THE IMPACT OF SMALLHOLDER IRRIGATION SCHEMES ON POVERTY REDUCTION AMONG RURAL HOUSEHOLDS OF VHEMBE AND SEKHUKHUNE DISTRICTS IN LIMPOPO PROVINCE, SOUTH AFRICA

by

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DECLARATION

I declare that the thesis hereby submitted to the University of Limpopo, for the degree of Doctor of Philosophy in Agriculture (Agricultural Economics) has not previously been submitted by me for a degree at this or any other university; that is my work in design and execution, and that all material contained herein has been duly acknowledged.

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Full names	**Date**

DEDICATION

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

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ABSTRACT

Many researchers in different parts of the world have advocated the use of irrigation water to reduce levels of poverty, especially among rural households. This is made possible through the development of irrigation schemes in these areas and giving the necessary support to these farmers. If this is done sufficiently, irrigation schemes` participants are sure to realise improved livelihoods and poverty reduction.

However, different communities are faced with different challenges and are subjected to rules and norms applied in their respective communities. On one hand, farmers are individuals who also have personal beliefs and characteristics that may be critical in determining the success of their irrigation schemes. On the other hand, certain characteristics (e.g., unequal distribution of water and land) can be inherited as challenges by farmers in such communities, making it difficult to overcome and thus posing threats to the success of irrigation schemes.

A purposive-multistage technique together with a simple random sampling were used to sample 300 smallholder farmers from the Vhembe and Sekhukhune districts of Limpopo Province. An analysis of data was done using a combination of analytic techniques such as the Binomial Logit, Principal Component Analysis, Multiple Regression Analysis, Poverty Indices and the Women Empowerment Agriculture Index. The latter was employed to examine whether or not there are efforts by the irrigation schemes to empower women. The main aim was to analyse the contribution and impact that irrigations schemes have on poverty reduction among smallholder farmers. There was also a need to consider the role that positive psychological capital may play in uplifting the hope, confidence, resilience and optimism by farmers in their irrigation schemes.

The results revealed that women's participation was high (58%) in the irrigation schemes as compared to men. However, this did not mean that women were empowered automatically. After administering the Women Empowerment Agriculture Index, it was found that women are actually disempowered in three (out of five) indicators that were used as a measure of empowerment. Meanwhile, most farmers who used irrigation, saw their livelihoods improve and their poverty status improve too. Irrigation was able to increase their yields, incomes, employment, and other household assets. It was again proven that positive psychological capital played a significant role in reducing poverty. However, factors such as lack of capital assets, social grants, illiteracy, old age, lack of vocational training and risk aversion in some instances contributed to poverty.

In order to enhance the livelihoods of smallholder farmers, the government and other relevant bodies should see to it that agricultural extension services are improved and include vocational training for these farmers together with the provision of market information and business training. This may help farmers realise the importance of farming as a business and not relying on government for everything they need. A larger share of income for most farmers came from social grants and remittances. This is likely to have a negative impact on the success of irrigation schemes. Therefore, farmers need to be trained for self-reliance. The need to promote women's participation in decision-making for water management and also suggests ways in which women's access to water can be improved through equitable development cannot be overemphasised. There is also a need to conduct a study on the measurement and role of psychological capital in rural livelihoods using other methods such as revealed preference approach, experimental economics and behavioural economics.

KEY CONCEPTS

Smallholder farmers, smallholder irrigation schemes, poverty reduction, women empowerment, psychological capital

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LIST OF ABBREVIATIONS

Agritex – Department of Agricultural, Technical and Extension Services

CPC – Compound Psychological Capital Scale

DAFF – Department of Agriculture, Forestry and Fisheries

FAO – Food and Agriculture Organisation

FPL- Food Poverty Line

GVA – Gross Value Added

IFAD – International Fund for Agricultural Development

IPTRID – The International Programme for Technology and Research in Irrigation and Drainage

NCES – National Centre for Education Statistics

PC – Principal Components

PCA – Principal Components Analysis

PCQ – Psychological Capital Questionnaire

PsyCap – Psychological Capital

RESIS – Revitalisation of Smallholder Irrigation Schemes

SADC – Sothern African Development community

SEC/SES – Socio-Economic Characteristics/Status

SIS – Smallholder irrigation schemes

SSI – Small-scale Irrigation

SLF – Sustainable Livelihood Framework

SPSS – Statistical Packages for the Social Sciences

VDM – Vhembe District Municipality

WUA- Water Users Association

5DE – Five Dimensions of Empowerment

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CHAPTER ONE

INTRODUCTION AND BACKGROUND / ORIENTATION TO THE STUDY

1.1 Introduction

In many parts of the world, including South Africa, the amount, frequency and distribution of rainfall, which is the principal source of water for crop production, is becoming more unpredictable and inadequate. Irrigation supports successful crop growing and stabilises crop yields. In essence, irrigation is required in most of the places experiencing uneven distributions of rainfall. This means that in drought-prone areas of the country, successful crop production is only possible with the support of irrigation.

Irrigation is one method of agricultural intensification and plays a dominant role in increasing agricultural productivity. In recent times it has become obvious that small scale irrigation is one of the areas emphasised by policy makers and planners. Though Sub-Saharan Africa has a rich and varied water endowment, only four percent (4%) of its cropland is irrigated (Bjornlund *et al*., 2020). Although 40 million hectares of its land are suitable for irrigation, only 7.3 million hectares are actually irrigated. For the millions of poor families in Sub-Saharan Africa, access to water makes a difference between starvation and food security, and between productive livelihood and one characterised by poverty (Shah, 2020).

Irrigation increases agricultural productivity and farm income per hectare, it protects the national agricultural economic sector against weather related shocks and provides a more stable basis for economic growth and poverty reduction. However, agricultural productivity is low due to the use of low-level agricultural technologies, risks

associated with weather conditions, diseases and pests, managerial incompetence and other psychological factors affecting famers (Yihdego, 2015).

Irrigation has the potential to stabilise agricultural production and mitigate the negative impacts of variable or insufficient rainfall. In terms of food security, irrigation reduces the risk of production failure, production seasonality and consumption shortfall. Furthermore, it creates opportunities for buffering future food supply shocks (Mhembwe *et al*., 2019). The foregoing effects can collectively be termed “direct effects” of irrigation agriculture. However, there are also “indirect effects” that are often unidirectional and long-term in nature. These include reduced rural-urban migration caused by rural employment, which is created through the development of agriculture, and increased resources for other sectors of the economy like education and health.

Notwithstanding these positive impacts, irrigation is known to have spillover and unintended negative effects. This results from the chemicals applied in crop cultivation that affect water resources downstream. Other effects include river bank cultivation which results in soil erosion, leaching of soil nutrients, and salinisation. Irrigation technology can also be costly in terms of scheme establishment and diseases that are associated with irrigation schemes like Malaria and Schistosomiasis (Hussain and Hanjra, 2004; Li and Long, 2019).

Although irrigation has been contributing to the use of other productivity enhancing agricultural inputs (Khan, 2014), and developments of antipoverty programmes, Chipfupa and Wale (2017) argue to the contrary, purporting that the benefits derived from modern irrigation are insignificant. In light of such a view, this study sought to explore the role and significance of irrigation schemes in poverty alleviation in rural areas, among other aspects.

1.2 Problem statement

It is widely believed that continuous access and use of irrigated farming generally allows poor people to increase production, household income and enhances income diversification opportunities that can contribute to poverty reduction (Masela *et al.,* 2018). However, these benefits are not distributed in the same way across different types of farmers; and as a result, the farmers are not equally successful (Bonthuys, 2017). For example, there is a common perception that the impact of irrigation farming on poverty alleviation is prevalent where land sizes are equally distributed among farmers. Irrigation farming benefits are also more prevalent primarily to large landholders (Borgenmagazine, 2017). Furthermore, it is assumed that equitable access to necessary human, social, financial, physical and positive psychological capital assets play a significant role in determining how (and how much) a farmer benefits from irrigation farming (Smith, 2004). However, psychological capital asset (i.e., confidence, hope, optimism and resilience) has not been given much attention in terms of its role in irrigation farming in South Africa (Moyo, 2016). Also, rural development literature reveals that youth and women are at the centre of poverty in rural areas, and that female headed households are poorer than their male counterparts (Borgenmagazine, 2017). Studies conducted in South Africa (e.g., Moyo, 2016) show that more households participating in irrigation farming are headed by male adults. This reveals that, there are minimal efforts exerted towards empowering women to participate in irrigation farming to reduce poverty in rural areas. The study conducted by Moyo did not explicitly state the impact made by smallholder irrigation schemes. This could have been achieved by capturing the complete poverty incidences among the irrigators and non-irrigators under study and their

determinants thereof. Therefore, it was imperative to empirically analyse the role and impact of smallholder irrigation schemes in the livelihoods of rural farmers in light of the physical and emotional characteristics that affect them.

1.3 Motivation of the study

Although a few studies (i.e., Mudau, 2010; Tekana and Oladele, 2011) have established that there is a positive relationship between participation in smallholder irrigation farming, and poverty reduction in South Africa, evidence to corroborate this claim is either unclear, unquantified or gathered in such a way that makes it easy to draw formidable conclusions. In general, smallholder irrigation farmers and their livelihoods have received little attention in some of the research that has been done in South Africa. Smallholder irrigation in South Africa covers 48 000 ha of land while independent farmers (those farmers who are outside irrigation schemes) irrigate about 52 000 ha (Van Koppen, 2017). Average plot sizes for irrigation schemes are as low as 0.2 ha while independent farmers are farming on 5-10 ha plots (Van Koppen, 2017; Van Averbeke *et al*., 2011; Denison and Manona, 2007).

Furthermore, previous studies (Bjornlund, 2020; Moyo, 2016; Sinyolo, 2014; Meliko and Oni, 2011) that have examined the relationship between smallholder irrigation farming and poverty in South Africa have not (empirically) examined the impact that smallholder irrigation farming has made to poverty reduction in South Africa, although they have established a positive relationship between the two. That is, they have quantified the extent of poverty reduction attributable to the various identified pathways through smallholder irrigation farming; examined the relationship between existing entrepreneurial attitudes or skills of

smallholder irrigation farmers and irrigation farming's contribution to poverty reduction; and indicated whether or not efforts were made to empower women among rural households through irrigation farming (Tekana, 2014; Chitja, 2016).

There is, therefore, a dire need to explore the impact of smallholder irrigation farming on rural poverty reduction in South Africa. This study employed different quantitative approaches to explore different socio-economic factors of smallholder irrigation farmers in the Vhembe and Sekhukhune districts of Limpopo Province. Arguably, it can be asserted that an increase in agricultural production and poverty reduction should come mainly through agricultural intensification and adoption of technologies that improve soil moisture to use more productivity enhancing inputs. The use of productivity enhancing inputs (such as fertilizer and high yielding varieties) depends much on the availability of moisture in which case, investment in irrigation becomes crucial (Zegeye and Chipfupa, 2018). The main focus of this study, therefore, was to try and explore the impact that smallholder irrigation schemes have on poverty reduction. This was done by evaluating the contribution that irrigation schemes have in the livelihoods of farmers, checking the effect that positive psychological capital has on the success of smallholder irrigation schemes, and outlining the potential contribution of smallholder irrigations schemes to women empowerment as they feature prominently in the debates on poverty in many developing nations.

1.4 Purpose of the study

1.4.1 Aim

The aim of the study was to investigate the impact of smallholder irrigation schemes towards poverty reduction among rural households in the Vhembe and Sekhukhune districts of Limpopo Province.

1.4.2 Objectives

The objectives of the study were to:

i. Profile the socio-economic characteristics of smallholder irrigation farmers.

ii. Determine the contribution of smallholder irrigation schemes towards poverty reduction of smallholder irrigation farmers.

iii. Investigate the contribution of smallholder irrigation schemes to women empowerment.

iv. Explore the effect of positive psychological capital assets on poverty reduction among smallholder irrigation farmers.

v. Determine the impact of smallholder irrigation schemes towards the poverty reduction of smallholder irrigation farmers.

1.4.3 Research hypotheses

i. Smallholder irrigation schemes do not contribute towards the poverty reduction of smallholder irrigation farmers.

ii. Smallholder irrigation schemes do not contribute towards women empowerment.

iii. Positive psychological capital assets have no effect on poverty reduction among smallholder irrigation farmers.

iv. Smallholder irrigation schemes do not have any impact towards the poverty reduction of smallholder irrigation**.**

1.5 Structure of the thesis

The study is organised into six chapters. Chapter one provides the general background and orientation to the study, including the problem statement, motivation of the study, aim, objectives and research hypothesis. The second chapter provides the literature review of the general benefits of irrigation to rural households and poverty reduction measures. Previous studies that speak of psychological capital are also explored in Chapter 2. In the third chapter, the methodology of the study is presented, including the description of the study area, data collection procedures, methods used in data analysis and variables considered. Chapter four presents the results of the descriptive analysis of variables used in the study whereas Chapter five presents the empirical results of the regression analyses and their discussion. Finally, Chapter six presents the summary, conclusion and policy recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter defines the key concepts used in the study and reviews literature on small-scale irrigation farming in South Africa and other countries. It further explains the essence of positive psychological capital in the success of small-scale irrigation farming drawing lessons from previous research results and concludes by outlining roles that irrigation farming plays in general, especially in women empowerment in South Africa.

2.2 Definition of key concepts

2.2.1 Smallholder irrigation and irrigation schemes

When describing smallholder irrigation, one needs to begin by defining a smallholder farmer. Terms used to describe smallholder farmers in many literatures include small-scale farmers, resource-poor farmers, peasant farmers, food-deficit farmers, household food security farmers, land-reform beneficiaries and emerging farmers (Machethe *et al*., 2004; Pienaar, 2015).

Generally speaking, there is no standard definition of a smallholder, but the term is used in the South African context to generally refer to producers who are black and otherwise distinct from the dominant (and white dominated) large-scale commercial farmers. There is no clear distinction between terms such as smallholder, small-scale, subsistence, communal or emergent since different researchers use them interchangeably in different contexts.

Notwithstanding, the concept ‘smallholder’ encapsulates the characteristics of a small farm size and a partially developed link to the larger economic system. Smallholder farmers are usually affected by prices, subsidies and markets, but their input and output markets, which are not fully formed, remain localised to some extent. This distinguishes smallholders from commercial enterprises, both large scale and family farms, which have access to fully formed external markets (Ellis, 1998). Smallholder irrigators in South Africa have been categorised into four groups (Crosby *et al*., 2000; Du Plessis *et al*., 2002; Van Averbeke, 2008), namely; (i) farmers on irrigation schemes; (ii) independent irrigation farmers; (iii) community gardeners; and (iv) home gardeners. According to Denison *et al*. (2016), there are 200 000 to 250 000 smallholder irrigators contained in these four groups. This study is concerned with smallholder irrigators operating on irrigation schemes.

In South Africa, smallholder irrigation schemes (SIS) can be defined as multi-farmer irrigation projects larger than five ha (5ha) in size that were established in the former homelands or in the resource-poor areas by black people or agencies assisting their development (Van Averbeke, 2008). These schemes are under local responsibility, controlled and operated by the local people in response to their felt needs, and use a level of technology that they can operate and maintain effectively. Such schemes vary in size, both in terms of the number of farmers supported by a particular scheme and the size of the scheme.

2.2.2 Poverty and poverty reduction

Poverty is a contested concept; and it is contested with good reason. Arguments over how poverty should be conceptualised, defined and measured go beyond semantics and academic hair-splitting. The conceptualisation, definition and measurement of

poverty in a society is like a mirror-image of the ideals of that society. In conceptualising, defining and measuring what is unacceptable in a society, we are also saying a great deal about the way we would like things to be. It is therefore vital that the concepts, definitions and measurements of poverty are appropriate to the society in which they are applied. In this sense, poverty definitions are referred to as working definitions since they are always changing to accommodate the characteristics of society.

Poverty and Inequality Institute suggested that poverty can mean a number of different things. In popular discourse, poverty is a ‘portmanteau’ concept that captures a range of meanings. One important ‘thread’ in poverty discourse is the notion of material lack – especially the lack of resources necessary for survival (Johanneburg, 2007). Poverty studies and definitions have resorted to identifying what goods a human being would require to prevent him- or herself from dying. But agency and dignity are also important threads in this regard: people who are able to survive may still be considered poor if survival requires them to give up their self-respect, or if they are not able to fulfil their minimal social obligations in society. Another important thread is that of subjective experience: people are ordinarily considered poor if they experience forms of lack that lead to suffering.

Poverty can be construed in a narrow or broad sense. In the narrowest sense, it means lack of income. In a broader sense, poverty can be seen as multidimensional, encompassing other issues such as housing, health, education, access to services and to other avenues of accessing resources, and what is somewhat controversially referred to as ‘social capital’, and access to social power relations (Magasela, 2005).

Poverty reduction is a set of measures, both economic and humanitarian, that are intended to permanently lift people out of poverty. Poverty reduction occurs largely as a result of overall economic growth (UNDP, 2013). Poverty alleviation also involves improving the living conditions of people who are already poor.

2.2.3 Rural households in South Africa

This study focused on rural households, regardless of whether they belong to a certain socio-economic category as defined by income source. Researchers often divide rural households into those with a farm holding and others. Households with agricultural potential are considered as farm holdings and are classified according to income sources, namely; agricultural, mixed and non-agricultural. This research was not limited only to households with farm holdings, but also took into consideration other households of modest economic income in rural areas, as long as they partook in the irrigation schemes found in their communities (Gange and Mdoda, 2020).

In other parts of South Africa, rural households are defined as people living in those areas that are without access to ordinary public services such as water and sanitation, and are without a formal local authority (IOA, 2013). These areas are characterised by inferior infrastructure, low income, poor site conditions, unreliable water availability, and poor access to health facilities. Rural areas are also informed by a lack of sufficient quantities of clean water, subsequently impairing the ability of most people in rural areas to engage in appropriate personal, food and environmental hygiene practices.

2.2.4 Women empowerment

The empowerment of women has, relatively speaking, recently become a significant area of discussion with respect to development and economics, although the

discussion mainly addresses or deals with gender inequality. Because women and men experience poverty differently, they hold dissimilar poverty reduction priorities and are affected differently by development interventions and poverty reduction strategies (Zukerman, 2002). In response to the socialised phenomenon known as the feminisation of poverty, policies aimed to reduce poverty have begun to address poor women separately from poor men. In addition to engendering poverty and poverty interventions, a correlation between greater gender equality and greater poverty reduction and economic growth has been illustrated by research through the World Bank, suggesting that promoting gender equality through empowerment of women is a qualitatively significant poverty reduction strategy (ILO, 2016).

Women play a pivotal role in agriculture. FAO (2011) describes women in agricultural production in developing countries and notes that rural women manage households and pursue multiple livelihood strategies. Efforts towards ensuring food security have identified women farmers as key role players in many contexts and set-ups (FAO, 2011). However, women's role in agriculture remains unrecognised in policy formulation and resource allocation (IFAD, 2012). A major intervention to improve agricultural productivity as the principal source of income for many farmers' households in rural areas of developing countries is the introduction of irrigation to supplement water supply for farming activities. In the right environment and with correct practices, irrigation provides more yield than rain-fed agriculture (Jaramillo, 2020).

Several platforms have been adopted and reiterated across many organisations in support of the empowerment of women with the specific aim of reducing poverty. Encouraging more economic and political participation by women increases financial independence from and social investment in the government, both of which are critical

in pulling society out of poverty. This study looks into the contribution made by smallholder irrigation schemes in empowering women.

2.2.5 Psychological capital

Psychological Capital (PsyCap) is defined as “an individual’s positive psychological state of development” (Luthans *et al*., 2007), which is characterised by having high levels of HERO; the four elements of Hope, (Self-)Efficacy, Resilience, and Optimism. The concept of PsyCap has become even more relevant with recent findings in the area of neuroplasticity. Since people’s brain is malleable, PsyCap can be developed and strengthened. Further, PsyCap can be managed and assessed.

Several scales have been developed to measure PsyCap. The original scale developed by Luthans *et al*. (2007) in the context of organisations is the Psychological Capital Questionnaire 24 (PCQ-24). For a more general application in all domains of life, Lorenz *et al*. (2016) developed the Compound PsyCap Scale (CPC-12), a twelve-item self-report scale (This scale is explained in Table 3.3).

2.2.6. Socioeconomic characteristics

Socioeconomic characteristics or status (SEC or SES) is an economic and sociological measure of a person’s work experience and of an individual’s or family’s economic and social position in relation to others. When analysing a family’s SEC, the household income, earners’ education, and occupation are examined, as well as combined income, whereas for an individual’s SEC only their attributes are assessed. However, SEC is more commonly used to depict an economic difference in society as a whole (NCES, 2009).

Socioeconomic status is typically broken into three levels (high, middle, and low) to describe the three places a family or an individual may fall into. When placing a family or individual into one of these categories, any or all of the three variables (income, education, and occupation) can be assessed.

Education in higher socioeconomic families is typically stressed as much more important, both within the household as well as the local community. In poorer areas, where food, shelter and safety are a priority, education can take a backseat (Anon, 2021)

2.3 History of irrigation farming in South Africa and abroad

Going back in history, an early description of smallholder irrigation and the type of support provided by the then apartheid government is found in the Irrigation Chapter 29 in the 1956 Tomlinson Report, the basis for the government's homeland policies (Van Koppen *et al*., 2018). This document reported vibrant irrigation by black people at the time. Some had taken up irrigation on their own initiative and explicitly requested government to support. For example, the Tomlinson Report mentioned how Pedi farmers in the current Sekhukhune District had voluntarily contributed labour to construct 60 earthen dams in collaboration with the agricultural section of the Native Department resulting in the production of 11 300 bags of wheat (Van Koppen *et al*., 2018). The report also mentions a total of 122 smallholder irrigation schemes in the Union of South Africa. Most of these schemes were in the north-eastern regions of the Transvaal (currently Limpopo and Mpumalanga Provinces). Within this region, the Olifants River was particularly important: 36 irrigation schemes were along the Olifants River whereas other schemes were mainly in the current Eastern Cape and KwaZulu-Natal.

