index for the different types of smallholder irrigation farmers. Tobit regression model is then used to determine factors affecting on-farm entrepreneurship index.

4.2. Descriptive analysis of household demographics and socio-economic characteristics

The total number of farmers that were interviewed is 221, comprising of 114 scheme irrigators, 46 independent irrigators, 24 home gardeners, 15 community gardeners, and 22 non-irrigators. The average age of the respondents was 50 years which suggests that the average smallholder farmer was a middle age adult. Empirical research thus far seems to indicate that traditional or production-oriented identities are still dominant among farmers (Burton and Wilson, 2006). However, there is also some evidence that new identities like entrepreneurial identity are emerging, especially among younger farmers (Bryant, 1999; Gonzales and Benito, 2001; Vesala and Vesala, 2010). This was not prevalent in Jozini where discussions with the farmers indicated that the young people appeared to be less interested in farming. The status of youth participation in farming activities is one of the major factors that determine the level of smallholder farmers' productivity and entrepreneurship. With middle-aged adults participating in labour intensive agricultural activities, the chances of low productivity are high (Tarway-Twalla, 2013).

The F-test results presented in Table 4.1 indicate that there were no statistically significant differences between the age of respondents, household size and education levels amongst the farmers. The number of days per week that a farmer was available for labour was statistically and significantly different in each group of farmers. Scheme irrigators employ relatively more farm labour per week. The distance between households and nearest irrigation scheme in minutes was statistically different between the farmers. Independent irrigators and community gardeners were the furthest away from irrigation schemes, taking them 69.72 and 64.13 minutes,

respectively, to walk to the nearest irrigation scheme. This would explain why these communities built their own gardens and others chose to irrigate independently.

The average size of land that farmers operated reflected that of smallholder farmers (Van Averberke, 2008), with irrigation scheme members operating the largest land of an average of 2.05 ha. Scheme irrigators had the highest value of livestock estimated, social grant household income as well as crop income. The relatively lower crop income was expected from the community and home gardeners. These two groups were operating on relatively smaller land and had little to no market participation. Non-irrigators made no income from crops. This was due to severe drought and high-temperature conditions that Umkhanyakude district was experiencing.

The number of years that household members were receiving child grant and foster child grant were significantly different amongst farming groups. Social grants as a form of income are expected to have a negative influence on on-farm entrepreneurship. The number of years in farming experience was also significantly different amongst the farmers. No group had experienced lower than 9 years. Farming experience is expected to have a positive influence on on-farm entrepreneurship.

Table 4.1 Continuous socio demographic variables description

Variable definition	Scheme Irrigators (n=144)		Independent Irrigators (n=46)		Home Gardener (n=24)		Community Gardeners(n=15)		Non-irrigators (n=22)		
	mean	Std.dev	mean	Std.dev	mean	Std.dev	mean	Std.dev	mean	Std.dev	F- test
Age of respondent	48.529	11.3	49.9	14.01	49.1	10.75	50.5	11.8	50.5	11.8	1.48
Household size	5.9	2.7	5.4	2.4	5.9	2.66	4.4	1.7	5.7	1.9	1.34
Availability of farmer for labour (days per week)	6.4	1.2	6.3	1.1	5.9	1.7	4.5	2.5	5.3	2.6	6.24***
Level of education	4.93	4.3	3.6	4.71	5	5.4	3.07	4	3.1	2.5	1.8
Years of experience in farming	12.21	9.5	15.7	15.1	12.8	9.7	15.73	13.7	18.3	10.1	1.9*
Distance of household to the irrigation scheme (km)	52	37.5	69.7	43.8	64.1	48.6	46.7	24	48.1	28.6	2.45**
Total size of land operated (ha)	2.05	3.24	1.56	3.14	0.23	0.34	0.77	0.9	0.9	0.9	2.89**
Livestock Value (000' Rands)	R 9.30	R26. 1	R 12.20	R25	R 9.20	R28. 8	R 7.40	R 11.10	R 10.30	R 28	0.145
Social grant Income (000' Rands)	R 1.70	R 2.90	R 1.40	R 1.50	R 0.80	R 0.80	R 0.70	R 0.90	R 1.30	R 1.20	1.4
Crop Income (000' Rands)	R 10.90	R 18.30	R 8.30	R 17.80	R 24.40	R 9.40	R 3.70	R 3.20	R 0	R 0	3.4***
Number of recipients of child grant in the household	2.38	1.9	2.4	1.8	2.9	1.55	2	1.07	2.33	1.3	0.8
Years receiving child grant	6.5	4.1	8.67	4.8	10.3	4.92	9	3.6	9	4.3	4**
Recipients of old age grant in the household	1.9	2.6	1.6	1	1	-	1.33	0.6	1.1	0.4	0.9
Years the household has been receiving old age grant	35	4.1	18	8	2	8.5	3	6.7	7	6.1	0.1
Number of recipients of foster child grant	2	-	-	-	1	-	-	-	1.5	0.7	2.*
Number of recipients of disability grant	1.3	0.7	1	-	1	-	-	-	1	-	0.9
Recipients of care dependency grant	4.3	1.2	1	-	-	-	-	-	-	-	0.6

Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively

Source: Survey data (2014/2015)

According to Shinnar *et al.* (2012), a better understanding of how cultures shape entrepreneurial intentions can serve to explain the gender gap in entrepreneurship and possibly identify strategies to reduce it. The results of Table 4.2 suggest that female-headed household dominated smallholder farming in all five groups. Furthermore, findings show that more female-headed households are involved in home and community gardening and independent irrigation compared to scheme irrigators. A majority of non-irrigators and community gardeners were married. A significantly large portion of scheme irrigators and independent irrigators were full-time farmers. Relatively less home gardeners and non-irrigators were full-time farmers. This was evident in the field visits, as these two groups mainly produced for household consumption.

Table 4.2 Categorical variables description

Variable definition	Categories	Scheme Irrigators (%)	Independent Irrigators (%)	Home Gardeners (%)	Community Gardeners (%)	Non-irrigators (%)	χ2 test
Farmer gender	1=Male	40.4	39.1	29.2	40.0	27.3	2.18*
	0= Female	59.6	60.9	70.8	60.0	72.7	
Marital Status of farmer	1=Single	43	56.5	50	33.3	18.2	10.58
	2=Married	52.6	41.3	45.8	60.0	72.7	
	3=Widowed	4.4	2.2	4.2	6.7	9.1	
Farmer's main occupation	1=Fulltime farmer	90.4	93.5	45.8	73.3	54.5	59.18***
	2=Regular salaried job	0.9	0	8.3	20.0	18.2	
	3=Temporary job	1.8	2.2	8.3	6.7	13.6	
	4=Unemployed	2.6	2.2	25.0	0	9.1	
	5=Self- employed	0.9	0	8.3	0	4.5	
	6= Retired	1.8	2.2	4.2	0	0	
	7=Aged	1.8	0	0	0	0	
Credit taken/loan facility		30.7	50.0	29.2	33.3	18.2	8.544*
Reason for not taking credit or loan facility	Interest rate is high	15.19	17.39	11.76	40	27.78	32.80***
	Could not secure the collateral	7.59	4.35	11.76	10	22.22	
	got my own sufficient money	12.66	8.70	17.65	10	22.22	
	It isn't easily accessible	49.37	17.39	23.53	30	16.67	
	I am risk averse	15.19	52.17	35.29	10	11.11	
Main source of credit/loan	Relative or friend	31.43	21.74	14.29	0	25	28.55*
	Money lender	14.29	13.04	0	0.00	50	
	Savings club	28.57	34.78	14.29	100	25	
	Output buyer	5.71	0	0	0	0	
	Financial institution	17.14	30.43	71.43	0	0	
	NGO	2.86	0	0	0	0	
Ability to pay back loan in time? 1=Yes 0=No		68.6	82.6	71.4	80	100	2.965

Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively**.**

Source: Survey data (2014/ 2015)

Credit taken in the past 12 months by farmers was statistically significantly different amongst farmers. Independent irrigators had the highest percentage of farmers who had taken loans in the past 12 months. This could have been attributed to the high costs of maintenance when irrigating independently. Scheme irrigators felt that loans were not easily accessible. This was the main reason why 49.37% had not taken any credit or used any loan facility. The main reason for home gardeners to avoid credit was their risk-averse nature. All the non-irrigators who had taken credit in the previous 12 months preceding the survey were able to pay back the loan in time. Table 4.3 displays the distribution of land between male and female farmers.

Table 4.3 Land size operating according to gender

		N=221	Mean	Std. Deviation	Std. Error Mean	F- test
Total size of land operated (ha)	Male*	83	2.8	4	0.4	60.7***
	Female*	137	0.8	1.3	0.1	

Notes: ***, means significant at 1% levels, * this gender refers to that of the farmer respondent, not the household head.

Source: Survey data (2014/ 2015)

Despite the fact male-headed households are a minority in the smallholder farming sample, males still operated on bigger plot sizes. The average total size of land operated by the male farmer was statistically and significantly 2 ha larger at 1% level. As seen in Table 4.3, males operated on an average of 2.8 ha while females operated under a mean of 0.8 ha.

Home gardeners (Table 4.4), were statistically the least trained in general irrigation practices, compared to the other farmers. Community gardeners and scheme irrigators had the highest percentages of farmers trained in irrigation management. Independent irrigators had statistically the lowest percentage of farmers trained in irrigation management. A majority of farmers had little to no training in processing and packaging of farm produce. This reflected in the high number of farm gates transactions with hawkers. The farmers made most of their sales in their plots, with very few of them traveling to markets. Training related to pricing of produce was also lacking in most farmers. This was again evident from the group discussion made with Maize

farmers. The maize farmers in the MIS complained that they did not have a uniform price for maize. The hawkers visiting the scheme took advantage of this resulting in them making losses.

Table 4.4 Proportion of farmers who received training

Training	Scheme irrigator (%)	Independent irrigator (%)	Home gardeners (%)	Community gardens (%)	Nonirrigators (%)	$\chi 2$ test
Training related to general irrigation practice	64	23.9	20.8	66.7	45.5	31.48***
Training related to general irrigation management	64.9	19.6	20.8	66.7	45.5	37.105***
Training related to agricultural commodity marketing	56.10	19.60	25	60	31.80	24.40***
Training related to packaging of fresh produce	43.9	23.9	25	60	27.3	14.13**
Training related to processing of farm produce	37.70	19.60	25	60	31.80	10.46**
Training related to pricing of produce	37.70	21.70	20.80	66.70	22.70	14.13***

Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively

Source: Survey data (2014/2015)

In addition to information on human, financial, natural, physical and social capital, psychological questions were administered to the farmers. The psychological capital is concerned with who the farmer perceives themselves to be or who they see themselves becoming. This was critical to the study attempting to understand the levels of entrepreneurship in both Makhathini and Ndumo B (McElwee, 2005; Morgan *et al.,* 2010).

