Factors affecting rural farming households' willingness to participate in a proposed irrigation scheme: A situation analysis of Guquka in Nkonkobe District Municipality, Eastern Cape, South Africa.

by

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List of Acronyms

WUA - Water User's Association

RDP - Rural Development Programme

FAO - Food and Agriculture Organization

SIS - Smallholder Irrigation Scheme

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ABSTRACT

Previous studies conducted in the study area recommended an irrigation scheme as a much desired intervention in order to reduce poverty levels, reduce unemployment, provide a livelihood for the households and trigger development. The Land Bank of South Africa has shown keen interest to provide funds to set up an irrigation scheme in Guquka. Absence of peoples' involvement and farmer participation has been identified as one of the causes of poor performance of smallholder irrigation schemes in South Africa. The poor performance of smallholder irrigation projects in South Africa provided a good basis for exploring factors that could possibly affect farmer participation and the success of the proposed irrigation scheme. This knowledge would be useful to providers of extension services, capital providers, policy makers and the recipients of the proposed irrigation scheme.

The main objective of this study was to investigate the factors affecting the willingness of farming households to participate in the proposed irrigation scheme. This investigation helped to analyse demographic; socio economic situation; farming practices; economic activities; water sources, uses and management in the study area. The major tool of enquiry in this study was the questionnaire which was used to collect data from the households. Household and farm characteristics were collected using structured questionnaires with the help of locally recruited and trained enumerators. The data used for the empirical analysis was obtained from a survey of 50 farming households in Guquka, in the Eastern Cape Province of South Africa. The following variables were selected to determine the scope of their influence on farmer willingness to participate in the proposed scheme: age; membership in local group; investment in agriculture, educational level of the farmers, knowledge, household size, labour and gender.

A logit model was used to determine the extent to which these selected characteristics influence the willingness of farmers to participate in the proposed irrigation scheme. The results showed that willingness to participate in the scheme was significantly influenced by the afore mentioned variables as well as knowledge about the planned irrigation scheme which is mainly provided by extension agents; and total household income. Age was found to decrease the willingness of farmers to participate in irrigation. A positive association existed between participation and the following variables; membership in local group, investment in agriculture, educational level of the farmers and knowledge. On the other hand, household

size, labour and gender were not significant variables affecting willingness to participate in the proposed irrigation scheme.

Based on the results from the logit regression model, it can be concluded that membership in a local group, investment in agriculture, education, knowledge and total household income are responsible for increasing the probability of participation. The negative relationship on age and participation indicates that the older the person is, the lesser the chances of participation. It is recommended that stakeholders should improve access to education and farmer training programmes. Support systems to disseminate information, training and knowledge should be enhanced. Improving institutional support and access to financial services should be prioritised by the stakeholders in the study area. Further studies on building institutional capacity and a cost benefit analysis of irrigation options in the study area are recommended.

CHAPTER 1

INTRODUCTION

1.1 Background

Many theories and models suggest that investment in irrigation is crucial in rural areas as it enhances agricultural production and socioeconomic circumstances. Improving agriculture and enhancing agricultural productivity will remain a key strategy for rural poverty alleviation in most low income countries, where the majority of the rural poor depend directly or indirectly on agriculture (Hussain and Hanjra, 2004). Fanadzo (2012) mentioned that over the years, many smallholder irrigation scheme (SIS) have been established in South Africa in order to gain accessibility to productive land and increase production in the different regions of the country. Despite huge investment in irrigation infrastructure in South Africa, the performance of SIS is continually underscoring the expectations of those involved in their development (Magingxa et al., 2006). Most of the schemes have collapsed or are utilized well below their potential (Tlou et al., 2006; Fanadzo, 2012). The causes of poor performance of smallholder irrigation schemes[1] in terms of productivity and economic impact are varied and include socio-economic, institutional, technical, political, climatic and design factors, as well as lack of farmer participation (Bembridge, 2000; Denison and Manona, 2007a). As such, the benefits of irrigation have not been realised in the smallholder sector of South Africa.

According to Fanadzo (2012), South Africa is a water scarce country and irrigated agriculture is the single largest user of water in the country. The water deficit is caused by low and erratic rainfall and high evaporative demand which limits dry land crop production in most of South Africa (van Averbeke et al., 2011). In a dry country like South Africa, irrigation presents an important advantage because it reduces or eliminates water deficit in crop production. Irrigation also increases crop yields where plant-available soil water is a yield-limiting factor during parts or all of the growing season (van Averbeke et al., 2011). Irrigation is important, providing approximately 40% of the world's food from less than 20%

[1] An irrigation scheme can be defined as an agricultural project involving multiple farm units that depend on a shared distribution system for access to irrigation water and in some cases a shared water storage or diversion facility. South African smallholder irrigation scheme can be defined as multi-farmer irrigation projects larger than 5 ha in size that were established in the former homelands or in the resource poor areas by black people or agencies assisting their development (van Averbeke, 2008).

of its area (FAO, 2003). Massive and useful input to global food security has been brought by irrigation (CA, 2007). Irrigation has improved livelihoods (Lipton et al., 2003) and stimulated broader economic development in many parts of the world. Turral et al. (2010) mentioned that this role is likely to persist far into the future as irrigation continues to provide a significant proportion of the world's food.

Like agriculture, which it serves, irrigation is at a turning point (Jensen, 1996). The types of irrigation investments being made and the way they are made are changing considerably (FAO, 2003). Today's irrigation needs to be adapted to a changing world. Smallholder irrigation schemes in South Africa are facing new challenges such as competing demands for water, emerging environmental issues, persistent food insecurity, poverty and financial difficulties (Perret, 2002; Schreiner et al., 2010). Investments in irrigation should be more strategic and more aligned with agricultural policies than in the past, taking into account the sustainability of the system and improving livelihoods (Turral et al., 2010). New and innovative approaches to irrigation are needed given the poor performance of irrigation schemes in South Africa (Fanadzo et al., 2010).

Consultations and collaborations with community members in Guquka during previous research projects identified the development of a small irrigation facility as a priority for triggering development. Research on issues of water use and availability brought that to the fore as a much desired intervention (Monde and Aliber 2007; Monde et al., 2005). Land Bank of South Africa and other stakeholders have shown keen interest in providing funds to develop the proposed irrigation scheme. For the proposed irrigation scheme to be effective, it should be based on a full understanding of the intended recipients, their motivation and willingness to be part of the scheme.