Government's growing investments in these irrigation schemes served a mix of political-economic goals. First, employment in irrigated agriculture was expected to reduce any movement of Africans to the white Republic of South Africa. Irrigation would mitigate the risk of 'black inundation'. Second, schemes provided food security (maize) for the few who got a plot. By the late 1980s, only 30 percent of the food consumed in the homelands was produced internally; the large majority of black people depended on the purchase of food produced by white farmers. Surplus maize and the cash crop of wheat, imposed crops to be grown, also provided for national food security. Third, schemes along rivers that separated the white Republic of South Africa from the homelands became well-controlled boundaries. Fourth, irrigation schemes allowed settling and pacifying the victims of forced removals from across the river or from larger distances that accompanied the apartheid's government rigorous territorial segregation (South Africa, 2016).

White farmers who had to leave their farms in future homelands received a monetary compensation. Fifth, by favouring allied chiefs of the region with plots, 'Pretoria' (the seat of government) could better impose its rule. Sixth, these irrigation schemes provided employment to the development corporations and white engineering and irrigation management firms. According to Van Averbeke *et al*. (2011), development corporations and white engineering firms in the homelands accelerated their efforts in a next round of investments. They upgraded the schemes to more expensive, more energy consuming, and more centralised technologies. These were 'excessively capital intensive', based on the most sophisticated modern technologies. This had a reason: Since consultants always received a fee based on a percentage of the capital expenditure, it was to their advantage to plan the most capital expensive system.

The South African government funded only capital expenditures and not running costs and it was thus easy to convince homeland governments to go for capital intensive projects, rather than those with higher running costs, e.g., labour intensive ones (Laker, 2004). It started a trend in which 'design solutions appear to have scaled down versions of first world technology rather than finding a solution that would work well for smallholder farmers' (Machethe *et al*., 2004). Over the course of the years, this centralised mechanisation ensured full white control over the production process, thoroughly enforcing dependency. Lastly, the divide-and-rule policies through these investments were gendered: they served to pacify men by giving them more power over the labour of their wives. Across South Africa, crop cultivation used to be the domain of women and their daughters-in-law. Men focused more on livestock. Male migration strengthened the importance of women's crop cultivation to reproduce the labour force by rearing the new generations of labourers, by caring for the sick and by providing a home for the elderly.

Apartheid irrigation development tried to change these gender relations by introducing the European and Afrikaner notion of the nuclear family, solely engaged in farming, with the male household head as the natural and sole household member entitled to land, technologies, and other productive resources. The latter included the fruits of their wives' labour. Thus, the Tomlinson Commission recommended a size of 1 or 1.5 morgen (1.28 ha) because: 'Out of the various farming and settlement systems, irrigated farming is undoubtedly the enterprise for which the Bantu have proven that they are able, under white management and leadership, to make an economic living out of full-time farming and to use the land economically for food production. Unlike rainfed agriculture, the man does not avoid activities here – the man and his whole family are active on the plots' (Van Kopper *et al*., 2018).

The Tomlinson Commission explained that a size of 1.5 morgen would allow such a nuclear family to cultivate full-time. Citing studies from the Olifants River scheme, the Commission explained how a gross income of 110 pounds could be derived from 1.5 morgen (1.28 ha). This was seen as enough income for a reasonable livelihood – according to white perceptions of Bantu standards. The Commission also gave strict instructions that all those who got plots should give up other farming and work full-time on the irrigation plots. Plot holders were not allowed to leave their homes for more than 14 days without written permission of the (white) scheme manager. Also, no other families were allowed in the dwellings of the irrigating households without the manager's permission (Van Koppen *et al*., 2018). The promotors of these relative privileges for men were silent about the culling of men's livestock under the notorious earlier betterment programs and men's ultra-exploitation in the white wage economy. Commenting on how native men often went for migrant labour, while women continued cultivation, magazines like the 'Bantu' stated that irrigation was the best way to raise men's interest in irrigated cultivation, so that men would stop migrating (Van Koppen *et al*., 2018).

In sum, the government's support to smallholder irrigation never had any ambition to initiate 'economically viable' irrigation or to avoid a dependency syndrome. The irrigators, who in reality were still mainly women, were no more than labourers in their own fields, bearing all the risks. After 1994, the new government dismantled the apartheid's development corporations; many of its staff were retrenched and joined the private sector firms.

From the year 2000 onwards, the Department of Agriculture initiated a 'Revitalization of Smallholder Irrigation Schemes' (RESIS). This was most active in the Limpopo Province (when comparing to other provinces in the country). RESIS envisaged

spending a total amount of R717 688 000 over five years 2004-2010, i.e., R119 552 400 pa. In this period, 126 schemes were planned to be revitalised, including the Flag Boshielo Scheme, covering a total of about 19 730 ha and directly involving 12 432 farmers. The replacement value of the infrastructure was estimated at R2.6bn and was 'mostly dilapidated, waning and none productive' (Shaker, 2005). The RESIS aimed at re-building, socially uplifting and profitable agri-business through a 'comprehensive programme to structure, train and capacitate smallholder farmers to run their scheme profitably and sustainably' (DAFF, 2015). An integrated and participatory process-oriented approach was envisaged, with extensive investments in human capital, besides upgrading of infrastructure. It envisaged responding flexibly to a wider range of community priorities, including homestead food production. It considered multiple uses of water, also for livestock, and interrelationships with dry land crop production (Van Averbeke *et al*., 2011).

However, in late 2004, the new leadership in the Limpopo Department of Agriculture radically abandoned this approach, changing to 'RESIS Recharge'. In this approach, government engaged in a public-private partnership with a commercial farmer as 'strategic partner' in a 'joint venture' with government and smallholders. The commercial farmer was supposed to provide for capital, forward and backward linkages and entire production, and receive a share of the net income. Government would provide for land and irrigation infrastructure. Farmers would give up their land and water infrastructure, and receive the other share, while bearing the risks (Tapela, 2016).

The overall results have been weak. By 2010, it was estimated that 206 schemes were still operational, but that 90 schemes, a third of the total, had collapsed (Van Averbeke, 2011). Of the two thirds of the schemes that were still operational, less than two third

of the farm area was, on average, cultivated (Denison and Manona, 2007). The water technology that had been installed influenced performance. Percentages of functionality were highest, 81 percent, for gravity-fed canals, which have lowest operation costs and can be controlled best by farmers. In contrast, only 70 percent of pumped surface irrigation schemes (65 percent for overhead irrigation and 56 percent for micro-irrigation) were still operational (Sambo *et al*., 2011).

2.4 Irrigation schemes and sustainable livelihoods

In Africa, where irrigation levels are very low with only 3% of crops being produced under irrigation, a paralleled slow pace in poverty alleviation has been experienced. World Bank Blog (2020) postulated that Sub-Saharan Africa was worst affected by poverty with over 40% of its population living in extreme poverty. In other parts of the world such as India, a correlation was drawn between irrigation development and poverty reduction. Irrigation development in India allowed for the adoption of agricultural technology that saw the use of fertilizers and pesticides that further enhanced irrigation production. The boost in agricultural technology led to rural economic development and decline in poverty levels.

Researchers highlight that intensive crop production that is facilitated by irrigation schemes increases land productivity and output per unit area. Irrigation allows a certain degree of crop diversification that one cannot afford to achieve using rainfed agriculture (Tan *et al*., 2009 and Mwaba, 2013). Crop intensification in irrigated conditions enables households to cultivate during wet and dry seasons and, therefore, has a high land augmentation effect. Per hectare, labour employment is greater in irrigated settings than in rainfed settings such that access to irrigation infrastructure generates almost an extra month of jobs during the wet season alone.

Sikwela (2008) noted that belief in the successes of irrigation schemes by the Zimbabwe government led to massive investment in irrigation and dam construction soon after independence. The aim of such investment in irrigation development was to reduce dependence on government, attain food security and foster rural development and alleviate poverty. In embracing the initiative, the government sought to bring communal farmers into the central economy and allow them to participate in the main economic market so that they could generate household income and sustain community development.

Rukuni Commission (1994) reiterated that “since independence in 1980 the government has undertaken several initiatives to meet these priorities including the following; improving physical infrastructure such as road network development in communal areas; guaranteeing incentive prices for food and cash crops; and encouraging irrigation development in semi-arid areas”.

A partnership between Europe Aid and Ministry of Agriculture at a cost of six million Euros had led to extended benefits to Gondo irrigators in Zimbabwe. The irrigation project helped 90 communities and 3600 beneficiaries. The project managed to reduce hunger per season from an average of 6 to 0 months. Gondo irrigation scheme farmers managed to increase maize yield from 1.1 to 4.5 tons per hectare. Income from the irrigation project enabled beneficiaries to pay for children’s school fees resulting in the rate of school dropouts decreasing from 13% to almost 0% and improved nutrition (Europe Aid, 2011).

Mupawose (1984) questioned the economic viability of smallholder irrigation schemes in Zimbabwe pointing out that some smallholder projects had failed and were underutilised. Mupawose attributed this to poor management and lack of inputs and

irrigation inexperience among farmers. In the same report, Mupawose called for reduced subsidies towards smallholder irrigation due to increased irrigation losses. A request was made for cost recovery mechanisms to be put in place in irrigation schemes.

Agritex (1999) in its evaluation of Chitora, Hama, Mavhaire, Mzinyathi and Wenimbi irrigation schemes, noted that small irrigation projects can be reliable sources of income. The assessment revealed that irrigators were earning as much as Z$ 5 833 per farmer from plots of 1ha while dry land revenues were Z$1 000 per month per 6 ha plot size. The income was higher than the minimum wage of Z$400 per month paid to unskilled workers and the lowest wage of Z$600 per month paid for skilled labourers in the agriculture industry. Agritex propounded that from a social perspective, an irrigator is better off than workers in the urban industries who have to deal with urban related multiple expenses such as rent, water and electricity charges on their incomes. Armed with that information, the government had channeled more resources to smallholder irrigation development.

2.5 Impact of Irrigation Scheme on quality of life in developing countries

The quality of life as accomplished through increased revenue and improved nutrition that rural irrigation schemes have led to improved rural livelihood in some communities. The schemes resulted in the quality-of-life improvements as advocated by the Human Development Index, developed by Alkire and Eli (2010). Through increased economic activities necessitated by the irrigation scheme, 100% of irrigators reported that they had access to tap water or borehole water. This was against a backdrop of 80 % of non-irrigators who indicated that they had access to clean water, although the need for water increased as one moved away to communities far away

from the scheme. This demonstrated the significance of the irrigation project where the improvement of people's standard of life was concerned.

Brooks *et al*. (2005) highlighted that one of the benefits of irrigation schemes is that they lead to asset accumulation that assists in poverty reduction and wealth accumulation. Their study noted that 75% of irrigators' homes had electricity and relied on either electricity or paraffin or stoves for cooking. In contrast, 5% of dryland farmers had electricity with heavy reliance on firewood for the kitchen. All irrigators' homes had either television or radio sets and had one or two mobile phones for communication.

Moving further away from the system, the signal was lost indicating no coverage for dryland farmers further off the irrigation project. Communications technology is a vital tool for development. It necessitates both voice and data communication. Through Information and Communication Technology (ICT), farmers can access market and compare prices for their commodities and conduct research on best farming methods to enhance productivity. In this regard, the study concluded that the irrigation scheme helped in improving the quality of life for the Lower Gweru community in and around the irrigation project (Brooks *et al.,* 2009).

Regarding housing, the research noted that 85% of the respondents had clean floors made out of concrete and cement. This was against the majority of respondents who indicated that their houses were either under asbestos roofing or corrugated iron sheets. The bulk of Lower Gweru, however, has less asbestos roofing and corrugated iron sheets with the majority of the houses predominantly being under grass thatching. The irrigation scheme in question is linked by a narrow-tarred road that is in a dangerous condition. This road makes communication easier with Gweru town. The tar ends a little more than 10km from the irrigation scheme. The transportation of inputs

and agricultural produce is made easier through the improved road network system. However, the benefits of a better highway network extend to other sectors of people's lives (Dube, 2016).

Studies comparing smallholder farmers with and without irrigation settings show that poverty is much higher in settings without irrigation. Studies using a dynamic concept of poverty such as those by Hussain *et al*. (2004) also show that the incidence of chronic poverty is significantly lower in irrigated than in rain-fed settings. The empirical evidence presented so far indicates that irrigation has significant impacts on poverty. However, as will be shown in the next sections, antipoverty impacts of irrigation vary across systems and depend on a number of factors.

Irrigation brings a range of changes in agriculture and contributes to uplifting the socio-economic condition of individuals in direct and indirect ways. Put differently, irrigation benefits have a direct effect at primary level and spillover effect at secondary level (Hussain *et al*., 2004). Most studies and project impact evaluation studies on irrigation have shown that productivity per unit of land and overall production in the irrigated area is increased and contributed to the poverty reduction. The primary as well secondary level benefits of irrigation can be summarised as:

Primary level benefits (direct effect):

- Increased productivity of land and overall crop production. Production of crops in irrigated farms is often higher than that of under-irrigated and rain-fed farms that enable poor and smallholder farmers to achieve high yield.
- Increased cropping intensity and crop diversification opportunities and the feasibility of year-round crop production activities that support the reduction of vulnerability and risks.

- Increased production and farm income that supports the increase of consumption at household level, increase the nutrition intake of poor farmers and improvement in health condition with enhanced capabilities.
- Increased opportunity of crop switching with substitution low yield and low profitable crops with high yielding and more profitable crops.
- Increased the opportunity of multiple use of water for bathing, washing, livestock and home gardens.
- Increased livelihoods capital, like human skills, houses, clothes, health and even social assets with involvement in WUA and participation in other various interactions related to the irrigation.

Secondary level benefits (spillover effect):

- Increased farm employment: more employment opportunities for farming families as well as for hired labourers in the locality, increased wage income and rates, although wage rate did not always happen in favour of the poor. Put succinctly, the powerful exploit the powerless.
- Reduced food (crop) prices allowing access to food for all, yielding more benefits to landless and subsistence families in rural areas and the urban poor, since they spend more than 50 percent of their daily income on food items.
- Non-farm increased demand for inputs (fertilizer, seeds, pesticides etc.) and supply of outputs (processing, storage and transportation), and created opportunities to enhance rural urban network.
- Increased recharge of groundwater, easy access to groundwater and less drudgery for women in fetching water for daily household needs.
- Reduced transaction costs, including reduced farm marketing costs due to increased access to farm link roads and other improved farms.

- Increased the value of land with access to water for irrigation.
- Reduced out-migration and increased return migration with opportunities of irrigated agriculture.
- Improved security against impoverishment with increased opportunities.
- Increased the flow of invest from government and private sectors with irrigation infrastructures.

However, irrigation development itself does not contribute to all categories of peoples in all the socio-economic situations. In fact, irrigation can be strongly pro-poor, neutral or even anti-poor depending on various factors (Hussain, 2007), such as landholding size, types of irrigation technology, irrigation management system, location of farm land, institutional setting, water distribution pattern, cropping pattern, agricultural support services available and empowerment of the poor.

Irrigation distribution generally follows land distribution. Water distribution also tends to be equitable or even pro-poor where land is equitably distributed. The anti-poverty impacts of land and irrigation distribution are stronger than the productivity performance of the systems. Most small and poor farmers own marginal and degraded land, where an irrigation facility is not available. Mostly, the traditional surface canal irrigation systems do not cover these marginal lands. Small landholders, within the irrigated areas are sometimes compelled to sell their small piece of land due to the increase of family size, over debt and limited livelihood options. It is general practice that poor people live in steep slopes, uplands, marginal barren lands where water sources are limited.

Generally, the power dynamics of the local community push those people to the marginal areas as they have limited skills, education, weak health and physical

conditions, and weak influence in terms of social capital. Due to this marginalisation, they do have limited access to the services provided by the governmental and non-governmental sector. So, the poor do not have access to the traditional surface irrigation systems. It may not be fair to generally say that those poor and marginal farmers are not getting benefits from surface canal irrigation schemes, but it is clear that these poor and marginal farmers are rarely benefitting. It is obvious that irrigated rural areas will have less poverty than adjoining unirrigated area (Lipton, 2007). Figure 2.1 below illustrates how poverty can be reduced through the availability of irrigation water. The figure also indicates that the availability of irrigation water may result in two outcomes, namely, the direct effects and indirect effects, which both benefit the farmer in question. Direct benefits include, among others; increased production, improved food security status, increased employment, and increased income as well as purchasing power by farmers.

On the other hand, indirect effects include, among others; reduced out migration, reduced indebtedness, increased resources for health and education and an increased resources base of farmers.

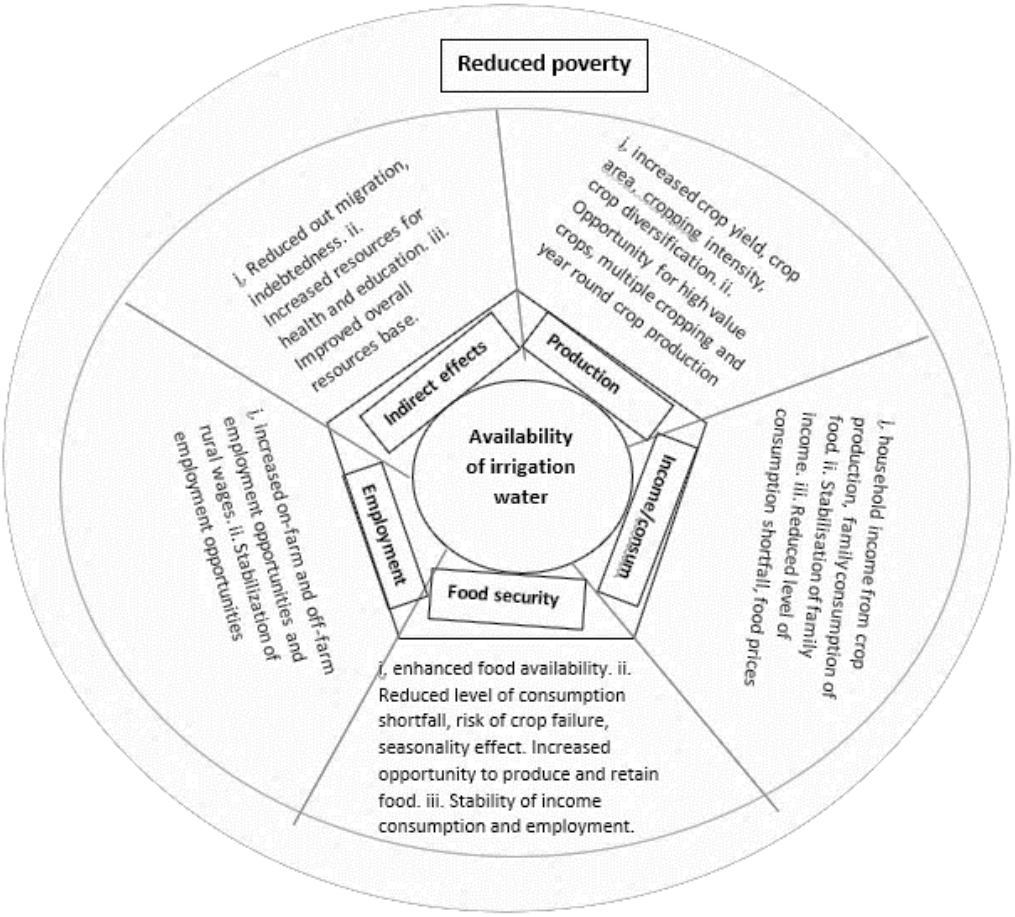


Figure 2. 1: Availability of irrigation water and reduced poverty

Source: Adopted from Hussain and Hanjra (2004)

2.6 The review and application of psychological capital

Psychological capital (PsyCap) refers to one's positive psychological state of development and consists of four personal qualities: self-efficacy, optimism, hope, and resiliency (Luthans *et al*., 2007). There has been substantial evidence showing that PsyCap is positively related to a number of beneficial outcomes, such as job satisfaction, health, and psychological well-being (Avey *et al.*, 2011; Cassidy *et al*., 2014), and is negatively related to several undesirable outcomes, such as job stress and anxiety (Avey *et al*., 2011). Although PsyCap is considered as an important and positive resource for personal development, very little research has tried to examine the effect of positive psychological capital on poverty reduction, especially in the field

of agriculture. Therefore, in this study, the researcher explores the potential effects of PsyCap among smallholder irrigation scheme farmers on poverty reduction. Most smallholder irrigation schemes receive the support and have the necessary infrastructure to upgrade themselves and move out of poverty. However, the outcomes are not satisfactory. Therefore, this necessitated evaluating the use of PysCap among these smallholder farmers.

The concept of PsyCap is based on theory and research derived from positive psychology. Seligman (1998) argued that traditional psychology focused mainly on mental illnesses and pathologies, and proposed positive psychology. Positive psychology focuses on making people's lives more productive and worthwhile and helping them actualise their potential as individuals (Luthans and Youssef, 2004). From extended positive psychology to organisational studies, Luthans (2002) proposed positive organisational behaviour (POB), as the study and application of positively oriented human resource strengths and psychological capacities. Positive organisational behaviour focused on enhancing people's resource strengths and psychological capacities in a measurable way so that the performance of individuals at the workplace could be improved. If performance is improved, productivity will ultimately improve as well.

2.6.1 Self-efficacy

Self-efficacy beliefs are not beliefs about an individual's level or type of skill set, rather they are about what can be accomplished by utilising the skills that individuals do have (Bandura, 1998). They are not concerned with what an individual intends to do, but with the beliefs about what one has the capacity or ability to do (Maddux, 2009). Self-efficacy beliefs have been noted as a contributing factor to individuals who take higher

levels of initiative, exert more effort and motivation to accomplish taks, and more readily persist in the face of failure or significant obstacles (Bandura, 1998; Luthans, 2002). Many studies have illustrated the theoretical and empirical relationships between self-efficacy and work-related performance in a variety of areas, including leadership development (Chemers *et al*., 2000), goal choice and task performance, decision making, work attitudes across cultures (Luthans *et al*., 2007), creativity (Tierney and Farmer, 2002), entrepreneurship, and academic success (Bandura, 1998).

Self-efficacy has a rigorous and tested developmental framework. Self-efficacy beliefs are built from four primary information sources (Bandura, 2007). The strongest source of information for developing self-efficacy beliefs is often referred to as enactive mastery experiences or performance attainments. However, it is not just achieving success that leads to increased self-efficacy, but the processing and interpretation of that success (Bandura, 2007). The second source of information that can aid in the development of self-efficacy beliefs is known as vicarious experience or modeling. Observing others achieve success can be helpful, especially if one can relate to and identify with the model (Luthans, 2002). Verbal persuasion is the third source of information that can aid in developing self-efficacy beliefs.