State of self-confidence: Levels of confidence in groups of farmers as seen in Table 4.5 below were statistically different within the groups of farmers. A majority of the independent irrigators were neutral regarding their state of confidence in themselves as farmers. Scheme irrigators were the most confident group of farmers. This group was also the group that felt confident they would succeed. A majority of community gardeners were neutral regarding their confidence. All the farmers envisioned themselves as potential commercial farmers with the exception of home gardeners. Only half of the scheme irrigators envisioned themselves as commercial farmers. Scheme irrigators were also very clear about their plan for their farm. Community gardeners once again responded neutrally. In similar studies by Bradley and Roberts (2004) and Hmieleski and Corbett (2006), each identified a robust positive relationship between the degree to which

individuals perceive themselves as having the ability to successfully perform the various roles and tasks of entrepreneurship and their actual satisfaction with their jobs as entrepreneurs.

Optimism: The levels of optimism of the farmers were statically significant. Scheme irrigators were relatively optimistic about the future of agriculture in their area. Scheier *et al.* (2001) have demonstrated a positive relationship between optimism and well-being. Particularly the study found that optimists, as opposed to pessimists, often enjoy experiencing various forms of adversity. The rest of the farmers in this study were moderately optimistic with neutral responses. The community gardeners' stated that they were only optimistic provided that government or the Department of Agriculture (DoA) helped implement irrigation infrastructure for them.

Resilient: Certainly the capacity to bounce back from adversity is critical to entrepreneurs, who need to persevere in the face of high risk and resource constrained conditions. However, little research has been conducted on the psychological resilience of entrepreneurs. The levels of resilience amongst the group of farmers were statistically significant. Scheme irrigators as well as non- irrigators perceived themselves as resilient to shocks such as drought and other natural disaster. This was evident with the non-irrigators who were adamant about farming despite the unfavourable drought conditions that they experienced at the time of the site visits.

Hopefulness: The non- irrigators remained hopeful that drought will end. They were hopeful that quality of life will get better. This was also evident for scheme irrigators and home gardeners. However, the community gardeners and independent gardeners had neutral responses regarding hope. They expressed that their hope was conditional as expressed above for community gardeners. Independent irrigators complained about the high costs of maintenance as well as other physical infrastructure problems which added to it. Studies done in the past found hope is positively related to life satisfaction and it is a fight against psychological distress. Hopeful farmers are expected to be more entrepreneurial, with a capacity to deal with unpredictable events that complex, multifaceted and risky agricultural market (Horton and Wallander, (2001); Ong *et al.,* 2006; Valle *et al.,* 2006).

Table 4.5 Dimensions of psychological capital

	Linkert Scale	Scheme irrigators (%)	Independent irrigators (%)	Home gardeners (%)	Community gardeners (%)	Non- irrigators (%)	χ2 test
State of confidence in yourself as a farmer	Very high	40.4	8.7	20.8	0.0	36.4	70.7***
	High	30.0	8.7	25.0	0.0	13.6	
	Neutral	22.8	82.6	54.2	100.0	45.5	
	Low	6.1	0.0	0.0	0.0	4.6	
I feel confident that I will succeed in farming.	Strongly disagree	1.8	0.0	4.2	0.0	0.0	71.2***
	Disagree	1.8	0.0	8.3	0.0	9.1	
	Neutral	28.1	82.6	62.5	100.0	45.5	
	Agree	32.5	10.9	12.5	0.0	13.6	
	Strongly agree	36.0	86.9	50.0	93.3	86.4	
Do you see yourself as a potential commercial farmer one day?	Yes	84.2	87.0	50.0	93.3	86.4	19.3***
I have a very clear plan for my farm.	Strongly disagree	1.8	2.2	4.2	0.0	4.6	77.3***
	Disagree	2.6	4.4	0.0	0.0	13.6	
	Neutral	27.2	82.6	70.8	100.0	36.4	
	Agree	34.2	6.5	8.3	0.0	18.2	
	Strongly agree	34.2	4.4	16.7	0.0	27.3	
Are you optimistic about the future of agriculture in your area?	Very optimistic	35.1	8.7	12.5	0.0	22.7	67.2***
	Optimistic	36.8	10.9	20.8	0.0	22.7	
	Neutral	23.7	80.4	66.7	100.0	50.0	
	Pessimistic	4.4	0.0	0.0	0.0	4.6	
State of resilience to shocks such as drought and other natural disasters	Very resilient	7.9	0.0	0.0	0.0	4.6	75.3***
	Resilient	45.6	8.7	12.5	0.0	22.7	
	Neutral	24.6	80.4	75.0	100.0	59.1	
	Sometimes susceptible	9.7	6.5	12.5	0.0	9.1	
	Susceptible to shocks	12.3	4.4	0.0	0.0	4.6	
I am hopeful regarding the future of agriculture in my area.	Strongly disagree	0.0	0.0	0.0	0.0	4.6	69.2***
	Neutral	26.3	80.4	54.2	100.0	40.9	
	Agree	40.4	10.9	33.3	0.0	22.7	
	Strongly agree	33.3	8.7	12.5	0.0	31.8	
I have hope that the quality of life will get better.	Strongly disagree	0.0	0.0	0.0	0.0	4.6	75.3***
	Neutral	24.6	80.4	54.2	100.0	36.4	
	Agree	38.6	10.9	33.3	0.0	18.2	
	Strongly agree	36.8	8.7	12.5	0.0	40.9	

Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively

Source: Survey data (2014/2015)

4.3. Capital endowment and its impact on unlocking on-farm entrepreneurial competencies: results from Ndumo B and Makhathini

The following sub-section continues to address the first objective of the study which aims at evaluating the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship. Principal component analysis is used to create an on-farm entrepreneurship index for the different types of smallholder irrigation farmers. Tobit regression model is then used to determine factors affecting on-farm entrepreneurship index.

4.3.1. Formulation of on-farm entrepreneurial competencies index: principal component results and discussion

Five principal components were extracted and retained using Pearson correlations and applying the Kaiser criterion of eigenvalues greater than one. The accumulated variation of PC1, PC2 PC3, PC4, and PC5 explained 64.7% of the variation. Only the PC vector of the first component is economically meaningful because, unlike the other components' vectors, none of its coefficients is negative.

The first PC (PC1) explains 43.7% of the variation, and it indicates that all the entrepreneurship indicators are dominant, and they move in the same direction. This implies that an on-farm entrepreneurial smallholder farmer is one that is characterised by all the entrepreneurship skills. This first component is dominated by highly motivated farmers who perceived their farms as means to make a profit and ambitious farmers who also understand how to motivate people.

The principal component was also dominated by farmers who had the ability to set goals and set new ones once attained. This suggested the importance of strategic thinking and planning as necessary tools for on-farm entrepreneurship. Farming business as a long-term venture with a view to making it sustainable and finding ways to complete tasks faster (innovation) also dominated.

The Cronbach's Alpha for the multi-item index used in the study was 0.95, which is higher than the acceptable value of 0.7 (Man *et al.,* 2008). This indicates a high level of internal consistency for the scale, implying that the 28 questions all reliably measure the same on-farm entrepreneurship index**.** All questions administered to the farmers were the composition of motivation, competencies; self-efficacy perceived themselves to have. Only the PC1 was retained and then used to generate the on-farm entrepreneurship index. The Positive weights for

all the variables in the first component vector can be taken as evidence that PC1 represents the aggregate variations due to the differing degrees (Manyong *et al.,* 2006). Component scores above a threshold 0.3 were put in bold in Table 4.6 below and the rest were disregarded (Jobson, 1992). The next sub-section investigates capital endowment and its impact on unlocking on-farm entrepreneurship.

Table 4.6 Generation of the on-farm entrepreneurship index: PCA results

Variable	PC1	PC2	PC3	PC4	PC5
I like being my own boss	**0.59**	**0.38**	-0.04	0,12	0.17
I view my farm as a means of earning profits	**0.68**	**0.41**	-0.2	-0.05	0.13
I know where the most profitable market for each enterprise is	**0.63**	**0.32**	0.29	-0.05	0.05
I am passionate about my farm business	**0.7**	0.13	-0.14	-0.2	0.05
I can adapt quickly to market changes and market opportunities	**0.68**	0.21	0.05	-0.23	0.001
I always look for better and profitable ways to run farm operations	**0.68**	0.29	-0.34	-0.07	0.02
I manage my farming business as a long-term venture with a view to making it sustainable	**0.7**	**0.39**	-0.24	0.12	0.06
I try things that are very new and different from what I have done before	**0.69**	0.18	-0.03	0.13	.0,17
I work long and irregular hours to meet demands	**0.67**	0.07	-0.04	0.25	0.27
I am highly motivated and ambitious	**0.73**	0.15	-0.03	0.4	0.11
I understand how to motivate people	**0.76**	0.25	0.27	**0.38**	-0.08
I always welcome change and view it as an opportunity	**0.54**	0.03	0.63	0.23	-0.16
I have the ability to inspire and energize others	**0.74**	0.18	0.18	**0.37**	0.04
I always cooperate with others	**0.68**	0.09	**-0.44**	0.11	0.12
I possess persuasive communication and negotiation skills	**0.68**	0.2	0.07	-0.04	0.09
I have the ability to set goals and set new ones once attained	**0.69**	0.09	0.26	-0.21	0.24
Despite many difficult circumstances, I often tend to not give up	**0.58**	0.1	0.17	-0.21	**0.52**
I am very competitive in nature	**0.67**	0.13	0.19	-0.13	0.23
I am always willing to learn new things	**0.65**	0.24	-0.23	0.01	-0.27
I am strong willed	**0.63**	**0.46**	-0.17	0.24	-0.11
I am very hands-on	**0.58**	**0.46**	-0.18	-0.03	-0.2
I welcome failures from which I am able to learn	**0.69**	0.23	-0.11	-0.03	0.18
I seek information that will help with tasks I am working on	**0.64**	**0.33**	0.03	-0.37	-0.26
I find ways to complete tasks faster	**0.72**	0.22	0.11	-0.3	-0,19
I weigh my chances of succeeding or failing before I decide to do something	**0.62**	**0.33**	-0.07	**-0.34**	-0.14
I know what and when resources and materials are needed and where to get them	**0.63**	0.24	0.28	-0.28	-0.06
I always take responsibility for solving problems that I face	**0.51**	0.09	-0.3	-0.01	0.37
I view my farm as a profit making business	**0.69**	**0.47**	0.06	0.08	-0.09
Eigenvalues	**12.2**	**2.1**	**1.5**	**1.3**	**1.0**
% of variance explained	**43.7**	**7.3**	**5.3**	**4.7**	**3.7**
Cumulative % of variance explained	**43.7**				**64.7**

Note*:* Five-point Likert scale values are: 1 = strongly disagree; 2 = disagree; 3 = neutral; 4= agree; 5 =strongly disagree

Source*:* Survey data (2014/ 2015)

4.3.2. Capital endowment and its impact on unlocking on-farm entrepreneurship: results from Ndumo-B and Makhathini

The highly significant F value indicates that the Tobit regression model fits the data well. The test for multicollinearity among the explanatory variables was tested using variance inflation factors (VIF), which were all below 10, with an average of 1.34. The robust standard errors were also estimated to correct for heteroskedasticity. It can be observed in table 4.7 that the likelihood ratio statistics as indicated by chi-square statistics are highly significant (P <0.000), suggesting the model has a strong explanatory power.