A combination of farm and farmers' associated attributes influences the producers' willingness to participate in the proposed irrigation scheme. ''Willingness to participate' refers to a farming household's motivation to adopt a new innovation, technology, and/or practice in their farming activities (Anderson, 1993). Adoption at the farm level indicates farmers' decisions to use a new technology in the production process (Aloyce et al., 1997). By identifying factors influential in the adoption decision of farmers, there is the potential to identify effective targets for research and extension (Llewellyn et al., 2005). This

understanding can allow research, development and extension activity to more effectively accelerate and improve participation/adoption[2] decisions.

1.2 Problem statement

Since the end of apartheid era in 1994, rural development has been a priority in South Africa. The majority of people residing in the study area are the poorest and struggle to cater for basic needs, especially food as there is unemployment. The income generating opportunities that exist offer small returns with people earning incomes below the poverty line of ZAR322 (Statistics South Africa, 2007). Small scale farming makes a modest contribution to livelihoods and food security in the study area. Rural women are the most affected due to gender disparities in power sharing, access to assets and changes in family structures caused by migration and poor health. All of these factors have placed additional burdens on women resulting in households engaging less in agriculture.

Land is scarce and people do not have the necessary skills and training on agriculture. People have low incomes which lead to little or no investment in agriculture. Low agricultural production has led to food insecurity and deepening poverty in the study area. Although farming households are interested in rain fed agriculture in Guquka, there is not enough water to enable cropping during droughts and dry seasons. This shortage of water is now being exacerbated by rainfall volatility and climate change.

The water sources available in Guquka that can be used for irrigation purposes are dams and water tanks. These are not a reliable source as they run out during the dry seasons. Due to multiple uses of water, there is not much water left in water tanks and dams for agricultural production purposes in dry seasons. The majority of people who own fields do not farm them due to lack of capital, water and labour. Some people who are interested in farming do not have the land. In some cases sharecropping between field owners and the landless exist. The sharecropping arrangements are usually marked with conflict about sharing of the produce or returns from farming.

[2] It should be noted that the terms “willingness to participate” and “willingness to adopt” have the same meaning in our context and will be used interchangeably in this study.

The government has announced the investment in new dams and irrigation schemes in the Eastern Cape and the Land Bank will finance the irrigation schemes. The Land Bank is planning to finance the development of an irrigation scheme in Guquka as a strategy of poverty reduction and employment creation. The problem is that farmers may not want to participate in the proposed scheme. The Land Bank has a worry that farmers might not want to be part of this new scheme because they "hate" irrigation farming because it is too costly and far too much work. They would rather practice rain fed agriculture and farm with livestock which is far easier and does not require key decision making issues and farming skills as well as entrepreneurial skills. The farming households do not think that participating in the proposed irrigation scheme will increase their income and improve their livelihoods.

All of the above challenges that farmers are facing in the study area provide useful insights into some issues that producers are likely to consider in deciding to participate in the proposed irrigation scheme. The poor performance and abandonment of many smallholder irrigation schemes in South Africa, concerns from both the Land Bank and farming households in Guquka, provides a good basis for exploring factors that could possibly affect farmer participation and the potential success of the proposed irrigation scheme.

1.3 General objectives

The above review suggests that irrigation can enable farmers to improve their income, livelihoods and the quality of life in Guquka. Despite the benefits associated with irrigation, not everyone in the study area may be willing to participate in the proposed scheme. This poses the questions: why are some farming households willing to be members of the proposed irrigation scheme while others reject it? Are there differences in characteristics of those ones willing to participate and non-participants? Given farmer participation as one of the reasons for under performance of smallholder irrigation scheme in South Africa, it is important to identify factors influencing the decision to participate in the proposed irrigation scheme. The main objective of the study is to show how the socioeconomic, institutional and technological indicators influence willingness to participate in the proposed irrigation scheme.

1.3.1 Specific objectives

1. To identify existing livelihoods and farming systems in Guquka.
2. To gain insight into the households' perceptions about the proposed irrigation scheme.
3. To evaluate the factors that influence farming households' willingness to participate in the proposed irrigation scheme.
4. Make recommendations based on the situation analysis.

1.4 Research questions

In pursuit of addressing the objectives of the study, the following research questions were investigated:

1. What are the existing livelihoods and farming systems in the study area?
2. What are the households' perceptions about the proposed irrigation system?
3. What are the factors that influence households' willingness to participate in the proposed irrigation scheme?

1.5 Justification

The government of South Africa has identified agriculture among other five departments that are tasked with providing five million jobs by year 2020. Policymakers believe that smallholder scheme development can create a substantial number of new employment opportunities in South Africa (van Averbeke, 2012). In order to meet these targets, there is need for investment in the agricultural sector especially in most rural smallholder irrigation projects. This study formed part of a bigger Land Bank of South Africa project that aims at introducing sustainable techniques and practices for farming in Guquka. In order to build the capacity of small-scale farmers in Guquka, the Land Bank is intending to invest in a new irrigation scheme. There is great concern about the failure and poor performance of irrigation projects in South Africa. Farmer participation in these schemes is one of the causes for the poor performance. Therefore, before the proposed irrigation scheme is implemented, it is

important that we: (1) understand the determinants of farmers' willingness to participate in the proposed irrigation scheme and (2) provide information to policy makers.

Little is known about the factors affecting the adoption decisions of farmers, the relationship between producers' attributes and their willingness to participate in the proposed scheme. According to Kirpich et al. (1999), adequate knowledge of critically important non-technical factors such as the social structure of the peasant farmers to be benefited, economic constraints at local and national levels, and environmental issues is essential. A holistic approach considering all these factors is needed in irrigation development. Aloyce et al. (1997) indicated that each of the factors which influence farmers decisions on whether to adopt a technology or not, is unique and specific to the study area. These characteristics make adoption studies site specific and often incomparable.

An understanding into the determinants of farmer willingness to participate in the proposed scheme is critical for the stakeholders and investors who want to invest their funds in this scheme. The majority of studies in literature focus on factors influencing adoption of technology after the technology has been implemented or made available to farmers. This study attempts to identify those factors which are likely to influence participation before the irrigation scheme is implemented in the study area. Such information will help prevent problems of farmer participation in future. The results from this study will provide original insight into faming households' willingness to participate in the proposed irrigation and help identify the assistance needed by households' in order to overcome the constraints and improve their participation.