This positive feedback and support from others can help to convince a person that he or she can achieve success at a particular task (Gist, 1987). The fourth source of information useful in developing self-efficacy beliefs is referred to as psychological and emotional arousal. Simply put, if an individual can reduce his or her anxiety about a situation, he or she may be more likely to see himself or herself as capable, strong, and less likely to fail (Bandura, 2007). These four sources of information, namely;

enactive mastery experiences, vicarious experiences, verbal persuasion, and physiological arousal, have been studied extensively as potential places from which self-efficacy beliefs can be drawn. However, the sources are just “raw data” and must be cognitively processed and reflected upon before change is likely to take place (Bandura, 2007).

2.6.2 Hope

Hope is defined as “a positive motivational state that is based on an interactively derived sense of successful (1) agency (goal-directed energy) and (2) pathways (planning to meet goals)” (Snyder, 2002). Hope is described as a motivational state that is based on three primary components: goals, pathways, and agency goal directed thinking. Said another way, people with high levels of hope have the “will” (agency) and the “ways” (pathways) to achieve goals (Snyder *et al*., 1991).

Hope theory assumes that humans are goal-directed in their behaviour. Goals can be either “approach goals,” such as getting a promotion, or “avoidance goals,” such as not losing a customer (Snyder, 2002). Goals can be short-term or long-term, and although some suggest that behaviour may be driven by nonconscious goals), most believe that goals need to have some degree of uncertainty (Snyder, 2002). It may be that hope is strongest when the likelihood of attaining a goal is intermediate, with some risk involved (Averill *et al*., 1990).

Pathways thinking involves the future potential for goal achievement. Those high in pathways thinking are characterised by their ability to generate one or more specific possible routes to reaching a goal. Individuals reporting high levels of hope have been shown to be very successful at coming up with many different routes to achieving their goals (Snyder *et al*., 1991). The third capacity within hope theory, agency thinking,

involves motivation that causes individuals to initiate and sustain movement along pathways toward achieving goals. Agency thinking may involve positive self-talk and other types of support that help individuals initiate and sustain goal pursuits. High levels of agency are especially beneficial in overcoming instances where one experiences difficulty in reaching their objectives. In these instances, people with high hope are able to move on to other pathways towards goal achievement (Snyder, 1994). Agency and pathways thinking work together, and may reciprocally feed off one another in the process of goal pursuit (Snyder *et al*., 1991).

Hope research has been linked theoretically and empirically to a variety of positive outcomes across a wide range of contexts. Related to the workplace, hope has been associated with profitability (Adams *et al*., 2002), satisfaction and retention (Peterson and Luthans, 2003), job performance, management (Snyder, 2000), leadership and supervisor-rated performance and salary (Luthans *et al*., 2005), and performance, job satisfaction, work happiness, and organisational commitment (Youssef and Luthans, 2007).

2.6.3 Optimism

Thinking about the future can be energising for some, while others struggle with the prospects of the unknown. In explanation, optimists are “people who expect good things to happen to them; pessimists are people who expect bad things to happen to them” (Scheier and Carver, 2009). This difference in expectancies causes optimists and pessimists to differ in how they approach problems as well as the success rate with which they deal with adversity.

Similar to other positive psychological capacities, expectancy-value theorists assume that individuals are in active pursuit of goals (Carver *et al*., 2009). The “value”

component of expectancy-value theories reflects the importance of the goal to the person. The other dimension, “expectancy,” reflects the level of confidence in goal attainment. Having low confidence about goal attainment will likely cause action to stop; higher confidence likely leads to an increased perseverance in the face of challenges. Expectancies comprise the most important component in the discussion of optimism (Scheier and Carver, 2009).

Several valid measures of the expectancy-value perspective of optimism. Expectancies can be measured simply by asking people whether they believe their outcomes will be good or bad (Scheier and Carver, 1992). Generalised expectancies are often measured with the Life Orientation Test (Scheier and Carver, 1985), which was later updated, modified, and re-released as the Revised Life Orientation Test. Optimism has been linked to a variety of workplace outcomes, including performance, job satisfaction, work happiness, and organisational commitment (Luthans *et al*., 2005; Youssef and Luthans, 2007). Prior experience with success and failure may play a role in nurturing increased levels of optimism, as previous experiences with success in particular may raise anticipations of future success. Additionally, adaptive coping skills and positive modeling may help individuals increase their level of optimism expectancies over time (Scheier and Carver, 2009).

2.6.4 Resilience

Resilience is defined as “the capability of individuals to cope successfully in the face of change, adversity, and risk” (Stewart *et al*., 1997). More specifically defined for POB researchers, Luthans proffered that resilience is “the capacity to rebound or bounce back from adversity, conflict, failure, or even positive events, progress, and increased responsibility” (Luthans, 2002). Resilience can vary from one situation to another

based on the specific circumstances presented (Staudinger *et al*., 1993). Because of this, resilience seems to be an important factor in everyday organisational life.

A number of scholars have studied resilience and its relation to workplace performance (Coutu, 2002; Harland *et al*., 2005; Luthans *et al*. 2004; Luthans *et al*., 2005; Youssef and Luthans, 2007). These scholars have constructed resilience theory and empirically tested it at the individual, group, and organisational levels of analysis. Their work has laid the groundwork for future interventions focused on developing resilient individuals and organisations. Groundbreaking research studies in child psychology also provided support to the notion that resilience is not entirely determined by genetics or the environment, but that it can be characterised as a process in individual development across the lifespan (Masten, 2001). Development of resilience can happen naturally over time through an individual's ongoing management of the challenges, risks, and stresses of everyday life, and allows individuals and organisations to bounce back from adversity with additional resources and strength (Sutcliffe and Vogus, 2003).

Positive psychological capital can better be explained in summary using Figure 2.2 below. If farmers possess and satisfy most and/or all the outcomes in each of the four PsyCap components, then positive psychological capital is achieved.

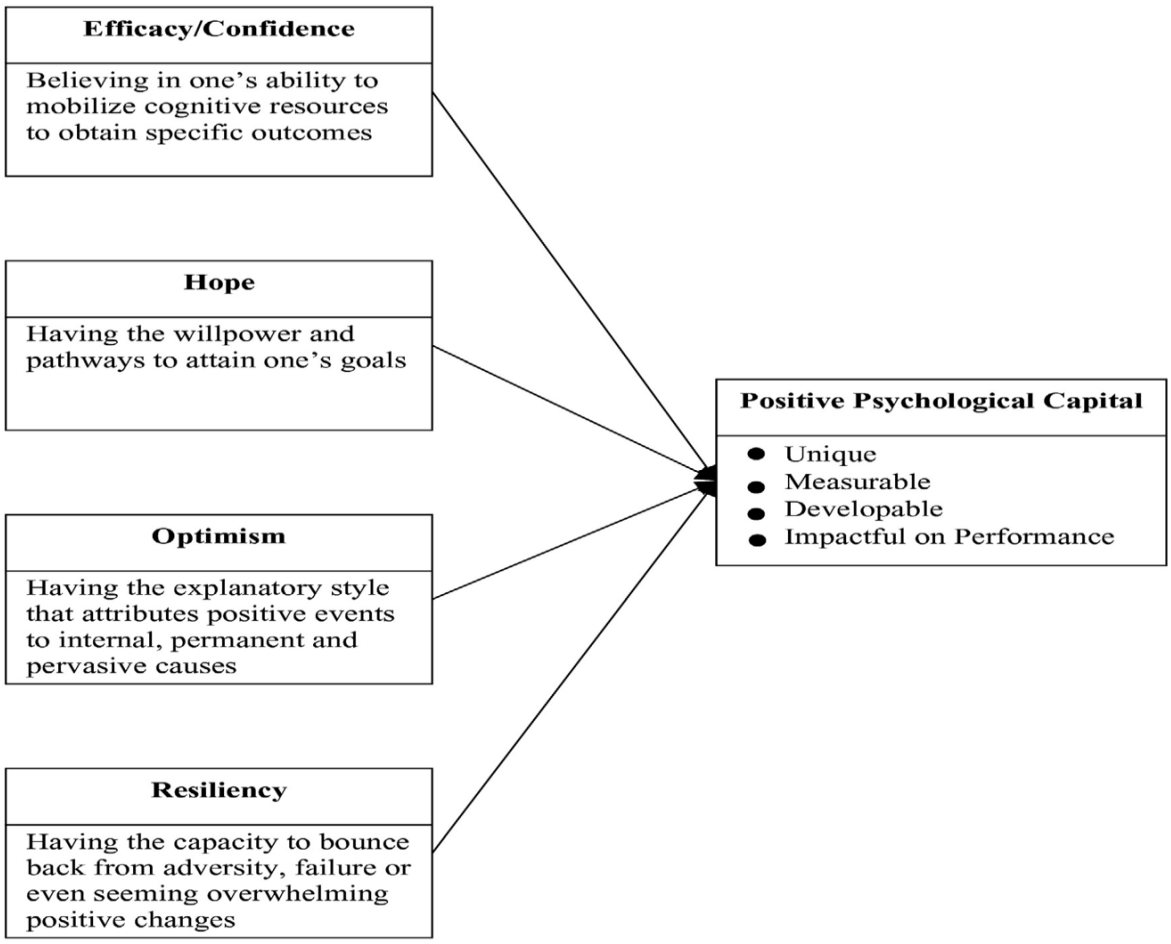


Figure 2. 2: Components of positive psychological capital

Source: Luthans and Youssef (2004)

2.7 Integrating livelihood assets, psychological capital and the conceptual framework of the study

A smallholder family farm depends on the accessibility of five forms of capital: social, natural, human, physical, and financial. Figure 2.3 below illustrates the sustainable livelihood framework (SLF) that can assess environmental as well as socio-economic conditions, applied mostly at the individual or household level to promote community-based improvements. Initiated primarily by multilateral donor agencies and international NGOs, sustainable livelihood frameworks are composed of five forms of assets, which are utilised within the context of vulnerability, and structures necessary

to pursue a combination of livelihood strategies leading to desired livelihood outcomes. A smallholder integrated farm depends on the access and use of the asset pentagon-natural (soil quality, water quality, biodiversity); physical (electricity, machinery); human (knowledge, skills); financial (savings, disposable assets); and social capital (networks, trust, support systems). It makes use of the assets within the context of vulnerability (trends, shocks, and seasonality); structures (government, private) and processes (policies, laws, and incentives), which define their livelihood options (Rao and Rogers, 2006). “Vulnerability” is manifested in terms of trends in market price, shocks such as biotic/abiotic stresses, and seasonality affecting farming; and “structures” connote institutional arrangements affecting farming and marketing of farm produce. Based on the asset holding, vulnerability and institutional and policy context (i.e., structures and processes), a farm household takes up one or more farm enterprises as livelihood strategies to achieve desirable production, food security, cash income, etc., i.e. livelihood outcomes.

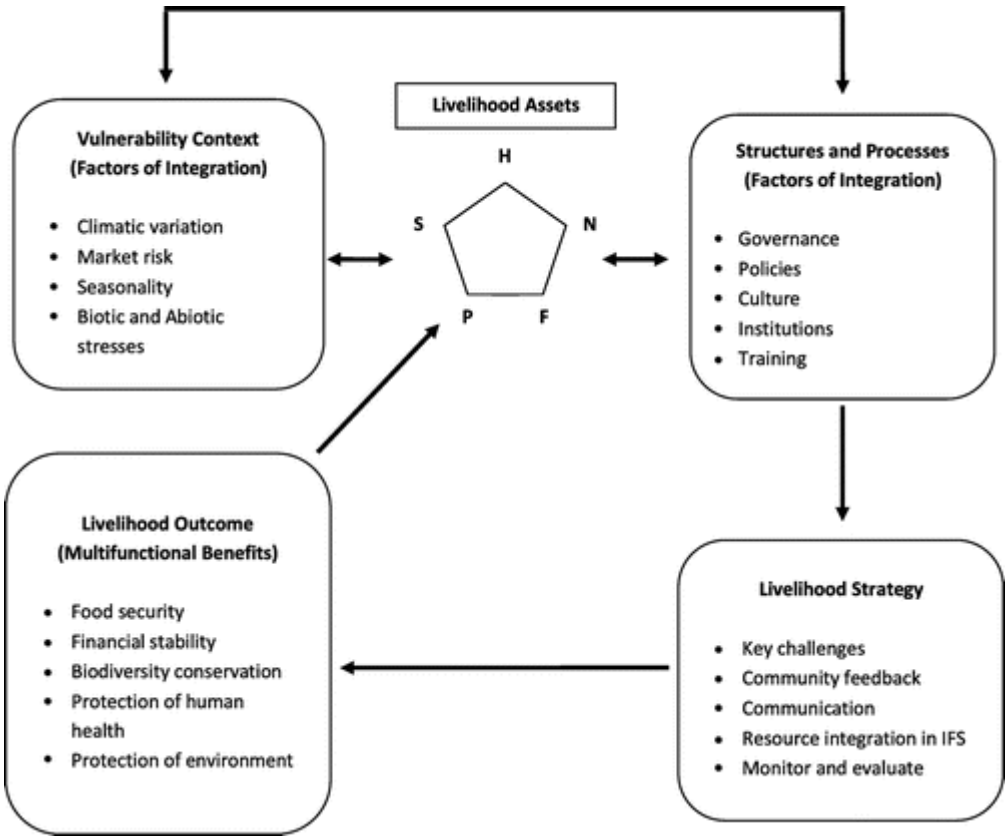


Figure 2. 3: General sustainable livelihood framework

Source: Multilateral donor agencies and international NGOs (n.d.)

Therefore, the conceptual framework of this study is based on the modified SLF (Figure 2.4), which integrates the PsyCap denoted by PS as the sixth livelihood capital. This is meant to explain diversity among farmers brought about by differences in individual mindsets. In the past, heterogeneity among small farmers was attributed to differences in indigenous knowledge, farm management practices and other resource endowments (Wale and Yalew, 2007; Muthamia *et al*., 2011). However, there is no literature to explain differences normally observed among smallholders working in the same village, having similar resource endowment and faced with similar institutional and infrastructural constraints. It was the view of this study that variations in PsyCap endowment can explain these differences. Indeed, Liu *et al*. (2016) posit that farmers'

different perceptions and attitudes towards their lives, affects their livelihood strategies and outcomes.

PsyCap emanates from the literature on positive organisational behaviour with firm foundations in the Social Cognitive Theory (Luthans *et al*., 2007). PsyCap can help to explain differences in the farmers' ability to take advantage of opportunities when they arise; the dependency tendencies observed among some smallholders; different levels of confidence in agriculture as a sustainable livelihood strategy; and the farmers' varying abilities to cope with different challenges.

Section 2.6 gave a detailed description of PsyCap as a concept. It mentions that PsyCap is mainly associated with four components or constructs, i.e., confidence, hope, optimism, and resilience (Luthans *et al*., 2015). Individuals who have self-confidence persevere even when faced with difficulties and those who are optimistic take these obstacles as opportunities to think differently (Simons and Buitendach, 2013). They always bounce back, and through hope, they generate different pathways to accomplish goals (Simons and Buitendach, 2013). When resources are limited and, individuals are faced with risky decisions, those with positive PsyCap are in a better position to make effective decisions and employ more resilient adaptation strategies. Positive PsyCap is, therefore, an important means to manage and utilise all other forms of resources effectively.

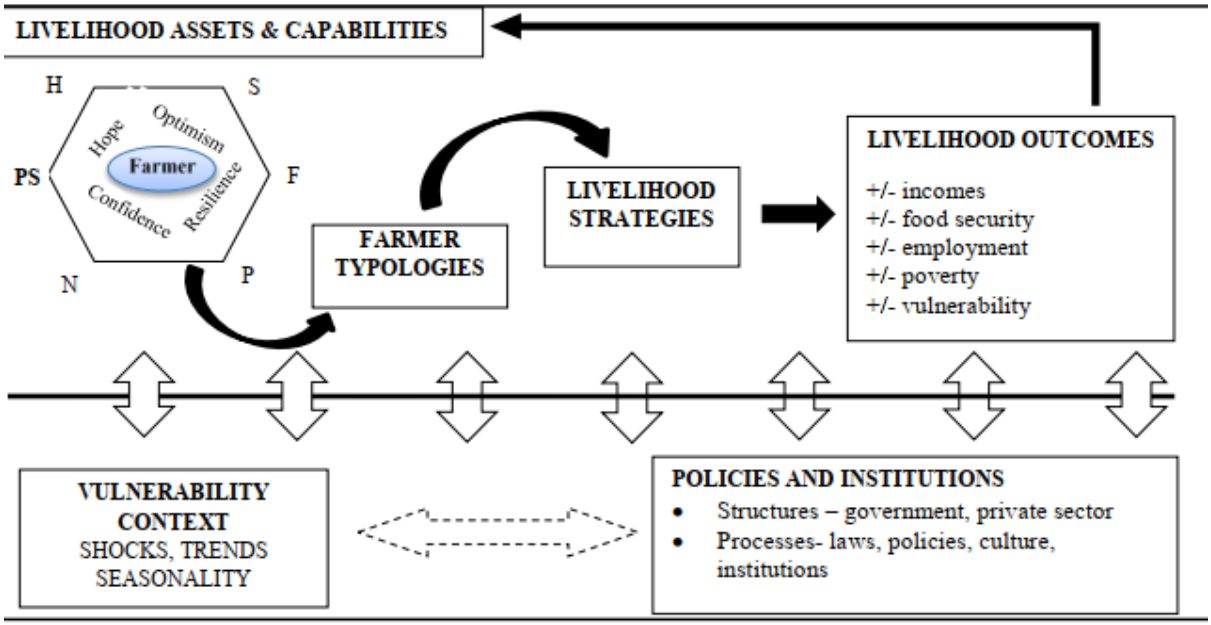


Figure 2. 4: PsyCap in the modified Sustainable Livelihoods Framework

Source: Dorward (2001)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research methods used in collecting and analysing data about the impact of smallholder irrigation schemes on rural households' poverty status and also assessing the effect of irrigation farming on women empowerment in the Vhembe and Sekhukhune districts of Limpopo Province. It discusses the study area, research design, population and sampling procedure, data collection method, data analysis, the expected outcomes, and ethical considerations.

3.2 Study area

The study was conducted in the Vhembe and Sekhukhune districts of Limpopo Province. These districts have high numbers of irrigation schemes compared to their counterparts. Within the research sites, the selected research areas bear similar contextual factors, such as agro-ecological factors, distance to markets, economic opportunities other than agriculture, farming practices and traditions, language and other cultural attributes. Great care was taken to select an operational irrigation scheme in each site, which does not face severe constraints like limited water supply, serious social conflict, highly dilapidated infrastructure or any other disabling factors. According to Van Koppen *et al*. (2017), operational irrigation schemes refer to moderate utilisation and full utilisation of schemes with 50-89 % and 90-100% of area equipped for irrigation that was irrigated in winter 2017/18, respectively.

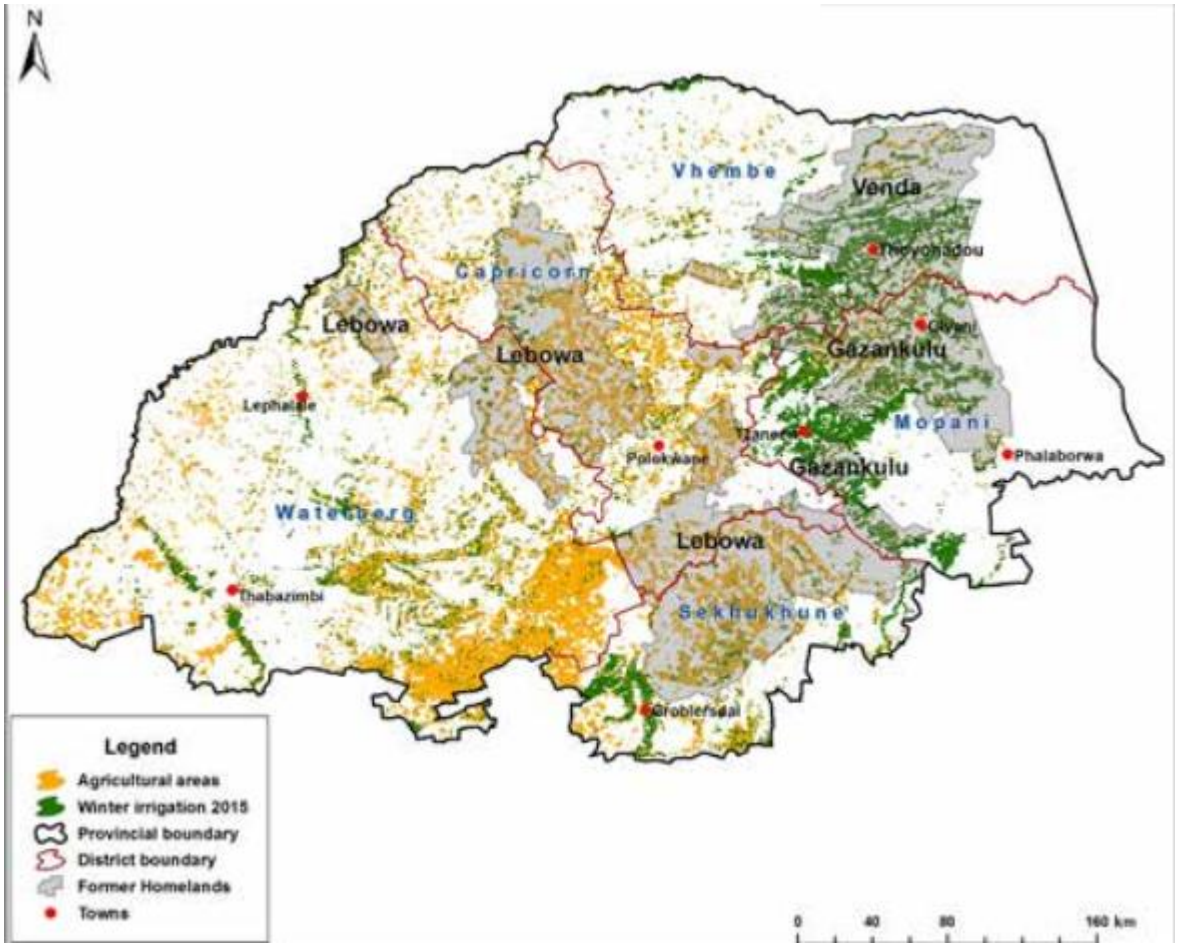


Figure 3. 1: Map of Limpopo Province irrigated areas

Source: Van Koppen *et al*. (2017)

Vhembe District

Vhembe District Municipality (VDM) shares borders with three Southern African Countries: Botswana, Zimbabwe and Mozambique. It has two neighbouring municipality Districts: Capricorn and Mopani District Municipalities. On the eastern side, it shares the border with the Kruger National Park. The Vhembe District Municipality covers 21 402 kilometres of land (Vhembe District Municipality IDP Report, 2011/2012). The VDM is one of these rural municipalities where the farmers are faced with numerous challenges (lack of climate change awareness and adaptation, high poverty and low crop production).

