# DETERMINANTS OF LIVELIHOOD STRATEGIES AMONG SMALLHOLDER FARMERS ON IRRIGATION SCHEMES IN THE NORTH-WEST PROVINCE, SOUTH AFRICA

## By

## ABONGILE BALARANE: 18006663

Master of Science (MSc) in Agricultural Economics (2013)

Bachelor of Science (BSc) Honours in Agricultural Economics (2011)

Bachelor of Science (BSc) in Agricultural Economics (2010)

Thesis submitted in partial fulfilment of the requirements for the Degree

Doctor of Philosophy in Agriculture (Agricultural Economics)

**Department of Agricultural Economics and Extension**

**Faculty of Agriculture, Science and Technology**

**North West University**

**PROMOTER: PROFESSOR O.I. OLADELE**

**CO-SUPERVISOR: PROFESSOR M.A. ANTWI**

**NOVEMBER 2015**

# DECLARATION

I, Abongile Balarane, declare that the thesis entitled "**Determinants of livelihood strategies among smallholder farmers on irrigation schemes in the North West Province, South Africa**", hereby submitted for the degree of Doctor of Philosophy in Agricultural Economics, has not previously been submitted by me for a degree at this or any other university. I further declare that this is my work in design and execution and that all materials contained herein have been duly acknowledged.

Date…………………………………………………

Student signature……………………………………

Abongile Balarane

# ACKNOWLEDGEMENTS

# ABSTRACT

*The study assessed determinants of livelihood strategies among smallholder farmers involved on irrigation schemes in the North West Province of South Africa. The study was conducted in three districts of the North West Province namely: Dr Ngaka Modiri Molema District, Bojanala District and Dr Ruth Segomotsi Mompati District. A structured questionnaire was used to collect data from 149 farmers involved in all the irrigation schemes of the North West province and those practising irrigation farming adjacent to the schemes. The data was entered into Microsoft Excel and later transferred to the Statistical Package for Social Sciences (SPSS) for analysis. Frequency counts, percentages, mean standard deviation, Multinomial Logit and Probit regressions were used to analyse the data. The results of the study revealed that the majority of respondents were females and aged above 50 years, married, Christians. Their highest level of education is primary school. The irrigation land is owned by the Chief and farmers are therefore unable to use the land that they farm on as a colateral to access production loans from commercial banks. Farmers highly rely on government grants in order to produce on their land. Majority of the farmers lease out their lands in order to have household monthly income, while others participate to other non-farm activities such as working in the mines or run own business. Although farmers participate in other non-farm activities, agriculture (42.3%) is the most preferred livelihood option amongst the respondents followed by non-farm activities (36.9%) or combination of agriculture and non-farm strategies (20.8%). The Multinomial Logit regression was used to determine choice of livelihood among farmers. Significant variables for the choice of agriculture as a livelihood startegy from agriculture, non-farm and a combination of agriculture and non-farm livelihood strategies significant variables were age, farm size, financial index, extension contact and gender. Significant variables for the choice of agriculture as a livelihood startegy from non-farm and agriculture using probit regression were age (Z=2.814), social index (Z=2.004) and extension contact (Z=-3.056). Significant variables for the choice of non-farm as a livelihood strategy from agriculture and non-farm using probit regression were age (Z=4.679), input (Z=-2.747), total income (Z=-5.113), expenditure (Z= -2.116) and education (Z=-1.883). Ten variables were insignificant. .* **Keywords:** Smallholder farmers, irrigation schemes, livelihood strategies, diversification, livelihood capitals

TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# LIST OF ABBREVIATIONS AND ACRONYMS

DFID:                      Department for International Development

FANRPAN:                   Food Agriculture and Natural Resource Policy Analysis
Network

FAO:                        Food and Agriculture Organisation

GDP:                       Gross Domestic Product

ICID:                      International Commission on Irrigation and Drainage

IFAD:                      International Fund for Agricultural Development

IFPRI:                     International Food Policy Research Institute

IFSS:                      Integrated Food Security Strategy

LA:                        Livelihood Approach

NWU:                       North West University

SPSS:                      Statistical Package for Social Sciences

TFP:                       Total Food Production

UNDESA:                    United Nations Department of Economic and Social Affairs

USA:                       United States of America

**CHAPTER ONE**

1.0                                    **INTRODUCTION**

## 1.1     Overview of smallholder agriculture and irrigation in South Africa

South Africa is regarded as one of the most prosperous and diverse countries in Africa. It has an exciting culture and a magnificent range of vegetation types, biodiversity, climate and different types of soils. South Africa's agricultural sector is economically dualistic by nature with a large number of smallholder farmers and few commercial farmers. The country is divided into different regions with areas that are favourable for summer and winter crops, while other regions are suitable for livestock farming (Van Rooyen & Howard, 1998). The commercial agricultural sector is characterised by resource-based farmers who have easy access to factors of production. They practise large-scale farming and majority of the farmers own the land which gives them more advantage to access formal financial institutions.

The subsistence sector is characterised by traditional methods of farming, low literacy levels, small land for farming, no easy access to formal financial institutions and in most cases, no access to formal markets and value chains. In terms of agricultural comparison with other countries, South Africa is a net importer of agricultural commodities such as beef, poultry and wheat, among others. It is also a self-sufficient country with high potentials of exportable commodities such as maize, sugar, wine, grapes and citrus. One of the major values of agriculture is that it plays a critical role on livelihoods, employment, income growth, food security, poverty alleviation, socio-economic development and environmental sustainability in most developing countries (Upton, 2004; IFPRI, 2005; World Bank, 2008; Gollin, 2010; Pingali, 2010). In low-income countries, the majority of people live in rural areas (UNDESA, 2012) and the poor are rural smallholder farmers who primarily depend on agriculture for their livelihoods (World Bank, 2008; Gollin, 2010; Salami *et al*., 2010). This implies that developments in agriculture can have far-reaching direct effects in uplifting the lives of the poor. However, many developing countries have not fully utilised agriculture in terms of its multiple functions (Pingali, 2010).

There has been a lot of changes that took place within the agricultural sector of South Africa however smallholder farmers who constitute the majority of rural poor do not yet benefit from agriculture. This is because they practise subsistence farming which excludes access to formal markets and income-mediated benefits. Balarane and Oladele (2011) maintain that one of the major constraints that limit smallholder farmers in accessing formal markets is the awareness and use of agricultural market information. Smallholder farmers in most rural areas are likely to be very old adults with little or no literacy level. Apart from the low literacy level of smallholder farmers, it is also possible that access to formal markets may not necessarily be a major issue. However, quality and quantity may also be factors that could discourage smallholder farmers from accessing formal markets.

The term smallholder is used to refer to farmers in the subsistence sector. These are the bulk farmers and in most instances, they are measured in millions while commercial farmers are measured in thousands (Hall, 2010). There are numerous ways of defining smallholder farmers in South Africa. Smallholder farmers are resource-poor farmers with small production land, low literacy levels, traditional farming methods, no easy access to formal markets, no easy access to financial capital, low entrepreneurial skills, poor access to value chains, high reliability on government support and the majority farm on communal land that belongs to tribal authorities.

In South Africa, the term smallholder farmers is sometimes viewed negatively. Smallholder farmers are classified as farmers who cultivate small pieces of land for their own consumption and in some cases, sell the surplus. In some instances, they are considered as farmers who are on communal land in an effort to become commercial farmers. Such farmers are found in the former Bantustans or homelands. Smallholder farmers are generally associated with the majority and most black farmers are considered as smallholders. These farmers rely on traditional farming methods and the majority of such farmers have low literacy levels and are unable to produce for commercial markets. This type of farmers generally do not have any legal document such as title deeds to indicate land ownership, the land that they occupy belongs to tribal authorities (Kirsten & Van Zyl, 1998). In terms of size, smallholder farmers relate to irrigation farming through the allocation of small plots in South Africa. These plots vary in size (between one and ten hectares).

The irrigation schemes in South Africa were firstly introduced in the early 1900 soon after the arrival of European settlers. Most of irrigation schemes started after the report of the Tomlinson Commission on the socio-economic condition of Bantustans. The report exposed settlement, land use patterns and irrigation development in black rural areas. Today, irrigation schemes found in the former homelands of South Africa are the legacy of the former apartheid regime. These irrigation schemes were developed for the majority of black people in the former homelands by the government. In terms of land under irrigation, South Africa has an estimated 1.3 million hectares of land that is used by both smallholders and commercial farmers (Perret, 2002a). Irrigation schemes are of importance in the former homelands, as they were initially developed as the main source of livelihoods for black people. In these areas, irrigation schemes have a significant potential in contributing to food security, income and are the main economic activities in areas where they are found (Lipton *et al.*, 1996). In the former homelands today, irrigation farming is the dominant source of livelihood strategy for rural households. Majority of households in some areas where mining is minimal, rely on irrigation farming for a living and to meet their household needs.

## 1.2    Analysis of sustainable livelihoods framework

Using livelihoods framework to measure the livelihood strategies of people in any area, a key issue that needs to be addressed, in most instances, is to consider the history of the people in that particular area, and understand the nature of resources at their disposal. A combination of available resources should include the different types of capital and what livelihood option these individuals can undertake. The choice of one livelihood strategy from another usually depends on the availability of resources (different types of capital). A combination of the different types of capital determines the livelihood of people (Scoones, 1998).

Figure 1: Sustainable livelihoods framework

Source: Adapted from DFID (2000)

The term livelihood is mostly used in studies that deal with the plight of rural people, their development or poverty-related writings. The term is defined differently according to the context in which it is used. According to Chambers & Conway (1992), livelihood comprises of the assets or means (physical and social assets) and all other activities that are essential and when combined, one can make a meaningful living out of them. According to Scoones (1998), livelihood assets refers to the means that people have access to such as: physical capital (storage facilities), irrigation infrastructure, financial capital (access to credit from banks and other lending institutions, including grants), natural capital (access to land), water and other natural resources, human capital (knowledge), skills development and labour, as well as social capital (networks and cooperatives). Vulnerability refers to issues such as structural changes in the economy, shocks that may occur such as natural droughts and seasonality. These cannot be controlled by human beings as they occur based on the state of the economy.

The focus of livelihood strategies is on the combination of all resources at the disposal of people. The combination of such resources determines the type of livelihood available to the people. Livelihood outputs are based on livelihood strategies such as improved incomes, well-being that includes access to health, improved household food security and improved financial capital in order to buy property and other assets such as farm inputs (DFID, 1999).

## 1.3    Problem statement

A livelihood strategy is defined as the combination of available resources in order to make a choice of living. These are planned activities by both men and women to achieve livelihood outcomes (Ellis, 2000). Since 1994, smallholder irrigation farmers have been the priority of government in its development strategies of rural-based people. In terms of numbers, these farmers are quantified in millions while commercial farmers are in thousands. In order to meet the demand of food for the population. The country depends mainly on production coming from the commercial farmers. Currently the population is growing at an estimated two per cent and this puts more pressure on the demand for agricultural commodities. This, consequently, can create an increase in the price of food, food insecurity and poverty within the society. The rural population is mostly constituted of smallholder farmers, yet they have no access to financial, physical and human capital. Smallholder farmers have always received a negative image in terms of their description, or classification in South Africa. The overall perception of this group of farmers is that their primary objective is to produce for their own families and in some instances, sell the surplus.  In many African countries for instance smallholder farmers are the backbone of the economy. Taking Botswana as an example the agricultural sector is dominated by smallholder farmers who are able to produce quality beef that meets the demand of export markets. The role of government in most instances is to organise the agricultural sector in order to enable all participants to benefit equally or better. Dorward *et al.* (2009) state that the level of natural resource endowment (high or low), level of poverty (poor or less poor) and local market opportunities determine the livelihood strategies and aspirations of farmers. From the identified enterprises which determine the livelihood strategies of farmers, it is important to maximise production capacity and improve market opportunities in order to meet the livelihood aspirations of farmers (based on resource endowment and allocation of resources).

Rural people participate in a number of livelihood activities such as agriculture and small businesses. They are at times employed in other sectors of the economy in order to ensure household food security. However, these people experience severe poverty and food insecurity. Rural people participate in different activities in order to ensure household food security. Policy makers have always ignored the contribution of the diversification of rural livelihood strategies (Carswell, 2000). Thus, an understanding of rural people and their alternative livelihood strategies is essential to transforming and changing their lifestyle. It is important to encourage rural people to build their livelihoods based on available resources rather than relying on untested assumptions about their livelihoods. In the former homelands of South Africa, rural households (in the old government) were allocated small plots to carry out agriculture as an alternative source of livelihood. These households relied essentially on these small plots for a living and irrigation farming is still largely practised in some former homelands. Government has continuously supported irrigation farmers in terms of infrastructure and the maintenance of schemes, in order for farmers to be able to produce their own food and meet their household needs. This study determined choice of livelihood strategies among smallholder farmers on irrigation schemes in the North West Province, South Africa.

**1.4      Research questions were:**

The following research questions were asked:

What are the socio-economic profiles of farmers on irrigation schemes?

What are the livelihood strategies pursued by farmers?

What are the factors considered by these farmers in choosing a livelihood strategy?

What are the constraints faced by farmers in choosing a livelihood strategy?

**1.5      Objectives of the study**

**1.5.1   Main objective**

The main objective of the study was to analyse determinants of the choice of livelihood strategies among farmers on irrigation schemes in the North West Province, South Africa.

**The subsidiary objectives of the study were to:**

- describe the socio-economic profiles of farmers;
- assess livelihood strategies adopted by different farmers on irrigation schemes
- identify determinants of the choice of livelihood strategies by farmers; and
- Examine constraints faced by farmers in choosing livelihood strategies.

## 1.6    Hypothesis

Null Hypothesis = Ho: There is no significant relationship between socio-economic profile and choice of livelihood strategies among smallholder farmers involved in irrigation schemes.

## 1.7    Significance of the study

The results of this study could contribute to knowledge from the discussions. Results of the study could also assist government in terms of designing policy frameworks for smallholder farmers involved on irrigation schemes, and also broaden knowledge on challenges faced by farmers. In addition, the findings of this study would also assist academia and researchers with in-depth knowledge and understanding of the dynamics faced by smallholder irrigators in the North West province.

## 1.8    Definition of terms

**Diversification:** A phenomenon practised by human beings, to change from one lifestyle to another based on available resources.

**Financial capital:** Access to credit, be it from formal or informal institutions.

**Human capital:** Refers to vocational training, access to extension services and skills equipment that include; record-keeping, water management, soil management, crop protection and soil management.

**Irrigation scheme:** An area of land under irrigation infrastructure utilised for agriculture and favoured by adequate access to water resources.

**Livelihood:** Includes capabilities, assets (stores, resources, claims and access) and activities required for a living.

**Livelihood strategy**: A choice of livelihood adopted by farmers based on available resources either, agriculture, non-farm or a combination of agriculture and non-farm.

**Natural capital:** In this study, natural capital refers to land and natural resources which farmers have the right to occupy.

**Physical capital:** Referred to access to bulk infrastructure such as roads, markets and storage facilities such as silos.

**Smallholder farmers:** Peasant resource-poor farmers characterised by low literacy levels, small-scale production and with small plots of land, sometimes produce for their own consumption and sell the surplus.

**Social capital:** This includes all social resources such as social network, which households can rely on in order to achieve their goals.

## 1.9 Outline of the study

The study is divided into five chapters as follows: Chapter 1 presents the introduction, the research problem, aim and objectives of the study as well hypothesis. Chapter 2 is the literature review (both national and international). Chapter 3 outlines the methodology used in conducting the study. Chapter 4 focuses on the analysis and interpretation of the results obtained in the study. Percentages, frequencies, tables, graphs and the probit regression are used to analyse and present the data. Chapter 5 presents the major findings, conclusion and recommendations.

## 1.10    Summary of chapter

This chapter has provided an overview of agriculture within the Southern African context. It also provided a definition of smallholder farmers, discussed the livelihood concept and approaches in measuring livelihood strategies. The research problem, objectives, research questions, the aim and objectives of the study were also discussed in this chapter. The next chapter is the literature review.

# CHAPTER TWO

## 2.0           LITERATURE REVIEW

## 2.1     Introduction

This chapter reviews literature on the determinants of livelihood strategies of smallholder farmers involved in irrigation schemes. The following aspects are discussed in the review: the livelihood concept; rural livelihoods in South Africa; livelihoods and food security in South Africa; sustainable rural livelihoods; contribution of smallholder and subsistence agriculture to food security; the impact of irrigation on poverty reduction; and challenges faced by irrigation farmers.

## 2.2     The livelihood concept and rural livelihoods in South Africa

The term livelihood refers to a combination of available resources or capabilities and all other activities required to make a living. A livelihood can be sustainable for the next generation and contribute to both local and global levels if capabilities and assets are adequately provided. It can also survive shocks and recover from stress when opportunities are available. Ellis (2000) states that livelihoods comprise of assets, activities and access to the combination of other factors that together determine the living gained by households or individuals. Households attempt to diversify their livelihood strategies by optimising the use of their capabilities and assets. According to (De Satgé, 2002), a household with more assets can easily cope compared to less fortunate households. This creates a safety net for households. When household diversify their livelihoods, they can also combine their salaries or any other income obtained outside their livelihood strategy. Households choose a livelihood strategy based on the combination of resources at their disposal. These resources are as follows: human capital (education and skills); social capital (which focuses on network and group cooperatives which a household can use to attain its goals for survival); natural capital (which includes access to land, water and other natural resources); physical capital (access to infrastructure such as roads, transport and markets); and financial capital (access to credit, saving and other grants).

Economic, political and social factors played an important role in changing the livelihood of many black people in South Africa. Before 1994, black South Africans were limited in terms of livelihood options to undertake. Majority were involved in farming, employed in the mining sector or working as domestic workers. These factors forced Africans to undertake different livelihood strategies in order to survive. Black South Africans were forced to reside in rural areas and townships, with only one capital at their disposal (land). Diversification of livelihoods was a common phenomenon among black people, especially when livelihood based on agriculture was stressed. Since there was a huge demand for labour from white-owned businesses, black people had to move away from agriculture and become labourers, especially in the mines.