Table 4.7 Explaining on-farm entrepreneurship using two-limit Tobit regression

Independent Variable	Coef.	Robust Std.Error	VIF
Household size (hholdsize)	0.01	0.01	1.2
Age (farmerage)	-0.001	0.002	1.82
Farmer gender (farmersex)	0.09*	0.05	1.48
Educational Level (edulevel)	-0.01*	0.01	1.41
Main occupation (ocuupf)	-0.16**	0.05	1.18
Marital status (married)	0.03	0.04	1.28
Farming experience (farmexp)	-0.004**	0.002	1.6
Agriculture marketing training	0.05	0.06	3.83
Product pricing training (prodprice)	-0.06	0.06	5.14
Credit (credit)	0.03	0.04	4.03
Irrigation distance (irridstnce)	-0.001*	0.001	4.11
Total land operating (totlandsize)	0.002	0.01	1.24
Independent irrigator (indepigtor)	0.07	0.05	1.17
Home gardener (homegdn)	0.09	0.07	1.93
Community gardener (commgdn)	0.06	0.06	1.43
Non-irrigtaor (nonigtor)	0.03	0.08	1.33
Social grant (socialgrnt)	3 e -5	0.7 e -4	1.23
Livestock (livestockvalu)	0.04 e -6	0.5 e -5	1.27
Crop income (incomecrop)	-0.12 e -4	0. 14 e^{-5}	1.38
Psychological capital (psycap)	1.06***	0.04	1.61
_cons	0.25**	0.12	1.43
/sigma	0.25	0.02	
F(20, 199)) = 80.02 Prob>F 0.000*** Pseudo R2 = 0.9191 Uncensored observations 190 Left censored observations 7 (Minimum ≤ --3.06) Right censored observations 22 (Maximum ≥ 1.27)			

Note: ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.
Source: Survey (2014/2015)

Farmer gender (farmersex): As expected, the significant positive sign of the estimated coefficient of farmer gender indicates that male household heads exhibit higher levels of entrepreneurial competencies. One explanation for this is gender bias in the community. Male household heads operated under relatively larger plot sizes of land. Females lacking access to

productive assets (land, labour and capital), were limited in their production capabilities. The possible reasons for the high entrepreneurial behaviour of male household heads may be due to their relatively secure financial condition that comes with the large size of land holding resulting in likeliness to take a risk and adopt new technologies. In addition to relatively secured financial condition, the farmers have a higher capacity to expand production. The majority of the women interviewed had domestic responsibilities and were unable to allocate the majority of their time to more productive and remunerative uses. Another study on agricultural rural service provision in Ethiopia, Ghana and India found that female farmers in all three countries had less access than male farmers because women are not perceived as agricultural decision-makers (IFPRI, 2009). Sampled women, according to Moock (1976), seem not to benefit, as the men do, from extension workers. Women in households find themselves reliant on their husbands for both access to land and cash. Wouterse (2015) found that women in female-headed households have a little cash reserve and cannot pay for the land upfront. Female workers, who are unlikely to control substantial amounts of land, have less of an incentive to effectively apply labour. They are therefore less motivated and less entrepreneurially skilled.

Education Level (edulevel): An unexpected result in table 4.4 is the significant but negative estimated coefficient sign of education level. The education levels of smallholder farmers were generally low. This result might be due to the fact that most of the better-educated farmers are leaving agriculture and motivated towards other off-farm occupations.

Main occupation (ocuupf): The coefficient estimate for full-time farmers was statistically significant in influencing on-farm entrepreneurship. This was contrary to the expectations and the findings of Musemwa *et al.* (2013) where specialisation had positive and significant impacts. Perhaps part-time farmers were all around entrepreneurial who ventured to other non-farm economics activities in addition to their part-time farming. Part-time farmers in the study had the ability and propensity to start additional non-farm businesses, in this respect, emerging as centres of mixed entrepreneurial talent. The combination of off-farm investments and farming business was witnessed mostly in Ndumbo B irrigation scheme. Some of the farmers interviewed had regular salaried jobs and worked intensively on their farms on weekends.

Farming experience (farmexp): The estimated coefficient for farming experience was statistically significant and unexpectedly negatively related to on-farm entrepreneurship. The explanation could be that more experienced farmers perhaps divide their time between their plots

in the irrigation schemes and other types of businesses. Results could also be picking up on observed trend in farmers who have lost interest in farming. Another possible explanation is the farming age which is usually positively correlated with farming experience. Older farmers are less likely to adopt innovations and thought to be more conservative in implementing modern technologies. Furthermore, additional discussions that were had with farmers in the survey regions corroborate with the study of Fischer and Quim (2012). These discussions revealed that the youth is not very interested in farming but rather hopes to find employment outside agriculture in the future, preferably in urban areas.

Irrigation distance (irridstnc): The estimated coefficient for the distance between farmers' homestead and the nearest irrigation scheme was found to be negative and statistically significant. Similarly Beyan *et al.* (2014) found that irrigation distance has a negative and significant effect on the probability of participation in small-scale irrigation scheme. This was in line with the observations made while in the field. The irrigation schemes are strategically built close to Pongolo Dam. Communities further away from the dam participated in less agricultural activities due to extremely high temperatures in Umkhanykude district. The district was also experiencing severe drought period during the time of the visits. Fischer and Qaim (2012) found that the probability of membership of banana farmers in a cooperative organization decreased with distance. Accordingly, the cost of transportation to banana collection centres and the cost of participation in group meetings increased with distance. Thus, only farmers living closer to irrigation schemes incurring fewer costs, have an incentive to become a member of a scheme. Jaleta *et al.* (2009) found that household crop market participation was determined by nearness to the marketplace and households' market orientation, which is the making of production decisions based on market signals. Hawkers are in most cases reluctant to reach isolated rural areas. Consequently, smallholder farmers fail to sell their produce. This tends to disadvantage communal farmers to participate in farming. The further away is a household from the main road the higher is spending on inputs. It is possible that fertilizer markets are thinner with less supply and higher prices when communities are more isolated.

Psychological Capital (psycap): The estimated coefficient for the psychological capital index was statistically significant and positive as expected. Relatively more confident, hopeful, resilient and optimistic farmers had high levels of on-farm entrepreneurial capacity. Psychological capital coefficient had positive results similar to the findings of Hmieleski and Corbett (2006).

The relationship becomes more positive as environmental dynamism increases. Farmers who are confident in their farming skills and perceived themselves in a positive light are more likely to venture off into more entrepreneurial activities. Hmieleski and Carr (2007) found that psychological capital reduced the negative effects of work tension of entrepreneurs on their level of job satisfaction using a national (United States) random sample of 144. Avey *et al.* (2010) find similar results. An analysis of Chinese factory workers sample of 272 also found a significant relationship between the workers' positive psychological capital and the performance outcome of relative merit-based salary (Luthans *et al.,* 2000). More empirical evidence from the Chinese factory workers studies noted previously found that each of their levels of hope, optimism, and resilience related at about the same level of performance outcomes. Yet, the combination of these three facets, indicating the shared mechanisms between them, had a higher relationship with rated performance than any one of them individually (Luthans *et al.,* 2005). Luthans *et al.* (2008) using a larger sample of 456 Chinese workers found similar results.

Constant Coefficient (const): The constant coefficient which served as the coefficient for the base category of the dummy variables of irrigation scheme members was positively significant to entrepreneurship. This implies that contrary to expectations, irrigation schemes members were on-farm entrepreneurially skilled. However, independent irrigators scored 0.07 points higher in the levels on-farm entrepreneurial competency, while home gardeners scored 0.09 higher competency levels. Community gardeners scored 0.06 points higher and non-irrigators scored 0.03 points higher than irrigation scheme members. Irrigation scheme receives relatively more support from the DoA. This relatively low entrepreneurship competency score of irrigation schemes could be picking up on the government hand-out methods impeding the entrepreneurship process in irrigation scheme. The focus group discussions revealed that independent irrigators continued to participate in the market against all odds, aiming to augment their cash needs. Resilience (one dimension of positive psychological capital) is what kept them in the market. Other farmers not participating in the markets were less patient and had lost hope and trust in the markets (negative psychological capital). These are likely to be households that now depend on migration income such as remittances or social support grants. Therefore, psychological capital could help explain why scheme irrigators had the lowest levels of entrepreneurship competency.

4.4. Summary

This chapter aimed to investigate capital endowment and its impact on unlocking on-farm entrepreneurship; using some data collected from Ndumo B and Makhathini. This was accomplished using PCA and two-limit Tobit regression model. By applying descriptive analysis and ANOVA, the study managed to analyse household demographics and socio-economic characteristics of Makhathini and Ndumo B irrigation schemes and surrounding communities. Despite the fact that the number of female exceeded males in the sample, males still operated in larger plot sizes. Levels of self-confidence, hope, resilience and optimism were statistically significant for all farmers interviewed. Scheme irrigators were the most confident group of farmers. Scheme irrigators as well as non- irrigators perceived themselves as resilient to shocks such as drought and other natural disaster. Apart from scheme irrigators, rest of the farmers in this study had neutral levels of optimism regarding the future of agriculture. The non- irrigators remained hopeful that drought will end. All farmers were hopeful that quality of life will get better. This was also evident for scheme irrigators and home gardeners. However, the community gardeners and independent gardeners had neutral responses regarding hope. Principal component analysis was used to create an on-farm entrepreneurship index for the different types of smallholder irrigation farmers. This entrepreneurship index was dominated by highly motivated farmers who perceived their farms as means to make a profit and ambitious and motivated farmers. Farmer gender, educational levels, main occupation, farming experience, irrigation distance and psychological capital were all statistically significant in explaining the variation of on-farm entrepreneurial competency. Scheme irrigators had the lowest levels of entrepreneurial competency relative to independent irrigators, non-irrigators, home gardeners, community gardeners. The following chapter presents the findings of the production function, linking on-farm entrepreneurship to crop productivity.

CHAPTER 5. LINKING ON-FARM ENTREPRENEURSHIP TO CROP PRODUCTIVITY

5.1. Introduction

This chapter presents the main findings of the study concerning on-farm entrepreneurship and its link to the productive use of irrigation water in Ndumo B and Makhatini. The chapter seeks to achieve the second objective of the study which is to examine the impact of on-farm entrepreneurship and capital endowment on enabling small farmers to productively use small-scale irrigation schemes.

5.2. Crop productivity results

Gross margin is the difference between the gross value of production and directly allocable variable costs (COMBUD, 2012). The gross margin per hectare can be compared with 'standards' obtained from other farms. The comparisons can give a useful indication of the production and economic efficiency of an enterprise. This chapter will compare gross margins according to entrepreneurship level to achieve the second specific objective of the study. From a sample of 159 farmers, gross margin for the top four crops were calculated for the different types farmers.

Cabbage: Scheme irrigators produced a mean yield of 32.526kg/ha (Table 5.1). However this is still well below the DaA recommended commercial target yield[5] of 77.111kg/ha. Scheme irrigators earned the most in gross income and managed to register up to R49.806/ha from investing in a hectare of cabbage. Community gardeners had statically higher total variable costs; however, when farm labour costs were taken into consideration, costs to community gardeners dropped from R15.942kg/ha to R13.871/ha. A similar trend continued for all other farmers and was also evident in mean gross margin calculations. Scheme irrigators had the highest mean gross margin values. After accounting for family labour costs, the mean gross margin increased from R33.864/ha to R35.935/ha.

[5] The DaA recommended commercial target yield cab be found on http://www.kzndard.gov.za.