The total population of the VDM is 1 294 722 and the density of 50.6 per km^2 (131/sg mi) (Census 2011). Its population was 1198 056 from the 2001 Census and 1 240 035 from the 2007 Community Survey. Census 2011 reveals that from 2001 to 2007, the population of Vhembe has increased by 41 979 people, and by 54687 from the 2007 to 2011 Community Survey and 2011 Census, respectively. The population mainly comprises 54, 4% females, 45, 5% males, with 51, 3% of the population being under the age of 20 years, which is the general pattern in the VDM. The district population composition is further characterised by a predominantly young population with 75% at 35 years and below. Unemployment is estimated at greater than 64% with a very disturbing poverty level of greater than 71%, which is primarily attributed to the rural nature and composition of the population (Musetha, 2016). Women are an integral part of this study analysis. Below is a map depicting the Vhembe District Municipality's irrigation schemes:

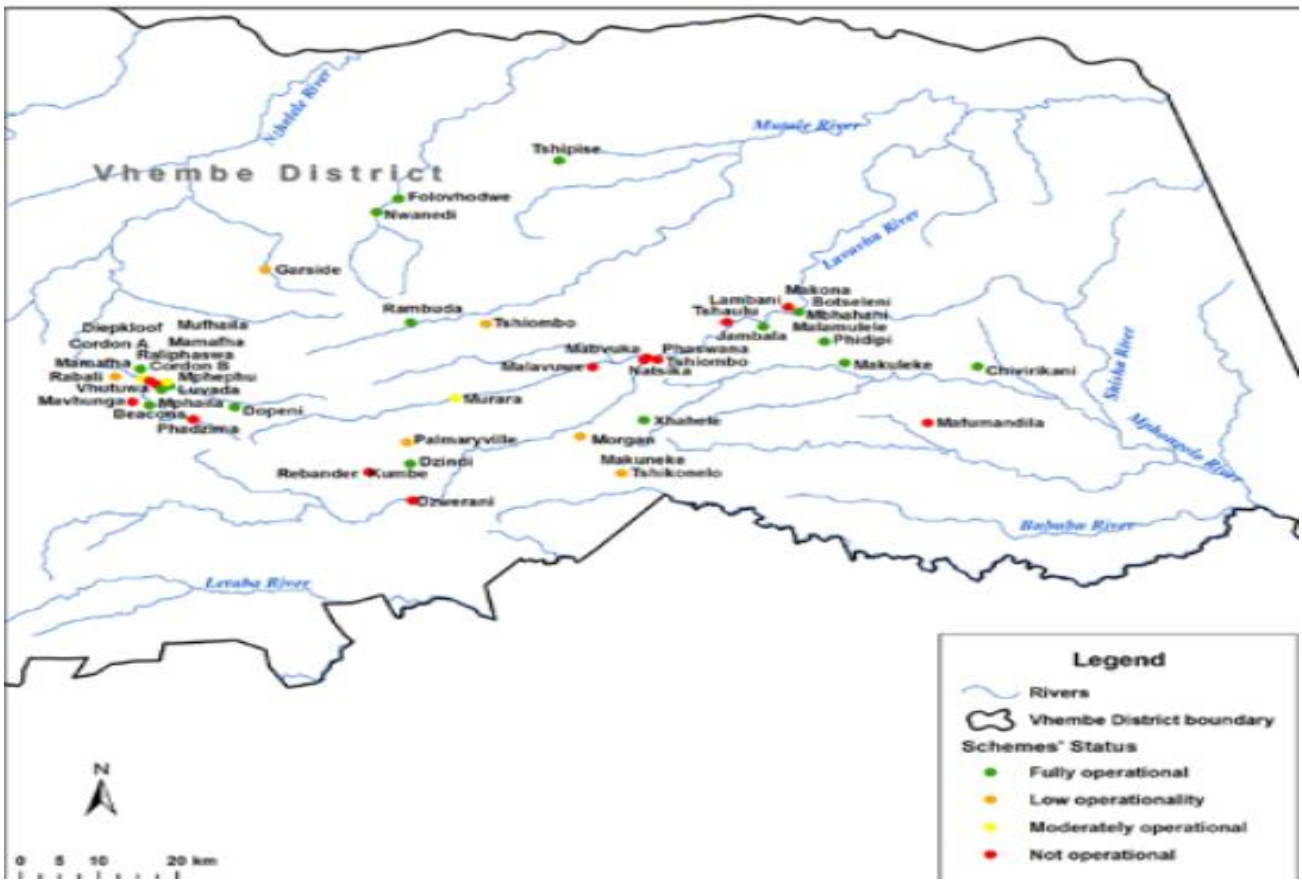


Figure 3. 2: Map of Vhembe District irrigation schemes

Source: Van Koppen *et al*. (2017)

Sekhukhune District

According to Mpandeli *et al*. (2015), Greater Sekhukhune District is largely rural, as 90% of the district population reside in the rural areas. Agriculture is considered the main contributor to employment and livelihoods. The Greater Sekhukhune District is rich with mineral deposits such as large reserves of platinum. The southern parts of the district have more agricultural potential than the rest of the district. The district's average annual rainfall is approximately 560 mm. Subsistence or smallholder agriculture accounts for 70% of the farming activities in the district whilst the other 30% is commercial agriculture (Mpandeli *et al*., 2015). The Sekhukhune District is situated in semi-arid areas and always experiences water shortages. However, the majority of

commercial farmers depend on irrigation systems for farming. Water shortages and poor rainfall distribution have been cited as among the constraints hindering the growth and the development of the agricultural production in the district.

Agriculture in the Sekhukhune District is a mixture of both commercial and subsistence farming. However, subsistence farming tends to dominate between the two. The Gross Value Added (GVA) of agriculture sector in 2018 was 0.6% and 7.9% in the district and Limpopo Province, respectively. The performance of this sector, being an important base for economic growth and employment in the district, indicates a setback in terms of achieving the district's economic growth and job creation (COGTA, 2020). The map below depicts the irrigation schemes at Greater Sekhukhune District Municipality:

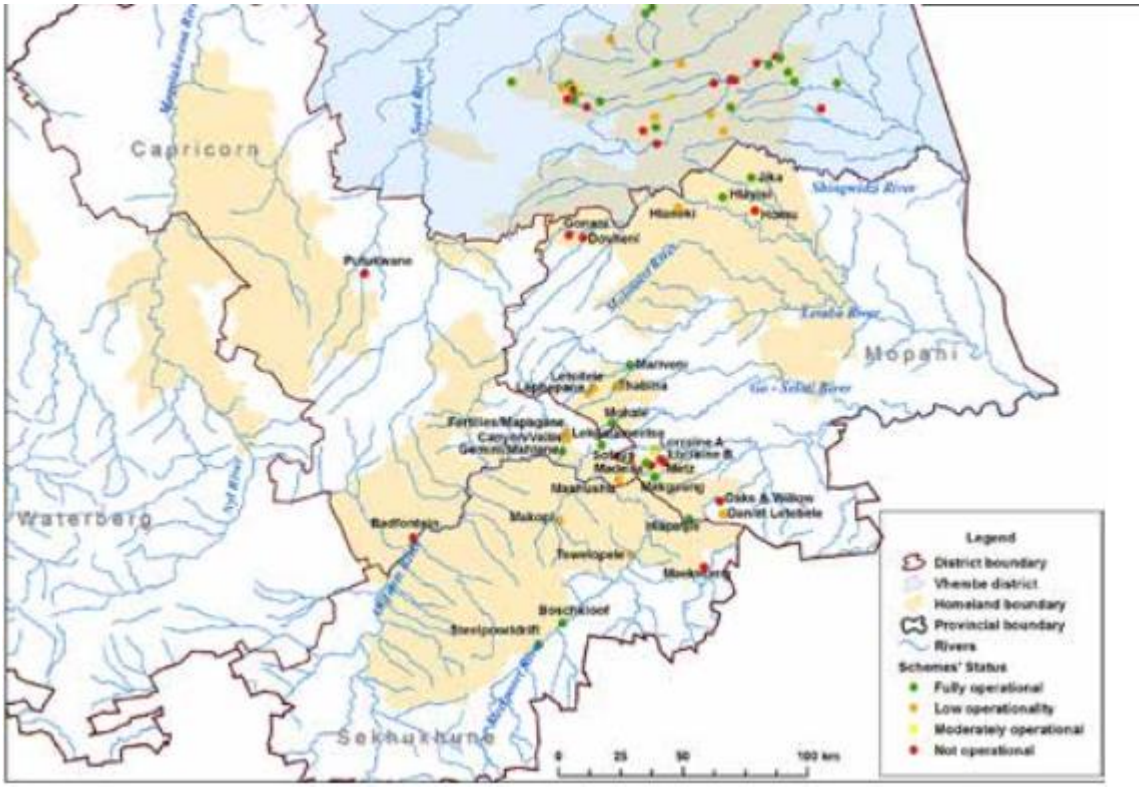


Figure 3. 3: Map of Greater Sekhukhune Municipality irrigation schemes

Source: Van Koppen *et al*. (2017)

3.2 Data collection instruments

Data was collected by use of semi-structured questionnaires in two stages, namely; individual interviews and focus group discussions. The study used existing baseline data and newly collected primary data. Baseline data is from previous census surveys and previously conducted studies in the study areas, as well as the Department of Agriculture and Rural Development (formally known as the DAFF). Primary data was collected from both Vhembe and Sekhukhune districts' smallholder irrigation farmers. In this study, a sample size of 300 smallholder irrigation farmers was used. An additional 150 smallholder farmers who are not attached to the irrigation schemes were randomly selected for the purposes of comparison with regard to the impact that irrigation schemes had on poverty reduction. This study also used a combination of the terms; Irrigators, non-irrigators, users and non-users, meaning smallholders farmers who participate in irrigation schemes and those who do not. A purposive-multistage sampling technique together with a simple random sampling based on probability proportion to sample size was employed to select the sample size.

The first step was to rank the schemes according to their degree of utilisation. This degree was defined as: the proportion of area equipped for irrigation that was factually irrigated in the preceding year (i.e., 2018/19 following the commencement of data collection in this study). Thus, four categories of schemes were defined according to their degree of utilisation. These were: (1) No utilisation, (2) low utilisation, (3) moderate utilisation and (4) full utilisation. For the purpose of this study, only category 3 and 4 were used to assess the impact that irrigation schemes had on the livelihoods of farmers without any outcome that could be associated with the state of the irrigation schemes.

Table 3.1: Sample size distribution between Vhembe and Sekhukhune districts

VHEMBE				SEKHUKHUNE			
	GENDER				GENDER		
SCHEME	F	M	Total	SCHEME	F	M	Total
Mbhahela	34	23	57 (30)	Mogalatjane	15	13	28 (25)
Rambuda	23	15	38 (21)	Tswelopele	12	9	21 (19)
Dzindi	27	19	46 (24)	Elandskraal	18	17	35 (32)
Makuleke	30	18	48 (25)	Phetwane	15	12	27 (24)
Total	114	75	189 (100)	Total	60	51	111 (100)

Source: *Research Survey,* 2019

Suitable interview dates and times were arranged with farmers and permission was obtained from the district offices of the Limpopo Department of Agriculture. The researcher, together with the trained enumerators (with the assistance of extension officers from both districts), conducted the interviews. The local extension officers helped in collecting data because they had a better understanding of the area in terms of farmers that were prominent in smallholder irrigation farming in the study areas. The interviewers explained to the anticipated respondents the purpose of the survey, the importance of their participation and co-operation during the interviews. Interviews were conducted face-to-face with farmers. The primary data was collected in two periods due to the prevalence of COVID-19 and the national lockdown that started in March 2020. The first period of data collection was in December 2019 to February 2020, and the second period was in November 2020 to February 2021.

The total of 300 close ended questionnaires were designed and administered to the farmers during face-to-face interviews. Kitchen and Tate (2011) define closed questionnaires as those in which the respondent is given answers, one of which they must choose as the most representative of their facts/views. The data contained in the questionnaires to be analysed quantitatively are usually generated using what are termed closed-ended questions. However, there was a challenge of language barriers

during the data collection as the questionnaires were prepared in English and most of the local farmers in both districts spoke Tshivenḓa and Sepedi. But the enumerators assisted the researcher with translating and interpreting during data collection in both districts.

The questions in the questionnaires were divided into sections according to all the objectives of the study as presented in Chapter one. After collecting data, the first step was to transfer it onto a spreadsheet using the Statistical Package for Social Sciences (SPSS) 17.0 version. According to Kumar (2010), it is important that the information obtained should be in the language that the computer will assimilate when a computer will be used to analyse the data.

3.3 Data analysis and general models

This section describes the approach that was used to analyse the data collected on the basis of the objectives set out in the first chapter of this study. The sustainable livelihood framework (SLF) was extensively applied as a guide to the research methods. The proposed methods of analysis captured the impact that irrigation farming had on the livelihoods and poverty reduction of smallholder irrigation farmers.

Table 3.2: Analytical techniques for the objectives

Objectives	Data analysis	Model specification
(i) To profile the socio-economic characteristics of smallholder irrigators in the Vhembe and Sekhukhune Districts of Limpopo Province;	Descriptive statistics (guided by Sustainable livelihood approach)	Frequency, central tendency, and variations
(ii) To determine the contribution of smallholder irrigation farming towards the livelihoods of	Natural logarithm of welfare ration; Logistic regression	$\ln\left(\frac{\hat{C}_i}{Z}\right) = X_i\beta_i + v_i;$

smallholder irrigators in the Vhembe and Sekhukhune districts of Limpopo Province;		$L_i = \ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + ... + \beta_n\chi_n.$
(iii) To investigate the effect of smallholder irrigation farming on women empowerment in the Vhembe and Sekhukhune districts of Limpopo Province;	Descriptive statistics; Women Empowerment in Agricultural Index; Multiple linear regression analysis	Empowerment index; $Y = f(\widehat{\beta_0} + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$ Multiple linear regression
(iv) To explore the effect of positive psychological capital assets in poverty reduction among smallholder irrigators in the Vhembe and Sekhukhune districts of Limpopo Province;	PsyCap questionnaire (PCQ); 12 Point Likert scale; Principal component analysis	$PC_1 = a_{11}X_1 + a_{12}X_2 + ... + a_{1n}X_n$ $PC_m = a_{am1}X_1 + a_{am2}X_2 + ... + a_{amn}X_n$;
(v) To determine the impact of smallholder irrigation farming towards the livelihoods of smallholder irrigation farmers in the Vhembe and Sekhukhune districts of Limpopo Province.	Poverty indices; Binary Logistic regression model	$\rho = \frac{1}{N}\sum_{i=1}^{q}\left[\left(Z_p - Y_p\right)\right]^{\alpha}$ $L_i = \ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + ... + \beta_n\chi_n.$

3.3.1 Using descriptive statistics to profile the socio-economic characteristics of smallholder irrigators

Descriptive analysis is a summary that describes the basic information in a study (Trochim, 2006). Descriptive statistics was used specifically to address the first objective of this study, which was to comprehensively profile the socio-economic characteristics of smallholder irrigators in the Vhembe District of the Limpopo Province. However, it was also applied in other objectives to extract the necessary

frequencies. According to Mishra *et al*. (2019), a descriptive statistic is used to measure the frequency, the central tendency, which includes the mean, median and mode, and to also measure the variation given by variance, standard deviation, standard error, quartile, interquartile range, percentage, range, and coefficient of variation.

3.3.2 The application of a Logistic Regression Model in measuring the impact of smallholder irrigation schemes on poverty reduction

Independent sample t and chi square tests were used for assessing the difference between irrigation users and non-users in terms of socio-economic factors. The poverty line was measured based on cost of basic needs (CBNs) derived from the lowest income quartile and poverty indices were computed using Foster Greer and Thorbecke (FGT) formula. Foster and Thorbecke (2010) suggested a useful general index for poverty measures. Their class of poverty indices takes the following form:

$$\rho = \frac{1}{N}\sum_{i=1}^{q}\left[\left(Z_p - Y_p\right)\right]^{\alpha}$$

A Logistic Regression Model was used to analyse the impact of smallholder irrigation schemes on the poverty reduction of rural households. Similar studies have used the Binomial Logit Model in irrigation impact analysis (Getaneh, 2011; Oni *et al*., 2011). Thus, poverty is the dependent variable, and is determined by independent variables such as irrigation use, household characteristics, asset holdings and access to services. The dependent variable is binary (1 if the household is poor and 0 if the household is non-poor). Following Gujarati (2003), the probability that the ith household is poor is given by:

$$\frac{P_i}{1-p_i} = \frac{1+e^{z_i}}{1+e^{-z_i}}$$

For expository convenience, the probability that a given household is poor is expressed as:

$$\rho_i = \frac{1}{1+e^{-(Z_i)}}$$

Probability for not poor is 1-P_i. Thus,

$$\frac{P_i}{1-p_i} = \frac{1+e^{z_i}}{1+e^{-z_i}}$$

is the ratio of the probability that a household was poor to the probability that it was non-poor. The natural log of Equation 3 is:

$$L_i = \ln\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + \ldots + \beta_n\chi_n.$$

Where P_i is a probability of being poor ranges from 0 to 1, Z_i is a function of n explanatory variables (x) which is also expressed as:

$$Z_i = \beta_o + \beta_1\chi_1 + \beta_2\chi_2 + \ldots. + \beta_n\chi_n.$$

βo is an intercept β_1, β_2,.....β_n are the slopes of the equation, Li is log of the odds ratio, which is not only linear in Xi, but also linear in the parameters, Xi is vector of relevant independent variable. If the disturbance term (Ui) is introduced, the logit model becomes:

$$Z_i = \beta_0 + \beta_1 \chi_1 + \beta_2 \chi_2 + \ldots \beta_n \chi_n + \cup_i$$

3.3.3 Exploring the effect of positive psychological capital assets on poverty reduction using Principal Component Analysis and Cluster Analysis

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

3.3.3.1 The approach to measuring PsyCap

In terms of measuring PsyCap, this study followed the work by Luthans *et al*. (2007), which has been successfully applied in several other studies, e.g., Luthans *et al*. (2015) and Simons and Buitendach (2013). They developed a PsyCap questionnaire (PCQ) measure with 24 Likert scale questions measuring the four PsyCap constructs, six questions for each. In this study, the PCQ was adapted to suit the context of

smallholders. Farmers were asked 12 five-point Likert scale questions (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree), three for each PsyCap component as depicted in the table below. The questions were meant to identify farmers' view regarding themselves, and how they rated themselves in relation to each question. Table 3.3 below presents the questions asked under each component and the average scores for the sample.

Table 3.3: PsyCap components measurements questions

Psychological components
Confidence
I am confident in farming as a way of life (CONF_AGRIC)
I am confident in myself as a farmer (CONF_FR)
I have the power to affect the outcome of my farming (POWER)
Optimism
I am optimistic about the future of agriculture in my area (OPTI_FR)
I do not give up easily (DNT_GIVE_UP)
I would not be farming if there was a better alternative source of income (ALTER_INC)
Hope
I have hope that the quality of work will get better (HOPE_LIFE)
I am willing to forgo a profit opportunity in the short-run in order to benefit from potential profits in the long-run (LONG_FOCUS)
I am willing to try new ideas even without full knowledge about the possible outcomes (TRY_IDEAS)
Resilience
I am able to cope with shocks such as drought and other natural disasters (COPE_SHK)
I am willing to take more risks (RISK_TAKE)
Government is responsible for the wellbeing of rural households (GOVT_RESP)

3.3.3.2 Principal component analysis

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

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots\ldots + a_{1n}X_n$$
$$PC_m = a_{am1}X_1 + a_{am2}X_2 + \ldots\ldots\ldots + a_{amn}X_n \;;$$

where amn represents the weight for the mth PC and the *n*th variable.

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

3.3.3.3 Cluster analysis

Clustering was conducted in two stages, i.e., hierarchical followed by K-Means clustering. Agglomerative hierarchical clustering using the Ward method and Squared

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

3.4 Variables employed in the analysis

Table 3.4 presents all the variables that were used in this study to analyse and address all the objectives of the study mentioned in Chapter one. This table captured the most important variables, however, other variables used in this study are presented in Chapter 4 and also in the questionnaire attached as an appendix.