1.6 Outline of the study

This study is divided into eight chapters. Chapter one is a general introduction to the whole study. This chapter gives background information and states the problem that led to this investigation. The aim and objectives of the study are also stated. Chapter 2 gives a literature review on history of irrigation in general and specifically the history of irrigation development in South Africa. It is noted that irrigation developed mainly as a mechanism to cope with shortage of water which is exacerbated by climate change. Smallholder irrigation scheme development in South Africa is divided into three phases which are also covered in

this chapter. A review of empirical adoption studies and the factors that influence technology adoption is covered in the end of this chapter. Chapter 3 provides a detailed description of the study site. The climate information which was obtained in Honey Dale Farm Weather station is also presented in this chapter. A description of the type of soils, land tenure, rangeland, social infrastructure and topography of the study site is given in Chapter 3.

The various methods used to collect data, sampling frame, data collection tools and sampling method employed are given and explained in Chapter 4. Chapter 5 presents the analytical and empirical model used to analyse the factors which are responsible for influencing farmer's willingness to participate in the proposed scheme. Hypothesized effects and variables included in the empirical model are explained in detail in this chapter. Chapter 6 gives the descriptive results of the survey which include demographic and socioeconomic characteristics, water sources and management, and perceptions of farmers towards the proposed irrigation scheme.

The empirical results of the survey are given in Chapter 7. The factors affecting farmers' willingness to participate in the proposed irrigation scheme are identified and the conclusion is given in Chapter 7. The summary and recommendations of the study are presented in Chapter 8 followed by a list of references used in this study. Appendices are given next. They cover the survey instrument used to collect data, topography maps of the study area and Tyhume River maps.

CHAPTER 2

LITERATURE REVIEW ON IRRIGATION AND FACTORS INFLUENCING THE ADOPTION OF AGRICULTURAL TECHNOLOGIES.

2.1 Introduction

This chapter begins by giving an overview of rural households and their sources of livelihoods. A brief history of irrigation is also given in this chapter. This chapter presents an overview of South African smallholder irrigation history, its development and its contribution to rural development. A review of different agricultural technology adoption studies and factors influencing different technology adoption in different parts of the world is also explored. The chapter ends by looking at these factors, which include household specific factors, institutional factors, technological factors and farm specific factors.

2.2 Livelihoods and significance of smallholder agriculture in Eastern Cape

Poverty is greatest amongst rural households of South Africa. The majority of rural households in rural areas struggle to meet basic needs, especially food as they earn incomes below the minimum level (poverty line) (Monde, 2005). Households try to escape poverty by employing different livelihood strategies. The most important livelihood strategy is to diversify the income sources i.e. earn income from different sources (Monde, 2003). In terms of contributions to total household income, external economic activities tend to be more important than local economic activities. Studies conducted in the Eastern Cape Province on rural livelihoods show that agriculture hardly ever constitutes the main livelihood strategy (van Averbeke et al., 1998; Monde, 2003).

Households in the province are engaged in both animal and crop production systems (Monde, 2005). Livestock species are kept in communal rangelands, from which they have to attain nutrients required for their maintenance and productive requirements. This significant dependence on communal rangelands makes them one of the few key resources that smallholder farmers can use to alleviate poverty in their communities. However, the

condition of communal rangelands to support livestock is being threatened by its significant deterioration over the last fifty years (Monde, 2005).

Crop production system is usually a dry land system. Crops and vegetables grown are usually for home consumption. Monde (2003) demonstrated how households in the Eastern Cape attained food security. In this study households in the province employed a variety of strategies including producing own food to secure their food needs. However, own production of food was not important in terms attaining food security. Households relied on purchasing food from urban markets as their main food security strategy. One of the main reasons for this state is that many farmers in the province are involved in dry land agriculture. This condition is exacerbated by erratic rainfall, which is the characteristic feature of the province.

Lipton (1996) suggested that irrigated agriculture is one of the most promising avenues for small scale farming to develop in South Africa. The results of the study conducted by Monde (2005) confirmed earlier studies conducted in the area that poverty and unemployment are important problems. Social grants obtained by claiming against the state are now the most important source of income. Finding formal employment was shown to be the most effective way to escape poverty, but few households had members who were employed formally. To augment their income the large majority of households engaged in agriculture. The contribution by agriculture to the livelihoods of rural homesteads was mainly in the form of food for own consumption (Monde, 2005). The scope to further increase the contribution farming makes in the food acquisition of households in the study area was deemed to exist, especially among the ultra-poor where this contribution was least in absolute terms.

2.3 History of irrigation

Irrigation is an adaptation to rainfall variability on a seasonal and annual basis (Turral et al., 2010). Irrigation is the artificial application of water to land for the purpose of enhancing plant production. Irrigation is said to be the most known agricultural technology, but up to this day improvements in irrigation methods and practices are being made. The future will require even greater improvements as competition for limited water supplies, input costs and production costs continues to increase (Turral et al., 2010). As the history of irrigation was summarised by Rukuda (1976); he emphasized on the development of the technical aspects of

irrigation and drainage. The oldest civilisations developed along the Nile, Trigis, Euphrates, Indus and Yellow Rivers and in Latin America. Cultivation along the Nile began 6000 B.C. Shallow wells and flooding from the Indus were used about 2500B.C. Records show that irrigation was practiced along the Yellow River in 2627 B.C and in Peru about 10000 B.C (Jensen, 1983). Earliest irrigation focused on increasing production with limited consideration on reducing the costs of running the systems. This was probably due to lack of technology and marketable systems.

The history of irrigation goes back at least 4000 years (Framji et al., 1982), in both the humid tropics, where wet rice became a staple crop, and a foundation of civilization, and in the arid and semiarid mid-latitudes, where rainfall was too little, too erratic, or too poorly distributed to ensure a harvestable crop (Postel, 1999). Where extensive irrigation development is found, it has typically been enabled by great rivers and the snow packs that feed them. The Himalayas, for example, support approximately half of the gravity irrigation in India and China (Thenkabail et al., 2006).

Turral et al. (2010) mentioned that where water was sourced directly from rivers, the supply has often been buffered by snowpack with seasonal accumulation and release, as in the Indus and Yellow rivers. Where this has been insufficient to even out supplies, engineers have built storage to allow controlled release of water across seasons and, in some cases, across years. At the same time, the construction and operation of artificial storage have had major impacts on the health of natural ecosystems and the services they provide in supporting agriculture and society (WCD, 2000). The more recent exploitation of groundwater storage was made possible by the advent of inexpensive small pumps and cheap and widely available energy to drive those (Turral et al., 2010). Over abstraction has occurred in many places notably in India and Pakistan under a policy of perverse energy a subsidy. This has raised major new challenges in the sustainable management and governance of water resources (Shah, 2007).