Maize*:* Scheme irrigators producing maize had a statically and significantly higher mean yield of 3.208kg/ha (Table 5.1). Scheme irrigators generated the highest mean gross income of R22.870/ha. Independent irrigators incurred the highest mean variable costs including family labour of R15.952/ha. However, the cost dropped to R15.952/ha once family labour costs were excluded. All maize production was viable with positive gross margin values, regardless of family labour.

Beans: Scheme irrigators had a statically and significantly highest yield of 1.422kg/ha (Table 5.1). Despite this, it is still slightly below DaA recommended target yield of 15.876kg/ha. Scheme irrigators also had the highest mean gross income of R20.050/ha. However, home gardeners had the highest average gross margin of R8.996/ha but increased to R16.196/ha when family labour costs were excluded.

Tomatoes*:* Independent irrigators dominated in the production of tomatoes with an average yield of 11056kg/ha and followed closely by community gardeners with a yield of R10.313/ha (Table 5.1). Community gardeners generated the highest average gross income of R42.667/ha. This did not meet the DoA recommended commercial target yield of 63.505 kg/ha. Community gardeners had a statically and significantly the highest mean total variable cost of R10.313/ha, which dropped to R6.710/ha when family labour cost was excluded. Community gardeners generated the average gross margin of R32.354/ha, increased to R35.957/ha excluding family labour

Table 5.1 Statistics on major crops cultivated in the study area

Crop	Farmer Type (N=159)	Mean yield (kg/ha)	Std. Deviation	F-test	Mean gross income (Rands/ha)	Std. Deviation	F-test	Mean TVC (Rand/ha)	Std. Deviation	Mean TVC (excluding family labour) (Rands/ha)	F-test	mean gross margin (Rands/ha)	Std. Deviation	Mean gross margin/ha (excluding farm labour) (Rands/ha)	F- test
Cabbage	Scheme irrigators	32.526	694	5.6***	49.806	26.332	3.9**	15.942	5.084	13.871	2.3*	33.864	24.594	35.935	2.7*
	Independent irrigators	19.712	716		35.712	35.219		11.771	5.153	10.507		23.941	32.895	10.695	
	Home gardeners	9.306	427		15.054	30.431		10.474	5.805	8.155		6.087	29.105	8.406	
	Community gardeners	25.058	846		46.229	22.359		17.953	13.539	16.313		28.277	13.765	29.917	
Maize	Scheme irrigators	3.208	1.598	0.9	22.870	12.212	1.8	13.200	10.747	13.201	0.7	10.558	9.987	1.3315	0.8
	Independent irrigators	2.604	1.914		14.929	13.117		15.952	12.110	15.952		6.543	12.681	11.144	
	Home gardeners	1.975	1.025		12.819	7.326		5.238	9.121	5.238		951	12.214	5.238	
Beans	Scheme irrigators	1.422	1.024	5.3**	20.050	13.542	4.7**	12.497	4.506	8.755	3.6**	7.553	11.864	11.295	2.1
	Independent irrigators	469	439		7813	7.641		7.631	5.942	5.389		182	8405	2.424	
	Home gardeners	1.200	-		19.200	-		10.204	-	3.004		8.996	-	16.196	
Tomatoes	Scheme irrigators	2.000	-	1.3	16.000	-	1.1	6.996	.-	4.956	2.9*	9.004	-	11.044	1.2
	Independent irrigators	11.056	12.550		31.044	35.031		2.424	1.478	1.904		28.620	33.628	29.140	
	Home gardeners	2.083	3.926		10.000	18.847		7.283	2.900	5.700		27.167	17.550	4.300	
	Community gardeners	10.313	9.865		42.667	40.058		10.313	4.920	6.710		32.354	35.769	35.957	

Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively

Source: Survey data (2014/2015)

5.3. Average crop gross margin according to on- farm entrepreneurship

Descriptive analysis was done to explore the linkages between on-farm entrepreneurship index and productivity measured by gross margins. The on-farm entrepreneurship index was used to rank farmers into groups of; 1- Least entrepreneurial; 2- Moderately entrepreneurial; 3-fairly entrepreneurial; 4- Most entrepreneurial. Many studies on the socio-economic status of households have used the 40th percentile as the poverty line when working with asset indexes (Filmer and Pritchett, 2001; Vyass and Kumaranayake, 2006; Achia *et al*., 2010).

A similar approach was adopted in this study and the on-farm entrepreneurship index at the 25th percentiles was employed to divide the farmers into four groups of different levels of on-farm entrepreneurship. This was done considering that entrepreneurship is a continuous variable. Table 5.2 below indicates that there is a statistically significant association between on-farm entrepreneurship ranking and the different farming group. The independent irrigators were mostly entrepreneurial, followed closely by community garners. These could be because irrigating dependently gave them the freedom to take initiatives on their own, without being constrained by the impact of what others do to their farming operations were fairly entrepreneurial. Scheme irrigators were fairly and moderately entrepreneurial. This is the case for irrigation schemes.

Table 5.2 On-farm entrepreneurship ranking according to farming group

Ranking (N=159)	Scheme irrigator (%)	Independent irrigator (%)	Home gardeners (%)	Community gardens (%)	χ2 test
Least entrepreneurial	22	31.6	29.2	13.3	
Moderately entrepreneurial	34.1	18.4	16.7	6.7	
Fairly entrepreneurial	25.6	15.8	25	46.7	15.43*
Most entrepreneurial	18.3	34.2	29.2	33.3	

Notes: * means significant at 10% levels

Source: Survey data (2014/2015)

5.4. Cabbage production function

One-limit Tobit regression model was estimated to measure on-farm entrepreneurship link to the productive use of irrigation water (Table 5.3). The highly significant F value indicates that the Tobit model fits the data well. The test for multicollinearity among the explanatory variables was tested using variance inflation factors (VIF), which were all below 10, with an average of 1.79. The robust standard errors were also estimated to test for misspecification in correcting for heteroscedasticity. It can be observed in table 5.3 that the likelihood ratio statistics as indicated by chi-square statistics are highly significant (P <0.0000), suggesting the model has a strong explanatory power.

Table 5.3 One- limit Tobit regression estimation of cabbage production function.

Independent Variable N=53	**Robust Coefficient**	**Robust Std. Error**	**VIF**
Household size (loghhldsize)	0.33*	0.18	1.48
Farmer age (logfarmage)	0.39	0.33	1.73
Educational level (logedulevel)	0.03	0.07	1.53
Farm experience (logfarmexp)	-0.17*	0.09	1.50
Total land operating (loglandsize)	0.09	0.05	1.58
Cabbage gross margin(logcbgrm_ha)	0.27***	0.05	1.38
Cabbage total variable cost(logcbtvc_ha)	1.09***	0.17	1.91
Cabbage head price (logcbprice_head)	-0.06	0.14	2.78
Type of farmer (typefarmer)	0.25**	0.10	1.47
Entrepreneurship index (entrep)	-0.11**	0.05	1.43
Credit (credit)	-0.20**	0.12	1.55
Training received by the farmer relating land preparation (landpreptrainin)	-0.004*	0.002	3.29
Training received by the farmer relating agricultural commodity marketing (commtrainin)	-0.29	0.17	3.31
Farmer gender (farmsex)	-0.08	0.13	1.88
_cons	-5.21***	1.87	1.25
/sigma	0.38	0.05	
F(14, 39) = 26.80 Prob>F 0.000*** Pseudo R2 = 0.6420 Uncensored observations 52 Left censored observations 1 at logCBHEADS_HA <=6.0900002 Right censored observations 0			

Notes: ***, ** and * means significant at 1%, 5% and 10% levels, respectively

Source: Survey data (2014/2015)

Household size (loghhldsize): The household size of respondents was statically significant in explaining marginal changes in cabbage yield. However, a 1% increase in the size of household could result in a 0.33% decrease in cabbage yield, *ceteris paribus*. This shows the poor managerial ability to effectively utilize the available labour force in the family. The result is contrary to those of Musemwa *et al. (*2013), where large families were more productive than smaller families who depended on hired labour. Mushunje *et al.* (2003) find similar results working with cotton producers in Zimbabwe. The idea is that family labour is more efficient than hired labour mainly because family labour is more motivated than hired labour. It does not require supervision and lurking is minimal. However, farmers with larger household were less productive, resulting from larger families having bigger demands for their own consumption of the cabbage produced. Larger households tend to produce staple crops which dominate their farms for their own consumption. Results corroborated with that of Coelli *et al.* (2002) indicating that large families are likely to be less productive.

Farming experience (logfarmexp): The level of farm experience was statistically significant to cabbage related yields. However, the relationship was negative. A farmer who was 1% more experienced, was 0.17% less productive, *ceteris paribus*. This could be explained by the fact that more experienced farmers were old farmers. Older and experienced farmers could have been reluctant to less adapt to new technologies that would increase production. This could be attributed, perhaps, to the more experienced farmers, with access to more information diversified their business and, therefore, produced less cabbage.

Total variable cost (logcbtvc_ha): The total variable costs of the production cabbage were statistically significant in explaining the marginal changes in yield. Contrary to expectation the relationship was negative. A majority of these costs are made up of fertiliser and herbicide control. An increase in expenditure in these items increases the yield. A 1% increase in costs could result in a 1.09% increase in productivity, *ceteris paribus*.

Credit (credit): Whether or not farmers had taken credit within a year before the survey was conducted was statistically significant to the variation in cabbage yield. However, contrary to expectations, the relationship was negative. Cabbage farmers who had access to credit were 0.20% less productive than to those who had no access to credit, *ceteris paribus*. The reason for this finding was that some farmers used credit for other purposes rather than agricultural activities like food purchase, children education expenditure. Another reason could be that

farmers did not get credit on time to purchase required inputs for production. Or perhaps with more income at their disposal it is likely that cabbage producers ventured to perennial crops such as sugar cane. An increase in income would also enable farmers to rent more land that is required for sugar cane production.

Entrepreneurship (entrep): The entrepreneurship index scores of farmers were found to be statistically significant, however, the sign of the estimated coefficient was negative. The negative coefficient on entrepreneurship suggests that production of cabbages and gross margin increases at a falling rate as the entrepreneurship of the farmer increases. The farmer who exhibits traits of on- farm entrepreneur is likely to engage in farm diversification. This would result in less land being allocated to cabbage production, resulting in decreased cabbage yield as an opportunity cost of producing other crops, *ceteris paribus.* This occurred at a rate of 0.11%.

Type of farmer (typefarmer): The relationship between scheme irrigators and cabbage yield was statistically significant and positive. This was expected since vegetable crop production requires frequent irrigation. With scheme irrigators being highly subsidized, they can afford this frequent irrigation. These results corroborate with that of Sinyolo *et al.* (2014, a), that highlighted the importance of irrigations scheme. Farmers who scheme irrigators had 0.25% higher yields than those who were not scheme irrigators, *ceteris paribus*.