Table 3.4: Variables employed in the analysis

Variables			**Description**	**Units of measurement**	**Expectation**
			Dependent variable		
Y_1	PVRD	Poverty status	1 if poor, 0 otherwise (non-poor)	Dummy	+/-
			Independent variables		
			Demographic factors		
X_1	AGE	Age	Age of the farmers	Number	+/-

X_2	SEX	Sex	1 if a farmer is a male, 0 if female	Dummy	+/-
X_3	LEDU	Level of education	1 if a farmer completed secondary education, 0 if otherwise	Dummy	+/-
X_4	MRST	Marital status	1 if married, 0 if otherwise	Dummy	+/-
X_5	FASZ	Family size	Number of the people in the family	Number	+/-
X_6	ACFT	Availability of credit facility	1 if farmers have access to credit, 0 otherwise	Dummy	+/-
X_7	INCR	Income	Income of the respondent	Number	+/-
Smallholder irrigation scheme factors					
X_8	LHSZ	Land holding size	Land size available for use by farmer	Ha	+/-
X_9	PIRS	Condi of irrigation system	1 if full utilization, 2 if moderate utilization, 3 if no utilization	Category	+/-
X_{10}	IRMS	Irrigation management system	1 if management is good, 0 otherwise	Dummy	+/-
X_{11}	LOFL	Location of farm land	1 if Lowveld region, 2 if Middle-veld region, 3 if Escarpment region	Category	+/-
X_{12}	EMPW	Empowerment	1 if farmer is empowered through irrigation 0 otherwise	Dummy	+/-
X_{13}	INCI	Irrigation income	Income received from irrigation	Number	+/-
X_{14}	INQT	Inequality	1 if farmer believes there is inequality in the distribution of	Category	+/-

			resources 2 if farmer believes there is equality in distribution of resources 3 I f farmer is uncertain		
X_{15}	CRPT	Cropping pattern	1 if used multiple cropping 0 otherwise	Dummy	+/-
X_{16}	ASSV	Agricultural support services	1 if received agricultural support services, 0 otherwise	Dummy	+/-
X_{17}	TITN	Type of irrigation technology	1 if uses drip, 2 if uses sprinkler, 3 if uses pivot, 4 if uses farrow, 5 if rain fed	Categorical	+/-
X_{18}	ACFT	Access to fertilisers	1 if have access to fertilizers, 0 otherwise	Dummy	+/-
X_{19}	HYVR	Access to high yielding varieties	1 if have access to high yielding varieties, 0 otherwise	Dummy	+/-
X_{20}	EXPF	Experience in farming	number of years of experience in farming	Years	+/-
Positive psychological capital components					
X_{21}	PSCP	Positive psychological capital components	Hope, resilience, confidence, Optimism	Likert scale	+/-

3.5 Ethical considerations

Approval from the University of Limpopo Research Ethics Committee to carry out the study was obtained prior to its implementation. All participants received a consent form that fully explained details of the study at the start of the initial meeting. This was accompanied by a statement of all ethical considerations pertaining to participants' rights that included a statement of confidentiality, nature of the study, voluntary participation, sharing of final results, and the researcher's contact information.

Rural communities in Vhembe and Sekhukhune are governed by tribal leaders. In consideration of the existence of the tribal authorities, every time a village was to be entered, the researcher and the enumerators would first report to the village *induna* and inform him about the purpose of the visit. Once verbal permission had been granted, the research team would, with strict adherence to confidentiality, interview the smallholder irrigation farmers in their respective schemes. During the second round of data collection, COVID-19 regulations were already in place following the emergence of Corona virus. As a result, all protocols and precautionary measures were taken into consideration when interviewing the farmers.

CHAPTER FOUR

DESCRIPTIVE RESULTS: SOCIO-ECONOMIC FEATURES

4.1 Introduction

This chapter presents and discusses the results of the survey. The results presented and discussed here pertain to the socioeconomic features of the sampled farmers. The results discussed concern particularly gender, age, marital status, education, income, ownership of assets, irrigation related factors and psychological factors or status of the sampled farmers. This chapter also provides a description of the socioeconomic characteristics of the farmers and sets the scene for the subsequent sections to be understood better and to aid further logical analysis. This is essential, given the fact that it was on the affairs of sampled farmers that further analysis and policy recommendations were based.

Data used in the study comes from the survey instrument that was employed. The sample size of the study was 300 respondents. Using the sampling technique that was explained in Chapter three, the results of the sampling technique was presented in various socioeconomic features and the presentation of these features was in a tabular format. Since the study consisted of two districts and eight irrigation schemes, the focus was on the overall sample rather than on the separate districts and irrigation schemes.

4.2 Socio-economic features

4.2.1 Gender

Table 4. 1: Gender orientation of respondents

Gender	Frequency	Vhembe	Sekhukhune
Female	174 (58)	114 (38)	60 (20)
Male	126 (42)	75 (25)	51 (17)
Total	300 (100)	189 (63)	111 (37)

Numbers in brackets are percentage of gender compositions

Source: *Research Survey* (2019)

It is important to study the composition of farmers in terms of gender orientation. In most areas, women serve as managers of their own households' activities. This is common in rural areas where formal employment opportunities are elusive. Therefore, a study and an intervention that together ignores the gender orientation of the sample could easily fail to produce the awaited rational evidence. This view is based on the fact that women are usually vulnerable, and men tend to dominate in taking up employment and other economic opportunities. In light of this, women should be brought to the fore in studies that seek to establish how they live. The outcomes of the survey on gender orientation appear on the table below.

Table 4.1 shows that the majority of the respondents in the study areas are women (58%) with Vhembe district constituting 38% and 20% from Sekhukhune. Men constitute the remaining 42%. This could mean that women are more interested in participating in smallholder irrigation schemes than men in the study areas. It also could mean that men are interested in finding employment outside of agriculture. This result is inconsistent with findings of Nkhata, (2014) where it was found that male-headed households had a higher likelihood of participating in irrigation when compared to female-headed households.

4.2.2 Marital status

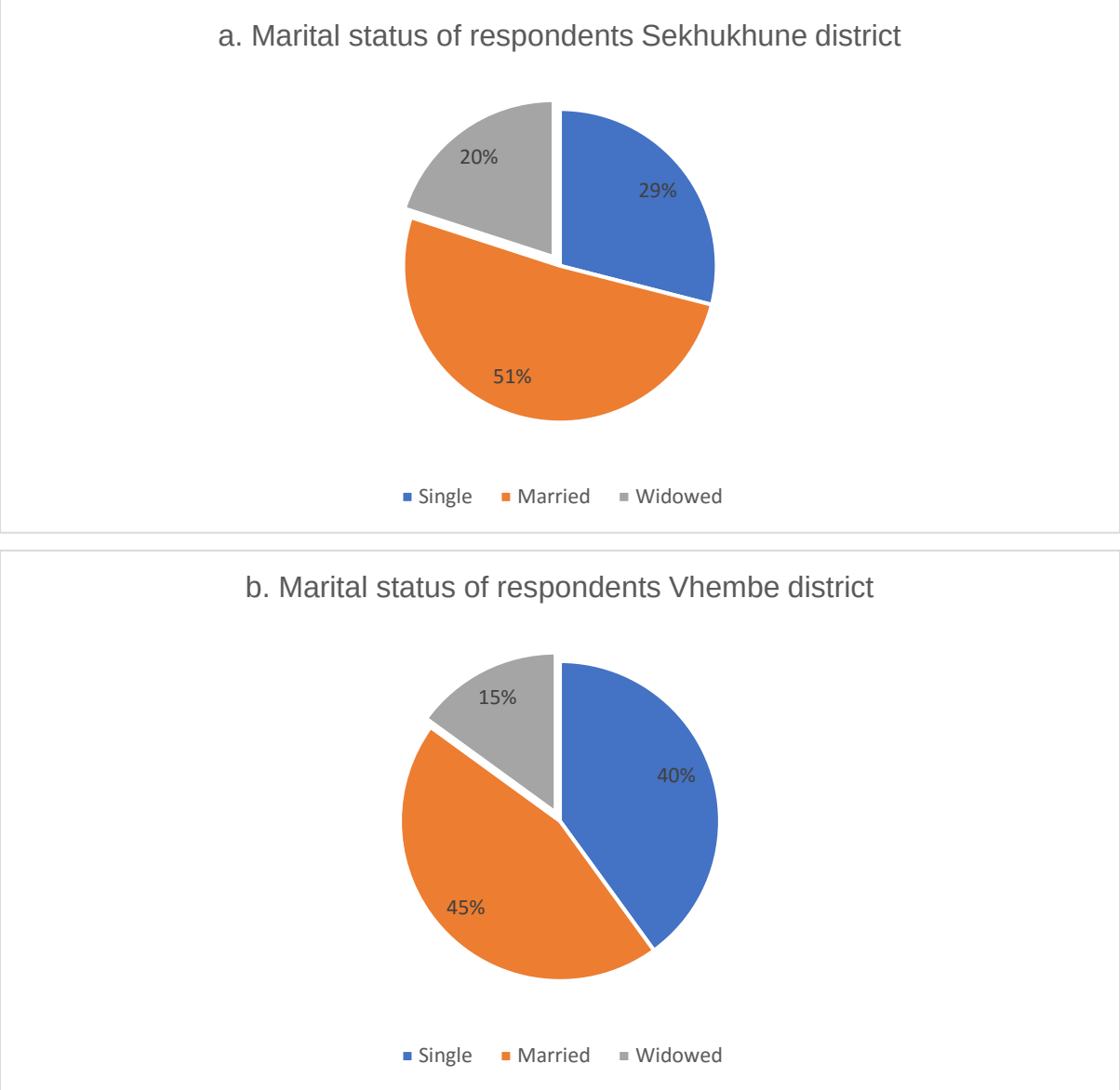


Figure 4. 1: Marital status of the respondent

Source: *Research Survey* (2019)

Following the results in Figure 4.1; in Sekhukhune district, about 51% of smallholder farmers are married whereas single and widowed farmers share the remaining 29% and 20% respectively. In Vhembe district, married farmers constituted 45% whereas single and widowed constituted 40% and 15% respectively. Marital status can also be an important factor when it comes to the success of irrigation schemes. For those who are married it may mean that they have to divide their focus and time among their

families and irrigation schemes. This may also be crucial when it comes to decision making and management of the irrigation schemes. Married individuals are likely to be influenced by the partners (Chitja, 2016).

4.2.3 Age

Table 4. 2: Age of sampled farmers in relation to gender

Vhembe n= 189	Age 21- 40	Age 41- 60	Over 60	Total
Female	14 (7)	66 (35)	34 (18)	114 (60)
Male	13 (7)	52 (28)	10 (5)	75 (40)
Total	27 (14)	118 (63)	44 (23)	189 (100)
Sekhukhune n= 111	21- 40	41- 60	Over 60	Total
Female	10 (9)	37 (33)	13 (12)	60 (54)
Male	15 (13)	25 (23)	11 (10)	51 (46)
Total	25 (22)	62 (56)	24 (22)	111 (100)

Numbers in brackets are percentage of gender compositions

Source: *Research Survey* (2019)

Table 4.2 shows that most respondents in both districts were female which resembles the sex structure of the two districts and province. The ages of the sampled farmers range from 21-80 years, and the majority of farmers were found to be between the ages 41 and 60 years. Only 16% of the sampled farmers in both districts (22% in Sekhukhune and 14% in Vhembe) are below the age of 40 years. This shows the limited participation of young people in smallholder agriculture. Several other studies have reported young people's lack of interest in farming as an occupation (e.g., Swarts and Aliber, 2013). For young people, agriculture is often seen as outdated, unprofitable and hard work. About 60% of the farmers (i.e., 63% in Vhembe and 56% in Sekhukhune) are between the ages 41 and 60, whereas 23 % are over 60 years of age. This includes 23% of farmers in Vhembe and 22% in Sekhukhune of farmers

sampled in the respective districts. These results show that old people still dominate in farming.

4.2.4 Household size

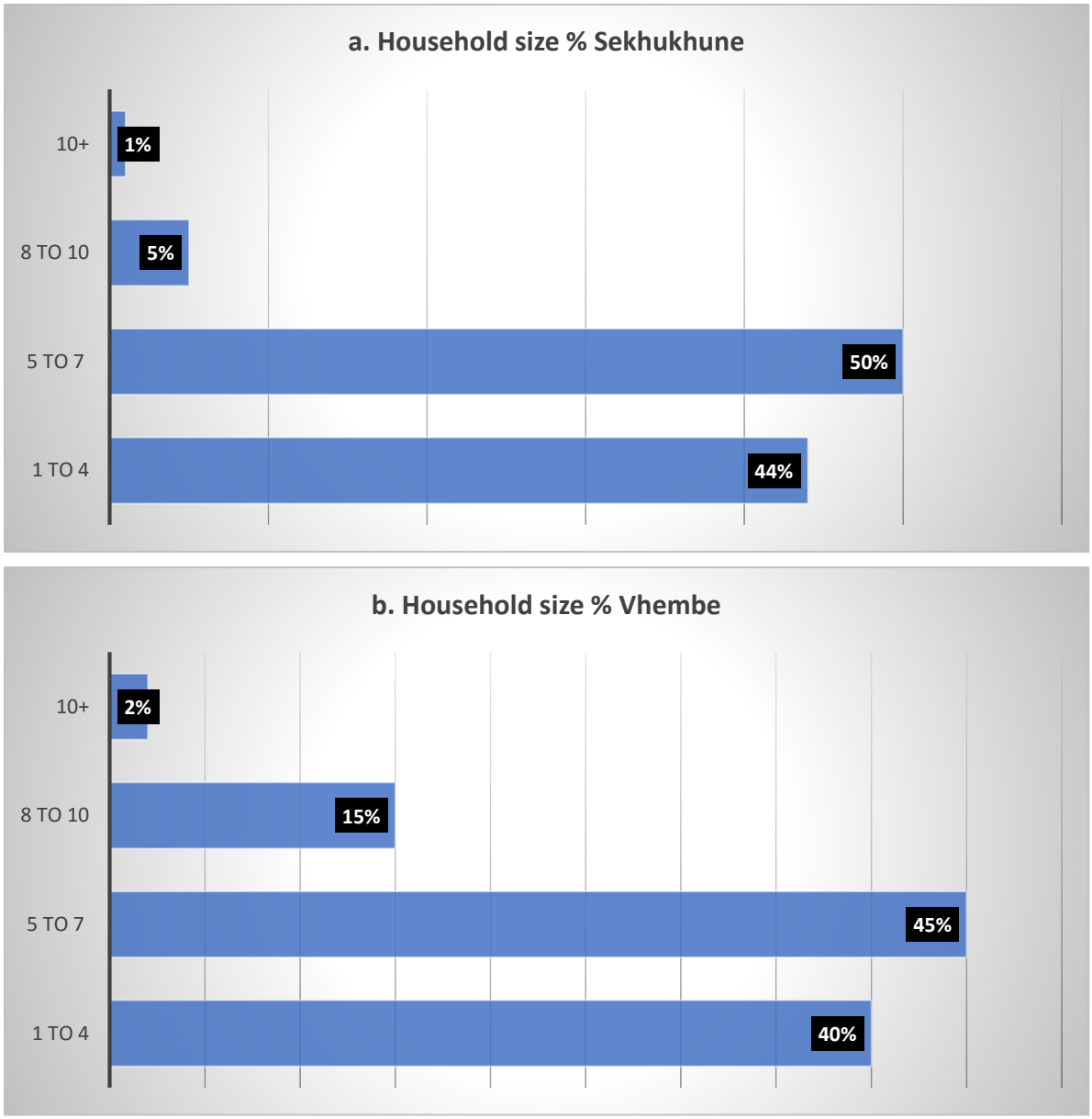


Figure 4. 2: Household size of sampled farmers

Source: *Research Survey* (2019)

The size of the household may also be important in the success of irrigation schemes and therefore the welfare of the household. The composition of a household in terms

of age, education status, income generation may be of interest when assessing the dependency burden of farmers. These are also relevant as a contributor to the welfare of the irrigation schemes. In Figure 4.2, about 50% (in Sekhukhune district) of the sampled farmers have household sizes of between 5 and 7 members when compared to about 45% in Vhembe district. This is followed by 44% of those farmers with household sizes of between 1 and 4. The remaining 4% and 1% had household sizes of 8 to 10 and over 10 respectively. This shows that over half of the sampled population is economically burdened since most of the household members are either scholars or not working and depending on grants and income from irrigation schemes.

4.2.5 Education level

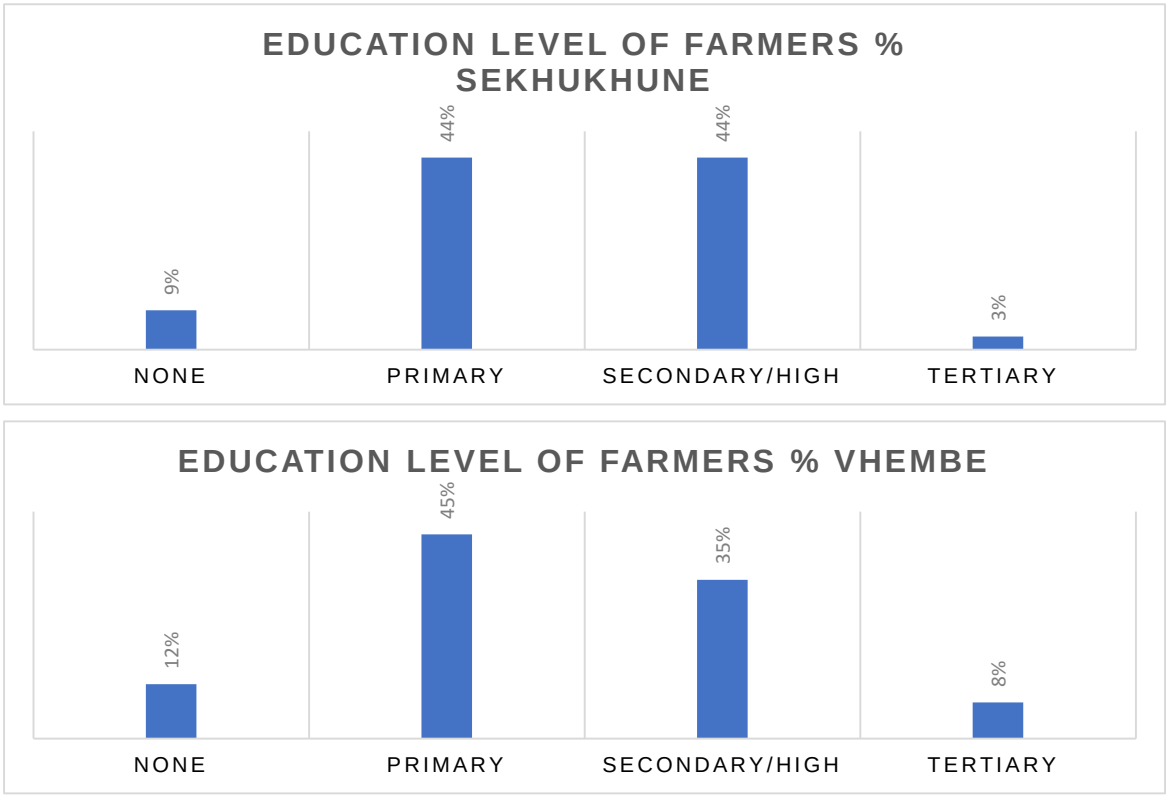
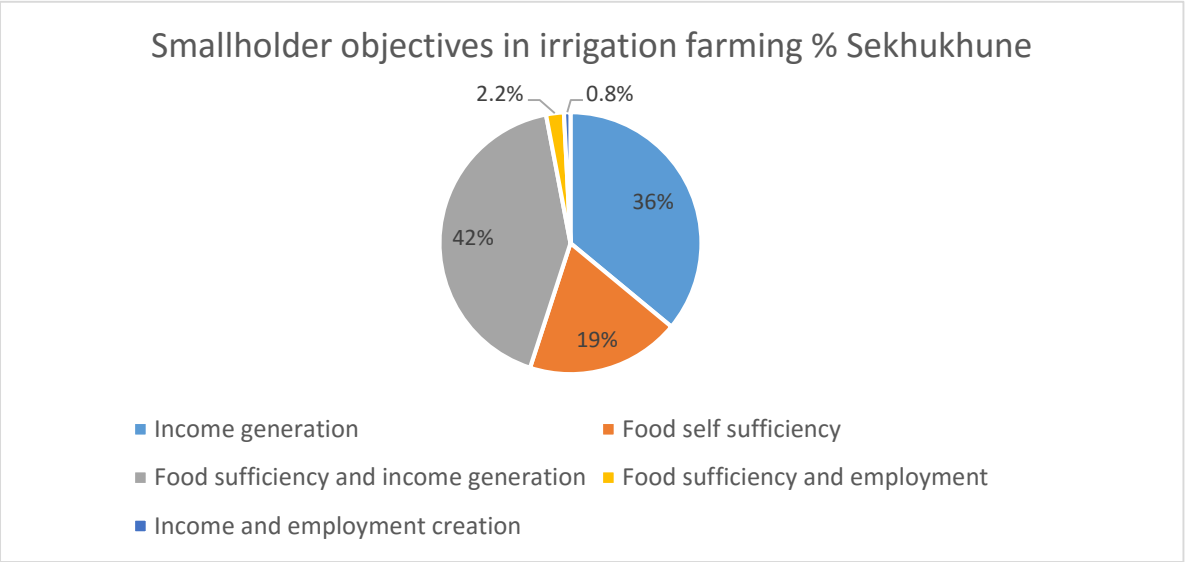


Figure 4. 3: Education level of sampled farmers

Source: *Research Survey* (2019)

Education is important for many reasons in the farmers' environment as it allows the farmers to quickly adapt to the changing world in agriculture. It may also assist them to look for better and relevant information and also help them to use improved suggested technologies in the farms, as well as improved sharing of knowledge to and from other farmers. Figure 4.3 indicates that in Sekhukhune district, about 88% of the sampled farmers indicated that they acquired some primary (44%) and secondary/high (44%) education, this is 10% higher than that of Vhembe district. Whereas only 3% indicated that they possess tertiary education as compared to the 8% of those in Vhembe. About 9% and 12% of the sampled farmers did not have any educational background in Sekhukhune and Vhembe respectively.