There are many functions of irrigation, which contribute to its utility and relevance. According to Turral et al. (2010), food security has been of paramount concern in the 19th and 20th centuries, with irrigation used to drought-proof regions such as northern India, provide national granaries (delta irrigation in India, modern systems in Malaysia) and to support the food needs and incomes of burgeoning populations (for example, in the Yellow river and North China Plain in PRC). Although the economic performance of irrigation schemes around the world has been judged as good generally, it is widely accepted that

irrigation developments over the last five decades have seldom performed to their design potential (Turral et al., 2010).

2.4 South Africa's irrigation history

2.4.1 Irrigation and rural development in South Africa

Irrigation allows the impacts of seasonal and inter annual hydrological variability on agriculture to be smoothed out. Where water deficit limits plant production, irrigation enables the effect of this limitation to be reduced or removed (Denison and Manona, 2007). Irrigation makes it possible to grow crops in areas where climatic conditions are too dry for production and to increase crop yields in areas where plant growth is limited by the availability of soil water during the growing season (van Averbeke et al., 2011).

According to Denison and Manona (2007) farmers can take irrigation water from a source and convey it to farms individually or in groups. When acting as a group, farmers are said to form part of an irrigation scheme. Van Averbecke et al. (2011) defined an irrigation scheme as an agricultural project involving multiple farm units that depend on a shared distribution system for access to irrigation water and in some cases a shared water storage or diversion facility. Irrigation scheme is also used when referring to a group of irrigation schemes that share a bulk water source such as a dam or river.

Vink and Van Rooyen (2009) indicated that smallholder schemes are important, though, because they are mainly located in the former homelands where poverty and unemployment remain high. While only about 34 158 people have land-rights on smallholder schemes, the schemes have a direct impact on between 200,000 and 250,000 people through family and kinship networks (van Averbeke et al., 2011). Approximately half the smallholder schemes are in Limpopo and a quarter in the Eastern Cape (Denison and Manona, 2007).

According to Perret (2002) and Bembridge (1996), South Africa had an estimated 1.3 million ha of irrigated land for both commercial and subsistence agriculture. The total area of irrigated land in South Africa is estimated at 1 399 221 million ha (van der Stoep, 2011). According to Denison and Manona (2007), smallholder irrigation forms only a small part of this with a current estimate of 47 667 ha, 3.4% of the total. Irrigated agriculture uses more

than 60% of the groundwater, surface water and recycled water (Backeberg, 1997) and adds almost 30% of total agricultural production (Backeberg and Groenwald, 1995). Perret (2002) mentioned that the smallholder irrigation sector alone accounts for about 4–5% of irrigated areas in South Africa. Racial segregation dominated most of the period when major developments in irrigation took place in South Africa (Backeberg and Groenewald, 1995). Irrigation schemes that were intended for black farmers typically serviced much smaller plots than those established for whites (van Averbeke, 2008).

As suggested by Perret (2002), about two thirds of the South African smallholder irrigation sectors are dedicated to food plots that support the livelihood of 300,000 black people. Most smallholder irrigation sector, however, have been inactive for many years (Bembridge, 2000). Major problems include infrastructure deficiencies emanating from inappropriate planning and design (Perret and Touchain, 2002), poor operational and management structure, inappropriate land tenure arrangements and lack of technical knowledge (Bembridge, 2000). In finding ways to mitigate these problems, a broader analysis is needed before an irrigation system is chosen. Such form of analysis will be able to identify the costs and benefits associated with each option to ensure sustainability and efficiency of an irrigation option.

2.4.2 Irrigation development in South Africa

Van Averbeke et al. (2011) indicated that the following three stages in irrigation development has taken place in South Africa from the late 17th century.

2.4.2.1 Smallholder development up to 1970

Smallholder irrigation development was established in the late 17th century by missionaries and extended with small town development, often as part of the domestic water supply system (van Averbeke and M'Marete, 1998; Denison and Manona, 2007). According to Backeberg and Groenewald (1995) as cited by van Averbeke et al. (2011), there was a gradual shift from the beginning of the 20th from privately-initiated and funded irrigation schemes to projects which were driven and financed by the government, including large-scale settlement and poverty-relief projects that aimed to benefit the white population Most of the smallholder schemes for black farmers were developed after the 1950s and three phases of state investment have been evident (van Averbeke et al., 2011).

The first phase took place in the 1950s and 60s with the development of food schemes, inspired partly by earlier schemes as well as by the findings of the Tomlinson Commission Report (1955) which documented the state of 122 existing irrigation schemes in the former Bantustans. The recommendations that were implemented included simple diversion works and furrows, the establishment of institutions for land and water management, and land holding sizes of between 1.3 ha and 1.7 ha, based on the rationale that irrigated farms should provide sufficient food and fodder production requirements for a family unit farming full-time (Vink and Van Rooyen 2009; Perret, 2002).

2.4.2.2 High-tech schemes of the homeland era

The second phase took place in the 1970s and 80s when a series of irrigation schemes was developed, mainly in the Eastern Cape, Limpopo, KwaZulu-Natal and Mpumalanga (van Averbeke et al., 2011). These high-tech modernised schemes were typified by large dams, pump stations, centre-pivots and sprinkler systems and were developed in a top-down fashion. In the former Ciskei and Transkei the consultants planning the schemes favoured sophisticated capital-intensive technology. These schemes were intended to increase production and to provide local people with the opportunity to generate income from cash-crops (van Averbeke et al., 1998). To achieve this, the schemes were usually divided into a commercial entity (a few hundred hectares), smaller individual commercial farms (4 to 10 ha) and irrigated food plots (0.1 to 0.3 ha in size). Control over farming was heavily enforced, with books kept by central management and farmers receiving a stipend and a yield-linked payment after harvest. According to Bembridge (2000) as cited by van Averbeke et al. (2011), these schemes caused substantial social upheaval due to their top-down approach and their high costs. The reorganisation of the original land holdings to accommodate irrigated farms and food-plots has resulted in ongoing contestation over land-use rights on many schemes.

2.4.2.2 Revitalisation and irrigation management transfer in the democratic era

The third phase of irrigation development in post-apartheid South Africa has been a process of irrigation management transfer (IMT) accompanied by revitalisation programmes (van Averbeke et al., 2011). Most schemes were previously administered centrally and subsidised through homeland parastatals such as Tracor, Ulimocor and the ARDC in the Transkei, Ciskei and Limpopo respectively. Perret (2002) mentioned that the state moved to cut costs

of involvement and in 1996 state subsidies were withdrawn. Almost instantaneously there was a widespread collapse of scheme operations. The large schemes from the 1970s and 80s were most affected, due to the termination of funding to their central management entity. High running costs, large size, technical complexity and the absence of local involvement meant that they could not be managed or financed by the participant farmers (Bembridge, 2000).