Land preparation training (landpreptrainin): Training related to land preparation was statistically significant in explaining marginal changes cabbage yield. However, the relationship between the training and yield was negative. The results suggested that individuals who had received training had 0.004% less gross margin relative to individuals who had no training, *ceteris paribus*. This was contrary to what was expected and to the findings of Masvongo *et al.* (2013) and Mutandwa *et al.* (2008). The farmers who have lower confidence in their skills and were producing at low levels are the ones who are likely to attend the training. Even after the training these farmers with could still have lower ability compared to the untrained. Therefore, the trained would still be relatively less productive compared to the untrained. Another explanation is that the training received could not have been well received or understood by the farmers which resulted in them making misinformed decisions that decreased yield. Farmers who relied on their indigenous knowledge, in this case, were more productive. Furthermore, Ali and Byerlee (1991) assert that the impact of training must be considered in a dynamic context. The notion is that productivity is likely to fall as farmers practice using the new methods. The

farmers adopted new land preparation techniques may initially be less productive as they learn how to apply the knowledge learnt.

Cabbage gross margin (logcbgrm_ha): The gross margin of cabbage per hectare harvested was statistically significant and positively related to changes in the yield. The quality of the cabbage is reflected in the price per kg achieved. Farmers achieving higher returns had a higher incentive to produce more cabbage. A 1% increase in gross margin would result in a 0.27% increase in yield, *ceteris paribus*. These results improve the financial understanding of crop production.

5.5. Summary

This chapter aimed to examine the impact of on-farm entrepreneurship and capital endowment on enabling small farmers to productively use small-scale irrigation schemes. Descriptive statistics and gross margin analysis were employed to achieve this. All the most important crops cultivated in Makahthini and Ndumo B were profitable, with positive mean gross margin values. A gross margin of R32.526/ha is derived from investing in a hectare of cabbage. These gross average margins were R14.896/ha, R19.250ha, R26.571ha and R8.948/ha for beans, maize, tomatoes and spinach, respectively. The most profitable crop judging from the mean gross margin per hectare values was cabbage, closely followed by tomatoes. Cabbage also had the highest total variable costs of R14.950/ha. Tomatoes had the highest yield of 6.846 kg/ha. However, scheme irrigators produced yields that were below those that are recommended by DoA. Descriptive analysis was done to explore the linkages between on-farm entrepreneurship index and productivity measured by gross margins. The PCA-derived on-farm entrepreneurship index was used to rank farmers into four groups: least entrepreneurial, moderately entrepreneurial, fairly entrepreneurial and most entrepreneurial. The on-farm entrepreneurship index at the 25th percentiles was employed to divide the farmers into four groups of different levels of on-farm entrepreneurship. This was done considering that entrepreneurship is a continuous variable which has to be conceptualized as a continuum. A one-limit Tobit regression was estimated for cabbage production, the main crop enterprise in the study area. The estimate coefficients of training related to agricultural land preparation, household size, farming experience, cabbage total variable costs, credit, cabbage gross margin and on-farm entrepreneurship were all statistically significant in explaining the variations in cabbage yield. Chapter the following chapter six presents the conclusions and policy recommendations.

CHAPTER 6. CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1. Recap of the research objectives and methodology

Literature has fallen short in producing quantitative methods for measuring entrepreneurship that is suitable for agriculture and more specifically, smallholder agriculture. Frequently neglected in the literature of irrigation schemes is the role of entrepreneurship in the productivity and sustainability of these schemes. Investments into irrigation schemes have also tended to focus on infrastructure and financial capitals. The traditional sustainable livelihood framework assures that an adequate ownership of human, social, physical, natural, financial is a key determinant of livelihood performance. However missing from this framework and empirical research has not is the recently recognized psychological capital.

Taking Makhathini and Ndumo B irrigation schemes in KwaZulu-Natal as case studies, the specific objectives of this study have been to: (i) evaluate the impact of human, physical, financial, social, natural and psychological capital assets on unlocking on-farm entrepreneurship, and (ii) examine the impact of on-farm entrepreneurship and capital endowment on enabling smallholder farmers to productively use small-scale irrigation schemes.

The SLF framework with the integration of psychological capital was employed to assess the state of the capital endowment of smallholder farmers surrounding the above irrigation schemes. The SLF ensures a holistic analysis of the smallholder assets and their operating environment. Improved access to all forms of capital assets is expected to improve the performance of farmers in terms of productivity, livelihoods and food security status.

In the absence of the previous study that quantitatively measured and explained on-farm entrepreneurship, the study also sought to generate the on-farm entrepreneurship index using PCA. Principal Component Analysis (PCA) was employed to generate on-farm entrepreneurship index and two-limit Tobit regression model was used to determine the impact of the capital endowment on on-farm entrepreneurship survey data from 221 randomly selected farmers (114 scheme irrigators, 46 independent irrigators, 24 home gardeners, 15 community gardeners and 22 non-irrigators). To evaluate the impact of on-farm entrepreneurship and capital endowment on crop productivity, a production function of major crop enterprise (cabbage) was estimated. The marginal effects generated show the impact of on-farm entrepreneurship on the productivity

of individual farmers in each category. Cobb-Douglas production functional form was chosen for this analysis because of its theoretical appeal. In sum, the empirical evidence of data analysis methods used were descriptive statistics, Analysis of Variance (ANOVA), principal component analysis, gross margin analysis, and one-limit Tobit regression model.

6.2. Conclusions

The study found that the average size of land that farmers operated reflected that of smallholder farmers, with irrigation scheme members operating the largest land of an average of 2.05 ha. Scheme irrigators had the highest mean value of livestock estimated, social grant recipients, household income as well as crop income. On- farm entrepreneurial index was dominated by highly motivated farmers who perceived their farms as a means of making a profit; a long-term business venture. Ambitious and motivated farmers, who had the ability to set goals, also dominated the index. This suggested the importance of strategic thinking and planning as necessary tools for on-farm entrepreneurship.

The econometric models indicated that the gender household head, education level, farmer gender, farming experience, psychological capital, scheme irrigators and irrigation scheme distance from homestead all statistically and significant in explaining the variation in on-farm entrepreneurship. The implication of this finding is that although many smallholder irrigation schemes have collapsed despite government investment on the physical infrastructure, the exact allocation of these funds needs to be rethought. Moving forward what will prove to be of critical importance is not just mere focus on infrastructure but a holistic approach placing the human aspect right at the centre. Support in the form of technical advice, training, marketing and other aspects previously neglected is required.

With male household heads having higher levels of on- farm entrepreneurial competencies, entrepreneurial skills training needs to be targeted on motivating female household heads. The majority of the women interviewed had domestic responsibilities and were unable to allocate the majority of their time to more productive and entrepreneurial uses. Much attention is required to improve the entrepreneurial competencies of female-headed households. Policy interventions that neglect gender roles are more likely to reinforce or exacerbate inequitable access to resources between men and women. To improve the economic performance of farming enterprises, an assessment of the goals and aspirations of current and potential female household heads should be made.

Therefore, support in smallholder irrigation for rural poverty reduction should continue but must be revised. Access to smallholder irrigation is not enough on its own to significantly reduce poverty to low levels among farmers. Attention is to be given to infrastructure and subsidies on inputs with empowerment through knowledge and skills. Empowering the poor through quality education and entrepreneurship training, to generate their own income is a more viable medium to long-term strategy for reducing and eventually eradicating poverty. Scheme irrigators had the lowest self-rating of their entrepreneurial competencies relative to other categories of farmers. This further highlighted the detrimental effect of government hand-out on the entrepreneurial spirit.

The more educated the group of farmers were, the less on-farm entrepreneurially skilled they were. With average farmer being middle aged this suggested that the younger generation which is the most educated had very little interest in farming as a career. There is a need for awareness creation to develop an interest in agriculture and to provide education and training for the required skills to make agriculture a viable career option. Government agriculture initiatives and campaigns could promote agriculture career opportunities in attempts to make them more appealing to the youth. In order to attract young people, agriculture will need to be more dynamic and appealing than it is now. ICTs and related innovate technology might be key to making agriculture more attractive, keeping the youth in rural areas and ensuring their knowledge remains updated.

Independent irrigators displayed statistically higher levels of confidence and resilience in irrigating independently. This highlights the importance of psychological capital previously neglected in SL framework but integrated into this study. This is a topic deserving further research in the context of farming, especially in rural areas. Since training and field visits for irrigation scheme are common in the area, it is recommended that fair amounts are also given to independent irrigators

What was further indicated was that among the five groups of farmers, scheme irrigators were the most productive, with highest positive mean gross margins for cabbage. However, the cabbage, mean yield was well below the DoA commercial yield targets. This re-enforces the notion that implementing operational irrigation schemes play an important but partial role in poverty reduction in the rural areas. Despite huge investments, irrigation schemes still

underperform or collapse. It is the innate entrepreneurship spirit and the psychological capital that sets the farmers apart and helps farmers reach commercial targets.

Furthermore, training related to agricultural land preparation, household size, farming experience, total variable cost, cabbage gross margin, credit and on-farm entrepreneurship were all statistically significant in explaining the variations in cabbage yield. This implied that cabbage producers in addition to entrepreneurial skills perhaps required cost management training. With production levels below commercial target, it will be important to go back to basic training to improve production levels on existing lands.

6.3. Policy recommendations

- Entrepreneurship can be your own innate behaviour that can be nurtured or learnt. With the majority of farmers having or showing a poor level of education, training of the farmers in business skills and provision of continued extension services by irrigation agents are crucial for the sustainability of the irrigation scheme. Providing entrepreneurial training as part of a rural extension package empowers the smallholder farmers with the business skills to sustain themselves in agricultural markets.

- With smallholder irrigation as far as this research goes, the major problem is not the lack of government support but the lack of the capacity to collectively manage the irrigation scheme. The ultimate objective, in the long run, should be to turn subsistence farmers into self-sustained commercial farmers. The system of continued hand-outs and the need for continued support for recurrent costs from the public sector cripples the entrepreneurial spirit and the rural community in the long run. Support in the form of financial assistance and other inputs should be made conditional, given only to those who are at the beginning stages of farming business and are receiving training. The monitoring and evaluation, not only of physical and financial targets but also of changes in incomes, employment and of impacts on poverty, must be given priority.

- In addition, since most of the sampled smallholder farmers are female-headed households, rural micro-projects and development initiatives, targeting women irrigation scheme members must be supported. Specifically targeting support to women and encouraging their participation in governance structures can enhance productivity, profitability and hence poverty reduction. To address the gender bias favouring men in

land distribution in the community, it is recommended that land user rights be awarded directly to more female farmers. Furthermore, the training schedules and marketing strategies need to be gender sensitive towards females' domestic responsibilities. Increased targeting of women for market participation may increase the impact of policy interventions that aim at improved market access. Going forward what will be essential for poverty-reduction projects design is the extensive understanding of the socio-economic profile of the target group, how they derive their livelihoods, what their constraints are and how they interact socio-economically.

- Lastly, there needs to be support for local innovation by promoting science and technology in tertiary, entrepreneurial, and technical and vocational training for young students to want to live in rural areas and work in agriculture. Improving the ICT infrastructure in the rural areas and enhancing the role of this technology in agriculture could be one of the focus areas of the intervention package. However, farmers cannot adopt technologies if roads and transport are inadequate and poor for them to acquire technology-related inputs, or to market their produce. As highlighted previously, adoption process does not only depend on the farmers' willingness but depends on the overall sustainable rural development process.