4.2.6 Smallholder irrigation farming objectives



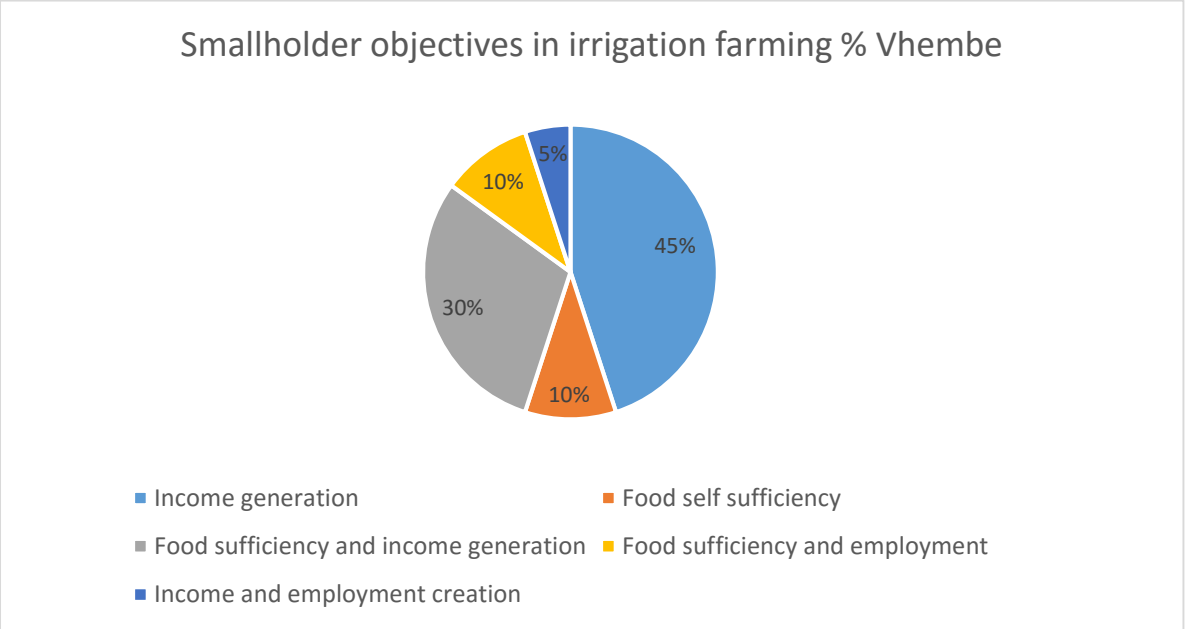


Figure 4. 4: Smallholder irrigation farming objectives

Source: *Research Survey* (2019)

Evidence from Figure 4.4 shows that most smallholder farmers in Vhembe district (45%) are engaged in irrigation farming mainly for the purposes of income generation followed by 30% of food sufficiency and income generation whereas very few (5%) farmers are engaged in irrigation for income generation and employment generation.

In Sekhukhune, over 40% of the farmers are engaged in irrigation farming for the purpose of food sufficiency followed by 30% of those who do farming for income generation. About 19% of the sampled farmers in Sekhukhune are engaged in irrigation farming solely for food self-sufficiency, as compared to about 10% in Vhembe. Very few farmers (0.8%) have the objective of income and employment creation in Sekhukhune. Denison *et al.* (2015) asserted that most smallholder farmers do not keep farm records (e.g., revenue and costs), which makes it difficult for one to make an assessment on whether or not they are making profit. This may mean that smallholder irrigation farmers' participation in irrigation farming is not necessarily to make profit but a combination of food self-sufficiency, income generation and employment creation.

4.2.7 Farm and non-farm income sources

Table 4. 3: Sources of income from sampled farmers (N = 300)

Income source	% Farmers		Mean (Rand)		Std. dev		% of total income	
	V	S	V	S	V	S	V	S
Income from crops	60	55	12,503	9,440	38,536	10,864	27%	20%
Income from livestock	10	12	1,253	3,268	4,652	5,689	3%	7%
Social grants	90	88	24,225	21,780	29,718	26,190	53%	47%
Permanent employment	4	5	3,550	5,590	9,062	9,468	8%	12%
Casual employment	13	20	880	1,800	3,859	4,544	2%	4%
Remittances	24	28	2,212	3,310	8,905	7,109	5%	7%
Arts and craft	3	5	918	1,440	3,851	3,735	2%	3%
Earned income			19,104	21,922	39,682	25,458	42%	47%
Unearned income			26,437	25,090	28.351	29,232	58%	53%

Note: V = Vhembe district; S = Sekhukhune district

Source: Research survey (2019/2020)

Table 4.3 shows the sources of income both from the farm and those from outside the farm. These income sources are categorised into two, namely; those that are earned (meaning farmers have to work for them), and those that are unearned (meaning farmers do not have to work for them). The results indicate that 58% of the income of sampled farmers in Vhembe district is unearned, whereas 42% is earned. While in Sekhukhune 53% and 47% of the income is unearned and earned respectively. This may have both a negative and positive impact on the success of irrigation schemes. On one hand, farmers may be reluctant to devote their full interest and focus in these irrigation schemes because they are getting more income from other sources other than those in the farm. On the other hand, this should allow them to spend more time on their agricultural activities as they do not have to spend time on their unearned activities. Social grants and remittances constitute over 50% of the income that farmers get, while income that directly comes from irrigation schemes contributed less than 30% in both districts of the total income that sampled farmers had.

4.2.8 Livelihood assets for sampled farmers

Table 4. 4: Access to livelihood assets

Capital category	V	S	V	S	V	S	V	S
Financial capital	Yes		%		No		%	
Access to credit from Banks	146	126	49	42	19	9	6	3
Relatives	154	134	51	45	11	1	4	.3
Personal savings	144	124	48	41	21	11	7	4
Contractors	118	98	39	33	47	37	16	12
Government subsidies	116	96	39	32	49	39	16	13
Cooperatives	150	130	50	43	15	5	5	2
Money lenders	148	128	49	43	17	7	6	2
Skills training								
Soil management	116	96	39	32	49	39	16	13
Crop protection	108	88	36	29	57	47	19	16
Record keeping	82	62	27	21	83	73	28	24
Water management	108	88	36	29	57	47	19	16
Equipment handling	120	100	40	33	45	35	15	12
Financial management	78	58	26	19	87	77	29	26
Human capital								

Extension service	118	98	39	33	47	37	16	12
Training	128	108	43	36	37	27	12	9
Vocational training	54	34	18	11	111	101	37	34
Physical capital								
Water supply	126	106	42	35	44	24	15	8
Markets	82	62	27	21	88	68	29	23
Storage	118	98	39	33	52	32	17	11
Road accessibility	112	92	37	31	58	38	19	13
Transport	80	60	27	20	90	70	30	23
Electricity	134	114	45	38	36	16	12	5

Note: V = Vhembe district; S = Sekhukhune district

Source: Research survey (2019/2020)

Table 4.4 shows the access to livelihood capital assets from sampled farmers in the study areas. Access to these capital assets may also have a strong bearing on the success of irrigation schemes and therefore the improved livelihoods of the farmers. Farmers seemed to have access to most capital assets, however, there are assets that remained that were not easily accessible. Looking at the financial capital, over 70% of the sampled farmers claimed to have access to financial capital from one or more sources listed in the table (e.g., Banks, relatives, saving, cooperatives, etc.). However, government subsidies and contractors were the least sources from which farmers could receive financial capital. This may mean that farmers are no longer completely dependent on government for support, but have other means of accessing financial capital.

When it comes to skills training, many farmers had acquired most of the skills. However, just over 50% of the farmers still did not have training on record keeping and financial management. Record keeping and financial management are key in the success of many businesses, including farming. These may assist farmers to evaluate whether or not they are making profit.

On the other hand, over 70% of the farmers indicated that they had access to human capital with the exception of vocational training being a challenge. About 71% of the sampled famers indicated that they do not have vocational skills. This is important to consider because it may mean that farmers lack technical skills and are not “experts” in what they are doing. However, most farmers believe in their indigenous methods and ways of farming, and may be content with these methods. Access to transport and markets proved to be the only challenges when it comes to physical capital. Just over 50% of the sampled farmers indicated that they do not have adequate transport and face difficulties when accessing output markets.

4.2.9 Psychological capital components measurements

Table 4. 5: PsyCap components measurements

Psychological constructs	**Mean**	**Std. Dev**
Hope I have hope that the quality of work will get better (HOPE_quality work)	4.25	1.78
I am willing to forgo a profit opportunity in the short-run in order to benefit from potential profits in the long-run (FORGOP_LongRunP)	4.88	1.07
I am willing to try new ideas even without full knowledge about the possible outcomes (TRY_Ideas)	4.33	1.45
Resilience I am able to cope with shocks such as drought and other natural disasters (COPE_Shock)	2.46	1.04
I am willing to take more risks (RISK_Take)	2.35	1.22
Government is responsible for the wellbeing of rural households (GOVT_Responsibility)	3.28	1.91
Confidence I am confident in farming as a way of life (CONF_Agriculture)	4.18	0.67
I am confident in myself as a farmer (CONF_Farmer)	4.83	1.16
I have the power to affect the outcome of my farming (POWER)	3.54	1.97
Optimism I am optimistic about the future of agriculture in my area (OPTI_FR)	4.35	0.89

I do not give up easily (DNT_Give_UP)	4.61	1.68
I would not be farming if there was a better alternative source of income (ALTER_Income)	2.93	1.99

Source: *Research Survey* (2019)

The importance of analysing the psychological capital of farmers was explained in the previous sections. Table 4.5 indicates the results from a 5-point Likert scale that was administered on the sampled farmers. It was important to check if farmers exhibit positive or negative psychological capital which could directly and indirectly influence their decisions and actions towards irrigation farming. There were four psychological constructs, with each construct having 3 questions ranked on a 5-point Likert scale. The scores 1, 2, and 3; and 4, 5 show that farmers are more likely to exhibit negative, neutral, and positive psychological capital behaviour towards irrigation farming.

Taking ‘’HOPE’’ as the first component on Table 4.5, farmers are more likely to exhibit positive psychology since the average mean of three questions are at least 4. This means that sampled farmers are full of hope and eager about trying new things, and believe that irrigation farming will profit them in the future. However, when it comes to resilience, farmers were not likely to be wanting in issues such as coping with shocks and taking up risks. This may be true because most smallholder farmers are not well equipped with the capacity to cope with shocks, and also being financially stable to take up risks. Most sampled farmers are confident and believe in irrigation farming as a means of sustain their living, and are convinced that if they put more effort on it, they will reap the benefits. Lastly; on Table 4.5, farmers seem to be very optimistic about irrigation farming and see it as an important contributor to their livelihoods, such that they will not easily give up even when they are faced with challenges.

CHAPTER FIVE

EMPIRICAL FINDINGS AND INTERPRETATIONS

5.1 Introduction

Irrigation brings a range of changes in agriculture and contributes to the upliftment of socio-economic conditions of individuals in direct and indirect ways. In other words, it can be said that irrigation benefits manifest at primary level as direct effect and spillover effect at secondary level. Most studies and projects impact evaluation studies on irrigation have shown that productivity per unit of land and overall production in the irrigated areas increased and contributed to poverty reduction (Dube, 2016). This chapter presents a number of factors that play a significant role in determining the success of irrigation farming. This was evaluated using empirical analysis where employed models proved whether or not these factors are relevant and significant in improving irrigation farming and reducing poverty incidences among smallholder irrigation farmers in the study areas. Analysing the role that positive psychological capital plays in the success of smallholder irrigation farmers and the importance of women empowerment is key.

5.2 Results of the empirical analysis

5.2.1 Principal Component Analysis on psychological capital dimensions

In a regression situation, an analysis of the principal components of the independent variables can shed some light on (a) how many variables should be retained, and (b) how to overcome the effects of multicollinearity. Multicollinearity arises when some or all of the independent variables are highly correlated. These inter-correlations increase the standard errors of the regression coefficients, and make the latter insignificant when determining the relevance of independent variables. Principal

component analysis (PCA) was performed to examine the interrelationships between variables.

PCA on the PsyCap measures generated three principal components that accounted for the 12 PsyCap measures indicated in Table 4.5 and Table 5.1. Components were rotated using varimax rotation to more easily defined groups of related dimensions (Rummel, 1970 in Eiseb, 2000).

Table 5. 1: PsyCap dimensions

Variables **(PsyCap measures)**	**Factors**		
	F1	**F2**	**F3**
OPTI_future	**0.733**	0.189	0.007
HOPE_quality work	**0.718**	0.203	0.060
FORGOP_LongRunP	**0.412**	-0.110	**0.641**
TRY_Ideas	-0.108	0.099	**0.824**
DONT_Give_UP	**0.889**	0.219	0.057
ALTER_Income	0.013	**0.878**	0.135
CONF_agriculture	**0.425**	**0.645**	**-0.412**
CONF_Farmer	**0.867**	0.277	0.014
POWER	**0.711**	**0.509**	-0.055
COPE_Shock	**0.437**	0.222	-0.052
RISK_Take	0.373	**0.589**	0.053
GOVT_Responsibility	**-0.688**	0.196	-0.338
% Variation	38.46	13.78	10.65
Cumulative % variation	38.46	47.59	**58.10**

Notes: KMO value = 0.79; Barlett's test of sphericity significant at 1%; only factors with loadings > 0.4 included in the explanation of the results.

Source: *Research Survey* (2019)

According to Stevens (2002), it is recommended to consider variables with loadings greater than 0.4 as this attaches economic interpretation to the principal components. If the principal components can be interpreted, it leads to a greater understanding of the variations in the data. The results of the principal component analysis are shown in Table 5.1. The different factors extracted represent different dimensions of PsyCap measures for smallholder irrigation farmers in the study areas (i.e, PsyCap dimensions or factors F1, F2, and F3 in Table 5.1). The first dimension (*CORH or F1*) has positive loadings on most PsyCap measures, and a negative loading for farmer's view regarding the government's responsibility for their wellbeing. It represents farmers who are independent, full of confidence, optimistic, hopeful about life, forward looking and resilient (hence, its abbreviated CORH)

The second dimension (*REOC or F2*) has positive loadings on four measures and represents farmers who are resilient, optimistic and confident in farming and their power to affect their success in farming. Their resilience emanates from them willingness to take more calculated risks than other farmers. The third dimension (*FUTURE or F3*) has positive loadings on two measures for hope and a negative loading on confidence in farming. It represents farmers who are venturesome and forward-looking but lack confidence in farming as a way of life. This may be due to the fact that farmers have a significant share of income from grants and remittances. The three PsyCap dimensions are included as variables in the PCA for all household livelihood assets, results of which are presented in Section 5.2.2 below.

5.2.2 Livelihood asset dimensions

The PCA on the livelihood assets resulted in seven livelihood assets factor dimensions as shown in Table 5.2. On Table 5.2, four of these factor dimensions (factors 3, 5, 6 and 7) had high loadings on the PsyCap measures. Factors 5 and 7 had high and positive loadings while factors 3 and 6 had high and negative loadings on PsyCap. Factor 1 represents farmers who are engaged in both crop irrigation and livestock farming, who possess physical assets and are women. Factor 2 represents elderly and less educated farmers who receive social grants. Factor 3 represents women farmers with larger land holdings and dependent on crop farming as a source of livelihood. However, this group of farmers lacks confidence, especially about what the future holds when it comes to irrigation farming. Factor 4 shows households with many dependents who rely mostly on income from social grants.

Factor 5 shows farmers who are well-endowed with financial assets, are resilient, not afraid to take calculated risks, optimistic and confident. Factor 6 represents farmers who are well-endowed with physical assets but are not resilient, confident and optimistic about agriculture; they rely mainly on other income instead of farm income sources. Factor 7 represents women farmers who are well-endowed with all aspects of PsyCap and rely much on income from irrigation farming. These farmers are endowed with social capital**.** These factors are relevant in determining the impact of smallholder irrigation schemes (i.e., farming) towards poverty reduction among farmers in the Vhembe and Sekhukhune districts. Their empirical impacts are indicated in the following section.

Table 5. 2: Household livelihood asset dimensions

Variables	Factors						
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**
AGE	0.008	**0.844**	0.111	0.178	0.039	0.189	0.034
GENDER	**0.473**	-0.097	**0.409**	-0.358	-0.152	-0.257	**0.440**
DEPEND RATIO	-0.033	-0.038	-0.083	**0.880**	-0.177	-0.045	0.058
EDUCATION	0.017	**-0.758**	0.181	-0.036	-0.068	0.159	0.061
CROPS INCOME	**0.828**	-0.084	**0.650**	-0.032	0.047	-0.188	**-0.483**
LIVESTOCK INCOME	**0.966**	-0.027	0.048	0.049	-0.127	-0.018	-0.040
SOCIAL GRANT	0.085	**0.466**	0.260	**0.757**	0.370	0.070	0.011
OTHER INCOME	-0.096	-0.035	-0.020	-0.055	-0.053	**0.887**	-0.016
CREDIT	-0.075	0.284	0.063	0.012	**0.556**	-0.153	-0.053
SAVING	0.547	-0.203	-0.051	0.191	**0.598**	0.339	0.039
HOUSEHOLD ASSETS	**0.544**	0.240	0.351	0.136	0.182	**0.421**	-0.035
LAND SIZE	0.279	0.174	**0.891**	0.090	0.021	0.155	0.117
SOCIAL NETWORK	0.289	0.019	-0.433	0.154	-0.279	0.042	-**0.400**
CORH	0.018	-0.033	-0.064	0.086	-0.082	0.012	**0.877**
REOC	-0.297	0.132	-0.219	-0.160	**0.512**	**-0.494**	-0.041
FUTURE	0.079	0.059	**-0.475**	0.051	-0.120	-0.020	-0.171
% Variation	**13.22**	**11.10**	**9.24**	**8.33**	**7.60**	**7.02**	**6.86**
Cumulative % variation	**13.22**	**23.69**	**32.38**	**37.96**	**43.32**	**49.91**	**56.38**

Notes: KMO = 0.69; Barlett's test of sphericity significant at 1%, only factors with loadings > 0.4 included in the explanation of the results. Section 5.2.1 provides the full explanation of the abbreviated variables in this table.

Source: *Research Survey* (2019)

5.2.3 Empirical results for women empowerment through smallholder irrigation schemes

5.2.3.1 Introduction

Although the South African Constitution supports gender equality, women in rural areas, however, experience limited use of water and limited knowledge to achieve food security. The lack of water and land use security refers to physical, legal and tenure insecurity while lack of food security implies insufficient physical, economic and social access by all people at all times to enough food for an active and healthy life. Empowerment of women through secure access to water and land, as well as by obtaining knowledge and developing skills may contribute significantly to poverty reduction. It was therefore necessary to conduct an analysis of the role that smallholder irrigation schemes play in empowering women.

5.2.3.2 Women empowerment indices and their determinants

A simple random sampling technique was used to select 174 (i.e., 114 in Vhembe and 60 in Sekhukhune) women from 8 irrigation schemes across Vhembe and Sekhukhune districts. Data were collected on their demographics and empowerment using a modified Women Empowerment Agriculture Index developed by IFPRI. The indices covered women's access and control to physical, natural, social, financial, and human livelihood capital. The study also examined empowerment indices to show different areas where women are empowered and disempowered. It also shows the significant determinants of empowerment.

Table 5. 3: Women farmers' characteristics

Age of the respondent %			Household size %			Level of income %			Marital status %			Education %`			Years of farming experience %			Dependents		
	S	V		S	V		S	V		S	V		S	V		S	V		S	V
21-40	10	17	1 to 4	45	42	R0-R4999	26	21	Single	29	32	None	13	8	1 to 10	60	55	0 to 4	73	70
41-60	71	65	5 to 7	48	46	R5000-R9999	30	33	Married	49	50	Primary	42	40	11 to 20	20	24	5 to 9	26	30
60+	19	18	8 to 10	6	10	R10000-R14999	32	30	Widowed	22	18	Secondary /High	43	44	21 to 30	14	16	10 +	1	0
			10+	1	2	Over R15000	12	16				Tertiary	2	8	31 to 40	5	5			
															41+	1	0			

Note: S = Sekhukhune district; V = Vhembe district.

Source: *Research Survey* (2019)

Table 5.3 shows the results of farmers (women) characteristics for the two districts considered in this study. The results show that 71% of the women in Sekhukhune district fall within the age group of 41 to 60 years. This is 6% higher than the number of women in Vhembe district. Women who are over 60 years of age constitute 18% and 19% of the population in Sekhukhune and Vhembe districts respectively. The lowest percentages from both districts were that of young women (i.e., between 21 and 40 year). This confirms the claims that the proportion of young people in agriculture is low, which is supported by Akinbile *et al.* (2006) who stated that active

participants in farming activities are between the ages of 40 and 50 years. Table 5.3 also indicates that over 40% of women farmers in both districts have household sizes of between 1 and 7 persons. This may indicate that family labour is available during peak seasons. Brebbia and Bjornlund (2014) aver that if the household size is small and is headed by a female, this could cause shortage of labour during the peak season and that also impacts on household income. According to Maffioli *et al*. (2007), female-headed households tend to be small in size, have low incomes and are less likely to adapt to technology, which hinders agricultural production. However, the results of this study show that most sampled women farmers have large household sizes. The results in Table 5.3 show that most women farmers in both districts (about 68%) have income levels of between five thousand and fifteen thousand rands monthly, while those who get over fifteen thousand rands made up only 12% and 16% of the population in Sekhukhune and Vhembe respectively. Level of income can also be an important factor when evaluating the empowerment of women especially in rural areas. In terms of marital status, Table 5.3 also shows that approximately 50% of women in irrigation farming from both districts are married, followed by approximately 30% of those who were single and around 20% of those who were widowed. According to Becker et al. 2006, this may mean that women, especially married women, are more likely to be influenced by their husbands when making decisions, which could impact negatively on empowerment as decision making is an important measure of empowerment.

Tekana and Oladele, (2014) also found that due to socio-cultural factors, women have little authority in decision making in agricultural production. Also, the results indicate that most (over 40% in both districts) women farmers have acquired primary and secondary education, 13% are without formal schooling in Sekhukhune and about 8% have tertiary education in Vhembe district. Education is an important factor to farming because of the rapid change in technology and the economic environment, which can be matched through the attainment of education.

The findings also indicated that 60% of women farmers in Sekhukhune have farming experience ranging from 1 to 10 years as compared to 55% in Vhembe district, indicating that most farmers are new entrants in farming, while only 1% in Sekhukhune indicates experience of more than 40 years. The results further indicate that dependency ratio is low in both districts since approximately 70% of the women have dependents within the range 0 to 4, while only 1% (only in Sekhukhune) have more than dependents.

Table 5. 4: Livelihood assets endowment.

Capital category	V	S	V	S	V	S	V	S
Financial capital	Yes		%		No		%	
Access to credit from Banks	81	57	49	42	84	78	51	58
Relatives	84	61	51	45	81	74	49	55
Personal savings	79	55	48	41	86	80	52	59
Contractors	64	44	39	33	101	91	61	67
Government subsidies	64	43	39	32	101	92	61	68
Cooperatives	82	58	50	43	83	77	50	57
Money lenders	81	58	49	43	84	77	51	57
Skills training								
Soil management	64	43	39	32	101	92	61	68
Crop protection	59	39	36	29	106	96	64	71
Record keeping	44	28	27	21	121	107	73	79
Water management	59	39	36	29	106	96	64	71
Equipment handling	66	44	40	33	99	91	60	67
Financial management	43	26	26	19	122	109	74	81
Human capital								
Extension service	64	44	39	33	101	91	61	67
Training	71	49	43	36	94	86	57	64
Vocational training	30	15	18	11	135	120	82	89
Physical capital								
Water supply	69	47	42	35	96	88	58	65
Markets	44	28	27	21	121	107	73	79
Storage	64	44	39	33	101	91	61	67
Road accessibility	61	42	37	31	104	93	63	69
Transport	44	27	27	20	121	108	73	80
Electricity	74	51	45	38	91	84	55	62

Note: S = Sekhukhune district; V = Vhembe district.