This became important for the white majority as they were able to secure cheap labour from desperate black people. This act was supported by the government of the time through legislation that forced black people to provide cheap labour for the white rather than earn a living from subsistence farming (Bundy, 1988). The imposed legislation came with numerous forms of taxes and created a need among black people to demand more income. There were restrictions imposed on black people not to own more land in order to make a living from farming. Yawitch (1982) maintains that the majority of people who left their families behind were males, migrating from villages to the cities for employment. The movement of males from their homelands to the cities to look for employment affected traditional settings which ensured that males involve in agriculture in order to produce sufficient food for their households.

This situation left the women helpless and desperate as they were unable to continue producing food for their families while their men were away. Today, majority of irrigation schemes are predominantly run by women. The incomes generated from non-farm activities was very important for the men. When they (the men) returned from the mines, they were able to buy one or two cows from the money saved during the year, contribute significantly to other household needs and send their children to school.

After 1994, a democratic South Africa was born and black people were given equitable opportunities as white people. Government introduced a number of policies that also supported agricultural incomes as well as non-farm incomes in the form of old age grants. Today, there is also what is commonly referred to as child support grant. These policy changes have made black people to now stay in their homelands as it is rare to find a household without a family member who is receiving child support or old age grant (Van Averbeke, Bediako *et al*., 1998). If people have access to livelihood capitals to meet their present needs, they will be assured that the future generation will be able to meet its needs. This has to go together with improved lifestyles for the less fortunate. Ellis (2000) states that livelihoods comprise of assets and activities. The ability to access them determines the standard of living of households or the lifestyle of individuals. Rural people move regularly between rural areas and towns or cities to seek employment, market their produce and buy manufactured products.

In order to diversify their livelihoods, especially if they have livelihood capabilities, rural families usually embark on small-scale irrigation as one of the options to supplement their income. The sustainable framework is designed in a way that it is be able to measure, analyse and have an insight on the different methods used by poor people to earn a living. For a livelihood to be sustainable, it needs to be supported by all interested stakeholders. For livelihoods that are dependent on irrigation schemes, the future and survival of such schemes depend on the farmers and government. In most rural areas of South Africa, irrigation farming is considered as a mine of diamonds and gold, most rural people rely on it as a source of living, and it is possibly one of the key drivers of livelihoods among the rural population. Participation of beneficiaries is essential in all the development stages of irrigation projects. According to Hoddder (2002), women are actively involved in irrigation projects and are the main drivers of household food security. The livelihood concept needs to be understood as it points out the main driving force behind it and provides an understanding of how people make a living from the assets at their disposal. Farming as a livelihood strategy has changed the lives of rural people throughout Africa in the past century.

## 2.3    Livelihoods and food security in South Africa

At the national level, South Africa is considered to be a self-sufficient country and has the ability to meet the growing demand for national food security. However, when this statement is narrowed down to the level of household food security, it is concluded that majority of people in South Africa are food insecurity, poor, living on low income levels and a high rate of people are affected by diseases such as HIV/AIDS (Department of Agriculture, 2002). Poverty, inequality and food insecurity in the country are the legacy of apartheid. Poverty in South Africa is not the same in all provinces. Some provinces are more affected than others, especially in provinces where there are high numbers of rural people (Limpopo, Mpumalanga, Eastern Cape and Kwa Zulu Natal). The most urbanised provinces have low numbers of people who are poor with no access to food. Poverty-stricken households rely on government grants to purchase food which does not take them for the entire month.

While in rural areas access to natural capital is not very limited, access to inputs, finance, markets and information is, however, the main concerns of smallholders in order to be able to produce sufficient food for their households. Households in urban areas that are food insecure are constrained by the inability to secure employment or generate income from other avenues such as small personal businesses. Poor households are characterised by low incomes, and many children rely on government grants for a living. Since 1994, government in South Africa has attempted to address challenges faced by black people through social programmes such as the School Nutrition Programme, Farmers Support Mechanisms that include comprehensive agricultural support programmes and transformation in the sector. However, little has changed in some parts of the country even though poverty is still the main issue among black people (Neves, Samson, Van Niekerk, Hlatshwayo & du Toit, 2009). After realising that majority of South Africans are food insecure, government introduced the Integrated Food Security Strategy (IFSS) aimed at addressing errors omitted during the apartheid era that left many blacks with no access to land and access to other resources. IFSS is a strategy structured around rural household food security. The vision of IFSS is aligned to that of the Food and Agriculture Organisation (FAO). Its vision is "to attain universal, physical, social and economic access to sufficient, safe and nutritious food by all South Africans at all times to meet their dietary and food preferences for an active and healthy life".

## 2.4    Non-farm income and livelihoods

The primary aim of cultivating and ploughing agricultural land is to generate income. It is also important for farmers to introduce the processing and transportation of goods and farm outputs   for additional income. The importance of non-farm incomes is clearly highlighted in many studies that support the development of smallholder farmers as indicated by DFID (1999). Rural households earn more than half of their income through diversification from agriculture to non-farm activities. Diversification is most likely to happen when there is scarcity of land for agricultural purposes takes.  Such diversification is driven by the need for households to cope with poverty and food insecurity (Haggblade, Hazell and Reardon, 2000).

Rosegrant and Hazell (1999) maintain that in South East Asia, there has some major experiences in terms of diversification - from agriculture to non-farm employment and income – due to the dynamic nature of economies. Many countries in Asia seem to be following Japan's strategy of generating more employment from the non-farm sector through industrialisation and retaining smallholder farms operating as part time enterprises. Even though agriculture is the dominant employer in South Africa, there is a growing movement of people or labour from agriculture to mining. People employed in the mines earn more than those in the agricultural sector. Due to inflation, people are attracted by the better wages in the mining sector and use this non-farm income to meet their household needs.

## 2.5    Overview of irrigation and history of irrigation schemes in South Africa

Irrigation farming refers to the area of land that has a comparative advantage of water throughout the seasons of the year. This area of land is usually used to grow cash crops and other high value crops. Artificial methods are used to provide water to the soil to ensure the growth of plants (Niekerk, 1995). Irrigation farming has been practised for centuries in most parts of the world for the production of food. Its initial purpose is to enhance productivity of cultivated land, particularly in areas with minimal rainfall. Rain water in normally collected in dams and channelled to the irrigation field through pivots. Vincent (1994) maintains that irrigation schemes or irrigated agriculture became the backbone for agricultural development, especially after the Second World War.

It is estimated that irrigation land increased tremendously in the early 50s, especially during the Green Revolution with the introduction of improved technology, improved yields, pesticides and fertilizers (Bhattarai, Sakthivadivel & Hussain, 2002). Prior to the dawn of the 20th century, it was estimated that irrigated agriculture occupied about 260 million hectares of land globally with improvements in most African countries where production seemed to be impossible without irrigation. An estimated 80% of irrigation farming in Africa is found in countries such as South Africa, Nigeria, Algeria, Angola, Libya and Sudan. Irrigation agriculture in these countries is supported by large rivers For instance, in South Africa, majority of irrigation schemes are found along the Orange and Vaal Rivers where there is access to water throughout the year (FAO, 1995).

The origin of smallholder irrigation schemes in South Africa could be traced back to the food security perspective. The two types of irrigation schemes recognised in the country are: Former Bantustan schemes that accounted for about 45 000 to 48 000 ha; and community schemes representing about 50 000 ha (Backeberg, 2006). The sizes of schemes dominated by smallholder farmers range from 1 to 10 ha, while farmers in the commercial sector occupy land sizes from 1 to 2000 ha. The objective of smallholder irrigation schemes was to enable rural people to produce food for personal consumption, while commercial schemes were set up for business-oriented activities. Schemes administered black people were never financially viable because they relied on government grants and money generated from the scheme has never been invested back into the scheme by the farmers (Perret and Geyser, 2007). Irrigation has always been the backbone of rural people in terms of producing food for personal consumption and for the rural population. Everywhere in the world, food is necessary for survival. Agriculture is the production of both livestock and crop production. Agriculture in many developing countries is the main and dominant employer. Farming is an old habit that has been practised from generation to generation. Smallholder farmers are considered as peasant farmers who practise farming activities through traditional farming methods, produce for personal consumption and sell the remainder to nearby people (Fraser & Van Averbeke, 2003). According to Lyne *et al*. (2009), irrigation farming offers possibilities for reducing risks of food shortage at all levels, increasing the overall supply of food, creating economic opportunities for vulnerable people and improving dietary diversity and the quality of food consumed by farm households.

Considering the importance of irrigation farming in the former homelands, there is a need to support and give priority to these schemes as they are the changing mechanisms of the livelihood strategies of rural people.

## 2.6    Role and contribution of smallholder irrigation to rural food security

Changing weather conditions have been experienced all over the world, and irrigation schemes have been contributing positively to control water resulting from flooding. The water is usually diverted to dams and stored to support crop production, especially during periods of drought. This enhances the production of food throughout the year and directly benefits farmers. It also acts as a significant contributor to employment. Andrew and Jackson (1996) maintain that irrigation land increased between the 1970s and the 1990s globally, however, the limiting factor has always been the expenditure involved in the construction phase of the schemes. In South Africa, certain areas are considered as food baskets of the country and favourable for irrigation farming. These areas include the Taung irrigation scheme, which is the biggest and the oldest irrigation scheme operated mainly by black smallholder farmers. In a study conducted on one of the most successful irrigation projects in Zimbabwe, Makumbe (1996) found that cash earned from the irrigation scheme assisted farmers in meeting their basic needs while others formed cooperatives to buy and share inputs such as included fertilizers.

Using a labour force survey, Aliber (2009) maintains that an increase in the number of rural households practising agriculture to supplement their incomes significantly increased between 2001 and 2004. The increase in the number of households practising agriculture as an additional source of income was driven by the growing demand for food, especially in villages scattered apart. Majority of rural people also identified a growing informal market for perishable cash crops. It is a well-known fact that subsistence agriculture has the potential to contribute to the food security of rural people, and such initiative will always depend on government support for survival. It is also necessary to acknowledge that smallholder irrigation schemes rely on women as they are the main drivers of such schemes.

Using China as an example, it is observed that the contributions of irrigation farming in terms of food security and poverty alleviation differ from one country to another. China made rapid changes in terms of achieving growth in food production and improving the standard of living of rural people. (Huang *et al*., 1999). China has been the net exporter of food since the 1980s until the start of the millennium when it became the net exporter of grains (Huang *et al*., 1999). In an effort to promote growth, food security and produce sufficient food for its people, the Chinese government has adopted as one of its strategies, to invest strongly in the control of water sources.

Through this effort, China has been able to successfully achieve sufficient food for its growing population. According to the National Statistical Bureau of China (2001a), investment on irrigation infrastructure has significantly contributed to rural livelihood and in reducing poverty among citizens. Higher crop yields are realised every season and the surplus exported, especially to Africa. Over the years, irrigation development has helped to lower food prices, creating employment and stability of farms in China (Lipton *et al*., 2003). Investment on irrigation has also increased incomes resulting in greater demand for non-farm goods and boosting other sectors of the economy through the multiplier effect of money. Although there has been a lot of investment in the irrigation sector resulting in improved productivity and in improving rural livelihoods, there have been some setbacks. Some have poorly managed the schemes, implemented them wrongly resulting in the wastage of resources. The positive impact is that it has contributed to the economic growth of many countries and improved the livelihoods of people.

## 2.7 Constraints faced by smallholder farmers involved in irrigation schemes

In the irrigation schemes, smallholder farmers face a number of challenges. Like any business that is still growing, funding will always be a challenge for the growth of the entity. Farmers involved in irrigation schemes are faced with challenges such as money to purchase variable inputs (fertilizers, seeds, chemicals, and diesel and irrigation pipes). This forces them to use their profits to buy what they can afford which negatively affects their crop yield and the quality of their produce (Makumbe, 1996).

Transport is also another challenge faced by smallholder farmers within irrigation schemes. Irrigation schemes are located far from urban areas. For instance, the Taung scheme that produces large quantities of Lucerne supplied to the dairy industry in Kwa Zulu Natal is approximately 600 to 700 kilometres away. This tends to disadvantage smallholder farmers from participating in the most paying market. Some of the irrigation schemes face the problem of access to roads. Rural areas, by their nature, have poor roads infrastructure (with gravel) and no easy access for trucks, especially when it rains (Jackson *et al*., (1997). Given the inaccessible state of the roads in rural areas, smallholder irrigators face risks of running at a loss, especially for their perishable products. Agriculture by nature, is a labour-intensive business. Majority of farmers are old and this plays a significant role in terms of productivity. Farmers in the study area depend on family labour. Sometimes, they plough and manage the irrigation scheme on their own. Considering their socio-economic characteristics, majority of people involved irrigation schemes are women, the presence of men is very minimal and there are times when men are needed to drive tractors and do repair works on irrigation pipes. Maintaining irrigation pipes is also another challenge faced by smallholder irrigators, since the schemes are old and the infrastructure has deteriorated over the years. Water has become a challenge recently, especially during periods of drought. Unavailability of water has a negative effect on the developmental stages of plants.

Access to productive land is one of the major challenges faced by smallholder farmers throughout the African continent. Farmers, in some regions, do not hold property rights as the sole owners of the asset that they could use as collateral to access credit from organised formal financial institutions. In South Africa, majority of smallholder farmers rely on communal land for farming. In this system, land ownership rights are vested on traditional authorities. This discourages smallholder farmers from accessing credit compared to commercial farmers. As a result of this situation, smallholder farmers are bound to perform poorly in terms of food production and become vulnerable in the supply chain. Unlike in Asia, in southern Africa, agricultural financial services are sparse. Credit is thus, often supplied by agricultural marketing companies and predominantly in the following forms: buying crops in advance; input traders supplying goods on credit to increase sales; and input credit under contract farming schemes.

Machete *et al.* (2004) stated that one of the constraints to the viability of smallholder irrigation schemes is the absence of credit to smallholder farmers. The agribusiness industry has somehow not favoured smallholder farmers and has made it difficult for them to obtain improved varieties of seeds and appropriate technology. Smallholder farmers struggle to get information regarding which cultivars of seeds are favourable to boost production within irrigation schemes. The well-known big corporative has commercialised agricultural inputs, putting smallholder out of their market, particularly in terms of access to inputs on credit. Access to inputs is crucial for the success of smallholder farmers. The poor infrastructure of smallholder farmers also constitutes one of the challenges of moving produce from rural to urban areas or to agro-processing facilities. Knowledge on market information is limited and market participation is also very limited.

Louw (2007) maintains that in most African countries, less quantity of food produced within the boundaries of the country enter commercial market channels beyond the local area due to the distance that separates villages from cities and the lack of an all-weather road infrastructure. Thus, agricultural surpluses cannot easily be moved from areas of surplus to areas where there is a deficit. Further barriers to markets include the lack of economies of scale and the inability to negotiate best prices for produce. Beinabe *et al.* (2004) argue that access to storage facilities by farmer increases flexibility in ensuring that farmers sell their produce in order to meet up with the bargaining power of the market.

Majority of smallholder farmers are illiterate and are unable to understand the economic behaviour of markets. In most instances, they have poor technological skills and this tends to push them away from understanding and accessing recognised institutions that disseminate technological knowledge (World Bank, 2008). The majority of smallholder farmers are not capacitated with skills such as financial and business management, water management, and marketing skills and also unable to meet or read their contractual obligations in order to be consistent with the demands of the market.

## 2.8    Other factors influencing choice of livelihoods amongst rural people

This section reviews case studies in selected countries on factors influencing the choice of livelihoods. Douglas *et al.* (2006) conducted a study to determine livelihood strategies in rural highlands in Kenya highlands and found that households that owned more hectares of land with some members of the family participating in non-farm employment tended to be able to achieve more per capita income for the household compared to their neighbours. The results revealed that there were two most remunerative livelihood strategies despite the differences between the two. Majority of Kenyans were able to live above the poverty line which was set at one US dollar a day (equivalent to KSh 43 a day). In conclusion, variation exists within livelihood strategies, however, the broader picture is that of considerable poverty in rural highlands of Kenya.

Block and Webb (2001) analysed dynamics of livelihood diversification post-famine Ethiopia and the results revealed that diversification of income is a key but not only for wealth, but also to reduce the vulnerability of poor rural people. Most of the poorest households face many constraints in diversifying from one livelihood strategy to another, especially in areas with poor access to resources. The authors observed that households that were surviving this stage of famine had more assets such as livestock and crops in the field, while those with no assets were the most affected. There were also no associations found for literacy to boost human capital post-famine which was a motivation for majority of households not to easily diversify their livelihoods.

Dillon (2011) examined the effects of irrigation on poverty reduction, asset accumulation, and informal insurance in Northern Mali and found that irrigation projects have the ability to contribute to the micro and macro levels of the country if investments are put in place and this could reduce poverty among rural people. Investing on irrigation schemes increases agricultural productivity which plays a role in changing the prices of goods. Increased agricultural productivity reduces the prices of output and offers the possibility to landless households to afford or produce their own food. The sustainability of rural irrigation schemes depend on the community investing in maintaining the quality of the land which may erode over the years and not be able to produce for future generations.

Burney and Naylor (2011) investigated smallholder irrigation as a poverty alleviation tool in sub-Saharan Africa and found that in promoting smallholder irrigation schemes as a tool to alleviate poverty, there should be a common vision between farmers and all other stakeholders involved in the irrigation. Technology should also be used to pave the way and to ensure that there is improvement in terms of the farming methods. In the long term, it should lead to institutional feedbacks that support sustained economic development and nutritional improvements.

Mohamed (2006) analysed the livelihood of small homestead plot holders in the Dzinzi canal irrigation scheme in South Africa and found five main livelihood strategies for rural people in the area and three farming methods. The results suggest that livelihood strategies and methods of farming of smallholder farmers are associated with diversity of livelihoods. Increasing access to water and land by institutions governing such resources were identified as major policy interventions that could enhance production and expansion of irrigation enterprises. This could possibly change the livelihood options of farmers. The results also suggest that broadening access to markets could reduce variable cost of production. Ibekwe *et al*. (2014) analysed the determinants of non-farm income among farm households in South East Nigeria and found that most countries in sub-Saharan Africa have not yet achieved the so-called successful agricultural revolutions.

In the findings, it was observed that productivity in the study area was low compared to other countries in the world and this has given more attention to the importance of agriculture in alleviating poverty.