6.4. Areas for further study

Unknown effects from interview translations into English might have impacted the reliability of the data adversely. A need, therefore, exists for entrepreneurial scales and terms to be officially translated and validated in isiZulu and other African languages in order to minimise misrepresentation and improve data reliability and validity. The study relied on cross section data collected from two irrigation schemes. More research insights could have been gathered if the study had covered a number of irrigation schemes across the country. Future studies could consider using panel data instead of cross-sectional data. Collecting data over a longer period of time could have enabled both spatial and temporal dimensions of the cause and effect relationships.

Future studies could compare water usage according to entrepreneurial rankings of the farmers. Sampling biases included the fact that many of the participants interviewed were middle age or older. More research insights could have surfaced in researching whether or not young smallholder farmers faced unique challenges, constraints or opportunities relative to older

farmers. A comparison of entrepreneurial rankings and gross margins of young and older smallholder farmers in future research would also be insightful. This study could have benefited from a larger sample of non-irrigators, community gardener, and independent irrigators. It is suggested that an extensive study is conducted to determine the entrepreneurial developmental paths of subsistent farming all the way to commercial farming. The detailed comparison of these paths between independent irrigators, scheme irrigators, a community gardener and non-irrigators would be insightful.

The survey conducted was not able to capture the true value of physical assets that farmers owned such as their houses. This was due to respondents failing to answer accurately due to lack of a well-established market for houses in Makhathini and Ndumo B and surrounding areas. The majority of the respondent's homes consisted of multiple little mud and brick house that served as rooms for different family members. There may be a need to modify or add more water components and dependable variables (capital assets) for entrepreneurs beyond those that were identified in this study.

Although the study has highlighted the importance of psychological capital of farmers in rural areas, the concept needs further empirical investigation. Perhaps a comparison of psychological capital between commercial, smallholder and subsistence farmers generate more comprehensive information. Qualitative research that examines the social or psychological foundations of entrepreneurial mindsets is another avenue for the future. Research on areas such as evaluating the quality of training programs, comparing outcomes of trained versus non-trained entrepreneurs, and evaluating the contribution of entrepreneurship toward curbing unemployment at the macro level still needs to be conducted.

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APPENDICES

Appendix A: Household questionnaire used for data collection

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 to examine **sources of livelihoods and opportunities to improve contribution by farming within available food value chains on the selected irrigation schemes.** There is no wrong or right answers to these questions .You are free to be or not part of this survey.

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

Date		Farmer ID*	
Village name		Ward No.	
Irrigation scheme		Type of farmer	
Questionnaire code		Enumerator	

**Farmer code: 1-Scheme irrigators 2-independent irrigators 3-home gardeners 4- community gardens (specify name_____) 5-non irrigators*

A. HOUSEHOLD DEMOGRAPHICS

1. What is the total number of your household members?

_____

Please complete table below *Record household head*details in the first row*).

Household member	Relationship to household head[1]	Age	Sex[2]	Marital status[3]	Level of education *(indicate level reached)*	Main occupation [5]	Availability in the household for family labour (*Days per week*). If zero, please indicate (*i.e.* sickness)

Key

Relation to household head[1]	**Age**[2]	**Marital status**[3]	**Main occupation**[5]	
1=Household head 2=Spouse 3=Daughter /son 4=Other (specify e.g., cousin)	1=Male 0=Female	1=Single 2=Married 3=Divorced 4=Widowed	1=Fulltime farmer 2=Regular salaried job 3=Temporary job 4=Unemployed 5=Self-employed 6=Student	7=Retired 8=Aged/permanently sick 9=Infant(under age) 10=Other (specify)

* *Household head refers to the household head that stays in the household for 4 or more days per week*

10. How many years of experience in farming do you have?

_____

11. What kinds of knowledge have you acquired (inherited) over the years from other farmers, your own experience and from your forefathers?

Have you ever taken training/education related to irrigation listed below?

Skills	**12.** 1=Yes 0=No	**13.** If Yes, who offered the training?
a. General crop/vegetable production		
b. Land preparation		
c. Fertiliser application		
d. Herbicide application		
e. General irrigation practices		
f. Irrigation scheduling		
g. Irrigation water management		
h. Agricultural commodity marketing		
i. Packaging of fresh produce		
j. Processing of farm produce		
k. Pricing of products		
l. If other (please specify)		

Complete table below and indicate extent to which you agree with the following statements

Statement	**14.** Indicate extent to which you agree with the statement
a. I attend all training sessions that are held in Makhathini/Ndumo B	
b. I fully understand the information provided in the training sessions	
c. I am able to put into practice all the advice I receive from the training	

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

B. FARMING IMPLEMENTS, INFRASTRUCTURE AND OTHER HOUSEHOLD ASSETS

Infrastructure	**1.** Are you satisfied with the state of the following infrastructure in your farming area?
a. Road accessibility	
b. Markets	
c. Electricity	
d. Agricultural water supply	
e. Drinking water supply	
f. Drinking water supply	

1=Strongly dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Strongly satisfied

Complete following table on ownership and access to assets

Assets	**2.** Own the asset as individual 1=Yes 0=No	**3.** Own the asset as a group 1=Yes 0=No	**4.** Current value per unit (R)	**5.** Have access to asset through hiring and borrowing?
a. Cell phone				
b. Radio				
c. Television				
d. Personal computer				
e. Block , tile house				
f. Block, zinc house				

Assets	**2.** Own the asset as individual 1=Yes 0=No	**3.** Own the asset as a group 1=Yes 0=No	**4.** Current value per unit (R)	**5.** Have access to asset through hiring and borrowing?
g. Block, thatch house				
h. Round pole and mud or shack				
i. Fridge/freezer				
j. Bicycle				
k. Motorbike				
l. Trailer/cart				
m. Water tank				
n. Motor vehicle in running order				
o. Generator				
p. Plough				
q. Planter, harrow or cultivator				
r. Wheelbarrow				
s. Tractor				
t. Other (specify)				

Complete table below on livestock ownership

Type of livestock	**6.** Number owned	**7.** Current value per unit (R)
a. Cows		
b. Calves		
c. Oxen		
d. Sheep		
e. Goats		
f. Domestic chickens		
g. Others (please specify)		

C. INCOME AND FINANCIAL STATUS

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

If yes complete the table below

Grant	**2.** Number of people receiving	**3.** Number of years receiving grant
a. Child grant		
b. Old persons grant		
c. Disability grant		
d. Foster child grant		
e. Care dependency grant		

Complete table below on sources of household income

	4. Source of income 1=Yes 0= No	**5.** Rank of income source (see codes below)	**6.** Estimate % of total household income
a. Remittances			
b. Arts and craft			
c. Permanent employment			
d. Temporary employment			
e. Welfare grant			
f. Crops - irrigated			
g. Crops – rain fed			
h. Livestock			
i. forestry			
j. fishing			
k. Other (please specify)			

Rank codes 1. Always 2. Often 3. Sometimes 4. Rarely 5. Not at all

7. If Yes on 4h and/or 4i, do you pay fees to utilize these resources? 1=Yes 0 =No

8. Please specify amount and unit/duration. **Amount**.....**Unit/Duration**.....

9. If No, do you need permission to utilize these resources? 1=Yes 0 =No

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

11. If yes to **10 above,** which type of saving? 1=Formal 2= informal (i.e stokvela) 3=both

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

13. If yes in what was the main source of credit/loan? 1= Relative or friend 2= Money Lender 3= Savings club (stokvel)

4= Input supplier 5=Output buyer 6= Financial institution (Specify name of institution……...)

14. If No to **12 above,** please specify the reason(s) (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 am risk averse 6=other, please specify……..

15. If you took credit or loan what was the purpose of the loan/credit? 1= Family emergency 2= Agricultural purposes

3= Other (specify…….)

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

17. Did you receive funding or any other sources of credit support from the government in the past 12 months? 1=Yes 0=No

D. WATER AVAILABILITY AND IRRIGATION

Complete section for farmers in irrigation schemes and independent irrigators

	Questions		Response
1	How far away is your household to the irrigation scheme? (km)		
2	What type of irrigation system are you using for the crop grown? 1=Sprinkler 2=Flood irrigation 3=bucket system 4=Center pivot 5=other please specify		
3	How is water pumped to reach your irrigation plot(s)? 1 = Gravity 2 = Electric pump 3 = Diesel pump 4 = Hosepipe 5 = Watering can/bucket, etc 6 = Other (specify)……		
4	How many functional sprinklers do you own?		
5	If you are a member of the irrigation scheme, what is your position along the primary canal? 1 = Head 2 = Middle 3 = Tail		
6	What effect does your position in **5** have on you operation? 1. Very Positive 2. Positive 3. Neutral 4.Negative 5.Very Negative		
7	How do you rate water accessibility to your plot(s)? 1. Very Good 2. Good 3. Neutral 4. Bad 5.Very Bad		
8	Indicate months of the year when you are able to do irrigation, i.e., when water is available in the main canal?	1 - Jan 2 - Feb 3 - Mar 4 – Apr 5 – May 6 – June 7 – July 8 – Aug 9 – Sept 10 – Oct 11 – Nov 12- Dec	
9	On average how many days per week do you irrigate your crops? (indicate number) [__|__]		
10	What are the average irrigation hours per day (this week)?		
11	Amount paid for water fee during this season (Rand per year)		
12	How much are you willing to pay irrigation water for a hectare of irrigated land? **A**. 600-800 **B.** 801-1000 **C**. 1001-1200 **D.** 1201-1400 **E.** 1401-1600 **F.** 1601-1800		
13	How do you feel about the water distribution schedule in general? 1 = Strongly satisfied 2 = Satisfied 3 = Neutral 4 = Dissatisfied 5 = Not satisfied		
14	Do you participate in the maintenance of the canals in the scheme? 1=Yes 0=No		
15	If Yes to 13**,** how do you contribute? 1= management 2=labour 3= funds contribution		

E. CROPPING PATTERNS AND AGRICULTURAL PRODUCTION

	Question		Response
1	The total size of land operated **(hectares)**?	Irrigated land	
		Rain-fed (dryland) land	
2	Of the irrigated land please indicate land area per means of ownership (in ha)	owned	
		leasing or renting	
		borrowed	
		received from the chief on a temporary basis	
		any other (please specify	
3	Of the rain fed please indicate land area per means of ownership (in ha)	owned	
		leasing or renting	
		borrowed	
		received from the chief on a temporary basis	
		any other (please specify	

4. Generally, are you satisfied with the present security of ownership of your own land?

a) Dryland…… b) Irrigated land…….. 1=Strongly dissatisfied 2=Dissatisfied 3=Neutral 4=Satisfied 5=Strongly satisfied

5. Do you find it difficult to make land use decisions due to the land tenure system? 1= Yes 0= No

7. If yes, please give details……
……

……
……..