Source: *Research Survey,* (2019)

Table 5.4 shows women farmers' access to livelihood assets. With regard to financial capital, it shows that 45% of women in Sekhukhune district obtained their credit from a relative followed by those that obtained their credit from cooperatives and money lenders (43% each). While most women in Vhembe district got their credit from relatives (51%) followed by cooperatives (50%), commercial banks (49%), and money lenders (49%). However, from both districts; very few women believed that credit from commercial banks is adequate. This is because they claim not to be getting enough credit to sustain their capital needs. In all farm operations, credit is important because it helps farmers to secure production inputs and other technologies needed in the farm.

According to FAO (2011), inadequate finance can also prevent farmers from investing in new methods of crop production and irrigation. Lack of access to credit is one factor that reduces women's efficiency and productivity. Machete (2004) argued that one of the most critical problems threatening the viability of smallholder irrigation is the absence of credit. Access to credit needs collateral mostly in the form of land rights, which some farmers, particularly women, do not possess.

According to Table 5.4, women farmers in both districts have received considerably very little extension services and vocational training as far as human capital is concerned. Extension service is important in boosting agricultural productivity. Only 39% of farmers in Vhembe reported to have received extension services as compare with a low 33% in Sekhukhune district. Both districts proved to be receiving very low levels of vocational training (i.e., 30% in Vhembe and 15% in Sekhukhune). With regard to skills training, 40% of women received training in equipment handling in Vhembe district, while soil management was at 39%. Other indicators of skills training were lower than 39% in Vhembe district. Sekhukhune had very low levels of skills training with none of the indicators exceeding 33%. Sekhukhune had received 33% skills training in equipment handling. Machete (2004) argues that an understanding of financial management will generate a continuous flow of irrigation scheme profitability, liquidity and reducing risks, which will provide a basis of forward planning for farmers. With regard to access to physical capital, Table 5.4 indicates that famers in both districts had challenges when it comes to physical capital with water supply and electricity availability standing at 42% and 45% in Vhembe respectively; as compared with only 35% and 38% in Sekhukhune respectively. Access to markets and transport proved to be the serious challenge in both districts with farmers having only less than

28%. Therefore, the two districts generally had low livelihood assets endowment which may impact negatively on the success of these farmers in their irrigation schemes.

The empowerment indices covered in this study include the use of income, access to productive capital, access to credit, leadership roles and decision making. From the scoring of the empowerment indices, the mean was calculated for each of the indices and used as the cut-off point. Women with scores below the mean depict disempowerment while those above the mean indicate empowerment. Use of Income in Table 5.5 indicates that 56% of women in terms of the control over the use of income are below the mean score of 16.80, which implies that they are disempowered in the control of the use of income as an index of empowerment.

Table 5. 5: Empowerment indices among women on smallholder irrigation schemes.

	Use of income	Productive capital	Access to credit	Leadership	Decision making	Total empowerment score
x	16.80	78.99	113.56	43.98	38.29	291.61
SD	8.55	35.41	38.24	10.85	10.64	84.48
low	98 (56)	104 (60)	104 (60)	90 (52)	92 (47)	104 (60)
high	76 (44)	70 (40)	70 (40)	84 (48)	82 (53)	70 (40)

Source: *Research Survey* (2019)

According to FAO (2014), women tend to spend most of their income on basic household needs, such as household essentials, while men tend to retain more of the income they control for their personal use, such as buying alcohol, drinking and leisure. The study also indicated that husbands are more likely than elsewhere to entrust the income to their wives, to prevent its misuse. But, some men are afraid to do so, in case the women might be tempted to leave them. Access to productive capital in Table 5.5 indicates that the proportion of women below the mean (78.99) for access to productive capital as an index of empowerment is 60%. This shows that women are disempowered in terms of their access to productive resources as an index of

empowerment. Jiyane (2011) argued that, although policies aimed at creating enabling environments have been established in nearly all countries for women to access, own, control, use and manage land for productive use, the actualisation of such still remains a challenge.

The gender approach of agencies and projects, as well as the local class and gender hierarchies, is also one of the causes of gender-related inequities in access to water resources in Sub-Saharan Africa (Van Koppen, 2015). Access to credit in Table 5.5 indicates that 60.2% of women's access to credit is below the mean score of 113.56, showing that women are disempowered in terms of access to credit as an index of empowerment. The IFPRI (2012) ascertained that lack of collateral, low levels of education with a resultant lack of numeracy and access to information are factors contributing to the fact that 10% of agricultural credit in the SADC region is accessed by women.

In some instances, women need the consent of their spouses to access credit and this makes them lose confidence in themselves and become disempowered. It is thus important for women to have not only access to credit, but also control over the use of the credit so that it is not diverted to male dominated production systems, at the expense of women's productive activities. Leadership role in Table 5.5 indicates that 52% of women in terms of leadership roles are below the mean score of 43.98. This indicates that in terms of women engagement in leadership roles the difference is quite marginal when compared with the mean score. This could be because of the fact that, due to unequal gender norms and relations, women have a lower socio-economic status, compared to their male counterparts, which limits their opportunities to access and participate in formal groups.

World Bank (2009) justifies the fact that women's freedom is constrained by men's control over their mobility, by sociocultural expectations that they are primarily responsible for all domestic work, and, in relation to this, by their uneven reproductive, productive, and community work burdens. Their restricted access to, control over, and ownership of land, credit, and information, as compared to men, gives them a disadvantage in meeting the conditions of formal group membership and leadership. However, Gizachew (2011) stated that, when women gain leadership positions, it helps them to build their self-confidence, exercise their political leadership, and gain respect from their male and female peers. There is also some evidence that, when there are women in leadership roles, there is a greater likelihood of other women participating in the organisation (Oxfam International, 2013).

Decision Making in Table 5.5 indicates that the proportion of women above the mean (38.29) for decision making as an index of empowerment is 53%, implying that they are empowered in decision making. Most women are not married and this could be the reason why they are actively involved in decision making. Women have been facing huge challenges in the area of decision making, firstly because of tradition and internal lowliness complex where they are not even sure if the decisions that they want to take will bear fruit or will make them aversive.

Table 5.5 indicates that 60% of women were below the mean of 291.61, which implies that women are disempowered. According to IFPRI (2012), an individual is identified as empowered in 'five domains of empowerment (5DE)'; the domains are used as indices of empowerment if there are adequate achievements in four of the five domains or if they enjoy adequacy in some combination of the weighted indicators that sum up to 80% or more, or if they have an adequacy score of 80 or above. Following the results in this study, women are reflecting empowerment adequacy in only one

indicator, decision making, and disempowerment in the other four indicators. This concludes that women are disempowered.

5.2.3.3 Factors influencing of women's empowerment

The influence of the socio-economic characteristics and empowerment model was estimated using a linear regression (Table 5.6). The independent variables were significantly related with an F value of 1.92, $p < .05$. Also, an R value of 0.616 showed that the independent variables explained about 62% of the variations in empowerment and that there was a strong correlation between socio-economic characteristics and empowerment. The results further predicted 38% of the variation in socio-economic characteristics.

Four out of thirteen independent variables were significant; with three variables being significant at 10% (expenditure, marital status and the use of drip irrigation system); while only one variable was significant at 5% (use of micro irrigation system). Expenditure and marital status are negatively significant while use of drip and micro irrigation systems are positively significant. These findings imply that, the lower the household expenditure the more empowered are the women, the greater the use of drip and micro irrigation the more empowered are the women and unmarried women are more empowered than married women.

This supports the results of World Bank (2013) that women's freedom is constrained by men's control over their mobility, by sociocultural expectations that they are primarily responsible for all domestic work, and, in relation to this, by their uneven reproductive, productive, and community work burdens. Women's restricted access to, control over, and ownership of land, credit, and information, as compared to men,

puts them at a disadvantage in meeting the conditions of formal group membership and leadership.

With regard to micro and drip irrigation systems use, Lopi (2004) argued that, although policies aimed at creating enabling environments have been established in nearly all countries for women to access, own, control, use and manage land for productive use, the actualisation of such still remains a challenge. However, access to these resources affects empowerment positively. The rest of the other independent variables do not have any correlation with the empowerment of women farmers in irrigation farming.

Table 5. 6: Multiple regression analysis between socio-economic characteristics and empowerment.

Variables	B	Std error	t	sig
Constant	93.698	126.764	0.463	0.463
Age	–0.129	0.551	–0.233	0.816
Marital status	–1.958	0.928	–2.11	0.094*
Number of dependants	3.198	2.721	1.175	0.244
Household size	–0.157	2.118	–0.074	0.941
Education	–1.102	4.291	–0.257	0.798
Labour source	3.588	6.004	0.598	0.552
Non-farming activities	8.563	15.677	0.546	0.587
Central pivot irrigation type	–6.734	24.291	–0.277	0.783
Expenditure	–37.368	18.547	-2.015	0.089*
Sprinkler irrigation type	31.899	25.504	1.251	0.216
micro irrigation type	54.515	24.269	2.246	0.028**
Drip irrigation type	15.489	7.062	2.193	0.092*
Farm size	–3.718	17.197	–0.216	0.830
R	0.616			
R square	0.379			
F	1.936			
p	0.036			
* Significant at 10% level ** significant at 5% level				

5.3 Empirical analysis for the role of smallholder irrigation towards poverty reduction

5.3.1 Summary of the findings

In analysing the impact that smallholder irrigation schemes have on poverty, there was a need to introduce another group of respondents (i.e., non-irrigators) so that conclusions may be drawn from the two groups of farmers. Here, 150 irrigators and 150 non-irrigators were compared**.** Table 5.7 indicates that the proportion of women irrigators was 58.2%, which implies that women's access to irrigation was by far above that of men. This differs with the findings Kinfe *et al*. (2012), who revealed that women's access to irrigation was limited. It can be concluded, therefore, that women are highly participating in irrigation farming, which is a step forward in trying to solve the problem of poverty since women are more likely to be victims as compared to their male counterparts.

The minimum and maximum age limits are 21 and 80, respectively, with mean age of 55. There seems to be a disparity of age towards accessing irrigation and there is a tendency for young farmers not to engage in irrigation farming. This concurs with the findings of other studies (e.g., Ntshangase, 2016., IFAD, 2016., Chipfupa, Tagwi, 2021) that purport that young people lack interest in agriculture and are less likely to participate in farming. The average household size was 6.5 members, with 1 and 12 being the minimum and the maximum, respectively. Education is one of the most significant factors that affect human behaviour. About 9% of the respondents are illiterate; of which 9.3% and 10.2% are irrigators and non-irrigators, respectively. This means that 9% of the respondents may not read and write, and there was no wide variation in the education attained between irrigation and no irrigation farmers. The rest 28.0, 28.85, 27.5 and 5.9% completed 1 to 4, 5 to 8, 9 to 12 grades and tertiary education, respectively (see Table 5.7). Illiteracy does not seem to be a bigger

problem in both categories since only less than 10% of the sampled farmers are uneducated. There is also no significant variation with respect to the number of dependents between irrigation users and non-users.

Table 5. 7: Socio-demographic profile of respondents.

Variable	**Irrigation user**		**Total**		
	Yes (N=150)	**No (N=150)**			
Discrete Variables					
Gender	**%**	**%**	**%**		
Female	58.2	74.5	66.4		
Male	41.8	25.5	33.6		
Continuous variables				**Min**	**Max**
Age					
Mean	55.6	48.5	52.1	**21**	**80**
Std. dev	16.6	14.7	15.7		
Household size				**1**	**12**
Mean	6.9	6.2	6.6		
Std. dev	2.7	2.5	2.6		
Education level				**0**	**13**
None	9.3	10.2	9.75		
Grade 1-4	29.7	26.3	28.0		
Grade 5-8	32.2	25.5	28.85		
Grade 9-12	25.6	29.4	27.5		
Tertiary	3.2	8.6	5.9		
Dependency ratio				**0**	**10**
Mean	2.82	2.35	2.59		
Std. dev	1.44	1.18	1.31		

5.3.2 Evidence from sampled farmers on the role of irrigation

Sampled farmers in the study areas perceive smallholder irrigation as a means to improve rural livelihoods. Following the results from meetings held with participants, almost all of the irrigation users in their specific schemes have improved their livelihoods as a result of irrigation. Many irrigation users have managed to improve their assets base, have increased their purchasing power, and are now able to access other important services such as better schools and medical needs. However, respondents also highlighted some challenges they are facing. Lack of vocational

training, efficient markets and frequent fall of commodity price were mentioned as major challenges. Furthermore, they indicated that there were several challenges in water use management. There were claims that there are no strong and functional water user associations (WUAs) in almost all of the sampled schemes. Conflicts between users, weak coordination and evaluation of these skills were also mentioned as challenges

5.3.3 The role of irrigation in improved yields, incomes and poverty reduction

Irrigation may lead to poverty reduction through increased yields and an opportunity to produce other cash crops (higher value crops), which may mean raising incomes and employment. Increased ‘‘mean’’ yields can mean increased food supplies, higher calorie intakes and better nutrition levels. Results show that there were significant differences in levels of yields, employment, asset endowment, consumption, and income between irrigation users and non-users.

5.3.3.1 Evidence on increased production through irrigation

Comparative yields analysis by crop type could not be done because of lack of uniformity in the use of inputs as different crop types require different inputs. However, gross yield for major crops by access to irrigation was presented in Figure 5.1. As expected, irrigation use has significantly contributed towards achieving households' goal of increased production and these results are similar to those of Getaneh (2011). Data analysis of major cereals and horticultural crops showed that mean crop yield per household for maize, cowpea, spinach (*muchayina*), tomato, and cabbage is higher for irrigation users than for non-users. This evidence has ensured that irrigation use is a guarantee for increased food supply and ensured food security. Crops like tomato, cabbage, spinach are grown mainly by those households with access to

irrigation. This is also an indication of the fact that irrigation use increases cropping diversification and intensity among the irrigators.

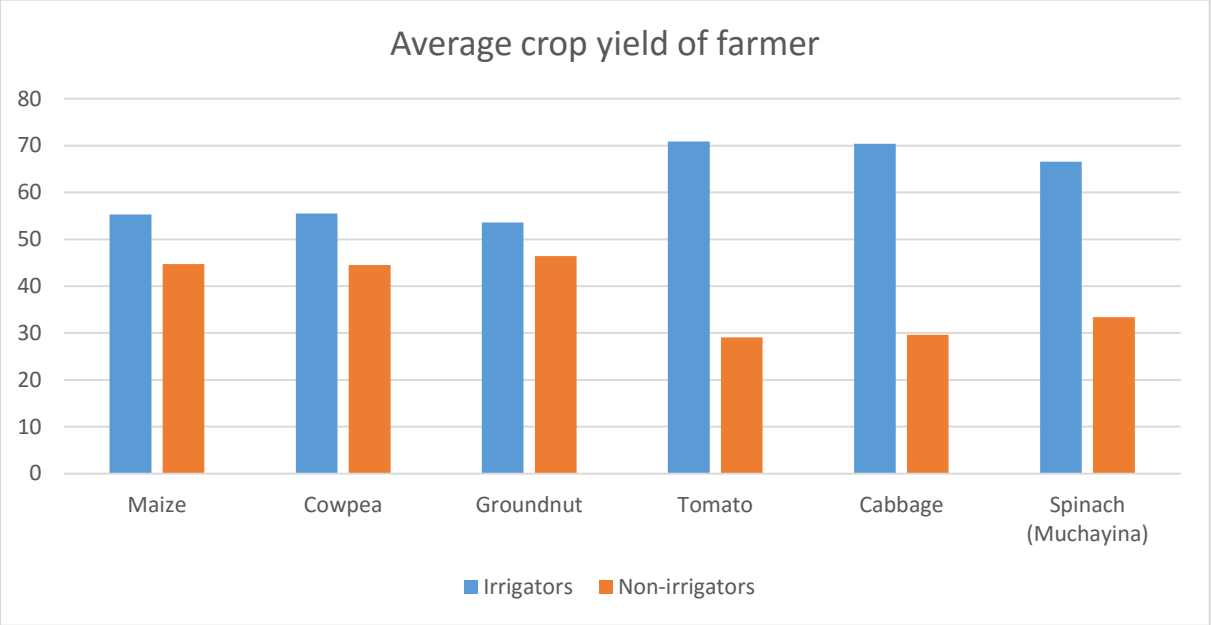


Figure 5. 1: Average crop yield of farmer

Source: *Research Survey* (2019)

5.3.3.2 Evidence on improved employment opportunities through irrigation

Looking at the many benefits of irrigation, employment generation is very vital. Considering the views of the beneficiaries of irrigation during focus group meetings held with them, most of them indicated that they have shifted from once a year (rainy season) to two and three harvests resulting in the need to employ more labour and thus labour use efficiency was improved due to irrigation. This implies that, irrigation is a catalyst to increased employment opportunity.

5.3.3.3 Evidence on increased income through irrigation

The findings of studies by Getaneh (2011) and Kinfe *et al*. (2012) predicted that irrigation would improve income earnings of farmers. Results of this study in Table 5.8 show that irrigation beneficiaries earned an annual mean income of R45541 per

household as opposed to R41612 among non-beneficiaries. Irrigation use has a positive impact on households earning from crop, and off-farm income, while the value of livestock income earning was higher for non-users. These findings are contrary to the findings of Getaneh (2011) which purport that small-scale irrigation has a negative impact on non-farm incomes. Income share by category indicates that 27.4% and 22.9% of total incomes for users and non-users, respectively, come from crop. A larger portion of income is contributed by off-farm sources at 69.8% and 68.6% for irrigators and non-irrigators, respectively.

Table 5. 8: Income earned by farmers

Irrigation use						
Income source	**Yes**			**No**		
	Mean	**Std. dev**	**Share (%)**	**Mean**	**Std. dev**	**Share (%)**
Crops	12503	10567	27.4	9536	7582	22.9
Livestock	1253	3032	2.8	3532	5038	8.5
Other (off farm)	31785	33754	69.8	28544	30526	68.6
Total	45541	34689	100	41612	36772	100

Source: *Research Survey* (2019)

5.3.3.4 Evidence on improved asset endowments through irrigation

Hussain (2004) predicted that irrigation allows a greater area of land to be used for crops and that asset ownership increases with access to irrigation. For this study, assets such as farm implements, household furniture, land, and livestock ownership were used. Following the results on Table 5.9, the value of assets owned by irrigators is two and half times more than that of non-irrigators. With regard to land size, access to irrigation increases mean land ownership by 0.53 ha and enhances livestock ownership by a factor of 0.77. This shows that access to irrigation is also important for

livestock production since livestock may directly and indirectly depend on the output from irrigation farming.

Table 5. 9: Asset endowment by farmers

Owned assets	Irrigation use	Mean	Std. dev
Total land size (ha)	Yes	2.06	1.85
	No	1.53	1.03
Total value of assets	Yes	48226	50056
	No	19272	22582
Total value of livestock (R`000)	Yes	6.66	5.17
	No	5.89	4.97

Source: *Research Survey* (2019)

5.3.3.5 Evidence on improved household consumption through irrigation

Expenditure pattern was used as a proxy indicator for the standard of living in order to measure the impact of irrigation on household consumption. Household consumption may be referred to as the ability of the household to produce and/or purchase a basket of goods containing the minimum recommended quantity of calories and non-food commodities for survival. Looking at the results on Table 5.10 below, the average consumption expenditure per adult equivalent per annum for irrigators is more than twice that of non-irrigators. Furthermore, the value of home consumption, food and non-food expenditures are significantly higher than that of non-users. For instance, non-irrigators' consumption from own production is only about 60% (i.e., 2068.2/3403.8) of that of irrigation beneficiaries. It can be argued that, access to irrigation improves food security through home consumption by increasing the frequency of production. Therefore, one may consequently say that there is a positive correlation between nutritional status and irrigation access. It also has a positive impact on non-food consumption, although the difference is not significant. The non-

food consumption value of non-users was 93.3% among the irrigators. From these findings, it can be argued that irrigation access improves the overall welfare of rural households through improved food, non-food consumption.

Table 5. 10: Expenditure patterns of farmers

	Irrigation use			
Consumption expenditure (Rand)	**Yes**		**No**	
	Mean	**Std. dev**	**Mean**	**Std. dev**
Food	2050.2	1862.2	982.3	1253.6
Non food	1324.5	2285.4	1235.9	1156.1
VOC	3403.8	10655	2068.2	1839.2

Source: *Research Survey* (2019)

5.3.3.6 Evidence of poverty reduction through irrigation

Poverty has many explanations from various disciplines. And as a result, it has been increasingly realised that poverty is a multidimensional concept, extending from low levels of incomes and expenditures to lack of education and poor health. It also includes other social dimensions such as powerlessness, insecurity, vulnerability, isolation, social exclusion and gender disparities (Rohwerder, 2016). In this analysis, the cost of basic needs was used to set poverty lines. The first activity in this approach was to identify a bundle of food and non-food items usually consumed by the 20% lowest income quartile and estimating the cost of meeting this need (Ravallion, 1994). Therefore, the food poverty line (FPL) used for this analysis was R561 per person per month (StatsSA, 2019), whereas the total non-food expenditure was between R417 and R666 per person per month, which covers clothing, medication, tax, and social obligation costs. Adding all these expenditures from the lowest income group will make

the total poverty line reach levels beyond which an individual is considered to be non-poor. Hence, the poverty line was R561 per person per year.

5.4 Results for poverty status and indices by access to irrigation

Table 5.11 shows that from the 300 sampled farmers, about 33.3% are poor, which accounts for 46.7% of non-users and 20% of the users of irrigation, implying that poverty incidence is 26.7% higher in non-irrigators than in irrigators. Thus, 80% of the users and 53.3% of non-users are non-poor. This emphasises that irrigation development is a key for poverty reduction. The evidence that 20% of irrigation users are poor means that, access to irrigation is a necessary, but not the only sufficient means to poverty alleviation; and poverty may be adversely affected where irrigation is mismanaged thus leading to poverty. In addition, one has to understand that poverty is a complex phenomenon. The results showed that 55% and 12% of the non-user and user households were living below the determined poverty line on the head count basis. The corresponding poverty gap by irrigation use was 0.042 and 0.17 for users and non-users, respectively; whereas poverty severity index (indicated by squared poverty gap) was 0.03 and 0.09 for users and non-users, respectively (see Table 5.11). Therefore, one may argue that poverty is more severe and widespread among non-irrigators than irrigators.