The findings revealed that non-farm incomes were above farm incomes. The results also showed that public sector support has declined in recent years with policy reforms intended to enhance agriculture, non-farm activities and transformation generally proving less than adequate. Small-scale farming still remains a key component of rural livelihoods in semi-arid areas. Off-farm diversification by poor households and the changing social context suggest a parallel need for the development of a growing off-farm economy. If poor households are able to raise themselves above the poverty level and not simply have their heads held above the water, then potential livelihood options will derive from considerations of the broader rural picture.

## 2.9    Summary of chapter

This chapter has reviewed literature on the origins of irrigation schemes in South Africa, the determinants of livelihood strategies among small-holder irrigators and the contributions of irrigation farming on household food security. The focus of the literature review was on smallholder irrigators in comparison to other studies in selected countries. The next chapter is the research methodology.

## CHAPTER THREE

## 3.0          RESEARCH METHODOLOGY

## 3.1     Introduction

This chapter focuses on the research methodology used in conducting this study. The chapter also describes instruments used in collecting data and how it was analyzed. The chapter is divided into five sections and cover the following aspects: description of the study area, the research design, sampling procedures, and sample size and data analysis.

## 3.2     Study area

The study was conducted in the North West Province, South Africa. The province is mostly rural with flat areas of scattered trees and grasslands. Thirty five percent of the population live in urban areas while sixty five percent live in rural areas. According to Statistics South Africa (2011), there are approximately 3 509 953 households in the North West Province. An increase population growth in terms of household was mostly observed in the Bojanala Platinum and Dr Kenneth Kaunda Districts, while a drop was noticed in Dr Ruth Segomotsi Mompati District, with slower growth rates in the Ngaka Modiri Molema District. The North West Province produces one third of the country's maize and also supplies other agricultural products such as tobacco, sunflower oil, groundnuts and Lucerne to other parts of the country. Livestock and horticulture are predominately practised in the eastern parts of the province. The semi-arid central and western parts of the province mostly practise livestock and game farming. The province has a well-developed commercial agricultural sector, while subsistence farming is a very prominent activity in the communal areas. The main economic sectors are agriculture, mining and tourism. Field crops and livestock are the foremost contributors to gross farm income in all districts of the province. The contribution of horticulture to gross farm income is moderate in most districts in the province with the exception of Bojanala Platinum, where it accounts for an estimated twenty six per cent of gross farm income earned. In terms of the major field and fodder crops produced, maize is used for the purpose of grain or silage while sunflower combined, accounts for 91.7% share in terms of total physical output of these crops. The other major field and fodder crops that make meaningful contribution to the province are wheat, groundnuts and Lucerne.

23

Figure 2: Map of North West Province

## 3.3    Research design

A descriptive quantitative research design was employed in conducting this study. One other advantage of descriptive research design is that the subject matter is observed and described in such a manner that it is not influenced in any way. Pietersen and Maree (2007) define research design as a plan used to guide the researcher on how to continue determining the nature of the relationship between variables. They further provide the purpose for the use of research design as it allows for the generalisation of a sample of a population in order to make inferences about some characteristics, behaviour or attitudes of that particular population.

## 3.4    Population of study

The study focused on smallholder farmers involved in all irrigation schemes in the North West province. Focus was placed on people practising irrigation farming adjacent to the schemes. The population size of the study was 238 irrigators selected from the list of farmers obtained from the North West provincial Department of Rural, Environmental and

Agriculture. Farmers in Brits, Disaneng, Taung and Zeerust irrigation schemes participated in the study.

## 3.5 Sampling procedure and sample size

A probability sampling method (simple random sampling technique) was used to select respondents from the list of irrigation farmers obtained from the Department of Agriculture and Rural Development, North West Province. 149 respondents were selected using Slovin's formula.

The confidence level was set at 95% which gave a margin error of 0.05.

The formula is: $n = N/1 + N (e)^2$

Where:

n= sample size,

N=population

e=error tolerance

Calculating the sample using Slovin's formula,

$n = N/ (1+ N (e)^2$

$n = 238/ (1 + 238(0.05)^2$

$n = 149.2$

Therefore, n = 149 people

Sampling involves determining the sample size that should be representative in order to conduct reliable analysis of the study using statistical tools.

A sample size relies greatly on the population as it represents the characteristics and qualities of the population (Bazeley, 2004; Onwuegbuzie *et al.,* 2003; Weisner, 2005). Roberts (2000) defines a sample as a collection of sampling units drawn from the sampling frame. A sample represents the population whose characteristics are a true reflection. The manner in which the sample should be selected is very important in order not to generalise the population on false information.

A statistically and qualitatively adequate sample is one that is of such size that the inferences drawn from the sample are accurate to a given level of confidence (Weisner, 2005).

A sample becomes inaccurate mainly due to human factor/bias and distortion due to the selection system. According to Weisner (2005), randomisation means selecting a part of the whole population in such a way that the characteristics of each of the units of the sample approximate the broad characteristics inherent in the total population. A simple random sampling technique was used to select respondents from the list of irrigation farmers obtained from the Department of Agriculture and Rural Development, North West Province.

## 3.6 Data collection techniques

A structured questionnaire was used to collect data from respondents. The questionnaire was designed in accordance with the objectives of the study and divided into four sections as follows: Section 1 focused on the socio-economic profile of farmers involved in irrigation schemes. The farmers were requested to provide information relating to household characteristics such as gender, age, marital status, race, religion, number of dependents, highest level of education, farming experience and farm size. Section 2 examined livelihood strategies adopted by farmers in the study area. This was done by determining resources at the disposal of farmers and whether the strategy adopted by farmers was based solely on agriculture, non-farming or both agriculture and non-farming livelihood strategies.

Section 3 examined determinants of the choice of livelihood strategies. This was done through identifying the five livelihood capitals that form the basis of a complete livelihood analysis such as financial, human, natural, physical and social capitals.

Section 4 examined constraints in choosing a livelihood strategy by smallholder farmers. This was done on a scale of 17 possible factors that could have constrained farmers in determining their choice of a livelihood strategy.

## 3.7 Measuring the method of livelihood capital

The measurement of livelihood capital is adapted from Fang, Fan, Shen and Song (2014). It is a combination of livelihood capital and the questionnaire method and main indicators are shown in Table 1. In order to measure the contribution of different capitals in livelihood strategies, standardising every variable is based on the following equation:

$$Z_i = \frac{X_i - X}{S}$$

Where, $X_i$ corresponds to the $i$th measurement of variable, X is the average value of $X_i$, and S is the standard deviation. As a result, livelihood capital can be written as:

$$C_i = \sum W_i Z_i$$

Where, $C_i$ is the estimated value of the livelihood capital (i = 1, 2, 3, 4, 5), $W_i$ indicates the weight for the $i$th observation (i), and $Z_i$ represents the normalised value for the $i$th observation (i). The detailed steps of the weighted scoring method are given below.

Step 1: Identify the key attributes and variables related to capitals. According to the definition of livelihood capital and the features of regional conditions, as well as the availability of data, several indicators of five capitals were identified.

Step 2: Select an expert group. A group of people with high authority and expertise in a special field consisting of the following members:
Scheme leaders, extension officers, researchers from the Agricultural Research Council and staff of Micro finance NGOs. A total number of 20 to make up the expert group.

Step 3: Score the options
Options are scored against attributes by reference to a scale, from 0 to 10. A score of 0 indicates that the option offers no benefit at all in terms of the relevant attribute, and a score of 10 shows that it represents some maximum. A score between 0 and 10 indicates the intermediate level of performance. The allocation of scores to each option reflects its relative importance.

Step 4: Calculate the weighted scores

According to Step 3, a score is weighted by the indicator weighting within each capital category. All the weighted scores were then added. For example, the size indicates that they account for 10% of the sample aggregate size variable was to contribute 0.10 to the total score (since each of the five capital categories is normalised to a score of one).

Table 1: Key indicators for livelihood capital and determination of weight

| Category of capital | Indicators | Weights were calculated after expert weighting |
|---|---|---|
| **Financial capital** | | |
| | Wages from agricultural labour | |
| | Savings | |
| | Savings from self-help groups | |
| | Insurance (micro) | |
| | Cash in hand | |
| | Cash in bank | |
| | Credit from relatives | |
| | Government subsidies | |
| | Access to banks | |
| | Money lenders | |
| | Credit unions | |
| | Credit from  neighbour or associates | |
| | Credit from self-help groups loan  (FBOs) | |
| **Human capital** | | |
| | Extension services | |
| | Technical training | |
| | Training in project management | |
| | Training in land  management | |
| | Treatment of diseases | |
| | Water management | |
| | Soil management | |
| | Marketing skills | |
| | Packaging skill | |
| **Physical capital** | | |
| | Road and transport to farms | |
| | Available agricultural water | |
| | Access to markets | |
| | Silos | |

| | | |
|---|---|---|
| | Agricultural machinery | |
| | Houses | |
| | Farm sheds | |
| | Electricity | |
| **Natural capital** | | |
| | Access to land | |
| | Utilisation of land | |
| | Utilisation of water | |
| | Land tenure arrangement | |
| | Land quality and fertility of soil | |
| | Watershed development and conservation facilities | |
| **Social capital** | | |
| | Relationship with relatives / neighbours | |
| | Labour networking (for farm work) | |
| | Community functions and festivals | |
| | Network with financial institutions | |
| | Network with transporters | |
| | Network with processors | |
| | Network with farmers' associations | |
| | Network with farmers' cooperatives (FBOs) | |
| | Network with other production group (NGOs and civic groups) | |
| | Network with professional organisations | |
| | Network with local trade unions | |
| | Network with village committees | |
| | Network with religious groups | |
| | Network with cultural associations | |

## 3.8    Measurement of variables

Variables considered in the study included demographic characteristics of farmers, their livelihood aspirations and coping strategies against poverty or food security

Table2: Measurement of variables

| Variable | Level of measurement | Analysis |
|---|---|---|
| Age | Nominal | Frequency, percentages, dummy in regression |
| Marital status | Nominal | Frequency, percentages, dummy in regression |
| Religion | Nominal | Frequency, percentages |
| Number of dependents | Interval | Frequency, percentages |
| Size of household | Interval | Frequency, percentages, dummy in regression |
| Total number of males in household | Nominal | Frequency, percentages |
| Total number of females in household | Nominal | Frequency, percentages |
| Level of education | Nominal | Frequency, percentages, dummy in regression |
| Farming experience | Nominal | Frequency, percentages, dummy in regression |
| Tenure status | Interval | Frequency, percentages |
| Farm size in Ha | Interval | Frequency, percentages |
| Member of farmers' group | Nominal | Frequency, percentages, dummy in regression |
| Contact with extension agents | Interval | Frequency, percentages, dummy in regression |
| Access to financial capital | Nominal | Frequency, percentages, dummy in regression |
| Access to human capital | Nominal | Frequency, percentages, dummy in regression |
| Access to physical capital | Nominal | Frequency, percentages, dummy in regression |
| Non-farm activity | Nominal | Frequency, percentages, dummy in regression |
| Income | Nominal | Frequency, percentages, dummy in regression |
| Expenditure | Nominal | Frequency, percentages |
| Livelihood | Nominal | Frequency, percentages, dependent variable in regression |

### 3.9 Data analysis

Data collected was coded and entered into Microsoft Excel and later transferred to the Statistical Package for Social Sciences (SPSS). SPSS is a programme that allows the analysis and description of data. In the SPSS, descriptive statistics such as frequency counts and percentages were used to describe the data with inferential statistics such as multinomial logit and probit regression analysis.

### Econometric model

Multinomial logit was used to analyse determinants of farmers' choice from 3 options of livelihood namely, agriculture, non-farm and a combination of non-farm and agriculture. In order to identify determinants of farmers' decision to engage in various livelihood strategies, it is assumed that within a given period and with asset endowment as their disposal, a rational household head chooses among the four mutually-exclusive livelihood strategy alternatives that offers maximum utility.

According to Greene (2003), suppose the $i^{th}$ respondent is faced with j choices, the utility choice j is specified as:

$$U_{ij} = Z_{ij} \beta + \varepsilon_{ij} \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (1)$$

If the respondent chooses j in particular, then it is assumed that $U_{ij}$ is the maximum among the j utilities. Therefore, the statistical model is derived on the probability that choice j is made, which is:

$$\text{Prob } (U_{ij} > U_{ik}) \text{ for all other } K \neq j \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2)$$

Where, $U_{ij}$ is the utility to the $i^{th}$ respondent from livelihood strategy j

$U_{ik}$ the utility to the $i^{th}$ respondent from livelihood strategy k

If a farmer maximizes his or her utility defined over the realisation of income, then the farmer's choice is simply an optimal allocation of asset endowment to choose the livelihood that maximizes utility (Brown *et al.*, 2006).

Thus, the ith farmer's decision can, therefore, be modelled as maximising the expected utility by choosing the jth livelihood strategy among J discrete livelihood strategies, i.e,

$$\max_j = E(U_{ij}) = f_j(x_i) + \varepsilon_{ij}; j = 0...J \quad .......................................... \text{ (3)}$$

In general, for an outcome variable with J categories, let the jth livelihood strategy be that the ith farmer chooses to maximize his or her utility could take the value 1 if the ith farmer chooses j[th] livelihood strategy and 0 otherwise. The probability that a farmer with characteristics x chooses livelihood strategy j, $P_{ij}$ is modelled as:

$$P_{ij} = \frac{\exp(X_i^{'}\beta_j)}{\sum_{j=0}^{J}\exp(X_i^{'}\beta_j)}, \quad \text{J=0... 3}........................................................ \text{ (4)}$$

With the requirement that $\sum_{j=0}^{J} P_{ij} = 1$ for any $i$

Where: $P_{ij}$ = probability representing the $i^{th}$ respondent's chance of falling into category $j$

$X$ = Predictors of response probabilities

$\beta_j$ = Covariate effects specific to j[th] response category with the first category as the reference.

Appropriate normalisation that removes an indeterminacy in the model is to assume that $\beta_1 = 0$ (this arises because probabilities sum to 1, so only J parameter vectors are needed to determine the J + 1 probabilities), (Greene, 2003) so that $\exp(X_i\beta_1) = 1$, implying that the generalised equation (4) above is equivalent to:

$$\Pr(y_i = j / X_i) = P_{ij} = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^{J}\exp(X_i^{'}\beta_j)}, \quad \text{for } j = 0, 2...J \text{ and}$$

$$\Pr(y_i = 1 / X_i) = P_{i1} = \frac{1}{1 + \sum_{j=1}^{J}\exp(X_i^{'}\beta_j)}, \quad ....................................... \text{ (5)}$$

Where: y = A polytomous outcome variable with categories coded from 0... J.

*Note*: The probability of $P_{i1}$ is derived from the constraint that the *J* probabilities sum to 1. That is, $p_{i1} = 1 - \sum p_{ij}$. Similar to the binary logit model, this implies that one can compute J log-odds ratios specified as:

$$\ln\left[\frac{p_{ij}}{p_{iJ}}\right] = x^{\cdot}\left(\beta_j - \beta_J\right) = x^{\cdot}\beta_j, if, J = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Table 3: Definition of model variables

| Dependent variable | Definition of variables and unit of measurement |
|---|---|
| Livelihood strategies | |
| Y=0, AG | If the choice of the HH lies in agriculture alone |
| Y=1, NF | Non-farm |
| Y=2, AG+NF | Agriculture and non-farm combination |
| **Independent variables** | |
| AGE | Age of household head in years |
| SEX | Sex of household head (1= Female, 0= Male) |
| EDUCATION | Level of education of household head in years |
| FAMILY | Family size of members of household in numbers |
| LAND | Size of land owned by the household in hectares |
| INPUT | Farm input used by the household (0= No, 1= Yes) |
| EXTENSION | Frequency of extension contact a farmer has with extension agents in a year |
| Physical capital index | Obtained from expert weightings |
| Social capital index | Obtained from expert weightings |
| Human capital index | Obtained from expert weightings |
| Natural capital index | Obtained from expert weightings |
| Financial capital index | Obtained from expert weightings |
| MKTDIS | Distance of the nearest market from dwellings in kilometres |
| REMITA | Economic support to the household |

Probit regression was used to analyse determinants of farmers' choice from 2 options of livelihood namely, agriculture and non-farm activities. Probit regression was used to choose between two livelihood options. This model is a type of regression where the dependent variable can take two values. The purpose of this model is to estimate the probability that an observation with particular characteristics will fall into a specific category.

The probit model is expressed as: $Y = B_o + B_i X_i + e_i$

Where $Y=1$, if agriculture is choice of livelihood, $Y= 0$, if non-farm activities is choice of livelihood.

$B_o$ = is the intercept

$B_i$ is the regression coefficient that explains the probability of agriculture as choice of livelihood, $e_i$ is the error term and $X_i$ = independent variables (i= 1, 2, 3……….13).

## 3.10    Ethical considerations

**NWU – ethical approval:** The research proposal was presented before the NWU School of Agricultural Sciences. After the approval of the proposal and comments from various departments, it was then sent to the NWU Ethics Committee for further review and to assess if the study could be conducted.

**Confidentiality**: Questionnaires used in collecting information from farmers were  kept safe for future analysis.

**Anonymity:** Respondents were advised not to mention their names, telephone numbers or address on the questionnaires.

**No deception:** Farmers were requested to personally complete the questionnaire. Those who could neither read nor write were assisted in completing the questionnaire. In compliance with the regulations of the North-West University, standardisation and uniformity were adopted for all respondents. Permission to enter the farms was obtained from the respective LDC managers and extension officers from the Department of Agriculture and Rural Development. They were consulted and informed of the objective of the study.

Information obtained from respondents was treated as confidential as possible and the results were only used for the purpose of the study. Respondents were treated with respect, dignity and the objectives of the study explained to them. Participation in the study was voluntarily for respondents and questions focused on issues related to the study.

## 3.11 Summary of chapter

This chapter has provided an overview on how the study was conducted. The study was conducted in three districts of the North West Province namely: Dr Ngaka Modiri Molema, Bojanala and Dr Ruth Segomotsi Mompati. A sample of 149 farmers were interviewed from a list of farmers obtained from extension workers. The study targeted both males and females involved in irrigation schemes and those adjacent to the irrigation schemes. A questionnaire was designed as the primary tool for data collection. Data was collected through face-to-face interviews. The data collected was coded and entered into Microsoft Excel and later transferred to the Statistical Package for Social Sciences (SPSS). Data was analysed through descriptive and inferential statistics as well as multinomial and probit regressions. The next chapter presents the results and the discussion.