6. Have you experienced any land dispute issues before? 1= Yes 0= No

7. If yes, please give details……
……

Did you experience the following natural hazards in the last production season? (Circle all applicable)

Natural hazard	**8.** How frequent have you experienced natural hazards in the last 10 years *1=never 2 =rarely 3=sometimes 4=often 5= never*	**9.** If experienced any hazard, what impact does this have on crop production
Drought		
Floods		
Hailstorm		
Floods		
Any other (please specify)		

10. How interested are you in farming perennial crops? Very interested =1 Interested=2 Neutral =3 Slightly interested=4 Not interested at all =5

11. What is the reason for your answer?_____

Complete table below for all crops grown in the 2015

Crop grown **(Codes A)**	Day planted	Month planted	Area under production (hectares)	Seed				Fertilizer (If not used, put Zero)				Manure	Herbicides		Pesticides			Oxen days	Total cost of hired oxen	Total cost of hiring tractor for ploughing
				Amount of (Kg)	Variety of crop **(Code B)**	Main seed source **(Codes C)**	Total cost if bought(Rand)	Amount of basal fertilizer	Total costs of basal if bought (Rands)	Top dressing (Rands)	Total cost of top dressing if bought	Amount applied (Kg)	Litres	Total cost (Rand)	Did you use homemade 1-Yes 2-No	Litres (bought)	Total cost (Rand)	Total ploughing days		
12	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**

Code A

1-Maize

2-Beans

3-Cabbage

7-Butternut

8-Calabash

9-Pepper

10-Sweet potato

11-Tomato

12-Chillies

13-Other (specify)

Code B1-Improved hybrid and/or OPVs

2-Unimproved/ recycled

Code C

1-Own saved (recycled)

2-Local agro-dealers

2-Individual community members

3-Government (Department of Agriculture)

4-NGO

5-Contract farming agency

6-Cooperative

7- Other specify.....

Complete table below for FAMILY LABOUR use for all crops produced in 2015

Crop grown (Code A)	Land preparation		Planting		Weeding		Fertilizer application n		Pest control		Mechanical control		In field fallow maintenance		Harvesting		Packaging		Marketing	
	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days	No of people	Number of days
	33	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**

Complete table for HIRED LABOUR for all crops produced in 2015

Crop grown (Code A)	Land preparation			Planting			Weeding			Fertilizer application			Pest control			Mechanical control			In field fallow maintenance			Harvesting			Packaging			Marketing		
	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day	No of people	Number of days	Cost per day
	53	**54**	**55**	**56**	**57**	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**	**82**

4. Have you ever failed to sell your produce due to lack of buyers? 1=Yes 0=No

5. If yes, how often do you fail to sell your farm produce due to lack of market?

1= Never 2= Occasionally 3= Sometimes 4= Often 5= Always

6. What is the distance from your homestead to the nearest road? _____Minutes

7. What alternative mechanisms are there for you to transport your produce to the selling points?_____

_____
_____.

F. SOCIAL CAPITAL

1. Are you a member of any agricultural cooperative / group? 1=Yes 0 = No

2. If Yes, please specify the name of co-op
_____

3. 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) _____

4. 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. Have never used the source 2. Don't know /Neutral 3. Not important 4. Important 5. Very important

Information Source	**5.** 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)	

6. How difficult is it to access agricultural information? 1= Very easy 2= Easy 3= Neutral 4= Difficult 5= Very difficult

Complete table below indicating whether the activity is done as a group

	7. Which activities do you do in groups? 0= Not at all 1= at times 2= regularly
a. Land preparation	
b. Planting	
c. Weeding	
d. Irrigation	
e. Harvesting	
f. Securing output market for commodities	
g. Hiring of transport for marketing	
h. Hiring of tractors/machinery for agricultural activities	
i. Marketing of agricultural produce	
j. Input procurement	
k. Negotiating market prices for the produce	
l. Canal maintenance	
m. Pump maintenance	
n. Any other (please specify)	

8. How often do disputes occur among farmers or between blocks on water issues?

1= Very Often 2= Often 3= Neutral 4= Occasionally 5= Never

9. Where do you report problems with the canal? 1=Department of Agriculture 2= Block Committee

3= Other (please specify)……

G. PSYCHOLOGICAL CAPITAL AND ENTREPRENEURIAL CHARACTERISTICS

1. What is your main reason for farming? 1=Income 2=Extra food 3= Leisure time 4=Employment 5=Other_____

2. You consider farming as a business and can be managed as such**?** 1= Strongly agree 2= Agree 3= Neutral 4=Disagree 5= Strongly disagree

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

4a. You are interested in expanding your farming operations (including increasing plots) 1= Strongly agree 2= Agree 3= Neutral 4=Disagree 5 = Strongly disagree

4b. If disagree or strongly disagree, what are the factors holding you up ?

_____

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

6. You feel confident to contribute to discussions about the irrigation scheme strategy 1= Strongly agree 2= Agree 3= Neutral 4=Disagree 5 = Strongly disagree

7. How satisfied are you with the performance of the scheme? 1=Very satisfied 2=Satisfied 3= Neutral 4= Dissatisfied 5= Very Dissatisfied

8. How interested are you in being a scheme committee member? 1= Very interested 2= Interested 3=Neutral 4= Slightly disinterested 5= Not interested at all

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

10. How high is your confidence in farming as a means to a sustainable livelihood? 1 =Very high 2= High 3= Neutral 4= Low 5= Very low

11. How high is your confidence in yourself as a farmer? 1 =Very high 2= High 3= Neutral 4= Low 5= Very low

Please rate the extent to which you agree with the following statements:

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

Farmer attitudes	**12. Response**
a. The social grant is sufficient money to maintain the household	
b. The government is responsible for the wellbeing of rural households	
c. The government must create more job opportunities	
d. People are poor because they were not given equal opportunities as others	
e. I do not blame anyone for the poverty of my family	
f. I have power to affect the outcome of my farming	
g. I trust other farmers	
h. I have interest in running a farm as a business	
i. I have sufficient capital to farm	
j. I often fail to sell farm produce due to lack of market access and poor market prices	
k. Input costs of farming are far too high	
l. Labour costs are too high	
m. My right or claim to water is secure	
n. Water is sufficient for my cropping requirements	
o. In general, availability and security of water constrains my performance	
p. In general, the water distribution network is not in a good condition	
q. Poor quality of the agricultural extension service is a major bottleneck	
r. I have the ability to pay for water and water-related services Yes=1 No=0	
s. Am interested in farming perennial crops	

13. In your opinion, who should pay for water services? 1= No one, government only 2= Everyone participating in irrigation schemes 3= Only those irrigating a lot 4= Only those that are making more money

14. Please indicate the extent to which you agree with following statements pertaining to your constraints to farming operations? Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

a. lack of access to inputs	
b. large unaffordable increase in input prices	
c. production below normal	
d. declining market prices for outputs	
e. increasing food prices	
f. land tenure not secure	
g. no enough land	
h. local and political conflict	
i. lack of support services	
j. high pump and maintenance cost	
k. Water availability	
l. Other (specify)	

15. **If farmer is not in an irrigation scheme**, is the farmer willing to join an irrigation scheme if the opportunity arises? Yes=1 No= 0

16. If No to **15**, please give reasons?

_____

17. If Yes to **15**, would you like to irrigate individually =1 or collectively =2

18. What are the reasons for your answer?_____

19. If farmer is not irrigating, please rate the extent to which you agree for the reasons why you are not irrigating: Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

m. Irrigation system is under construction	
n. There is no water source	
o. Irrigation scheme is far away from my plots	
p. I produce only for the household	
q. I can't pay (financial constraint)	
r. Other (specify)	

20. If farmer is an independent irrigator, please rate the extent to which you agree with the following reason(s) for irrigating independently: Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

a. There are no available plots in irrigation schemes	
b. There is a lot of red tape involved in land allocation in irrigation schemes (e.g. waiting list)	
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. Water theft is a major concern for irrigation schemes managed collectively	
h. Lack of enforceable rules in collectively managed irrigation schemes is a challenge	
i. Other (specify)	

21. If farmer is a home gardener, please rate the extent to which they agree with the following reasons for sticking to home gardening: Strongly disagree=1 Disagree=2 Neutral=3 Agree=4 Strongly agree=5

a. Lack of farming experience	
b. Shortage of finance	
c. Shortages of resources (land and other nonfinancial resources)	
d. Land tenure issues	
e. Other (specify)	

Please indicate the extent to which you agree with the following statements:

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

22. Entrepreneurial Characteristics	**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 means of earning profits	
e. I view my farm as a profit making business	
f. I know what and when resources and materials are needed and where to get them	
g. I know where the most profitable market for each enterprise is	
h. I am passionate about my farm business	
i. I can adapt quickly to market changes and market opportunities	
j. I always look for better and profitable ways to run farm operations	
k. I am able to recognize market gaps and exploit market opportunities	
l. I deal with problems as they arise rather than spend time to anticipate them	
m. I manage my farming business as a long-term venture with a view to making it sustainable	
n. I try things that are very new and different from what I have done before	
o. I stick with my decisions even if others disagree strongly with me	
p. My production decisions are based on what is possible, not just what I need	
q. I work long and irregular hours to meet demands	
r. I am highly motivated and ambitious	
s. I understand how to motivate people	
t. I have the ability to inspire and energize others	
u. I always welcome change and view it as an opportunity	
v. I am very flexible and always willing to adapt	
w. I always take responsibility for solving problems that I face	
x. I always cooperate with others	
y. I possess persuasive communication and negotiation skills	
z. I have the ability to set goals and set new ones once attained	
aa. Despite many difficult circumstances, I often tend to not give up	
bb. I am very competitive in nature	
cc. I am always willing to learn new things	
dd. I am strong willed	
ee. I am very hands-on	
ff. I tend to take control in unstructured situations	
gg. I welcome failures from which I am able to learn	
hh. I seek information that will help with tasks I am working on	
ii. I find ways to complete tasks faster	
jj. I weigh my chances of succeeding or failing before I decide to do something	
kk. I seek the advice of people who know more about the tasks I need to accomplish	
ll. When faced with a difficult problem, I spend a lot of time trying to find a solution	
mm. I prefer situations in which I can control the outcome as much as possible	
nn. I am willing to co-operate with other farmers to buy inputs	
oo. I prefer activities that I am familiar with and with which I am comfortable	
pp. I take action without wasting any time to gather additional information	
qq. If one problem is persistent, I try alternative approaches to address it	
rr. I think of solutions that benefit everyone when solving a problem	

22. Entrepreneurial Characteristics	**Response**
ss. I am happy to do someone else's work in order to get the job done	
tt. I am able to meet deadlines and do my work on time	

Appendix B: Household crop marketing 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 to examine **sources of livelihoods and opportunities to improve contribution by farming within available food value chains on the selected irrigation schemes.** There is no wrong or right answers to these questions .You are free to be or not part of this survey.

Would you like to participate in this survey? Yes_____ No_____

Date		Farmer ID*	
Village name		Ward No.	
Irrigation scheme		Type of farmer	
Questionnaire code		Enumerator	

**Farmer code: 1-Scheme irrigators 2-independent irrigators 3-home gardeners 4- community gardens (specify name_____) 5-non irrigators*

H. MARKETING OF AGRICULTURAL PRODUCE

I. Complete table for crops grown in the 2014/2015 production season

Crops **(Code A)**	Output produced (indicate unit) (kg)	Quantity sold (kg) this season	Given as gifts to others (kg) this season	Output used as seed (kg)	Output consumed (kg) from this season production	If sold, what was your main markets (indicate at most 2 major ones) **Code B**	Walking distance to 1st major market (minutes) *Farmgate=0*	Walking distance to 2nd major market (minutes) *Farmgate=0*	Are these the preferred markets *1-Yes 2-No*	Reason for selling in the indicated markets **Code C**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

Code A 1-Maize 2-Beans 3-Cabbage 4-sugercane 5-Carrot 6-Spinach 7-Butternut 8-Calabash 9-Pepper 10-Sweet potato 11-Tomato 12-Chillies 13-Other (specify)…….