According to van Averbeke et al. (2011), the state has more recently increased its reliance on commercial partnerships as the basis of revitalisation efforts; the land-rights holders provide the primary resources (land and water-use rights), the state pays for infrastructure rehabilitation and the commercial partner provides production capital, farming skills and marketing. Typically these operate on a 50-50 profit-share arrangement, but so far the outcomes of these partnerships have been varied.

2.5 Factors influencing the adoption of agricultural technologies: A review

Adoption at the farm level indicates farmers' decisions to use a new technology in the production process (Aloyce et al., 1997). Therefore, to adopt an irrigation scheme or participate in a proposed irrigation scheme has the same meaning in this study as highlighted in chapter one. Few studies have conducted willingness of farmers to participate in proposed agricultural technologies. Therefore, most of the literature which follows is on adoption of agricultural technologies in general. The literature review will give us an insight into various factors which farmers consider when deciding to participate/adopt a given technology. Many economic studies of the decision whether or not to adopt a new agricultural practice emphasise that the decision involves a dynamic learning process (e.g. Abadi Ghadim and Pannell 1999; Marra et al., 2003).

A farmer’s decision to adopt or reject a new technology at any time is influenced by the combined effects of a number of factors. The literature on the adoption of agricultural technologies is widely varied, with focuses ranging from the adoption of resistant maize technologies and its impact on household income in Western Kenya Mignouna et al. (2011); Factors affecting farm operators’ interest in incorporating riparian buffers and forest farming practices in northeast and southeast Missouri (Valdivia, 2008); Factors Affecting Landowner

Participation in Ecosystem Management (Raedeke,2001); Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of southwest Cameroon (Adesina et al., 2000). These studies have indicated that there are a number of factors that influence adoption decisions. The decision is not linear as farmers consider the factor listed simultaneously (French, 2007). The interaction between factors influencing farm household's decision given by French (2007) is shown in Figure 2.1:

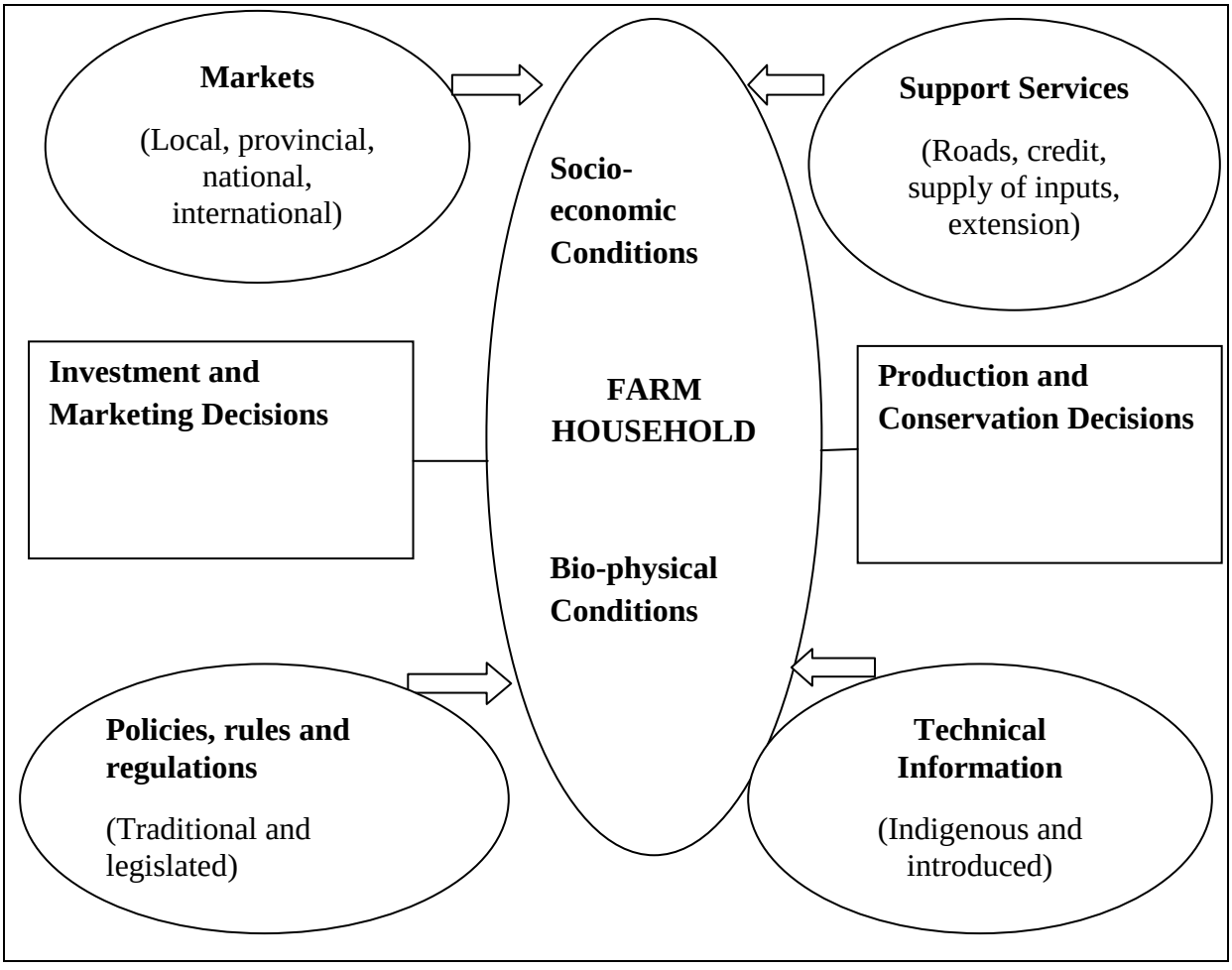

Figure 2.1: Interaction between All Factors Influencing Household Decisions

Source: French (2007)

Socio economic status, institutional, and technological factors play a major role in the planning and execution of development programmes (Tiwari et al., 2005). A household's socio economic status would mean the ranking of the household in the setting, to which it

belongs, in respect of defined variables, like physical assets, economic status, education, occupation, social position, social participation, caste, muscle power, political influence, among others (Tiwari et al., 2005). Socio economic status affects labor availability, money to expend on purchasing inputs, savings and investment decisions, and types, amounts and uses of crops grown. It also affects the numbers and variety of animals a livestock farmer could keep, as well as, their management tactics and use. According to Ojiako et al. (2009), given his/her varied needs and problems, a farmer's socio economic status could also influence his/her ability or otherwise to adapt to proposed agricultural technologies.