**CHAPTER FOUR**

**4.0          RESULTS AND DISCUSSION**

**4.1      Introduction**

This chapter discusses and interprets results obtained from the survey. The results discussed in this chapter include information on the demographic characteristics of farmers, farming enterprises of farmers, annualy farm enterprise income, irrigation methods practised by farmers and sources of water for irrigation farming. The chapter also discusses production expenditure, livelihood capitals available to farmers, coping strategies against household food security and the results of multinomial and probit regressions.

**4.2      Demographic characteristics of farmers in the study area**

Table 4 presents demographic information of smallholder farmers involved in irrigation schemes in the North West Province. The study focused on both male and female farmers involved inn irrigation schemes. About 55.7% of respondents were female while 44.3% were male farmers. The high percentage of females on irrigation schemes could be attributed to the movement of males from the agricultural sector to mining. History has revealed that the first trend in the decline in former so-callled bantustants or homeland agriculture was seen in the early 1950s. Majority of homesteads were, however, still practising farming as their source of living. However, majority were unable to reach their subsistence requirements while very few were able to produce surplus. Income was supplemented through diversification and the movement from agricultire to non-farm actvities such as mining and other forms of employement in the cities. Income earned from non-farm activities were used or invest back in rural areas,maintain homesteads and develop agricultural practices through the purchase of farming inputs (Houghton, 1952). In some parts of the province, mining is still dominant and is the major employer after agriculture. Majority of respondents (65.8%) were above 50 years old, married, christians and with highest level of educational being primary school. The study revelead agriculture is practised predominantly by old people. This could be due fact that youth has rellocated from villages to join universities, colleges or to seek employment somwhere else outside their area (Hebinck and Van Averbeke, 2007).

One other reason could be the less interest from the youth in practising or studying agriculture, because agriculture in some instances, is considered as a very labour-intensive field (Lahiff, 2000). About 87.3% of respondents had an average household size of ten members with less than five dependents.  It is common practice in  rural areas of the country that grandparents, in most instances, look after their grandchildren while their parents leave for nearby cities or Gauteng province in search of employment. Farmers were also requested to indicate their level of experience in farming or agricutural-related businesses. About 57% of  farmers revealed that they had above 50 years of experience in farming. This is because some respondents have never worked elsewhere before except in farming, while others might have worked somewhere before as miners  and returned to the village for retirement and started farming as an alternative source of  living. Farmers in the irrigation schemes are formally grouped and registered in  cooperatives. Each cooperative shares farming equipment such as tractors and implements provided by government. About 80.5% of respondents indicated that they form part of the cooperatives, they also plough and irrigate land on their own. Farmers also receive technical advisory support through agricutlural extension services from government. According to the respondnets, this support is made available to them on a regularly basis, especially at the begining of the planting season and when there is a specific buyer such as the South African Breweries (SAB) who may want to enter into partnership with primary producers. The results further revealed that 84.6% of farmers are not involved in non-farming activities. Those involved in non-farming activities are either sewing clothes, own a tuckshop, transport kids to school or practise as traditional healers in the community. Non-farm activities have increasingly become one of the most important livelihood strategies among rural households to supplement their agricultural-related income (Haggblade *et al.*, 2007). The reasons for diversification from agriculture to other non-farm activities is to survive risks associated with agricultural commodities such as drought and the outbreak of diseases that could mitigate profit margins for the  produce (Lanjouw, 1999). Household sometimes become interested in non-farm activities when the returns from non-farm activities are high with less risks and working hours compared to agriculture or when farming is less profitable due to uncontrollable natural occurrences (Reardon, 1997).

Table 4: Demographic characteristics of farmers in the study area

| Variable | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 66 | 44.3 |
| Female | 83 | 55.7 |
| **Age in years** | | |
| <40 | 16 | 10.7 |
| 40-50 | 44 | 23.5 |
| Above 50 | 89 | 65.8 |
| **Marital status** | | |
| Single | 41 | 27.5 |
| Married | 82 | 55 |
| Widowed | 24 | 16.1 |
| Divorced | 2 | 1.3 |
| **Race** | | |
| African | 149 | 100 |
| **Religion** | | |
| Christianity | 138 | 92.6 |
| Other | 11 | 7.4 |
| **Number of dependents** | | |
| <5 | 102 | 68.4 |
| Above 5 | 47 | 31.6 |
| **Size of household** | | |
| <10 | 130 | 87.3 |
| Above 10 | 19 | 12.7 |
| Total number of males in household | 52 | 34.9 |

| | | |
|---|---|---|
| Total number of females in household | 97 | 65.1 |
| **Educational level** | | |
| Primary school | 60 | 40.3 |
| Secondary school | 63 | 42.3 |
| High school | 17 | 11.4 |
| College | 6 | 4.0 |
| University | 2 | 1.3 |
| No education | 1 | 0.7 |
| **Farming experience in years** | | |
| <10 | 85 | 18.8 |
| 10-20 | 36 | 24.2 |
| Above 20 | 28 | 57 |
| **Membership of farmer's group** | | |
| No | 29 | 19.5 |
| Yes | 120 | 80.5 |
| **Contact with extension workers** | | |
| No | 25 | 16.8 |
| Yes | 124 | 83.2 |
| **Frequency of contact** | | |
| Regularly | 48 | 34.2 |
| Occasionally | 50 | 33.6 |
| Rarely | 51 | 32.2 |
| **Organisation of the extension** | | |
| Government | 146 | 98.0 |
| NGO | 2 | 1.3 |
| Parastatal | 1 | 0.7 |
| **Number of workers** | | |

| | | |
|---|---|---|
| <5 | 133 | 89.2 |
| 5-10 | 12 | 8.1 |
| Above 10 | 4 | 2.7 |
| **Sources of labour** | | |
| Self | 103 | 69.1 |
| Family | 11 | 7.4 |
| Hired | 35 | 23.5 |
| **Number of years in the irrigation scheme** | | |
| <10 | 82 | 16.2 |
| 10-20 | 43 | 29 |
| Above 20 | 24 | 54.8 |
| **Involvement in non-irrigation farming activities** | | |
| No | 126 | 84.6 |
| Yes | 23 | 15.4 |
| **Non-irrigation farming activities** | | |
| Livestock keeper | 1 | 0.7 |
| Sewing | 133 | 89.2 |
| Tuck-shop | 7 | 4.7 |
| Traditional healer | 4 | 2.7 |
| Transport school kids | 4 | 2.7 |

## 4.3    Different farm enterprises practised by farmers in the irrigation schemes

Figure 3 shows different farming enterprises practised by farmers in the irrigation schemes. From the list of 22 enterprises, about 55.7% of respondents produce cabbage, carrots, green peas, onion and spinach respectively.

These horticultural crops are well-adapted to the climatic conditions of the areas and are supplemented by the availability of water throughout their growing season. A survey conducted by Jackson *et al.* (1997) in Zimbabwe revealed that irrigation farming has the general potential of boosting production of horticultural and other grain crops. Tomatoes is the second most popular crop produced in the irrigation schemes representing 50%, followed by maize with 38.9% and barley (16.1%). These crops are produced on contractactual basis according to specifications from the South African Breweries. Dalelo *et al.* (2003) also found that smallholder farmers have the ability to diversify the crops they grow according to the seasons. These crops are maize and potatoes. Majority of farmers produce horticultural crops such as cabbage, spinach and beetroot. The climatic conditions of South Africa favour the growth of these crops. About 16.1% of respondents grow lucern for crop rotational purposes in order to keep the soil fertile. Citrus is not a commonly produced plant in the schemes. This is due to the limited water rights and resources in areas where it used to be cultivated in the past. In the past, citrus used to be grown around Zeerust and  Brits irrigation schemes. Over the years, production has gradually dropped and there are currently very few growers in the Province. Sorghum and Sunflower (1.4%) respectively are the least produced crops in the irrigation schemes although their market value is very high compared to horticultural crops such as cabbage and carrots. Respondents maintained that inputs to plant these crops are very expensive, especially the cost of pesticides and lime. Farmers also indicated that they do not have storage facilities to preserve crops after harvest in order to sell when their prices are good. Farmers thus tend to shift their focus to other crops that are less capital and labour intensive such as tomatoes. According to Mamvura *et al.* (2006) and Mutsvangwa (2006), irrigation farming is able to empower and emancipate farmers socially. Chenje *et al.* (1998) maintain that the role of irrigation farming is to increase crop production and allow the cultivation of crops in drought-prone areas or where irrigation farming is an activity that would normally be impossible due to lack of water. Punnet (1982) highlights the success of the Martha Fenai Pradesh scheme in India. In this scheme, farmers grow about three different crops that produce good yields, instead of producing only one crop. Irrigation farming in some parts of the world, especially in Africa, is considered a cheap substitute for costly disaster relief by governments.
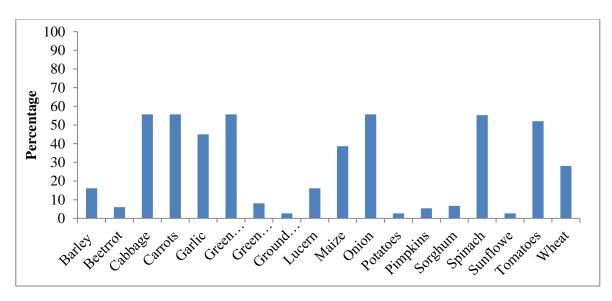
Fig 3: Farming enterprises practised by respondents

## 4.4  Annual income realised by farmers from enterprises on irrigation schemes

Table 5 shows annual income per enterprise and crops produced in the irrigation schemes. The crops were grouped into two categories as follows: grain and horticultural crops. The purpose of comparing the market value of crops is to be able to advise farmers in terms of making decisions on the type of crops that have more returns and also take into consideration available resources. Livelihood strategies are defined as activities undertaken by households to provide a means of living. Livelihood strategies are diverse at every level (Brown *et al.*, 2006).

Economists group households by shares of income earned in different sectors of the rural economy. The results revealed that about 99.3% of respondents produced sunflower and wheat respectively. Annually, they generate less than thirty and fifty thousand Rand from their production. This clearly shows that majority of smallholder farmers are still trapped in the dark with or less or no knowledge on marketing information, especially in determining future prices of produce. According to Grain South Africa (2015), at the time of the study, the price of white maize per ton was (R2770.00 while wheat was priced at (R3823.00). According to Grain South Africa, an average maize yield per hectare stood at 4.2 tons/ha and wheat 5.7 tons/ha.

This mathematical calculation is an indication of how much smallholder farmers are supposed to earn. If the price of white maize stood at (R 2770.00) per ton, with an average of 4.2 tons per hectare, it means smallholder farmers were allocated about 10 ha depending on the area of the irrigation scheme. Farmers indicated that they received between (R100 000.00 - R200 000.00) for their harvested crop. However, it is assumed that if knowledge and participation in formal markets are common pratices among farmers, they should receive better prices for their produce. Farmers involved in the scheme have contracts that bind them for a number of years and they are forced lease land and earn less returns from their productive land. In terms of classified horticultural crops, about 99.3% of farmers earned less income for potatoes and tomatoes respectively. However, about 6.1% of respondents earned more (R21 000.00) for bulk cabbage sold for school feeding programmes.

Table 5: Annual income from farm enterprise

| Crop | Annual income (R) | Frequency & percentage |
|------|-------------------|------------------------|
| **Grain crops** | | |
| Barley | < 30 000 | 139(93.3) |
| | 30 000- 60 000 | 7(4.6) |
| | Above 60 000 | 3(2.1) |
| Groundnuts | < 26 000 | 145(97.3) |
| | Above 26 000 | 4(2.7) |
| Lucern | < 30 000 | 143(95.9) |
| | 30 000-40 000 | 4(2.8) |
| | Above 40 000 | 2(1.3) |
| Maize | < 30000 | 111(74.5) |
| | 30 000-40 000 | 18(12.1) |
| | Above 40 000 | 20(13.4) |

| | | |
|---|---|---|
| Sunflower | < 30 000 | 148(99.3) |
| | Above 30 000 | 1(0.7) |
| Sorghum | < 48 000 | 147(98.7) |
| | Above 48 000 | 2(1.3) |
| Wheat | < 50 000 | 148(99.3) |
| | Above 50 000 | 1(0.7) |
| **Horticultural crops** | | |
| Beetroot | < 24 000 | 140(94.1) |
| | Above 24 000 | 9(5.9) |
| Cabbage | < 21 600 | 140(93.9) |
| | Above 21 600 | 9(6.1) |
| Carrots | < 15 000 | 146(98) |
| | Above 15 000 | 3(2) |
| Green pepper | < 30 000 | 148(97.3) |
| | Above 30 000 | 1(0.7) |
| Green peas | < 6000 | 147(98.7) |
| | Above 6000 | 2(1.3) |
| Onion | < 18 000 | 147(98.7) |
| | Above 18 000 | 2(1.3) |
| Potatoes | < 27 000 | 148(99.3) |
| | Above 27 000 | 1(0.7) |
| Pumpkins | < 24 000 | 147(98.7) |
| | Above 24 000 | 2(1.3) |
| Spinach | < 24 000 | 140(94) |
| | Above 24 000 | 9(6) |
| Tomato | < 12 000 | 148(99.3) |
| | Above 12 000 | 1(0.7) |

*Figures in parentheses are percentages

**4.5     Different irrigation systems used by smallholder farmers in the scheme**

Figure 4 shows the different irrigation methods used by farmers in the study area. The results revealed that about 80% of farmers were using central pivots connected to the electricity and automatically operated. Central pivots, by their nature, have the ability to reduce capital and labour because they are not more labour intensive and can operate on their own. This irrigation method is commonly found in Brits and Taung irrigation schemes. The Taung irrigation scheme is the biggest of all the schemes in the province while the Brits scheme is operated commercially and is viable.

About 10% of respondents indicated that they were using the drip irrigation method to irrigate their produce. This irrigation method has a comparative advantage in terms of saving large volumes of water. Maisiri *et al*. (2005) found that low cost drip irrigation has the ability to save up to 50% of the variable inputs in an irrigation enterprise compared to flood and sprinkler irrigation methods. Also, crop yields are not influenced by the type of irrigation method but influenced by the type of fertiliser and application methods. 55.7% of farmers indicated that they were using the flood and sprinkler irrigation method respectively while 60% of respondents relied on rain. This is because such farmers settled on dry land irrigation methods for the cultivation of maize. Cetin and Bilgel (2002) found that sprinkler and drip irrigation have been suggested as a means of supplying most types of crops with frequent and uniform applications of water, adaptable over a wide range of topography and soil conditions.
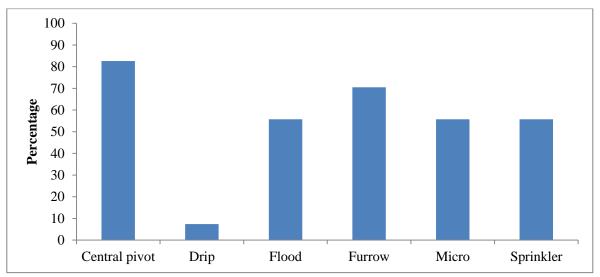


Fig 4: Figure: Different irrigation systems

## 4.6 Different sources of water for irrigation schemes

Figure 5 shows the different sources of water used by farmers in irrigation schemes. Farmers indicated that they are allocated water rights by the local municipality and pay for the water used on a monthly basis. The results further reveal that 94% of water used for irrigation farming is obtained from rivers and stored in dams. The water is then channelled through canals up to the irrigation land.

About 2% of respondents indicated that they use water from the fountain to irrigate their crops when there is no water supply from the municipality. Rivers are the main source of water. About 96.7% of water used in the irrigation schemes is obtained from rivers, either pumped directly, diverted by means of weirs, or through dams. Only 3% of groundwater and 0.2% of municipal water is pumped, stored and used for irrigation farming. Smallholder irrigation schemes in South Africa were developed some decades ago. However, a survey conducted in 2010 revealed that most of the schemes built in the 1950s were no longer in good condition. The infrastructure has deteriorated over the years and as a result, productivity of the schemes is also not the same as it was in the past. The Taung irrigation scheme is one of the oldest schemes developed during the apartheid era alongside the Ncorha scheme in the Eastern Cape. Today, the state of infrastructure of these schemes is deplorable with very old canals (Van Averbeke, 2008).
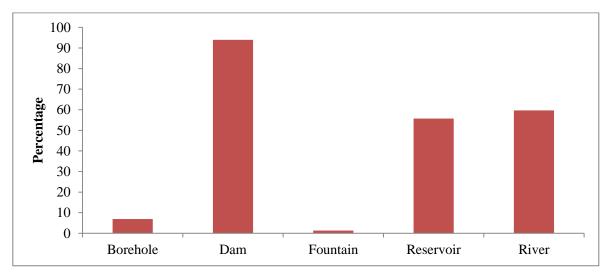


Fig 5: Sources of water

## 4.7    Ownership of irrigation land

Figure 6 shows ownership of irrigation schemes. About 92% of irrigation land is owned by the Chief or Kgosi (in Setswana). In South Africa, there are areas referred to former homelands developed by the former apartheid government. These areas were dominated by black people who lived in villages and townships. In the village setup, there is a Chief for every village and it is his responsibility to allocate land to the people.