Table 5. 11: Poverty status and indices by access to irrigation

	Poverty status					
Irrigation use	**Non poor**		**Poor**			
	N	**%**	**N**	**%**	**X^2**	**P**
Yes	120	80	30	20	53.32	0.001
No	80	53.3	70	46.7		
Total	200	66.7	100	33.3		
Irrigation use	**Head count index (α = 0)**		**Poverty gap (α = 1)**		**Squared poverty gap (α = 2)**	
Yes	0.12		0.053		0.03	
No	0.55		0.19		0.09	

Source: Research Survey (2019)

5.4.1 Factors determining the poverty status of farmers

Binary Logistic Regression Model was used to analyse the determinants of households' poverty. The major focus of this study was to investigate the role of irrigation in poverty reduction. Poverty is considered was the dependent variable of the model, while the independent variables are listed in Table 5.12 below. Most of these variables are derived from the previous analysis (in this study) as factors and are used in the Binary Logistic Model as new variables. These independent variables determine the likelihood of being poor or not. Prior to running the model, tests on the variance inflation factor and contingency coefficients were conducted to check for multicollinearity among continuous and discrete variables, respectively. The test results showed that, multicollinearity was not a serious problem among the continuous variables.

5.4.2 Interpretation of significant variables from binary logistic regression model

Table 5. 12: Binary Logistic Regression Model for determinants of poverty

Variable	**B**	**S.E.**	**Wald stat**	**Sig. difference**	**Exp (B)**
Irrigation user	- 0.150	0.042	12.755	0.021**	0.861
Women empowerment	0.058	0.532	0.012	0.913	1.060
Factor 1	-0.117	0.022	27.803	0.000***	0.889
Factor 2	1.013	0.444	5.212	0.022**	2.753
Factor 3	0.066	0.027	5.867	0.015**	1.068
Factor 4	0.318	0.099	10.213	0.001***	1.374
Factor 5	-0.099	0.048	4.266	0.039**	0.906
Factor 6	0.144	0.783	0.034	0.854	1.155
Factor 7	-0.651	0.334	3.811	0.051*	1.918
Constant	-9.561	1.662	33.112	0.000***	0.000

***, **, * significant at less than 1%, 5% and 10% respectively.

Findings of the Binary Logistic Regression Model on the signs of independent variables concur with those of the researcher's prior expectations. Looking at the results (Table 5.12), irrigation use with the odds of being poor over non-poor was negatively correlated and significant. This means that the probability of being poor decreases by a factor of 0.861 for those farmers with access to irrigation keeping other factors constant. This predicts that the probability of being poor decreases if one has access to irrigation. These findings are different to the findings of Getaneh (2011) who found that there is no significant difference between farmers with irrigation and those without irrigation in terms of the probability of being poor. Hussain (2004) also noted that irrigation contributes to poverty alleviation both directly (i.e. through improved production, incomes and employment) and indirectly (i.e. through reduced indebtedness, reduced vulnerability to risk and improved resource base). Irrigation

may lead to poverty reduction through increased yields, increased cropping areas and higher value crops and thereby raising employment opportunities and incomes of people (FAO, 2003).

Women empowerment was positively correlated with poverty and was found not to be significant in determining poverty status. This may be since almost all women proved to be disempowered as evinced by the empowerment indices used. Focusing on the factors that were used as variables in the models, factor 1 (which represents farmers engaged in both crop irrigation and livestock farming, who possess physical assets and who are women) is negatively correlated with poverty and significant at 1% level. This means that the probability of being poor decreases by a factor of 0.889 for those farmers with access to irrigation keeping other factors constant. Factor 2 (which represents the elderly and less educated farmers who rely heavily on social grants) is positively correlated with poverty and significant at 5% level. This means that the probability of being poor increases by a factor of 2.753 for these farmers keeping other factors constant. These results were expected since education and the ability to generate additional income are presumed as critical in poverty reduction among households. These results are similar to those of Ayalneh and Korf (2009), who found that the educational level of household heads has a positive impact on poverty. In terms of age, the results of this study indicate that as the age of the household head increases, it contributes to household poverty. The possible reason here may be that with age, assets deplete, for example, land decreases upon inheritance by children. These results are consistent with the study of Gyekye and Akinboade (2001) and Sabir *et al*. (2006). However, it contradicts that of Ayalneh and Korf (2009), which stated that older households have greater likelihood of being non-poor.

Factor 3 (which represents farmers with larger land holdings and dependent on crop farming as a source of livelihood but lack confidence about what the future holds) is also positively correlated with poverty and significant at 5% level. This means that the probability of being poor increases by a factor of 1.068 for these households keeping other factors constant. This shows that lack of confidence, which is one of the components of positive psychological capital, may also play a significant role in determining poverty regardless of the size of land that the farmer might have.

Factor 4 (which shows households with many dependents who rely mostly on income from social grants) has a positive correlation with poverty and significant at 1% level. This means that the probability of being poor increases by a factor of 1.374 for these households keeping other factors constant. This ratio allows one to measure the burden weighing on members of the labour force within the household. It is also in agreement with findings of Cruz and Ahmed (2018) and Sinnathurai (2017), which stated that poverty is more likely to be associated with large households with a high dependency ratio.

Factor 5 (which shows farmers well-endowed with financial assets who are resilient, not afraid to take calculated risks, optimistic and confident) is negatively correlated with poverty and significant at 5% level. This means that the probability of being poor decreases by a factor of 0.906 for these households when keeping other factors constant. These are households that are well equipped with all the four components of positive psychological capital coupled with capital assets endowment. Farmers who are resilient, optimistic and confident in farming have the hope and power to affect their success in farming.

Similarly, factor 7 (which represents farmers who are again well-endowed with all aspects of PsyCap and social capital, and rely much on income from irrigation farming)

is negatively correlated with poverty and is significant at 10% level. Again, this means that the probability of being poor decreases by a factor of 1.918 for these households when keeping other factors constant. Factor 6 was not found to be significant in determining the poverty status.

CHAPTER SIX

RESEARCH SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary, conclusions and recommendations of the study. The chapter begins with summary of the study, which includes key aspects of the study and significant findings in section 6.2. It is followed by the conclusions drawn from the findings of the study in section 6.3. Section 6.4 provides the recommendations and a proposed framework based on the findings and conclusions of the study. Lastly, section 6.5 provides concluding remarks on the contribution of the study, limitations of the study and future research areas.

6.2 Summary

The research problem was based on the many claims (most of which are indicated in the introductory and the literature review sections) made by scholars that access to irrigation water may positively affect poverty reduction, and from the South African government to support smallholder farmers with irrigation infrastructure. Numerous studies within and outside South Africa have shown that irrigation may reduce poverty among smallholder farmers participating in irrigation schemes. However, literature is diverse when it now comes to actual determinants of poverty reduction among these farmers, hence there was a need to do an analysis of the farmers who do not use irrigation to see if there was a significant difference in terms of poverty incidence.

The aim of the study was to determine the impact of smallholder irrigation schemes towards poverty reduction among rural households in the Vhembe and Sekhukhune districts of Limpopo Province. The objectives of the study were to:

- Profile the socio-economic characteristics of smallholder irrigation farmers.

- Determine the contribution of smallholder irrigation schemes towards the poverty reduction of smallholder irrigation farmers.
- Investigate the contribution of smallholder irrigation schemes to women empowerment.
- Explore the effect of positive psychological capital assets on the poverty reduction among smallholder irrigation farmers.
- Determine the impact of smallholder irrigation schemes towards the poverty reduction of smallholder irrigation farmers.

Chapter 1 of this study provided the background and motivation of the study, identified the research problem, stated the aim and objectives of the study, as well as the significance of the study. Chapter 2 was a literature review on the study under investigation whereas Chapter three covered the methods used in analysing the data that was collected. Both Chapters 2 and 3 covered conceptual frameworks and empirical findings of the past studies which were relevant to the topic of this study. Chapter two focused on the role of irrigation farming in the livelihoods of farmers. This was also coupled with the review of literature on the role of irrigation towards women empowerment and the role that positive psychological capital has on poverty reduction.

The study followed a quantitative approach where the sampling process involved both stratified and purposive techniques to select the irrigation schemes as well as participants of the study, respectively. The study was undertaken in Limpopo Province from two districts, Vhembe and Sekhukhune. 300 smallholder irrigation users were engaged for data collection purposes. An additional sample of 150 smallholder farmers who were not members of the irrigation schemes were also

engaged. The principle of informed consent was applied to ensure full cooperation and adequate knowledge of the study among the respondents. The study also followed a protocol and procedure to get approval from all relevant bodies in relation to this study. Protocol and procedures enforced to combat the spread of the Covid-19 pandemic were also followed during the researcher's engagement with the respondents. The following section describes the key findings of the study in relation to the objectives of the study.

6.2.1 The contribution of irrigation schemes to livelihoods of farmers

The findings from interviews and group meetings held indicated that farmers who use irrigation are more likely to be better off in terms of welfare when compared to their non-irrigator counterparts. This was evinced by the contribution that smallholder irrigation had on (1) increasing the yield with regard to the crops that farmers were producing, (2) increasing incomes of farmers using irrigation, (3) increasing the value of household assets that irrigation farmers own, and (4) improving the employment opportunities for other households, especially by or within farmers who use irrigation. Irrigation proved to be significant in all these indicators as all of them contributed positively to the livelihoods of farmers.

6.2.2 The contribution of smallholder irrigation towards women empowerment

- In order to investigate the contribution of irrigation towards women empowerment, the study used the Women Empowerment Agricultural Index, focusing on the following aspects: the use of income, access to productive capital, access to credit, leadership roles and decision making in the irrigation schemes.
- An individual was identified as empowered on the basis of the 'five domains

of empowerment' (5DE), that is, the domains used as indices of empowerment if there are adequate achievements in four of the five domains or if they enjoy adequacy in some combination of the weighted indicators that sum up to 80% or more, or if they have an adequacy score of 80 or above.

- It was found that women in the study areas reflect empowerment adequacy in only two indicators, leadership role and decision making, and disempowerment in three indicators. The influence of the socio-economic characteristics and empowerment model was estimated using a linear regression. The results further predicted 38% of the variation in socio-economic characteristics**.**
- Four out of thirteen independent variables were significant; with three variables being significant at 10% (expenditure, marital status and the use of drip irrigation system); while only one variable was significant at 5% (use of micro irrigation system). Expenditure and marital status were negatively significant while use of drip and micro irrigation systems were positively significant.

6.2.3 The effect of positive psychological capital assets on poverty reduction

- A number of analyses were conducted to capture the effect of psychological capital on poverty reduction. Principal components analysis was conducted on the PsyCap dimensions and on the livelihood dimensions. Factors were extracted from both analysis and these were used as variables in the Binary Logistic Model.
- The results for psychological capital of farmers were obtained a using 5-point Likert scale that was administered on the sampled farmers. This was used to check if farmers exhibit positive or negative psychological capital which could

directly and indirectly influence farmers' decisions and actions towards irrigation farming. There were four psychological constructs, with each construct having 3 questions ranked on a 5-point Likert scale. The scores 1, 2, and 3; and 4, 5 showed that farmers are more likely to exhibit negative, neutral, and positive psychological capital behaviour towards irrigation farming.

- The results show that a significant number of farmers possess positive psychological capital assets as they satisfy the three components of PsyCap (i.e., hope, confidence and optimism). However, a lot of farmers did not seem to possess the 'resilience' component, meaning this group of farmers was not well equipped with the capacity to cope well with shocks, and being financially stable to take up risks.

6.2.4 Determinants of the impact of irrigation schemes on poverty reduction

- The Binary Logistic Model was used to analyse the determinants of poverty. The determinants used included women empowerment index, irrigation use, and 7 factors that were extracted from the PCA for both PsyCap and livelihood dimensions. PsyCap dimensions were obtained using a combination of hope, confidence, resilience and optimism.

- Household livelihood dimensions used a combination of age, gender, education, source of income, land size, capital and social asset endowment, household size and dependency ratio. The results showed that eight out of ten variables used in the model were significant in determining poverty.

- From these eight variables, four were negatively correlated with poverty (This means the probability of being poor decreases) and the other four were

positively correlated with poverty (This means the probability of being poor increases). However, the most important result was that irrigation use has been found to be significant and negatively correlated with poverty, meaning access to irrigation improves the chances of farmers being non-poor.

6.3 Conclusions

According to the findings from theoretical analysis and empirical results, smallholder irrigation schemes (together with the presence of positive psychological capital among smallholder farmers) have played a positive role in poverty reduction among smallholder farmers in the Vhembe and Sekhukhune districts of Limpopo Province. It increased the yields of many farmers as well as their incomes and assets endowment. However, given the high number of women participants in the sampled irrigation schemes, women empowerment remained a challenge in these districts, requiring urgent intervention. The conclusions drawn from the findings are as follows:

- Smallholder irrigation technologies look promising for farmers practicing crop production, particularly those producing vegetables (tomatoes, cabbage and spinach). It can contribute to meaningful socio-economic development, especially in rural areas where most people depend on farming for their survival.

- Results of the study have shown that farmers could gain financially, and thereby redeem themselves from poverty as well as improve their social conditions. Vocational training and participation of the younger generation in irrigation farming can be critical for farmers to benefit fully from smallholder irrigation.

- The roles that SIS played were seen in terms of increasing production, income, assets, and employment opportunity, as well as poverty reduction. Both the

descriptive and econometric analysis showed that irrigation use has a positive effect on farm production, income, asset endowment, and employment opportunity and poverty reduction. Thus, it is pertinent to conclude from this study that irrigation development helps to increase household income and reduces the incidence of poverty at the household level.

- It can benefit the poor through raising yields and production and nonfarm employment. However, the economic performances of irrigation systems in the study areas were constrained due to financial shortages. Therefore, using this evidence, we can reject the two null hypotheses that irrigation schemes do not contribute towards poverty reduction among smallholder irrigation farmers, and that smallholder irrigation schemes do not have any impact towards poverty reduction among smallholder farmers.

- In endeavours to improve the performance of smallholder irrigation farming, a special approach is needed in the form of the concept called PsyCap. The lessons from behavioural economics are found to be of special relevance in this regard. The farmers' mindset is one critical resource that determines farming decisions and behaviour, hence it influences the entrepreneurial spirit/attitude towards their farming operations. Although changing farmers' mindset can take time, it is an essential step towards unlocking on-farm entrepreneurship among participants in the irrigation schemes. Positive psychology towards irrigation farming has proven to be key for the success of many farmers in the study areas. Therefore, the null hypothesis that positive psychological capital has no effect on poverty reduction among smallholder irrigation farmers can be rejected as this was proven otherwise.

- The study has highlighted that many women have their livelihoods built around enterprises practised on the irrigation scheme and their access to livelihood assets for such livelihood activities were enhanced by the scheme. However, the indices for women's empowerment revealed that women were empowered in terms of leadership and decision making but disempowered in relation to use of income and access to productive capital. Factors identified as influencing the level of women's empowerment were expenditure, the use of drip and micro irrigation, marital status and age. Therefore, for the success of irrigation schemes, old-aged women can make way for the youth so as to improve the efficiency of the schemes. Married women are also less likely to be empowered because their husbands may take part or have a say in the decisions taken in the scheme. Following that many empowerment indices showed that women were disempowered, we can then accept the null hypothesis that smallholder irrigation schemes do not contribute towards women empowerment in the sampled schemes.

6.4 Policy Recommendations

The study proposes the following recommendations based on the findings from its analysis:

Improving the performance of smallholder irrigation schemes

Even though the study found that irrigation had a significant impact on food security, there were still other irrigating farmers who faced food insecurity problems. To significantly improve food security, there is need to increase the area under irrigation. The average land size of the farmers has been deemed inadequate to meet food security needs of households. The other way round is to increase the number of times

crops are grown in a year up to the level that meets household food requirements. This can be done through the use of high yielding varieties (crops) with a shorter mature period. There is a need to conduct a similar study using panel data so that changes can be observed over time. There is also a need to encourage farmers to participate in irrigation agriculture because this study has found small scale irrigation to be poverty reducing, crop productivity enhancing, crop income raising, and has the potential to improve food security. Government with the assistance of private organisations needs to construct irrigation infrastructure for farmers.

Given the increasing water scarcity problem that South Africa is facing, farmers, the Government, and private organisations have an equal responsibility in ensuring improved water values in the smallholder farming sector. The government needs to implement sound strategies to enable farmers to productively use irrigation water because the gross margins attained clearly indicate poor return on the investment in irrigation infrastructure.

Farmers have to take responsibility in collectively managing the irrigation schemes. Transformation in policies and institutional processes is required in how the Government and private organisations offer services to farmers in order to eliminate the dependency syndrome that has (over the years) resulted in negative psychological capital. For example, the Government has been handing out inputs and cash to farmers, instead of enabling them to be self-reliant. The Government's responsibility should focus on providing public goods and services such as infrastructure development (roads, electricity, communication infrastructure, etc.) so that farmers can have better access to markets.

Increase the psychological capital endowment of smallholder farmers

It is recommended that the Government should reconsider the usual model of 'hand-outs' (inputs, finance, etc.), which has entrenched a dependency behaviour. There is a need to re-visit direct farmer support by being more heavily involved in their day-to-day activities (i.e., purchasing inputs, running the irrigation schemes on their behalf, etc.). The strategy should rather look forward and aim to enable farmers to change their behaviour to be self-reliant and own their own destiny through on-farm and off-farm economic activities. This will reduce their dependency. The results indicated that, among other proxies for human capital, experience is a significant factor in influencing water values. Hence, experienced farmers can transfer skills through various means such as workshops, where platforms with successful farmers can be created for experience sharing and motivation which will build confidence, hope, optimism, and resilience and directly increase the level of social capital among farmers and the community at large.

According to the results of the study and conclusions reached, scheme irrigators achieved better levels of water values compared to non-scheme irrigators since they are transacting in groups as cooperatives which have enabled them to bargain and receive more support in terms of accessing training, inputs, and services. The results show that social capital is vital in the collective management of irrigation water use. It can be recommended that home and community gardeners and independent irrigators should run their farming operations collectively in small groups (through purchasing inputs and selling output collectively in order to be able to supply in large quantities). This can directly address land size challenges. Building trust for collective action is key to building institutions and groups set up to achieve common objectives and enabling farmers to take advantage of collective bargaining, input, and output price negotiations, reaping the benefits of economies of scale and reducing transaction costs of accessing inputs and services.

The study stressed the need to promote women's participation in decision-making (i.e., in smallholder irrigation schemes) for water management and also suggested ways in which women's access to water can be improved through equitable development. This can be enforced by the Government since they are the initiator of smallholder irrigation schemes. The study also proved that women in both districts received very little training with regard to extension services and vocational training. Therefore, government should strengthen the human capital for women through provision of adequate extension services and vocational training.

There is a need to conduct situation analyses of the individual SIS in order to come up with major themes in terms of constraints, and then address the specific problems with the participation of resident farmers. Finally, there is a need to conduct a study on the measurement and role of PsyCap in rural livelihoods using other methods such as revealed preference approach, experimental economics and behavioural economics.

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APPENDIX A: STUDY QUESTIONNAIRE

All information in this questionnaire is strictly confidential and will be used solely for research purposes by the researcher and enumerators at the University of Limpopo working on this project **"The impact of smallholder irrigation schemes on poverty reduction among rural households of Vhembe and Sekhukhune Districts in Limpopo province, South Africa"**. There is no wrong or right answer to these questions. You are free to be or not part of this survey and you can withdraw from the survey anytime you feel like doing so. However, your cooperation is greatly appreciated.

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

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

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

A. HOUSEHOLD DEMOGRAPHICS

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

A8	Number of household members 65 years and above	

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

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

B. INCOME AND CREDIT

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

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

If yes, complete the table below

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

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

Complete the table below on sources of household income

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

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

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

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

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

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

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

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

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

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

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

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

Complete the table below on livestock ownership

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

C. CROP PRODUCTION AND MARKETING

Land ownership and tenure issues

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

C4. Generally, are you satisfied with the present security of ownership of the land you are using?
1=Very unsatisfied 2=Unsatisfied 3=Neutral 4=Satisfied 5=Very satisfied

C5. Do you find it difficult to make land use decisions due to the current land ownership system?
1= Yes 0= No

C6. If Yes, please give details

_____

_____

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

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

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

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

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

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

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

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

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

_____

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

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

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

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

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

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

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

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

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

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

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

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

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

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

_____

_____

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

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

_____

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

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

D. SKILLS AND TRAINING

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

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

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

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

_____

_____

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

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

E. WATER AVAILABILITY AND IRRIGATION

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

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

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

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

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

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

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

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

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

_____

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

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

F. PSYCHOLOGICAL CAPITAL

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

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

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

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

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

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

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

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

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

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

Complete following questions regarding interest to expand irrigation farming operations

F7. If an opportunity arises, are you interested in expanding your farming operations, i.e. moving into small-scale irrigation (including increasing plots in the irrigation schemes)

1=Not interested at all 2=disinterested 3=Neutral 4=Interested 5=Very interested

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

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

F9. If you interested in expanding farming operations, what are the factors holding you up?

*1=financial constraints 2=land availability and security constraints 3=Lack of access to inputs and machinery 4= Water availability constraints 5= Market constraints 6= Local and political constraints 7=Other (specify)*_____ ***(multiple answers possible)***

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

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

_____

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

_____

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

F14. How interested are you in being part of a collective institution governing water use?

1=Not interested at all 2=disinterested 3=Neutral 4=Interested 5=Very interested

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

F16. How interested are you in taking part in training in collective management of irrigation scheme?

1=Not interested at all 2=disinterested 3=Neutral 4=Interested 5=Very interested

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

Complete table on the entrepreneurship characteristics of the farmer

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

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

G. SOCIAL CAPITAL

Are you a member of any of the following groups?

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

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

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

APPENDIX C: FGD CHECKLIST

Focus group discussion checklist of guiding questions

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

For scheme irrigators only

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

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

THANKS FOR YOUR PARTICIPATION