2.5.1 Household-Specific Factors

Age and education are factors that are often taken into account when determining adoption willingness. According to Daberkow and McBride (1998), age has a negative effect on the willingness to adopt technology or innovations. However, Jensen et al. (2007) indicated that age is not a significant factor in the adoption decision. Several examples in the literature show that attaining a higher level of education has a positive effect on adoption of technology (e.g., Jensen et al., 2007; Nkonya, Schroeder, and Norman 1997; Norris and Batie 1987).

The gender of the household head is expected to positively influence the adoption of technology (Mignouna et al., 2011). The assumption is that the head of the household is the primary decision maker and men have more access and control over vital production resources than women due to many socio-cultural values and norms. Education level of the household head increases a farmer's ability to obtain, process, and use information relevant to the adoption of technology. Thus, educated farmers are more likely to adopt technology.

Household size is a proxy to labor availability. It is the major source of labor for farm activities (Mignouna et al., 2011). Large households have the capacity to relax the labor constraints required during technology adoption. Mignouna et al., 2011 indicated that it is expected that a larger household size will affect positively the decision of adopting a technology. Total household income's effect on innovation adoption has been analyzed by multiple studies as well (Jensen et al., 2007; Norris and Batie 1987; Ellis 2006). Ellis (2006) found that having an income that is low had a negative effect on adoption. Jensen et al. (2007) hypothesized that greater total household income would have a positive effect on the

adoption of a new crop. Norris and Batie (1987) found that income had a positive effect on new conservation techniques.

2.5.2 Institutional Factors

Mignouna et al. (2011) indicated that belonging to a rural social group enhances social capital allowing trust, idea and information exchange. Thus, membership to a group could increase the technology adoption. According to French (2007), household decisions are also affected by policies, rules, and regulations that are enforced by the state and community. These may be enforced either at the local or the national level. Apart from formal legislation and policies, there are traditional customs and practices that govern management of agricultural lands. According to French (2007), external support services are often needed to take advantage of market and production opportunities. Depending on the extension strategy and readiness of the farm household to respond to market forces, different support services will play varying roles. Farm families need outside information for making investment and marketing decisions (French, 2007).

2.5.3 Technological Factors

The reason behind the inclusion of perception in this study is that the characteristics of the technology play a critical role in the adoption decision process. Mignouna et al. (2011) indicated that farmers who perceived Imazapyr-Resistant Maize as being consistent with their needs and compatible to their environment were expected to adopt since they find it as a positive investment.

2.5.4 Farm-specific factors

According to French (2007) a central factor affecting investment, production, and conservation decisions is the farmer's level of control over his land. A farmer with secure tenure is much more likely to think of long-term production and conservation activities than are sharecroppers or migrant laborers. Land ownership is a factor that has been analyzed in multiple studies (Fernandez- Cornejo, Beach, and Huang 1994; Fernandez-Cornejo, Daberkow, and Mcbride 2001; Jensen et al., 2007; Ellis 2006). The results have shown inconsistencies in its effects on the rate of adoption. These inconsistencies are thought to be due to the nature of the innovation being such that it is tied to the land, in the instance of

switchgrass, or it does not require land tied investments, as is the case for bio-engineered crops (Fernandez-Cornejo, Daberkow, and Mcbride 2001). Mignouna et al. (2011) found that large land contributes to increased willingness to invest in Imazapyr-Resistant Maize (IRM) technology. Biophysical factors are for the most part, beyond the control of the farm family (French, 2007). These factors include rainfall, irrigation, slope, altitude, aspect, pests and diseases. These factors have a direct influence on selection of a crop.

CHAPTER 3

SURVEY OF STUDY AREA

3.1 Introduction

This chapter begins by presenting the location of the study area. This section provides a general description of Guquka, where the new irrigation scheme will be built. In terms of its geographic location, history, land issues, livelihoods, resources and agricultural potential. A biophysical description of the study area which includes soils and climatic information which was mainly obtained in Honey Dale Farm and from a review of literature is covered in this chapter.

3.2 Description of study area

The selected study site is Guquka which is in Tyhume Valley under the Nkonkobe municipality in the Eastern Cape Province. Guquka lies in the upper part of the Tyhume valley in the foothills of the Amatola Mountains. Guquka lies in the former magisterial district of Victoria East and with the neighbouring villages of Khayalethu Gilton, Msompondo and Phundu constitute the AmaKhuze Tribal Area (van Averbeke et al., 1998). The reason for choosing this village for this study is that the proposed irrigation scheme is planned to be implemented there.

Guquka is located about 30 kilometres north of Alice in Nkonkobe Local Municipality, central Eastern Cape Province. The valley is traversed by the Tyhume River. Guquka and is located in the Tyhume Valley. The fields planned for irrigation are those that are near the Tyhume River (see appendix 2.1.3). The size of the fields earmarked for the implementation of the irrigation scheme is approximately 10 hectares. Guquka lies just below the escarpment of the Amatola Mountains with the upper Tyhume River flowing past them (see appendix 2.1.4). The Tyhume River passes Hala on the western side and acts as a border between Guquka and Khayaletu.

3.3 Local economic activities

There have been numerous research activities done in the study area previously which gives us a great deal of socio-economic contextual understanding of the sites. Work showed for example that local household rely on external economic activities or sources of income, especially state grants, for more than 90% of their income (Monde, 2003; Monde et al., 2005). However, the contributions from these external economic activities and sources do not ensure that rural households escape poverty. According to Monde and Aliber (2007), there is a high level of poverty in the area, with more than 80% of households in the village having incomes that are below the poverty line, with some being so far below as to be categorised as 'ultra-poor' (those whose incomes fall below half the poverty line).

Among local economic activities, farming has traditionally been the most important (Monde and Aliber, 2007). However, as in many other rural areas of the Eastern Cape, farming in Tyhume Valley has declined over time to a point where presently it consists primarily of home garden production. Home gardening contributes little to the overall diet of these people relative to food purchased from shops and supermarkets (Monde, 2003). Given the variability of rainfall, most households do not cultivate their fields due to water shortages. The challenge therefore is to improve community members' access to water as a means of improving their overall livelihoods. In principle, this would be of particular importance to poorer households for whom lack of own production during dry periods contributes to absolute deprivation.

3.4 Climate and soils

3.4.1 Climate

Climate data was obtained from Honey Dale Farm Weather Station. Climate is one of the most important factors which has a major influence on soil formation and also determines the type of crops that can be produced in a certain area. Climate includes rainfall, temperature, humidity, wind, frost and hail.