Several studies have revealed that males are entitled to own plots, while the role of females is to cultivate the land (Machete *et al*., 2004; Tlou *et al.,* 2006). Majority of households in the former homelands were given permission to occupy and utilise land by the Chief. Even today, there are few farmers who hold title deeds for land in rural areas. The results revealed that only 8% of farmers had ownership rights of the land they occupied. These are mostly commercial farmers around Brits irrigation schemes. In this area, allocation of land is not the responsibility of Tribal Authorities. Land is either bought from government or inherited from forefathers. The tenure system that was applicable for nearly all schemes precluded farmers from using their holding as collateral to access loans from registered financial service providers (Crosby *et al*., 2000). Tenure on irrigation schemes is different from what is stated in the legislation in terms of allocation of land to rural people (Manona *et al.,* 2010). It is therefore practically difficult to trace how land was allocated in the schemes. However, recent literature indicates that ownership of land lies with traditional authorities and government. When farmers enter into farming contracts, they tend to rely on government to assist them in terms of interpreting the terms of the agreement.
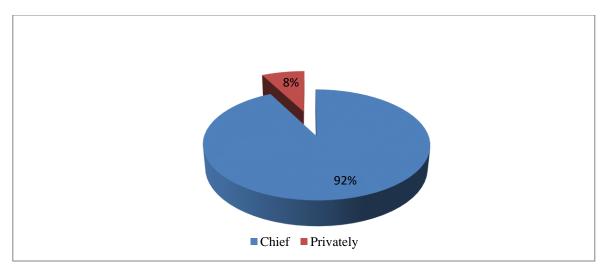
Fig 6: Ownership of irrigation land

## 4.8    Sources of income to smallholder farmers

Figure 7 shows other sources of income for farmers who participated in the study. The results revealed that about 91% of farmers were able to generate additional income of less than one thousand Rand a month from leasing their farm equipment. About 98% of farmers indicated because they are unable to afford inputs, they are forced to lease out their land to other producers. In return, they will charge less than three thousand Rand per month for that particular season. Makhumbe (1996) maintains that lack of inputs among farmers is a major setback and negatively affects yields and quality of crops. At times, this may result in no production for that particular season. In South Africa, senior citizens who are above sixty years qualify for the government pension fund. Majority of respondents as indicated in the literature, were above 50 years. This implies that those who have already reached the government threshold of sixty years may qualify for such funds. The results revealed that about 81% of respondents were receiving a monthly government grant of one thousand, two hundred and sixty Rand as their additional source of income to supplement income received from farming operations. In order for people to have a sustainable livelihood, it is advisable not to rely only on one livelihood strategy. The results showed that apart from irrigation farming, other respondents still keep their livestock as this is a common practice in rural areas where farmers in most cases will keep cattle as a symbol of wealth or pride. About 90% of respondents who owned livestock indicated that in most cases, they generate less than three thousand Rand when they sell their cattle.
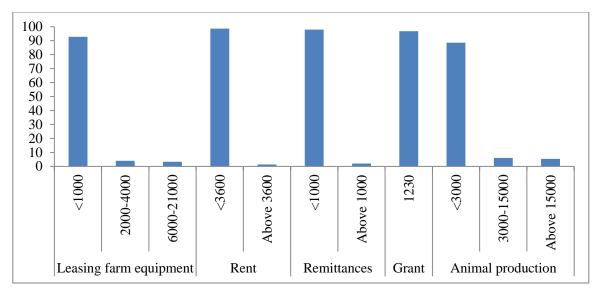
Fig 7: Sources of income of farmers

## 4.9    Annual production expenditure of farmers

Farmers were asked to indicate their production expenses. The results showed that about 90% of farmers spent more in transporting their produce to the markets. Farmers around Zeerust and Brits indicated that the best market for them is the Tshwane fresh produce market situated at the heart of Pretoria (the capital city of South Africa). About 70% of famers revealed that they spend more on electricity and water bills, especially for farmers in the Taung irrigation scheme where they use electricity-generated pivots. About 82% of respondents indicated that they spend more in maintaining their irrigation technology. In some instances, pipes break down and farmers in the scheme have to make arrangements to fix damaged or leaking pipes. Due to the structural changes in the country, in the past, maintenance of irrigation infrastructure was the sole responsibility of governments. Nowadays, it is the responsibility of producers to sustain their farming business.
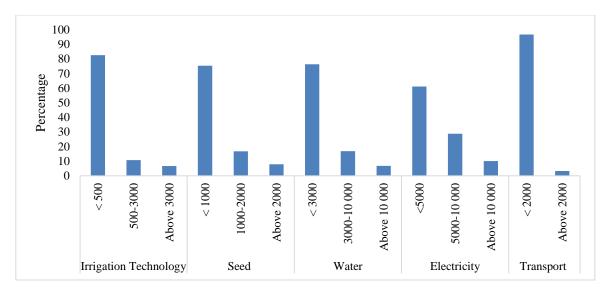
Fig 8: Production expenditure

## 4.10     Typologies of household livelihood strategies among irrigation farmers

Table 6 shows the livelihood strategies of households. The results revealed that about 42.3% of respondents depend solely on agriculture (irrigation farming and little livestock holding) for their livelihood strategy. About 36.9% rely on non-farm activities such as sewing, transportation of school children and traditional healing.

Non-farm activities assist farmers in terms of filling in income and food gaps that agriculture is unable to do. The remaining 20.8% of respondents derived their livelihood strategy from agriculture and non-farm activities. These results are supported by Gecho *et al.* (2014) who found that majority of households in Ethiopia sustained their livelihood strategies by combining agriculture with non-farm activities. However, some of the households relied on non-farm activities as the primary livelihood strategy rather than agriculture. It is essential to encourage rural people to choose alternative livelihood strategies by promoting what they are currently depending on. If irrigation farmers rely on crop farming as their livelihood, they need to be encouraged to combine crop farming with livestock and not necessarily increasing their land size but to meet household food security (Twomlow & Bruneau, 2000). Investment should also focus on promoting non-agricultural enterprises such as harvesting indigenous worms such as mompani worms to support household means of generating income (Misselhorn, 2005).

Table 6: Distribution of respondents based on household livelihood strategies

| Livelihood strategy | Frequency | Percent |
|---|---|---|
| Agriculture alone | 63 | 42.3 |
| Non-farm | 55 | 36.9 |
| Agriculture and non-farm | 31 | 20.8 |
| Total | 149 | 100.0 |

## 4.11    ACCESS TO LIVELIHOOD CAPITALS BY FARMERS

### 4.11.1  Access to financial capital by farmers on irrigation schemes

Table 7 shows five livelihood capitals that are were used on determining livelihood strategies among farmers. Financial capital, this enables access to credit, be it from formal or informal institutions. There were 7 identified access points of credit to farmers in the study area. The results revealed that about 88.6% of farmers were able to access credit from cooperatives, while about 75.8% had a comparative advantage of accessing credit from contractors.

Some farmers indicated that they had private partnership contracts with institutions such as the South African Breweries Monsters (SABM). In this form of partnership, farmers use land as their contribution and all other production costs are covered by SABM. Profit is shared after harvest. Although this sounded as a good partnership, respondents indicated that they were not satisfied with the arrangement.  This is because of the amount of profit received at the end of the lease term. About 49.0% of the farmers indicated that they had inadequate access to credit from formal institutions such as banks, while 44.3% indicated that they had access to credit. About 6.7% of farmers indicated that the credit received from banks was inadequate. Farmers also indicated that they were constrained by lack of title deeds. This prevents them from using the land that they occupy as collateral to access credit from banks. Moobi and Oladele (2012) reported that farmers in the Ngaka Modiri Molema district of the North West Province interact more with informal financial markets than formal financial markets. Oladeebo (2008) also found that smallholder farmers have relatively more access to informal and semi-formal credit institutions than with formal credit institutions. Oruonye and Musa (2012) concur that access to agricultural credit constitutes a major challenge for smallholder farmers in Nigeria.

People in in the area were forced to establish a local system of micro finance (bada kaka) to enable them overcome challenges faced in terms of accessing production loans from banks. Due to involvement of the middlemen on the schemes, majority of farmers pulled out, as there were also harsh conditions coupled with the exploitation.

### 4.11.2 Access to human capital by smallholder farmers

Human capital refers to skills and training. About 56.4% of farmers indicated that the training they received was inadequate. The only type of training that was available for farmers was in the form of advisory services from extension workers and occasional farmer's days organised by the local Department of Agriculture. 54.4% of farmers indicated that they had adequate access to extension services. About 59.1% of farmers indicated that they are able to perform record-keeping of their farming enterprises although the record-keeping is not done perfectly. About 53% of respondents indicated that they have adequate skills in terms of financial management. Lack of support services has always been a major issue in the development of smallholder farmers. Training of farmers is essential in ensuring that farmers are capacitated with farming knowledge. Creating networks by smallholder farmers is also essential in order to understand the dynamics and behaviour of the free-market system. Support services to smallholder farmers are the principal mandate of government extension services (Magingxa *et al*., 2009).

### 4.11.3 Access to physical capital by smallholder farmers

Physical capital this includes access to bulk infrastructure such as roads and markets, among others. From the list of six physical capitals identified, about 79.9% of farmers indicated that they do not have adequate access to electricity, while 61.7% indicated that they had inadequate access to roads and markets. Physical capital is essential in order to achieve livelihood goals and include access to basic services such as water, transport, electricity and markets. Roads in the villages are not in good conditions. This makes it very difficult for rural villagers to convey their produce easily to the markets, especially during raining season (Montshwe, 2006).

Farmers also indicated that they had inadequate access to markets, especially after the harvesting season. According to IFAD (2001), access to markets plays a remarkable role in ensuring better income and welfare of smallholder farmers through diverse channels. By raising income, markets increase the purchasing power which in turn creates the demand for consumer goods and enhances the welfare of farmers.   Access to markets access can be improved if the flow of market information is made available to farmers on time rather than relying on neighbours in order to understand prices set by traders. Oduro *et al*. (2004) argue that age and gender have negative and positive effects on market participation. Older people tend to have more dependents and more subsistence activities hence low market participation. Infrastructure and services are important defining parameters of market proximity and therefore, effective market participation (Holloway *et al.,* 2000). The results further revealed that access to transport (55%) is not adequate to farmers. According to Goletti and Wolff (1998), access to transport is one of the major important factors in agriculture to ensure that produce move easily from one point to another.

### 4.11.4  Access to social capital by smallholder farmers

Social capital includes all social resources such as social network, which households can draw upon to attain their goals. The results revealed that farmers network with registered cooperatives. In these cooperatives, farmers share cost of inputs and also work together, especially when there is a demand from the market for a particular cash crop. Apart from sharing resources, farmers also work together to lobby for funding. In each cooperative, there is a committee that handles all administrative issues such as interpreting market information, assisting with contracts, taking into consideration the fact that majority of farmers have low literacy levels. Farmers also network with other commercial cooperatives through the provincial Department of Agriculture. The communal way of life in many rural set-ups is transferred to business organisations formed by farmers and often clash with profitability objectives of such organisations. Gadzikwa *et al*. (2006) researched on the crippling problems of working as a group in primary production.

Poor management and technical capacity of co-operatives has been found to be problematic for institutions managed by smallholder farmers thus hindering access to markets (Thamaga-Chitja *et al*., 2011). These researchers argue that poor understanding of the communal way of life of rural people also tends to influence 'group' projects. This needs to be unpacked and properly understood for the success of business-oriented interventions and investment in smallholder agriculture. In most instances, communal 'sharing and working' clashes or mismatches the profit-oriented way of business and this in turn, adversely affects access to market, for smallholder farmers. The researchers also believes that communal farming can be harnessed to strengthen volumes and yield targets for access to markets, so long as this is accompanied with extensive capacity building programmes that are sensitive to the needs of smallholder farmers.

Table 7: Access to financial, human and physical livelihood capitals by farmers

| Financial capital | Very adequate | Adequate | Not adequate |
|---|---|---|---|
| **Access to credit** | | | |
| Banks | 10(6.7) | 66(44.3) | 73(49.0) |
| Cooperatives | 132(88.6) | 9(6.0) | 8(5.4) |
| Money lenders | 111(67.1) | 4(2.7) | 34(22.8) |
| Relatives | 89(59.7) | 19(12.8) | 41(27.5) |
| Personal savings | 90(60.4) | 16(10.7) | 43(28.9) |
| Contractors | 113(75.8) | 11(7.4) | 25(16.8) |
| Government subsidies | 75(50.3) | 69(46.3) | 5(3.4) |
| **Human capital** | | | |
| Training | 12(8.1) | 53(35.6) | 84(56.4) |
| Vocational training | 11(7.4) | 74(49.7) | 64(43.0) |
| Extension service | 67(44.9) | 81(54.4) | 1(0.7) |
| Record-keeping | 52(34.9) | 88(59.1) | 9(6.0) |
| Water management | 71(52.3) | 44(29.5) | 34(22.8) |
| Equipment handling | 64(42.9) | 53(35.6) | 32(21.5) |
| Financial management | 79(53) | 35(23.5) | 35(23.5) |
| Soil management | 73(49) | 51(34.2) | 25(16.8) |
| Crop protection | 65(43.6) | 46(30.9) | 38(25.5) |
| **Physical capital** | | | |
| Transport | 10(6.7) | 57(38.3) | 82(55) |
| Water supply | 98(65.8) | 39(26.2) | 12(8.0) |
| Markets | 9(6.0) | 52(34.9) | 88(59.1) |
| Road accessibility | 8(5.4) | 49(32.9) | 92(61.7) |
| Electricity | 7(4.7) | 23(15.4) | 119(79.9) |
| Storage | 9(6.0) | 48(32.3) | 92(61.7) |

### 4.11.5  Access to natural capital by smallholder farmers

According to ICID (2007), natural capital refers to the natural-occurring, as opposed to manmade, phenomenon or products. They are goods and services that relate to the natural environment rather than products of the manufacturing process. Natural capital in this study, refers to land and natural resources which farmers had the right to occupy. The results revealed that 91.3% of the farmers were granted permission by chief to occupy and use land for agricultural-related activities, while 1.4% of the land is privately leased. This is due to the adaptation of the customary system for land allocation in rural areas of South Africa. There is no household that can claim formal ownership of land, the allocation of land and responsibility over it lies with the tribal authority (the Kgosi or chief).  The average size of land allocated to farmers in irrigation schemes ranges between 1.5 and 20 hectares. Insecure tenure limits farmers' incentives in making long-term development investments on their land because ownership of the land does not necessarily lie with farmers but solely with the Chief (Bembridge, 2000). Rukuni (2002) reported that communal ownership of land could promote productivity only if communal ownership was secured in terms of providing farmers with title deeds in order to access other production necessities such as production loans from formal banking institutions.

Table 8: Access to natural and social livelihood capitals by farmers

| | | |
|---|---|---|
| **Natural capital** | **Yes** | **No** |
| Access to land | 136(91.3) | 13(8.7) |
| **Type of tenure** | | |
| Lease | 1 | 2(1.4) |
| Permission to occupy | 2 | 114(76.5) |
| Communal land | 3 | 31(20.8) |
| Other | 4 | 2(1.3) |
| **Total size of land** | **Ha** | |
| | <10 | 61(40.9) |
| | 10-70 | 83(55.7) |
| | 80-85.5 | 5(3.5) |
| **Social capital** | | |
| Member of farmers' group | Yes | No |
| | 136(91.3) | 13(8.7) |
| **Name of irrigation scheme** | | |
| Bosele | 32(21.5) | |
| Ipelegeng | 18(12.1) | |
| Motlhaka | 20(13.4) | |
| Nyatese | 22(14.8) | |
| NCPA | 25(16.8) | |
| Rethuseng | 4(2.7) | |
| Reaitlhoma | 1(0.7) | |
| Tshidiso | 25(16.7) | |

*Figures in parentheses are percentages

**4.12    Constraints faced by farmers in the choice of livelihood strategies**

Table 9 presents constraints faced by farmers in choosing livelihood strategies. A list of 17 constraints was presented to respondents in the study area.  About 71.1% of farmers indicated that prices of agricultural commodities were too high, followed by high prices of inputs and low agricultural production representing 69.1%.  About 65.8% of respondents indicated that they cannot afford to buy agricultural inputs such as fertilisers and seeds during other planting seasons. In most instances, the farmers indicated that they are occasionally granted inputs by local government and private retailers in the form of donations.

The results showed that 65.1% of farmers lack capital to start or expand their agricultural businesses; this could be attributed to lack of title deeds.  In a communal arrangement as mentioned in the literature, farmers do not have title deeds that they can use as collateral to access funding from formal financial institutions. In most instances, this exposes farmers to situations were they lease out their land to certain individuals on contractual basis. Other reasons identified by farmers that could impede the choice of livelihood include very low agricultural produce (58.4%) and late delivery of inputs by suppliers. In most instances, primary producers are always getting the lowest returns for their produce. This is due to the farm gate prices received from buyers.  Farmers indicated that better profits are in the value chain of the product and it is the processor of the produce who benefits the most. Over the past year, food production has improved significantly and outpaced the population due to investments in irrigation farming that has pushed yields up and drastically reduced food prices (Bruinsma, 2003).

Table 9: Constraints faced by farmers in choosing livelihood strategies

|  | Yes | No |
|---|---|---|
| Cannot afford / lack of agricultural inputs (fertilizers, seeds) | 98(65.8) | 51(34.2) |
| Prices of inputs high | 103(69.1) | 46(30.9) |
| Unavailability of agricultural inputs | 85(57) | 64(43) |
| Late delivery of inputs by suppliers | 83(55.7) | 66(44.3) |
| Low agricultural production | 103(69.1) | 46(30.9) |
| Drought | 81(54.4) | 68(45.6) |
| Lack of adequate land | 94(63.1) | 55(36.9) |
| Prices of agricultural produce too low | 87(58.4) | 62(41.6) |
| Lack of buyers for agricultural produce | 88(59.1) | 61(40.9) |
| Lack of capital to start or expand agricultural business | 97(65.1) | 52(34.9) |
| Lack of credit to start agricultural production or buy inputs | 95(63.8) | 54(36.2) |
| Lack of employment opportunities | 85(57) | 64(43) |
| Prices of commodity too high | 106(71.1) | 43(28.9) |
| Very low salary/wage | 96(64.4) | 53(35.6) |
| Business not doing too well | 86(57.7) | 63(42.3) |
| Too much competition | 45(30.2) | 104(69.8) |
| Decline in the economy | 65(43.6) | 84(56.4) |

*Figures in parentheses are percentages

**4.13** *Multinomial Logit regression of determinants of choice of agriculture and non-farm livelihood strategies among farmers*

Livelihood strategies as defined are activities undertaken by households or farmers to provide a means of living. Livelihood strategies are diverse at every level. There are different definitions of livelihood in the literature. However, most economists usually tend to group farmers by shares of income earned in the agricultural sector and throughout the rural economy. In this study, farmers' livelihood strategies were classified as agriculture alone, non-farm, agriculture and non-farm.