Code B 1- Farm gate; 2 = Hawkers 3= Local shops 4 = Shops in town; 3 = Contractors; Roadside 5 = small informal agro-dealer 6= large agro-dealers 6= Others (Please specify)…….....

Code C 1- Only market available 2- Low quality 3-Have a contract 3-Better prices 4- Good markets are far away 5-Don't have transport 6-other (specify)……

For crops sold as shown in table above, please indicate the price for each output per unit in Rand

Crops **(Code A)**	Unit of output	Time of selling **Code D**	Price/ unit peak	Price/ unit off season	Total Revenue		Did you know the price prior to going to the market *1-Yes, 2-No*	Source of market price information **Code E**	Days taken to sell crop in the market? **Code F**
					Peak	Off			
	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**

Code D 1-Immediate after harvest (within one week) 2- between 2-4 weeks 3- between 5-12 weeks 4-more than 12 weeks

Code E 1-Radio 2-TV 3-Dept of Agriculture Extension Officer 4-Fellow farmer 5-Cooperative 6-NGO 7-Contracting agency 8-Hawker 9-Other (specify)_____

Code F 1= up to 1 day 2= 2-3 days 3= 4-5 days 4= more than 5 day

For crops sold this season as shown in table above, please indicate actual marketing and other cost incurred per crop in Rand

Crops **(Code A)**	Transport of produce to market (include fares and transport hire)	Cost of materials (e.g. bags)	Other costs (specify)
	20	**21**	**22**

23. Did you sell some of your produce collectively or as a group? 1= Yes 0= No

24. If you sell your produce collectively, how much money do you pay as subscriptions for you to sell through the group or cooperative?

a) Frequency of payment 1= once off payment per season 2= monthly 3= yearly 4= other (specify)_____

b) Amount (Rand)_____

25. How much do you pay for your tv/ radio licenses per year? _____

26. How many days do you spend negotiating with traders for selling of your crops? 1= anything up to a day 2= 1-3 days 3= 4-7 days 4= 8-11 days 5= 12-14 times 6= above two weeks

27. Did you spend time looking for price information prior to selling? 1= Yes 0= No

28. How are your predictions of crop prices compared to the final selling price? 1= always lower 2= often lower 3= equal 4= often higher 5= always higher

29. Is accessing transport to markets a problem? 1= no problem 2= minor problem 3= problem 4= significant problem 5= major problem

30. Is a fee payable to sell in local or urban markets? 1= Yes 0= No

31. If Yes, how much do you pay each time you visit the market? _____

32. How many times do you visit the market per year? 1= 1-2 times 2= 3-4 times 3= 5-6 times 4= 7-8 times 5= 9-10 times 6= above 10 times

33. Is the risk that the product/ produce will not be bought a problem? 1= no problem 2= minor problem 3= problem 4= significant problem 5= major problem

34. Do you sell some of your crop produce on credit? 1= Yes 0= No

35. If Yes, on average how many days does it take to get paid? 1=less than 30 days 2=30-59 days 3= 60-89 days 4= 90 and above

Do you do any value addition to the crops before selling and if yes what are the costs of value addition in Rands?

Crops **(Code A)**	Value addition *1-Yes 0-No*	Washing (Cost)	Packaging (Cost)	Shredding (Cost)	Drying (Cost)	Grading (Cost)	Other (specify) (Cost)
	36	**37**	**38**	**39**	**40**	**41**	**42**

Appendix C: Focus group discussion checklist

University of KwaZulu-Natal & WRC

The information to be captured from this discussion is strictly confidential and will be used for research purposes by staff and students at the University of KwaZulu-Natal to examine **water use productivity and its role in diversifying rural livelihood options: case studies from Ndumo B and Makhathini irrigation schemes, UMkhanyakude District, KwaZulu-Natal Province.**

Are you willing to participate in this study? Yes ____ No _____

FOCUS GROUP DISCUSSION AND KEY INFORMANT CHECKLIST QUESTIONS

1. What are the major sources of income for farmers in and outside the irrigation schemes?
2. How important is farming compared to other sources of income? 1=not important 2=neutral 3=moderately important 4=important 5=very important
3. Which farming enterprises or crops have significant contribution to the livelihoods of farmers?_____
4. Which crops are working best (in terms of production and marketability) for farmers in the irrigation schemes _____
   and those outside of the scheme?_____
5. What are the most important production constraints for the above mentioned crops?
   _____
   _____
6. What are the most important marketing constraints for the above mentioned crops?
   _____
   _____
7. Where do farmers access the different inputs required for producing the above crops?
   _____
   _____
8. Who are the major economic agents selling the inputs to farmers?_____

_____

9. How affordable are the inputs to the farmers in and outside the irrigation schemes?
   1=not affordable 2=neutral 3=moderately affordable 4=affordable 5=very affordable
10. What are the other major non-price constraints in accessing the inputs?_____
    _____
    How accessible is hired labour in and out of the irrigation schemes? 1=not accessible
    2=neutral 3=moderately accessible 4=accessible 5=very accessible
11. Are there any differences in hired labour availability depending on the time of the year? Yes
    _____ No _____
12. If Yes, which time of the year is labour abundantly available?_____
13. If Yes, which time of the year is labour scarce?_____
14. Does variation in labour availability have an impact on the cost of hired labour?
    Yes _____ No _____
15. Does the wage rate vary across periods in a year? Yes _____ No _____
16. What are some of the natural hazards affecting farming that farmers often experience?
    _____
    _____
17. At what periods of the year do farmers experience such hazards?_____
18. What mitigation strategies are in place to assist farmers to cope with the effect of the
    hazards?_____
    _____
19. How do farmers sell their produce? 1 = Individually? 2= Cooperatives or Associations? 3=
    Contracts?
20. Is there value addition that is done by farmers before they sell their produce?
    Yes ____ No _____ (Probe only for the major crops in question 4 above)
21. For the most important crops, what are the common marketing channels?
    a) Farmer – Consumer_____
       _____
    b) Farmer – Middleman Including Hawker – Consumer_____
       _____
    c) Farmer – Retailer_____
    d) Farmer – Wholesaler – Retailer – Consumer _____
    e) Other Channels

22. a) Which channel does benefit the farmer the most?_____

    b) Why?_____

23. Who are the major buyers and players involved in the selling/ marketing of major crops?

    _____

    _____

24. Do the prices offered by different buyers differ and why?_____
25. What are the prices of major crops offered by different buyers along the value chain?

    _____

    _____

26. What are the major marketing costs incurred by farmers in marketing their produce?

    _____

27. Are the costs significantly different across farmers? Why?_____

    _____

28. Are there markets where farmers would like to sell but cannot?_____

    _____

29. Why are farmers failing to sell in their preferred markets?_____

    _____

30. What do you think needs to be done to increase farmers' production output and income from the identified key crops on irrigation schemes and/ or outside of the scheme?

    _____

    _____

31. Are farmers interested to be part of a small scale irrigation scheme? Yes _____No_____
32. If Yes, Why _____
33. If No, Why not? _____
34. If participation in irrigation farming means changing enterprise combination, are farmers prepared to do so? Yes _____ No _____

For scheme irrigators only

1. How much are farmers paying for water? _____
2. Are the fees paid monthly? Yearly? Or at what interval?

    _____

3. Are farmers charged based on the amount of water they use or a flat rate?

A. Amount of water used_____ **B.** Flat Rate_____

4. If flat rate how are farmers over-irrigating monitored?_____

   _____

5. What are the farmers' opinions on the water charging system?_____

   _____

6. Are most farmers willingly paying water fees? Yes ____ No _____
7. If No, why are some not paying?_____
8. If No, what could make farmers not pay their water fees?_____

   _____

9. Do you know the purpose the fees are used?_____

   _____

10. Are you aware of the process the fees are allocated to different purposes?

    _____

11. Who is responsible for maintenance of irrigation infrastructure in the scheme?_____

    _____

12. What is the farmers' contribution in the maintenance of irrigation infrastructure?

    _____

13. What is the water use/ sharing arrangement?_____
14. Are there any conflicts that arise between farmers regarding water use/ sharing?

    Yes _____ No _____

15. If Yes, what are those conflicts? _____

    _____

16. What are the underlying common causes of such conflicts?_____

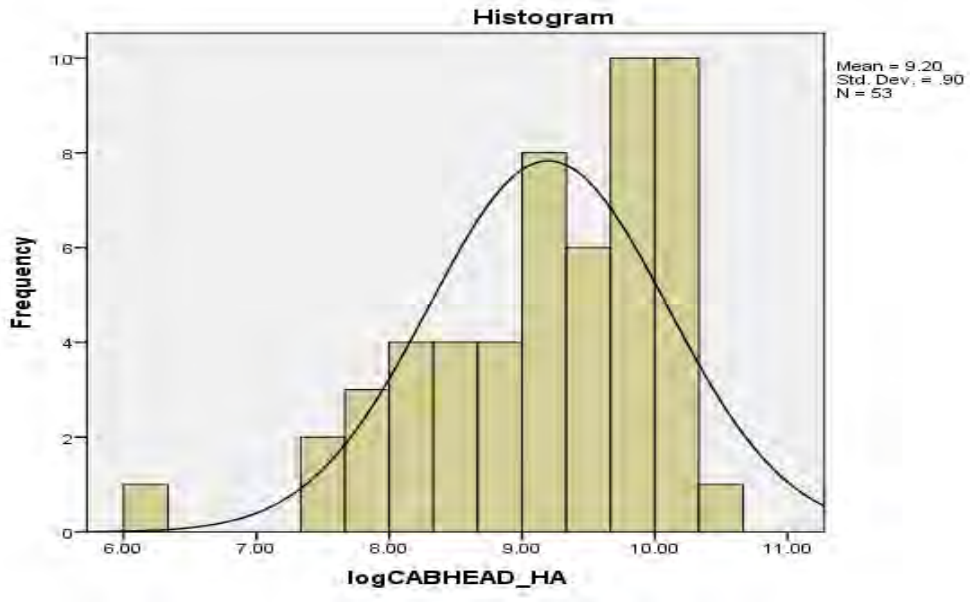
    _____

17. What is the source for water used for irrigation?_____
18. What are the other major competing uses of water from the same source?_____

    _____

19. Do farmers recognize that water is a scarce resource? Yes _____ No _____
20. If No, what do you think needs to be done so that farmers can realise that water is a scarce resource?_____

Appendix D: Cabbage yield negative skewness



Descriptive Statistics

	N	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
logCABHEAD_HA	53	9.1970	-1.163	.327	1.446	.644
Valid N (listwise)	53					

APPENDIX E: Psychological capital statistic

Table E1. KMO and Bartlett's test for psychological capital index

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.886
Bartlett's Test of Sphericity	Approx. Chi-Square	1900.428
	df	28
	Sig.	.000

Table E 2. Psychological capital principal components

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.663	70.782	70.782	5.663	70.782	70.782
2	.980	12.253	83.035			
3	.560	7.001	90.036			
4	.291	3.644	93.680			
5	.192	2.402	96.081			
6	.143	1.783	97.864			
7	.118	1.481	99.346			
8	.052	.654	100.000			

Extraction Method: Principal Component Analysis.