Table 3. 1: Summarised climatic information (1979-2011)

Month	Average Max T °C	Average Min T °C	Average Rainfall(mm)	Evaporation A pan (mm)	Average Mean T°C
January	28.23	16.24	67.27	189.85	22.24
February	28.58	16.59	66.90	157.72	22.58
March	27.17	14.92	63.57	137.30	21.05
April	25.09	11.61	48.37	106.01	18.38
May	23.20	8.25	20.66	95.75	15.73
June	20.59	5.37	21.40	87.43	12.99
July	20.89	5.05	18.36	101.89	12.97
August	21.78	6.85	31.58	117.27	14.31
September	23.30	8.83	34.23	130.71	16.05
October	24.18	11.30	60.36	147.13	17.73
November	25.46	13.17	80.90	156.32	19.32
December	27.18	14.93	73.52	189.07	21.05
Total	__	__	571.01	1577.65	__

(Source: Honey Dale farm Weather Station, 2012).

3.4.3 Temperature

Guquka has high temperatures during summer months from (October to March) as shown in Table 3.1, and low temperatures in winter months from (April to August). Temperatures range from moderately hot summers to moderately cool winters (Monde et al., 2005). Table 1 shows the summarised climatic information for the study area collected in Honey Dale Farm Weather Station.

3.4.2 Rainfall

Rainfall on the high ground is around 1000 mm per annum whereas it is much lower in the valley bottom (600 mm) and can only support limited rain fed cultivation (Water Research

Commission, 2006). The climate of Guquka is sub humid (Monde and Aliber, 2007). The mean annual rainfall in Guquka is 541mm, making rain-fed crop production possible (Honey Dale farm Weather Station, 2011). Although the mean annual rainfall is relatively high, the winter period is generally dry, with June and July as the driest months. One can expect only 7% of the total annual rainfall in these months, compared to roughly 70% in the months of October through March (Bennet, 2003). Although the annual rainfall is high, the intensity is also high. The wet season is very short between October and March. The unpredictable conditions of rainfall in Guquka necessitate irrigation for successful agricultural production.

3.4.4 Soils in Guquka

Soils in the Tyhume valley are of alluvial origin which means they are generally deep and well drained. According to Monde et al. (2005) the higher areas of the village consist of dominantly brown, fine sandy clay loam or clay loam overlying weakly ferruginous gravel, which overlies weathered rock within 60 cm from the surface. Soils have variable depths with fine sandy, clay loam or clay loam textures of relatively slow permeability. The distribution of soils in the study area is closely related to topography and parent material (Verdoodt et al., 2000). The main parent material consists of a variation of sedimentary rocks, including shales, mudstones and sandstones, but in places, dolerite, a basic dyke rock is found at the surface (Verdoodt et al., 2000).

The following detailed soil classification was given by Monde et al. (2005): The area consists of very shallow lithosols onto rock or ferricrete which is scattered throughout the area. Weakly hydromorphic soils are found in the lower slopes and bottomlands. The dominant soils are Glenrosa (Gs2111) and Cartref (Cf1100). The Mispah (Ms 2100) soil form is subdominant. However at selected sites dark greyish brown, apedal, fine sandy loam overlies mottled weathering ferricrete and ferruginous loamy gravel at a depth of between 60 and 90 cm (Monde et al., 2005). Matrix material of the gravelly layer is distinctly red in some cases. Chemical analysis of soils showed cultivated soils to have low organic carbon contents, ranging from 0.37 to1.36% and low levels of base saturation, ranging from 52 to 99% (Verdoodt et al., 2000).

3.5 Rangeland

The communal grazing land in Guquka is shared among community participants and to a lesser extent with other nearby communities (Monde et al., 2005). The total area is estimated to cover an area of 578ha. The boundaries of the community grazing land are well defined in relation to residential and arable blocks, but the high elevation grazing land shared by several communities is not well defined. Cattle may be found at or around the summits of the mountain terrain at 1600-1650m, but much of this formerly valuable high elevation grazing resources has been lost or degraded (Monde et al., 2005). Apart from nearby indigenous forest, two major vegetation units occur, namely, mixed grassland and Karoo shrubs on the bottomlands and lower slopes, and grassland on the mid to upper slopes (Monde et al., 2005).

The local veld type is a combination of Dohne and Highland Sourveld (Acocks, 1988). Sour veld is not well suited to livestock production, as it is nutritionally deficient during the winter months and does not generally tolerate high grazing pressures (Monde and Aliber, 2007). Both cattle and sheep are forced to compete for available forage on the arable lands during the winter. According to Monde et al., 2005), preferred grazing resources such as crop residues are quickly exhausted and thereafter shortage of adequate winter forage becomes a real problem at the village. The lack of central control over grazing aggravates the problem and has, in many cases, forced livestock production efforts to be limited to the individual level. Due to the inconsistent climatic conditions compounded by poor grazing practices, the Valley has experienced land degradation in the form of sheet, gulley and donga erosion on the foot slope areas (Water Research Commission, 2006).

3.6 Social Infrastructure

Guquka is accessible by relatively good road systems. The settlements are within an hour's drive of centres with shopping, and financial and administrative services, most of this journey being on tarred roads (Monde et al., 2005). Residents make use of taxis that operate from locations about 5 km from the study area. A primary school and secondary level education is available nearby. Similarly, residents have access to clinics in a nearby location called Gilton. There is a spaza shop (mini supermarket) in Guquka. The majority of residents make use of supermarkets in Alice. However, some make use of local shops in nearby villages. Almost all residents of both communities have access to electricity which they use mainly as

a source of lighting. Guquka residents make use of water from various sources which include Tyume River by fetching it or by using it at river's edge, stand-pipes in the centre of the village, and several small dams also exist, which are used by both animals and residents (Monde et al., 2005).

3.7 Land tenure system in Guquka

According to Monde *et al.* (2005), land at Guquka is held by means of 'Permission to Occupy' (PTO). The PTO register in the magistrates' court in Alice contained 59 registrations of residential sites 1/8 morgen in size (Holbrook, 1998). In 1997 Guquka counted 121 residential sites, leaving 62 not accounted for in the register. Also, only 41 individual fields were counted, meaning that 80 households did not own fields. Interviews with landowners and landless residents suggested that landless people could access a field in one way only, namely through sharecropping. The local arrangement by the land right holders demanded share croppers to carry all production costs and to hand over half of the yield to the land owner for the use of his land (Monde et al., 2005).