**Interpretation of econometric results**

Multinomial Logistic Regression Model was used to identify determinants of livelihood strategies among smallholder farmers involved in irrigation schemes. The independent variables examined in this study are:

**Age of household head (AGE):** This variable was found to negatively influence decision by farmers to diversify non-farm activities and was significant at ($p<0.05$). This relatively implies that farmers are likely to participate in non-farm activities at a decreasing rate as they grow old. This is because young people would normally prefer to work in the mines or go to the university to further their studies. Older farmers had larger portions of land while the younger ones had only smaller land size that could be inherited or bought. Barrett *et al.* (2001) found that farmers tend to engage in non-farm activities at a younger age because older farmers tend to own larger portions of land. This pushes the young generation to resort to other sectors of the economy such as processing and manufacturing.

**Farm size:** The land area owned or occupied by farmers in the study area was found to be significant at ($p<0.05$). The results showed that households with more land sizes tend to follow agricultural-based activities rather than diversifying from agriculture since they gain means of living from their productive land. It is noted that other households who lack agricultural inputs tend to lease their land to private commercial farmers and the likelihood is that such households would diversify from agriculture to non-farm activities.

Lanjouw (1995) maintains that landholding by individual farmers is sometimes negatively correlated with participation in low productivity. Farmers consider non-farm activities as a last resort, especially when frustrated of not having farm inputs.

**Financial index:** This variable was found to positively influencing farmers' decisions on practicing either agricultural or non-agricultural activities and it was found significant at (p<0.05). This implies that the decision by famers to diversify from agricultural activities was influenced by inadequate access to formal financial institutions such as credit from banks (49%) and personal savings (28.9%). This implies that formal and informal credit is an important asset for rural smallholder farmers not only to enhance production but also to finance loss during drought and seasonal food shortage. The results suggest that farmers' access to financial institutions plays a significant role in promoting agricultural development rather than diversifying into non-farm activities.  Brown *et al*. (2006) and Khan (2007) fount that access to credit has the potential to accelerate production and boost rural economy.

**Extension contact:** This variable was found to be significant at (p<0.10) with correlation of likelihood to choose agriculture and non-farm livelihood strategy rather than relying and sustaining on agriculture alone. Everything being equal, the likelihood of participating in agriculture and non-farm activities will increase by 24% for individuals who benefitted from frequent extension contacts. The objective of extension is to broaden farmers' knowledge on existing innovations, especially in their difficulties to adapt better solutions for their farming activities. The information disseminated through extension and obtained by farmers may influence decision-making in terms of improving production and farm management.

**Gender:** This variable affects diversification of options including the choice of income generating strategy on both agriculture and non-farm. This is supported by existing social mobility limitations and access to assets (Galab *et al.*, 2002). The results of this study revealed that sex of household head was found to be negative and significantly (p<0.05) influencing diversification into non-farm activities by both male and female. Male farmers in the study area were likely to diversify from agriculture to non-farm activities such as getting formal employment from the mining sector or opening up personal mechanical workshops. While females were likely to leave agriculture and look for work in the city as domestic workers or open small businesses such a tuck-shops.

Haggblade *et al.* (1989) found that women dominate many non-farm activities such as food processing, tailoring, trading and other services. They, likewise, hold major interests in many declining rural non-farm occupations. Consequently, women would be key in the economic transformation of the rural economy.

The marginal effect shows that if age index improves by 1%, the probability of farmers to choose agriculture or a choice of non-farm livelihood is likely to increase by 4%. If improvement in farm size index increases by 1%, the probability of farmers to choose agriculture or non-farm livelihood would improve by 3.1%. If financial index improves by 1%, the choice of livelihood for farmers will also improve by 1%. If contact with extension workers improves by 1%, the probability of farmers to choose agricutlture as a non-farm choice of livelihood will improve by 2.4%. If gender index improves by 1%, the probability of choice of livelihood for farmers will improve by 1.9%.

Table 10: Multinomial Logit regression of agriculture and non-farm livelihood strategies

| | B | Std. Error | Wald | df | Sig. | Marginal effects |
|---|---|---|---|---|---|---|
| Intercept | -23.047 | 12.98 | 2.90 | 1 | **.001** | 0.003 |
| Age | -.130 | .044 | 8.663 | 1 | **.003** | .004 |
| Farming experience | .053 | .052 | 1.060 | 1 | .303 | .272 |
| Input | .000 | .000 | 2.553 | 1 | .110 | .316 |
| Farm size | .000 | .000 | 5.032 | 1 | **.025** | .031 |
| Total income | .179 | .140 | 1.620 | 1 | .203 | .128 |
| Expenditure | .000 | .000 | 1.698 | 1 | .193 | .113 |
| Financial index | 69.077 | 22.119 | 9.753 | 1 | **.002** | .001 |
| Human index | 2.143 | 1.362 | 2.474 | 1 | .116 | .172 |
| Physical index | 4.368 | 12.324 | .126 | 1 | .723 | .244 |
| Natural index | -1.235 | 2.538 | .237 | 1 | .627 | .828 |
| Social index | -2.220 | 5.822 | .145 | 1 | .703 | .103 |
| Size of household | 14.913 | 16998.218 | .000 | 1 | .999 | .186 |
| Education | 18.211 | 18241.122 | .000 | 1 | .999 | .073 |
| Extension contact | -17.592 | 9.335 | 3.551 | 1 | **.059** | .024 |
| Sources of labour | 2.115 | 1.836 | 1.327 | 1 | .249 | .075 |
| Gender | 6.296 | 3.021 | 4.343 | 1 | **.037** | .019 |
| Cox and Snell | .594 | | | | | |
| Nagelkerke | .675 | | | | | |
| McFadden | .425 | | | | | |
| Chi-Square | 134.190 | | | | | |
| Df | 74 | | | | | |
| P | 0.00 | | | | | |

The reference category is agriculture and non-farm ** Significant at < 0.01 level: *
Significant at< 0.01 level

**4.14**    *Probit regression to determine choice of agriculture as livelihood strategy among farmers*

Table 11 shows the result of the probit model on the influence of independent variables on choice of livelihood strategies based on agriculture. In this study, choice of livelihood strategy based on agriculture was classified as 1 and other as 0. The intercept of the choice of livelihood strategy based on agriculture was -1.323. The model had a good fit and was significant at p<1% and p<1%. Three explanatory variables were significant while thirteen were insignificant. The significant variables were age (Z= 2.814), social index (Z= 2.004) and extension contact (Z= -3.056) while insignificant variables were farming experience, inputs, farm size, total income, expenditure, financial index, human index, physical index, natural index, household size, education, labour sources and gender. The probit model was employed to determine factors that influence the choice of livelihood strategies based on agriculture among smallholder irrigation farmers in the study area. The probit model explains the probability of a household to choose a livelihood strategy based on agriculture and taking into consideration the sixteen identified independent variables. The signs of the coefficients of independent variables and significance of independent variables were used in to determine the impact of each variable on probability of farmers engaging only on livelihood strategy based on agriculture. The signs of two the coefficients (age and social index) did not comply with a priori expectations but are statistically significant at 1% and 5%. The coefficient of extension contact has a negative coefficient and is statistically significant at 1%. This indicates that there is an indirect relationship between contact with extension workers and livelihood strategies based on agriculture among farmers. This implies that education and knowledge gained by farmers through frequent contact with extension agents led to improved farming skills with likelihood of reduced risks rather than diversifying from agricultural activities. If age of farmers in the study area improves by 1%, the probability of farmers to choose agriculture alone as their choice of livelihood is likely to improve by 1%. However, if social index of farmers through group networks such as becoming a member of a registered cooperative that shares inputs and market information increases by 1%, the probability of farmers to choose agriculture as the dominant livelihood option could increase by 1.1%.  If contacts with extension agents increase by 1%, the probability of farmers to choose agriculture as their livelihood option will increase by 3.1%.

Table 11: Probit regression of choice of livelihood strategies based on agriculture

| Parameter | Estimate | Std. Error | Z | Sig. | Marginal effects |
|---|---|---|---|---|---|
| Intercept | -1.323 | .186 | -7.106 | **.000** | 0.509 |
| Age | .004 | .002 | 2.814 | **.005*** | .001 |
| Farming experience | .002 | .002 | .878 | .380 | -.002 |
| Input | .000 | .000 | .605 | .545 | .000 |
| Farm size | -.008 | .006 | -1.534 | .125 | -.019 |
| Total income | .000 | .000 | 1.237 | .216 | .000 |
| Expenditure | .000 | .000 | -.425 | .671 | .000 |
| Financial index | .033 | .763 | .043 | .966 | 0.462 |
| Human index | -.121 | .345 | -.350 | .726 | 0.797 |
| Physical index | -.346 | .569 | -.608 | .543 | 0.460 |
| Natural index | -.008 | .009 | -.889 | .374 | -.024 |
| Social index | .481 | .240 | 2.004 | **.045**** | .011 |
| Household size | -.013 | .009 | -1.415 | .157 | -.031 |
| Education | .020 | .014 | 1.398 | .162 | -.008 |
| Extension contact | -.189 | .062 | -3.056 | **.002*** | -.310 |
| Sources of labour | .005 | .021 | .261 | .794 | -.035 |
| Gender | .175 | .115 | 1.528 | .126 | -.049 |
| Chi-Square | 1273.330 | | | | |
| Df | 132 | | | | |
| P | 0.00 | | | | |

The reference category is agriculture *** Significant at < 0.01 level: ** Significant at< 0.01 level

### 4.15    Probit regression to determine choice of non-farm based livelihood strategy among farmers

Table 12 shows the result of the probit model. This was used to determine the influence of the dependent variable on non-farm based livelihood strategies. In this study, choice of livelihood strategy based on non-agricultural activities was classified as 1 and other as 0. The intercept level of non-farm based livelihood strategy was -1.145. The model had a good fit and was significant at p<1%. Five explanatory variables were significant while eleven were insignificant. The significant variables were age (Z= 4.679), input (Z= -2.747), total income (Z= -5.113), expenditure (Z= -2.116) and education (Z= -1.883) while the insignificant variables were farming experience, farm size, financial index, human index, physical index, natural index, household size, extension contact, labour sources and gender. The probit model was employed to determine factors that influence choice of livelihood strategies based on non-farm activities among smallholder irrigation farmers in the study area. The probit model explains the probability of a household engaged in non-farm livelihood strategy as a result of sixteen identified independent variables. The signs of the coefficients of independent variables and significance of the independent variables were used to determine the impact of each variable on the probability of farmers engaging solely on livelihood strategies based on non-farm activities. The signs of one coefficient (age) did not comply with a priori expectations but were statistically significant at 1%. The signs of the coefficients for input, total income, expenditure and education were negative and statistically significant at 1%. This shows that there is an indirect relationship between input, total income, expenditure, education and non-farm based livelihood strategies among farmers. This implies that lack of agricultural inputs by farmers, low total incomes and low literacy levels are likely to affect farmers' decision in diversifying from agricultural activities to non-farm activities.

The literature revealed that majority of farmers have secondary level of education. It was also revealed that farmers tend to lease out their land because of lack of agricultural inputs. In some instances, the farmers leave agriculture to join other sectors such as mining which is the highest contributor in terms of provincial Gross Domestic Product (GDP). If the age index improves by 1%, the probability of farmers to choose non-farm activities as livelihood strategy will increase by 0.4%.

If farm input index, farm income and expenditure improve by 1% respectively, the probability of farmers to choose non-farm activities as their choice of livelihood will not change. However, if the education index improves by 1%, the choice of farmers' livelihood is likely to change by 5.2%. This implies that if farmers are educated, they will probably have an insight in terms of choosing other strategies such as joining formal employment to supplement their incomes from irrigation farming. Ellis (2000) suggests that diversification is mostly driven by changes in income-earning opportunities that are promoted by structural adjustment and market liberalisation policies. Smallholder households are diversifying their livelihood strategies and increasing the shares of non-farm income earned. Smallholder farmers generate some income from non-farm activities and such diversification is supported by the increasing scarcity of natural resources (Reardon *et al.*, 1998; Carney, 1998).

Table 12: Probit regression of   choice of non-farm livelihood strategies

| Parameter | Estimate | Std. Error | Z | Sig. | Marginal effects |
|---|---|---|---|---|---|
| Intercept | -1.145 | .185 | -6.196 | **.000** | 0329 |
| Age | .007 | .001 | 4.679 | **.000\*\*\*** | 0.004 |
| Farming experience | .001 | .002 | .379 | .705 | 0.003 |
| Input | .000 | .000 | -2.747 | **.006\*\*\*** | 0.000 |
| Farm size | -.003 | .005 | -.518 | .604 | 0.013 |
| Total income | .000 | .000 | -5.133 | **.000\*\*\*** | 0.000 |
| Expenditure | .000 | .000 | -2.116 | **.034\*\*** | 0.000 |
| Financial index | -.145 | .730 | -.198 | .843 | 0.576 |
| Human index | .298 | .335 | .890 | .374 | 0.358 |
| Physical index | -.834 | .550 | -1.516 | .130 | 0.913 |
| Natural index | .008 | .006 | 1.196 | .232 | 0.005 |
| Social index | -.290 | .232 | -1.249 | .212 | 0.745 |
| Size of household | .009 | .009 | 1.040 | .299 | 0.008 |
| Education | -.025 | .014 | -1.883 | **.060\*** | 0.052 |
| Extension contact | -.092 | .065 | -1.408 | .159 | 0.219 |
| Sources of labour | .013 | .021 | .600 | .548 | 0.029 |
| Gender | .056 | .114 | .489 | .625 | 0.168 |
| Chi-Square | 1632.90 | | | | |
| Df | 132 | | | | |
| P | 0.00 | | | | |

The reference category is non-farm \*\*\* Significant at < 0.01 level: \*\*Significant at< 0.01 level: \* Significant at < 00.1

## 4.16 Summary of chapter

The results of the study revealed that out of 149 respondents interviewed, 55.7% were females while 44.3% were male farmers. Majority of respondents (65.8%) were above 50 years, married, christians and with the highest level of educational being primary school. The results further revealed that 36.9% of farmers were involved in non-farming activities. The non-farming activities practised were as follows: sew clothes, run a tuckshop, transport children to school or practise as traditional healers within the community. The results revealed that about 80% of farmers used central pivots connected to the electricity and operated automatically. The results further revealed that 94% of water used for irrigation farming was sourced from dams. The water is then channelled through canals up to the irrigation farming land.

About 92% of the irrigation land is owned by the Chief or (Kgosi). In South Africa, there are areas that are referred to as former homelands developed by the former apartheid regime. 49.0% of farmers indicated that access to credit from formal institutions such as banks was inadequate, while 44.3% indicated that they had access to credit. 6.7% of farmers maintained that they had adequate access to credit from banks. About 79.9% of farmers indicated that they do not have adequate access to electricity, while 61.7% maintained they had inadequate access to roads and markets. 71.1% of farmers indicated that the prices of agricultural commodities were too high, 69.1% maintained the prices of inputs were high while agricultural production was low. About 65.8% of respondents indicated that they cannot afford to buy agricultural inputs such as fertilisers and seeds during other planting seasons. In most instances, farmers indicated that they were occasionally granted inputs by local government and private retailers in the form of donations.

**CHAPTER FIVE**

**5.0    SUMMARY, CONCLUSION AND RECOMMENDATIONS**

**5.1    INTRODUCTION**

This chapter provides the conclusion, a summary of results and major findings of the study. It also makes recommendations for future planning by policy and decision-makers. The study assessed determinants of livelihood strategies among smallholder farmers involved in irrigation schemes in the North West Province, South Africa. One hundred and forty nine farmers were randomly selected using a simple random sampling technique. Data was collected through a structured questionnaire that sought information on demographic characteristics of respondents, farming enterprises, types of irrigation systems, sources of income, production expenses, personal expenses, livelihood aspirations, determinants of choice of livelihood and constraints in determining choice of livelihood by smallholder farmers.

**5.2    Summary and Major Findings**

The study assessed determinants of livelihood strategies among smallholder farmers involved in irrigation schemes in the North West Province, South Africa. The objectives of the study were to: describe the socio-economic profiles of farmers involved in irrigation schemes; assess livelihood strategies adopted by different farmers in the study area; identify determinants of farmers' choice of livelihood strategies; and examine constraints involved in the choice of livelihood strategies among farmers. The population of the study included smallholder farmers involved in irrigation farming in the study area. Respondents were organised by extension workers through their daily and weekly visits and the researcher was accompanied by extension workers on the field. The sample size was one hundred and forty nine farmers (eighty six females and sixty six males). A structured questionnaire based on the objectives of the study was used to collect data in the form of interviews and group discussions.

Interviews (as a key component of data collection) allowed the researcher to explore key issues of the study through face-to-face encounter and involve the researcher in the study. The questionnaire consisted of three different sections based on the four objectives of the study. The questionnaire sought information on demographic characteristics of respondents, farming enterprises, types of irrigation systems, sources of income, production expenses, personal expenses, livelihood aspirations and household coping strategies against poverty. Data collected was analysed through the Statistical Package for Social Sciences (SPSS), frequencies and percentages, multinomial and probit regression. The results of the study showed that majority of respondents were females and above 50 years, married, christians and with highest level of educational being primary school. The results also showed that only few farmers were involved in non-farming activities sewing of clothes, running a personal tuckshop, transporting children to school or practising as traditional healers in the community. The results revealed that about 80% of farmers used central pivots connected to the electricity and operated automatically. The results further revealed that 94% of water used for irrigation farming was sourced from dams which is later channelled through canals to the irrigation land. From the results, about 88.6% of farmers were accessing credit from cooperatives, while about 75.8% had a comparative advantage of accessing credit from contractors. About 49.0% of farmers indicated that they had inadequate access to credit from formal institutions such as banks, while 44.3% maintained that they had access to credit. 6.7% of farmers indicated that they had adequate access to credit from banks. About 56.4% of farmers indicated that they had inadequate training. The only type of training available to farmers was in the form advisory services from the extension workers and other occasional farmers' days organised by the local Department of Agriculture. About 54.4% of the farmers indicated that they had adequate access to extension services. About 59.1% of farmers maintained that they were able to perform record-keeping for their farming enterprises although it was done electronically.

About 79.9% of farmers indicated that they do not have adequate access to electricity, while 61.7% maintained they had inadequate access to roads and markets. Physical capital is essential to achieve livelihood goals and include access to basic services such as water, transport and electricity, as well as markets. Majority of villages in rural areas had inadequate and poorly maintained road networks.

The results showed that 91.3% of farmers had permission granted by the chief to occupy land and utilise it for agricultural-related activities, while 1.4% of the land is privately leased. The results further revealed that farmers networking in the form of registered cooperatives. In such cooperatives, farmers share cost of inputs and also work together, especially when there is a demand from the market for a particular cash crop. Apart from sharing resources, farmers also work together to lobby for funding and in each cooperative, there is a committee that handles all administrative issues such as the interpretation of market information, assisting with contracts, taking into consideration the fact that majority of the farmers are not very literate. The results of Multinomial Logit regression for agriculture and non-farm livelihood strategy revealed that age of household head was significant and influenced a farmer's decision negatively to diversify to non-farm activities. This implied that there was a likelihood that as farmers grow old, they may not want to participate on non-farm activities. Farm size, area of land owned or occupied by farmers was significant with positive correlation. Extension contact was found to be significant with the correlation of likelihood to choose agriculture and non-farm livelihood strategy instead of relying and sustaining on agriculture alone. Gender affects diversification of options including the choice of an income-generating strategy for both agriculture and non-farm activities. The results revealed that gender of household head negatively and significantly influenced diversification into non-farm activities.

The results of the probit model were used to determine the influence of the dependent variable on livelihood strategies based on agriculture. The model had a good fit and was significant. Three explanatory variables were significant while thirteen were insignificant. The significant variables were age, social index and extension contact. The insignificant variables were farming experience, inputs, farm size, total income, expenditure, financial index, human index, physical index, natural index, size of household, education, sources of labour and gender. The results of the probit model were used to determine the influence of the dependent variable on livelihood strategies based on non-farm activities. The model had a good fit and was significant. Five explanatory variables were significant while eleven were insignificant.

## 5.3    Conclusion

This study analysed determinants of livelihood strategies among smallholder irrigators in the North West Province, South Africa. Irrigation farming is a dominant economic activity and the primary source of income for rural households in the study area. Majority of respondents were female farmers with low levels of education levels (primary school).  Farmers involved in the irrigation schemes had access to physical capital such as land, with permission to occupy from the chief. Land size in the irrigation schemes ranged between one and ten hectares. Farmers had access to physical capital such as roads and markets, however, access to electricity was inadequate. Farmers in the irrigation schemes had access to credit from cooperatives, but were unable to access loans from commercial banks.

Farmers were organised in the form of cooperatives. Farmers shared equipment (tractors and implements) in such cooperatives donated by government in the form of grants. Constraints influencing choice of livelihoods included low prices of agricultural commodities, high prices of inputs and low agricultural production. Smallholder farmers in the irrigation schemes have diversified or changed from agriculture to non-farm activities. Farmers had contact with extension workers on a regular basis in order to obtain market information and training. Farmers generate income from irrigation farming and supplement such income by engaging in other non-farm activities. Farmers spent their incomes on personal expenses that are essential for the households. They also spend the bulk of their incomes in purchasing farm inputs such as fertilizers, pay electricity and water bills.

## 5.4 Recommendations

The results of this study revealed determinants of livelihood strategies among smallholder irrigators in the North West province. The results revealed that majority of farmers were females with low literacy levels, had small land holding and inadequate access to financial institutions. Furthermore, the results showed that farmers in the study area practise diversified livelihood strategies in addition to agriculture. Based on the results of the study, the following policy recommendations and possible areas of intervention are advanced for farmers to adopt best suitable livelihood strategies taking into consideration the resources at their disposal. Majority of respondents were female farmers with low educational levels (primary school). It recommended that policy makers should consider developing and promoting initiatives aimed at capacitating adults such as adult-based education and training. Once farmers are capacitated, this will assist them in making informed decisions for both their farms and non-farm businesses. Farmers in the irrigation schemes have access to physical capital such as land with permission to occupy from the chief. The size of farms in the irrigation schemes range between one and ten hectares. It is recommended that government, through land reform and restitution programmes, consider implementing strategies to enable the registration of communal land ownership under farmers who occupy such portions of land. In this manner, farmers could be able to use land as collateral in accessing funding from formal financial institutions. In order for farmers to be considered commercial in nature, their scale of production needs to increase, therefore, increasing the size of land allocated to farmers could improve their farming operations.

Farmers have access to physical capital such as roads and markets, however, access to electricity is inadequate. Farmers in the irrigation schemes accessed credit from cooperatives, but were unable to access loans from commercial banks. Farmers organised themselves into cooperatives. In such cooperatives, farmers share inputs such a government tractors and implements donated in a form of grants. It is recommended that policy makers increase the supply of electricity to the area by developing a number of electricity substations to improve power cuts in irrigation schemes. Alternatively, diesel generators could be installed as backup when there is load-shedding.

Farmers need to be capacitated in terms of saving their income in banks so that they can be able to have an insight in terms of their spending and investments. Constraints faced by farmers in the choice of livelihoods include low prices of agricultural commodities, high prices of inputs and low agricultural production.  It is recommended that extension workers increase the number of contact sessions with farmers. This could assist in providing more knowledge to farmers and improve the price of agricultural produce. Smallholder farmers involved in irrigation schemes have diversified or changed from agriculture to non-farm activities. It is recommended that government support to smallholder farmers be improved upon and subsidise fully farmers through comprehensive agricultural support programmes and transformation funds from industries should be utilised accordingly and in support of agribusiness activities. Government should also consider investing more on agricultural training programmes in a form bursaries for youth to study agriculture and be employed within the same sector or assist graduates in developing their own farm enterprises.

**REFERENCES**

**ADUGNA LEMI, (2005).** The Dynamics of Livelihood Diversification in Ethiopia Revisited: Evidence from Panel Data, Department of Economics University of Massachusetts, Boston

**ALIBER, M. & HART, T.G.B., (2009).** *Should subsistence agriculture be supported as a strategy to address rural food insecurity?* Agrekon Vol. 48:4

**ALTMAN, T. G. B., & JACOBS P. T., (2009).** *Household food security status in South Africa.* Agrekon Vol. 48:4

**ARARSO, G.S., SCHULTZ, B., HOLLANDERS, P., (2008).** Planning water management for secure food production in sub-Saharan Africa. Irrigation and Drainage, doi: 10.1002/ ird.444.

**BACKEBERG GR, BEMBRIDGE TJ, BENNIE ATP, GROENEWALD JA, HAMMES PS, PULLEN RA and THOMPSON H (1996).** Policy Proposal for Irrigated Agriculture in South Africa. WRC Report No. KV96/96. Water Research Commission, Pretoria, South Africa. Pp 119.

**BACKEBERG, G.R. (2006).** Reform of user charges, market pricing and management of water: problem or opportunity for irrigated agriculture? *Irrigation and Drainage*, **55**(1): 112.

**BAGCHI, D.K., BLAKIE, P., CAMERON, J., CHATTOPADHY, M., GYAWALI, N. and SEDDON, D. (1998).** Conceptual and methodological challenges in the study of livelihood trajectories: case studies in Eastern India and Western Nepal. *Journal of international Development*, **10**:453-466

**BAIPHETHI, M. N. & JACOBS, P. J., (2009).** *The contribution of subsistence farming to food security in South Africa.* Agrekon Vol. 48:4

**BALARANE, A. and OLADELE, O.I., (2012).** Awareness and use of agricultural market information among small scale farmers in Ngaka Modiri Molema District of North West Province. *Life Science Journal*, *9*(3), Pp.57-62.

**BARRETT, C.B., REARDON, T. and Webb, P., (2001).** Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food policy*, *26*(4), Pp.315-331.

**BAZELEY, P (2004).** Issues in Mixing Qualitative and Quantitative Approaches to Research. In Applying Qualitative Methods to Marketing Management Research. R. Buber, J. Gadner, eds. Pp 141–156. Hampshire, United Kingdom: Palgrave Macmillan.

**BIENABE, E., Coronel C., Le Coq, J. and LIAGRE, L. (2004).** Linking smallholder farmers to markets: Lessons learned from literature review and analytical review of selected projects. Study Report, Final draft, March 2004. CIRAD & IRAM. World Bank

**BEINART, W (2001).** Twentieth-century South Africa. Oxford: University Press

**BEMBRIDGE, T.J. (1996).** *Small-scale farmer irrigation schemes in South Africa. In: Backeberg et al. Policy proposal for irrigated agriculture in South Africa.* WRC Report, Pretoria, South Africa

**BEMBRIDGE TJ, (1997).** Small-scale farmer irrigation in South Africa: Implications for extension. S. Afr. J. Agric. Ext. 26 71-81.

**BEMBRIDGE T (2000).** Guidelines for Rehabilitation of Small-Scale Farmer Irrigation Schemes in South Africa. WRC Report No. 891/1/00. Water Research Commission, Pretoria, South Africa. Pp 163.

**BEZEMER, D. J. and LERMAN, Z., 2002.** Rural Livelihoods in Armenia: The Centre for Agricultural Economic Research, the Department of Agricultural Economics and Management Discussion Paper No. **4**.03

**BHATTARAI, M., SAKTHIVADIVEL, R. & HUSSAIN, I. (2002).** Irrigation impacts on income inequality and poverty alleviation: policy issues and options for improved management of irrigation systems. Working paper 39. Colombo: International Water

Management Institute.

**BLOCK, S. and WEBB, P., (2001).** The dynamics of livelihood diversification in post-famine Ethiopia. *Food policy*, **26**(4), Pp.333-350.

**BROWN, D.R., STEPHENS, E., C., OKURO, M.J., MURITHI, F.M., BARRETTE, C.B, (2006)**. Livelihood Strategies in the Rural Kenyan Highland. AfJARE. 1(1): 21-30.

**BRUINSMA, J. (Ed.), (2003).** World Agriculture: Towards 2015/2030, An FAO Perspective. Earth scan, London and Food and Agriculture Organization, Rome.

**BUNDY, C. (1988).** *The rise and fall of the South African peasantry*. 2nd ed. Cape Town: David Philip.

**BURNEY, J. A& NAYLOR, R.L (2011**). Smallholder irrigation as a poverty alleviation tool in Sub-Sahara Africa.

**CARSWELL, G., 2000.** Livelihood diversification in southern Ethiopia IDS working paper 117

**CARNEY, D. (1998).** Implementing the sustainable rural livelihoods approach. In: Carney, D. (ed.). *Sustainable rural livelihoods: what contribution can we make?* London: DFID.

**CETIN, O., and L. BILGEL, (2002).** "Effects of different irrigation methods on shedding and yield of cotton." *Agricultural Water Management* 54.**1**: 1-15.

**CHAMBERS, R and GORDON C (1992).** *Sustainable Rural Livelihoods: Practical concepts for the 21st Century*. IDS Discussion Paper 296, IDS, Brighton, UK, February 1992

**CHENJE, M., SOLA, L. and PALECZNY, D., (1998).** The state of Zimbabwe's environment 1998.

**CROSBY CT, DE LANGE M, STIMIE CM and VAN DER STOEP I, (2008).** A Review of Planning and Design Procedures Applicable to Small-Scale Farmer Irrigation Projects. WRC Report No. 578/2/00. Water Research Commission, Pretoria, South Africa Pp 240.

**DALELO, A., (2003).** RURAL ELECTRIFICATION IN ETHIOPIA: OPPORTUNITIES AND BOTTLENECKS By.

**DEPARTMENT OF AGRICULTURE FORESRTY AND FISHERIES.** *The integrated Food Security Strategy for South Africa (2002),* [online] Accessed from www.daff.gov.za [Accessed: 2014-06-05]

**De SATGE, R. (2002)**. *Learning about livelihoods: Insights from Southern Africa.* Cape Town: Periperi

**DFID (Department for International Development). (1999).** Sustainable livelihoods guidance sheets 1-4. London: DFID [Online]. Available from: http://www.livelihoods.org/info/info_guidanceSheets.html [Accessed: 10/04/2015].

**DFID, (2000).** Sustainable Rural Livelihoods Guidance Sheet, London, UK

**DILLION, A. (2011).** The effect of irrigation on poverty reduction, asset accumulation, and informal insurance: Evidence from Northern Mali.

**DORWARD, A., KYDD J., POULTON C (2009).** Coordination Risk and Cost Impacts on Economic Development in Poor Rural Areas, *Journal of Development Studies*, Vol: 45, ISSN: 0022-0388, Pages: 1093-1112

**ELLIS, F., (2000).** Rural Livelihoods and Diversity in Developing Countries, Oxford University Press

**ELLIS, F. (2000).** The determinants of rural livelihood diversification in developing countries, *Journal of Agricultural Economics* **51:2**, 289-302

**ELLIS, F. (2000).** *Rural Livelihoods and Poverty Reduction Policies*: London, Routledge.

**FANG YI-PING, JIE FAN, MAO-YING SHEN, and MENG-QIANG SONG (2014)** Sensitivity of livelihood strategy to livelihood capital in mountain areas: Empirical analysis based on different settlements in the upper reaches of the Minjiang River, China. Ecological Indicators 38 (2014) 225–235.

**FAO. (1995).** *Irrigation in Africa in figures*. Water Reports. FAO: Rome [Online].

Available from: http://www.fao.org/ag/agl/aglw/aquastat/glossary/index.jsp [Accessed: 16/08/2015].

**FOOD & AGRICULTURE ORGANISATION. (2001).** Information System for Water and Agriculture: glossary of land and water terms [Online]. Available from: http://www.fao.org/ag/agl/aglw/aquastat/glossary/index.jsp [Accessed: 16/11/2014].

**FRASER, G., MONDE, N., and VAN AVERBEKE, W. (2003).** Food security in South Africa: a case study of rural livelihoods in Eastern Cape.

**GALAB, S. and RAO, N.C., (2003).** Women's self-help groups, poverty alleviation and empowerment. *Economic and Political weekly*, Pp.1274-1283.

**GADZIKWA L, LYNE MC, HENDRIKS, S (2006).** Collective action in smallholder organic farming: A study of the Ezemvelo farmers' organization in Kwa Zulu Natal. The South African Journal of Economics, **74**(2): 344-358

**GECHO, Y., AYELE, G., LEMMA, T and ALEMU, D. (2014).** Rural household livelihood strategies in the case of Wolaita Zone, Southern Ethiopia. Social Sciences Journal 2014; 3(3): 92-104

**GOLLIN D (2010).** Agricultural Productivity and Economic Growth. Handbook of Agricultural Economics, Vol. 4: 3825-3866. Elsevier.

**GREEN, H.W., (2003)**. Econometric Analysis: Fourth Edition. New York University Macmillan Publishing Company.

**HAGGBLADE, S., HAZELL, P. and BROWN, J, (1989),** Farm-Non-farm linkages in rural sub-Saharan Africa', World Development, **17**(8): 1173-1201.

**HAGGBLADE, S; HAZELL, P. and T. REARDON (2000).** Transforming the Rural Non-Farm Economy. John Hopkins University Press Baltimore.

**HALL, RUTH, and MICHAEL ALIBER, (2010).** *The case for re-strategizing spending priorities to support small-scale farmers in South Africa*.

**HASNIP, N., MANDAL, S., MORRISON, J., PRADHAN, P., SMITH, L.E.D., (2001)**. Contribution of Irrigation to Sustaining Rural Livelihoods. HR Wallingford, Wallingford, UK.

**HEBINCK P and VAN AVERBEKE W, (2007).** Rural transformations in the Eastern Cape. In: Hebinck, P and Lent PC (eds.) *Livelihoods and Landscapes: The People of Guquka and Koloni and Their Resources*. Afrika-Studiecentrum Series Vol. 9. Brill, Leiden, the Netherlands. 33-66.

**HUANG, Q., DAWE, D., HUANG, J., ROZELLE, S., Wang, J., (1999)**. Irrigation, poverty and inequality in rural China. The Australian *Journal of Agricultural and Resource Economics* 49 (**2**), 159–175.

**HOLLOWAY GJ, CHARLES N, CHRISTOPHER D, STEVEN S, SIMON E 2000**. Agro-industrialization through institutional innovation: *Transaction costs, cooperative and milk market development in East African Highlands. Agricultural Economics Journal*, **23**: 279-288.

**HOUGHTON DH, (1952).** Life in the Ciskei: A Summary of the Findings of the Keiskammahoek Rural Survey 1947-51. SA Institute of Race Relations, Johannesburg, South Africa. Pp 72.

**IBEKWE, U. C., C. C. EZE, and D. O. OHAJIANYA (2014)**. "Determinants of Non-Farm Income among Farm Households in South East Nigeria." *The AYER* 1 (2014): **32**-39.

**INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE C (ICID), (2007),** "Call for Second African Regional Conference on the theme: Contribution of rainfed and irrigated agriculture to poverty alleviation through increased productivity in Africa", SANCID (Johannesburg), 6-9 November.

**INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT (IFAD). (2001).** rural poverty report 2001: the challenge of ending rural poverty. Oxford: Oxford University Press.

**INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE [IFPRI] (2005).** The future of small farms: Proceedings of a research workshop, Wye, UK, June 26-29, Washington, DC.

**JACKSON AND STEENHUIS, T (1997).** *Environmental Issues*. Small Hotters Sectors, University of Zimbabwe.

**JIN, S., HUANG, J., HU, R., ROZELLE, S., (2002)**. The creation and spread of technology and total factor productivity in China_s agriculture. *American Journal of Agricultural Economics* 84 (4), 916–930. Kennedy, P., 1998. A Guide to Econometrics. The MIT Press, Cambridge, MA.

**KIRSTEN JF, VAN ZYL (1998).** *Defining Small-scale farmers in the South African context.* Agrekon, **37**(4):560-571

**KHAN, S., TARIQ, R., YUANLAI, C., Blackwell, J., (2006).** Can irrigation be sustainable? Agric. Water Manage. **80** (1–3), 87–99.

**KUNDHANDE, G.M, GROENEWALD, D.C. BAIPHETHI, M.N And VILJOEN, M.F (1994)** *Environmental Systems* (Certificate Course) Bulawayo ,Tyrocrafters Press.

**LAHIFF E, (2000).** *An Apartheid Oasis? Agricultural and Rural Livelihoods in Venda*. Frank Cass Publishers, London Pp 299.

**LANJOUW, P. (1999).** Rural Non Agricultural Employment and Poverty in Ecuador Economic Development and Cultural Change; **48**(1):91-122.

**LEWIS, R. A, (2002).** CRC dictionary of agricultural sciences. London: CRC Press

**LIPTON M (1996).** Rural reforms and rural livelihoods: The context of international experience. In: Lipton M, De Klerk M and Lipton M (eds.) *Land, Labour and Livelihoods in Rural South Africa, Volume One: Western Cape*. Indicator Press, Dalbridge, Durban, South Africa.

**LIPTON, M., LITCHFIELD, J., FAURE` s, J.M., (2003)**. The effects of irrigation on poverty: a framework for analysis. Water Policy 5 (5–6), 413–427

**LIAO, Y., (2003).** Irrigation water balance and food security in China. Ph.D. Dissertation, the Chinese Academy of Agricultural Science.

**LOUW, A., CHIKAZUNGA, D., JORDAAN, D., and BIENABE, E. (2007).** Restructuring food markets in South Africa: Dynamics within the context of the tomato subsector. *International Institute for Environment and Development (IIED) London*.

**LYNE MC, HENDRICKS SL, CHITJA JM (2009).** Agricultural growth and food security. In: S L Hendricks and M C Lyne (ed), Does food security improve when smallholders access a niche market? Lessons from the Embo Community in South Africa. The African Centre for Food Security, University of KwaZulu-Natal, South Africa. ISBN: 978-1- 86840-687-6.

**MACHETE CL, MOLLEL NM, AYISI K, MASHATOLA MB, ANIM FDK and VANASSCHE F, (2004).** Smallholder Irrigation and Agricultural Development in the Olifants River Basin of Limpopo Province: Management Transfer, Productivity, Profitability and Food Security Issues. WRC Report No. 1050/1/04. Water Research Commission, Pretoria, South Africa. Pp 112.

**MACHETE, CL., MOLLEL, NM., AYISI, K. (2004).** Smallholder Irrigation NAD Agricultural Development in the Olifants River Basin of Limpopo Province: Management transfer, productivity, profitability food Security Issues, South Africa WRC Report No 1050/ 04 ISBN 1-77005-242-9

**MAGINGXA LL, ALEMU ZG and VAN SCHALKWYK HD, (2009).** Factors influencing access to produce markets for smallholder irrigators in South Africa. *Dev. S. Afr.* **26** (1) 47-58.

**MAKADHO, L. (1992).** *Water and Agriculture in Zimbabwe Policy and Management Options for the Small Holders:* Mount Pleasant, Harare. University of Zimbabwe.

**MAKUMBE P. (1996).** *The Role of Popular Participation in Programmes of Social Development,* Journal of Social Development in Africa, Oxfam.

**MAISIRI, N, (2005).** "On farm evaluation of the effect of low cost drip irrigation on water and crop productivity compared to conventional surface irrigation system." *Physics and Chemistry of the Earth, Parts A/B/C* 30.**11**: 783-791.

**MANONA S, DENISON J, VAN AVERBEKE W and MASIYA T, (2010).** Proposed land tenure and land administration interventions to increase productivity on smallholder irrigation schemes in South Africa. Paper presented at 'Overcoming Inequality and Structural Poverty in South Africa: Towards Inclusive Growth and Development', 20-22 September 2010, Birchwood Hotel and Conference Centre, Johannesburg. URL: http://www.phuhlisani. Com/oid%5Cdownloads%5CManona%20et%20al.pdf (Accessed 15 July 2015). Pp 23.

**MATSHE, I. (2009)**. Boosting smallholder production for food security: some approaches and evidence from studies in sub-Saharan Africa. *Agrekon*, **48**(4): 483-511.

**MISSELHORN, A.A., (2005).** What drives food insecurity in southern Africa? A meta-analysis of household economy studies. Global Environmental Change **15**, 33–43.

**MESSER, N. & TOWNSLEY, P. (2003).** *Local institutions and livelihoods: guidelines for analysis*. Rome: FAO.

**MONTSHWE, B.D., (2006).** Factors affecting participation in mainstream cattle markets by small-scale cattle farmers in South Africa. Unpublished master's thesis. University of Free State, Bloemfontein.

**MOLLER, V. & DEVEY, R. (2003).** Trends in living conditions and satisfaction among Poorer older South Africans: objective and subjective indicators of quality of life in the October household survey. *Development Southern Africa*, 20(4): 457-476.

**MUTSVANGWA T and DORANALLI, K (2006).** Agriculture and Sustainable Development, Netherlands, The Hague University Press.

**NARAYAN, D., and PRITCHETT, L (1999).** "Cents and sociability: Household Income and Social Capital in Rural Tanzania", Economic Development and Cultural Change, Vol. **47**, No. 4: 871-897

**NEVES, D., SAMSON, M., Van NIEKERK, I., HLATSHWAYO, S., Du TOIT, A (2009)**. *The use and effectiveness of social grants in South Africa*. Cape Town: PLAAS and EPRI

**NIEKERK, A.I. (1995).** Opening address. In: Southern African irrigation symposium, Durban, 4-6 June 1991. *Proceedings*. WRC Report No. TT 71/95. Pretoria: Water Research Commission: 1-2.

**OLADEEBOO J. O. and O.E. OLADEEBO. (2008).** Determinants of loan repayment among smallholder farmers in Ogbomoso Agricultural Zone of Oyo State, Nigeria. *J. Soc. Sci*. 17 (1): 59–62.


**ORUONYE E. D. and MUSA Y. N** Challenges of small scale farmers access to micro credit (*Bada Kaka*) in Gassol LGA, Taraba State, Nigeria.


**ONWUEGBUZIE, A. J., and C. TEDDLIE (2003).** A Framework for Analyzing Data in Mixed Methods Research. In Handbook of Mixed Methods in Social and Behavioral Research. A. Tashakkori and C. Teddlie, eds. Pp. 351-383. Thousand Oaks, CA: Sage.


**PERRET, S. (2002 b).** Water policies and smallholding irrigation schemes in South: Africa: A history and new institutional changes. *Water Policy,* **4** (3): 283-300.

**PERRET S., GEYSER M. (2007).** The cost of irrigation: adapting existing guidelines to assess the full financial costs of irrigation services. The case of smallholder schemes in South Africa, *Water SA* **33**: 67-78.


**PIETERSON, J. & MAREE, K (2007).** Statistical analysis 1: descriptive statistics. (In Maree, K., ed. First steps in research. Pretoria: Van Schaik. Pp.183-196).


**PINGALI PL (2010).** Agriculture Renaissance: Making "Agriculture for Development" Work in the 21st Century. Handbook Agric. Econ. **4**:3867-3894. Elsevier.


**PUNNET, W. (1982**) *Man, Land and Resources:,* Yew York. Macmillan

**REARDON, T. (1997).** Using Edidence of Household Income Diversification to inform Study of the Rural Non-farm Labour Market in Africa. World Development, **25** (5):735-748.

**REARDONT, J E TAYLOR, K STAMOULIS, P LANJOUW and A BALISACAN (1998).** Effects of nonfarm Employment on rural income inequality in developing countries: An investment perspective, *Paper prepared for the symposium: Rural Diversification in the Developing World, Agricultural Economics Society Annual Conference*, 25-28 March 1998, University of Reading, UK

**REVENGA, C., BRUNNER, J., HENNIGER, N., KASSEM, K., PAYNER, R., (2000).** Pilot Analysis of Global Ecosystems. Freshwater Systems. World Resources Institute, Washington, DC.

**RICHTER, B.D., BRAUN, D.P., MENDELSON, M.A., MASTER, L.L., (1997)**. Threats to imperiled freshwater fauna. Conservation Biology 11 (5), 1081–1093.

**ROSEGRANT M.W. and HAZELL, P.B., (1999).** Rural Asia transformed: The quiet revolution. *International Food Policy Research Institute, Washington, DC*.
**RUBEN, R. and M. Van den Berg. (2001).** Non-Farm Employment and poverty Alleviation of Rural Households in Honduras. World Development **29**(3): 549-560.

**RUKUNI M, (2002).** Why Land Tenure Security in Africa is Central to Land Reform and Community Based Governance, Economic and Social Progress. South Africa: University of Pretoria.

**SALAMI A, KAMARA AB, BRIXIOVA Z (2010).** Smallholder Agriculture in East Africa: Trends, Constraints and Opportunities, Working Papers Series N° 105 African Development Bank, Tunis, Tunisia.

**SCOONES, I. (1998).** Sustainable livelihoods, a framework for analysis, IDS working paper number 72, Brighton.

**STATS, S.A., (2011).** Mid-year population estimates. *Statistical release* Pp, 302.

**THAMAGA-CHITJA JM, DLAMINI TR, MAKANDA I (2011).** Qualitative elements constituting effective agricultural cooperative among small-scale farmers. Indilinga African Journal of Indigenous Knowledge Systems: Indigenous Knowledge Systems. The Challenge, **10**(1): 1-16.

**TLOU T, MOSAKA D, PERRET S, MULLINS D and WILLIAMS CJ, (2006).** Investigation of Different Farm Tenure Systems and Support Structure for Establishing Small-Scale Irrigation Farmers in Long Term Viable Conditions. WRC Report No. 1353/1/06. Water Research Commission, Pretoria, South Africa. Pp 174.

**TWOMLOW, S., BRUNEAU, P., (2000).** Semi-arid soil water regimes in Zimbabwe. Geoderma **95**, 33–51.

**UPTON M (2004).** The Role of Livestock in Economic Development and Poverty Reduction, PPLPI Working paper 10, FAO/PPLPI, Rome

**UNITED NATIONS, DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS, POPULATION DIVISION (2012).** World Urbanization Prospects: The 2011 Revision, CD-ROM Edition. Available at http://esa.un.org/unup/CD-ROM/Urban-Rural-Population.htm Accessed 6 July 2014.

**VAN AVERBEKE, W., BEDIAKO, A., LANGEVELD, P. & BARRETT, H. (1998).** The role of old age pensions and other social welfare grants in livelihoods in the central Eastern Cape of South Africa. In: *International Symposium of the Association for Farming Systems Research, 15th, 1998*, vol. 2. Pretoria: University of Pretoria: 1311-1319.

**VAN AVERBEKE W, (2008).** Best Management Practices for Sustainable Subsistence Farming on Selected Irrigation Schemes and Surrounding Areas through Participatory Adaptive Research in Limpopo Province. WRC Report No. TT 344/08. Water Research Commission, Pretoria, South Africa. Pp 318.

**VAN ROOYEN, JOHAN, and HOWARD SIGWELE, (1998).** "Towards regional food security in southern Africa: a (new) policy framework for the agricultural sector." *Food Policy* 23.6: 491-504.

**WEISNER, T.S. (2005).** Discovering Successful Pathways in Children's Development: New Methods in the Study of Childhood and Family Life. Chicago: University of Chicago Press.

**WITHERS, B. & VIPOND, S. (1974).** *Irrigation: design and practice*. London: BT Batsford.

**WORLD BANK. (2007).** World Development Report 2008: Agriculture for Development. <http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf> Accessed May 27, 2014.

**WORLD BANK (2008).** World Development Report 2008: Agriculture for development. 1818 H Street, NW, Washington, DC 20433, USA. World Bank (2012). World Development Indicators. Available at http://data.worldbank.org/indicator/all Accessed on 17 May 2014

**YAWITCH, J (1982).** Betterment: the myth of homeland agriculture. Johannesburg: The South African Institute of Race Relations.

**Appendix A**



# FACULTY OF AGRICULTURE, SCIENCE & TECHNOLOGY

## *SCHOOL OF AGRICULTURE*

Tel:          27 18 389 2746   Fax: 27 18 3892748   *Internet: htt://www.nwu.ac.za*

Dear sir/madam,

## TO WHOM IT MAY CONCERN

Mr Abongile Balarane is a Phd student in the Department of Agricultural Economics and Extension, North-West University, Mafikeng Campus, South Africa. He is currently conducting research work with farmers. The title of his study is: "Determinants of livelihood strategies among smallholder farmers on irrigation schemes in the North West Province, South Africa". Therefore, your assistance and cooperation towards the success of the study is highly appreciated.

**Appendix B**

**Questionnaire**


QUESTIONAIRE ON DETERMINANTS OFLIVELIHOOD STRATEGIES AMONG SMALLHOLDER IRRIGATON FARMERS IN THE NORTH WEST PROVINCE

Dear respondent,
This questionnaire is designed to collect data for the study entitled: "DETERMINANTS OF LIVELIHOOD STRATEGIES AMONG SMALLHOLDER FARMERS ON IRRIGATION SCHMES IN THE NORTH WEST PROVINCE, SOUTH AFRICA". The information provided will be treated as confidential as possible. You are requested not to write your name on the questionnaire and the analysis will be group referenced. Could you please spare some minutes to complete the questionnaire? Thanks for your cooperation.

Personal characteristics

Gender: 1= Male 2 = Female
Age: _____
Marital status: Single          Married                  Widowed        Divorced
Race:   African               White          Coloured          Indian        other: _____
Religion: Christianity     Bahai          Hinduism          Islam        Other: _____
Number of dependent(s): _____
Number of household: _____
Total number of people in the household:  Male              Female
Highest level of educational: Primary school Secondary School High School         College University
No formal education
Number of months /years in farming: _____
Tenure status: Personal          Rented     Allocated
Farm size: _____
Are you a member of farmers' group?          Yes, No
Do you have contact with an extension agent?          Yes, No
If yes, how often? Regularly       Occasionally       Rarely
Is the extension officer from: Government       Non-governmental NGO       Parastatals (CASIDRA/ARC)
Number of workers: _____
What are your sources of labour?:  Self       Family  Hired
How long have you been farming?   _____years?
How long have you been part of an irrigation scheme? _____Years?
Please mention the irrigation scheme_____
Number of workers in the scheme: Female    Male
Do you engage in non-farming activities?  Yes        No
If yes, please mention them:_____

Indicate the farming enterprises in which you are engaged in?  (Mark with an X)

| Crops | Ha | Income |
|---|---|---|
| Maize | | |
| Wheat | | |
| Sunflower | | |
| Sorghum | | |
| Groundnut | | |
| Barley | | |
| Lucern | | |
| Tomatoes | | |
| Potatoes | | |
| Cabbage | | |
| Spinach | | |
| Pumpkins | | |
| Green pepper | | |
| Onion | | |
| Garlic | | |
| Green beans | | |
| Citrus | | |
| Carrots | | |
| Beetroot | | |
| Mushroom | | |
| Lettuce | | |
| Cucumber | | |

Type of irrigation system

| | |
|---|---|
| Central pivots irrigation system | |
| Flood irrigation system | |
| Sprinkler irrigation system | |
| Micro irrigation system | |
| Drip irrigation system | |
| Other: | |

Sources of water for the irrigation scheme

| | |
|---|---|
| Dam | |
| River | |
| Reservoir | |
| Bore hole | |
| Municipal water | |
| Fountain | |
| Other | |

Nature of ownership of irrigation scheme

| | | |
|---|---|---|
| Privately-owned | | |
| Community | | |
| Government department | | |
| Private stakeholders | | |
| Other: | | |

Total annual income

| Source of income | Rand (R) |
|---|---|
| Leasing farm equipment | |
| Rent | |
| Remittances | |
| Government grants | |
| Animal production | |
| Other: | |

Total annual expenditure: Production purposes

| Expenses | Rand (R) |
|---|---|
| Maintenance of irrigation technology | |
| Seeds | |
| Water | |
| Electricity | |
| Transportation | |
| Workers' salary | |
| Fungicides, pesticides | |
| Fertilizers | |
| Other farm expenses: | |

Expenses: personal use

| Expenses | Rand (R) |
|---|---|
| School fees | |
| Transportation/ fuel | |
| Food | |
| Electricity | |
| Water | |
| Clothes | |
| Entertainment | |
| Saving (funeral, society, bank e.t.c) | |
| Other: | |

Reasons for involvement in the scheme, please tick. You may tick as many as possible

| Personal interest | |
|---|---|
| Only source of income | |
| Husband / partner has migrated | |
| Community development | |
| Other: | |

LIVELIHOOD ASPIRATIONS

| FINANCIAL CAPITAL | Availability | Very adequate | Not adequate |
|---|---|---|---|
| Access to credit from: | | | |
| Banks | | | |
| Cooperatives | | | |
| Money lenders | | | |
| Relatives | | | |
| Personal savings | | | |
| Contractors | | | |
| Government subsidies | | | |
| HUMAN CAPITAL | | | |
| Training | Yes, No | | |
| Vocational training | Yes, No | | |
| Extension service | Yes, No | | |
| Skills training | | | |
| Record-keeping | Yes, No | | |
| Water management | Yes, No | | |
| Equipment handling | Yes, No | | |

| | | | |
|---|---|---|---|
| Financial management | Yes, No | | |
| Soil management | Yes, No | | |
| Crop protection | Yes, No | | |
| Any other (Specify) | Yes, No | | |
| How often do extension officers visit you? | Frequently | 1 | |
| | Sometimes | 2 | |
| | No Visits | 3 | |
| PHYSICAL CAPITAL | | | |
| Transport | Yes, No | | |
| Water supply | Yes, No | | |
| Markets | Yes, No | | |
| Accessibility of roads | Yes, No | | |
| Electricity | Yes, No | | |
| Storage | Yes, No | | |
| Irrigation types | Sprinkler | | |
| | Pivot | | |
| | Dragline | | |
| NATURAL CAPITAL | | | |
| Land | Yes, No | | |
| Type of tenure | Leased | 1 | |
| | Permission to occupy | 2 | |
| | Communal land | 3 | |
| | Others | 4 | |
| If rented, how much do you pay? | | | |
| The size of the land cultivated | | | |
| Total size of the land | | | |

What do you think constrained the choice of your livelihood?

| What has contributed to the poor nature of your household? | Yes | No |
|---|---|---|
| Cannot afford/ lack of agricultural inputs (fertilizers, seeds) | | |
| Prices of inputs high | | |
| Unavailability of agricultural inputs | | |
| Late delivery of inputs by suppliers | | |
| Low agricultural production | | |
| Drought | | |
| Lack of adequate land | | |
| Prices of agricultural produce too low | | |
| Lack of buyers for agricultural produce | | |
| Lack of capital to start or expand agricultural business | | |
| Lack of credit to start agricultural production or buy inputs | | |
| Lack of employment opportunities | | |
| Prices of commodity too high | | |
| Salary/ wages too low | | |
| Business not doing too well | | |
| Too much competition | | |
| Decline in the economy | | |