In literature, problems of sharecropping have been well documented including marshallian inefficiencies that result from sharecropped land. Guquka has not been spared from the discourse surrounding sharecropping. According to Monde et al. (2005), the sharecropping arrangement caused resentment on the part of past and potentially new sharecroppers. Without exception they considered it unreasonable and would not enter or re-enter sharecropping unless the terms were substantially revised. Most favoured a long lease (a minimum of three to five years) against payment of a pre-determined fee. Land right holders were not entirely against renting out their land, but they favoured a one-year arrangement, motivated it seemed by a fear of losing control over their land when entering leases of longer duration (Monde et al., 2005). One of the important challenges to rural development in the region is to find out if enhancing the security of tenure in the PTO system can remove such fears and lead to an increase in exchanges of arable land.

3.8 Topography

The biophysical characteristics of the study area are dynamic and impose limitations to rural livelihoods. Topography and landscape together with past and current agricultural practices

have negative environmental and health implications in the study area. Agricultural activities in Nkonkobe Municipality are facilitated by the terraced basin topography and foot slope bottom lands enclosed by the steep mountain slopes (Water Research Commission, 2003). According to Monde et al. (2006), the study area is located at a high altitude of more than 700m. The high altitude provides a relatively short growing season and frequent frost during winter months.

Topographically the study area is located on two river terraces, separated from each other by a steep slope. On the lower terrace, found at the bottom of the valley, are poorly drained Katspruit and Kroonstad type soils which occur where micro-topography prevents rapid drainage (Verdoodt et al., 2000). Shallow Mispah and Glenrosa type soils are dominant on the steep slope separating the two terraces, but Westleigh and Longlands type soils often subject to gully erosion, are also found (Monde et al., 2006). The second terrace, which is sloping, supports well drained Oakleaf soils on the ridges and imperfectly drained Oakleaf soils in depressions. According to Verdoodt et al. (2000), Oakleaf and Glenrosa soil types are less suited for crop production. Low rainfall and steep slopes are major limiting factors limiting yields of crops. Runoff is a major cause of soil water losses. Soil conservation is a priority in these areas, because of their persistent susceptibility to erosion.

3.9. Stakeholders, Role players and Support services in Guquka

Most of household/farm activities, projects were initiated and funded by Water Research Commision, Department of Agriculture; Agricultural Research and Development Institute, Social Development and Welfare, Nkonkobe Municipality and the Nkonkobe Economic Development Agency (NEDA) and University of Forte

3.10 Conclusion

Guquka is characterised by a high mean annual rainfall although June and July are the driest months. The rainfall is high on the high ground and low in the lower valley which means that it can support limited rain fed agriculture. Low rainfall and steep slopes are major limiting factors limiting yields of crops. Runoff is a major cause of soil water losses. This necessitates irrigation in the study area. Guquka has high temperatures in summer form October to March. Soils in the Tyhume valley are of alluvial origin which means they are generally deep, well

drained and can support crop production. The communal grazing land in Guquka is shared among community participants and to a lesser extent with other nearby communities. The lack of central control over grazing causes shortage of winter forage leading to limited livestock production by households. Due to the inconsistent climatic conditions compounded by poor grazing practices, the study area has experienced land degradation in the form of soil erosion on the foot slope areas.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

This chapter presents data collection methodologies used in this study. The sampling frame and sampling method used are described below. The section on data collection methods explains the tools that were used for collecting data and the variables considered.

4.2 Sampling frame

Bless and Smith (2000) defined a sampling frame as a list of all units from which a sample is to be drawn. The statistical guidelines of determining a sample size described by Watson (2001) were used in this study. The sample size of 50 was then chosen using systematic sampling technique. In this study a sample of 50 households was selected due to limited resources and time. If enough resources were available, data from the entire population of Guquka, which is 104 households, could have been collected. The respondents were selected regardless of whether they were involved in agriculture or not.

4.3 Sampling method

In this study systematic sampling was used as a method of selecting households for interviews. This is a probability sampling technique. A probability sampling method is any method of sampling that utilizes some form of random sampling. According to Babbie (2001), randomization 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.

In order to have a random selection method, this procedure assured that the different units in the population had equal probabilities of being chosen. Given that the total number of households in the study area is 104, and our required sample size was 50, systematic

sampling was done. The interval size was 2.08 % (104/50). Sampling was started with the second unit in the list of households and every second unit was taken. This resulted in the following sampling units 2, 4, 6, and so on through 100 and which lead to the 50 required households in the sample. The sampled households are a good representation of the entire population of Guquka.

4.4 Data collection

Data was obtained through interviews using structured, interviewer-administered questionnaires. The unit of analysis was a household. Interviews were carried out with the heads of the households. When a head of household was absent at the time of the interview, other senior members of the household were interviewed. The questionnaires were pre-tested with 10 farmers then revised to incorporate households' suggestions on the dynamics of farming and livelihoods in their farms and in their villages. Another purpose of pre-testing the questionnaires was to identify and remove any ambiguity in the wording of the questions. The interviews were conducted in Xhosa (the local language) for easy understanding since most of the respondents do not understand English well. The questionnaire had 4 main sections: the demographics; livelihoods and expenditure patterns; land and farming; water sources, management and perceptions on irrigation (see Appendix 1).

The questionnaires were interviewer-administered so as to alleviate the problem of misinterpretations or misunderstandings of words or questions and to obtain the information from respondents who could neither read nor write. The aim of the questionnaire was to get enough information that could help in identifying those factors responsible for influencing farmers' willingness to participate or not in an irrigation system. The questionnaire consisted of both open ended and closed ended questions. Open ended questions helped respondents to express their views freely. The majority of the questions were closed questions in order to make the coding of responses easier so as to get as much information as possible from the respondents without taking too much of their time. Each interview lasted between 30 to 50 minutes.

4.5 Data analysis

The Logit model was estimated by a maximum likelihood method using a statistical package called STATA 11. It was used to identify variables that affect farmers` willingness to participate in the proposed scheme. Descriptive statistics and inferential statistics such as mean, frequency and percentages were created using Microsoft Excel 2010.

4.6 Conclusion

The sample size used in this study was 50 households and the unit of analysis was a household. Systematic sampling method was used to come up with 50 households. Data was collected using questionnaires which were administered by interviewers. The data was analysed using Ms Excel 2010 and statistical package called STATA 11.

CHAPTER 5

DATA AND MODEL SPECIFICATION

5.1 Introduction

This chapter reports the analytical model used in this study. It begins by giving details about the binary choice model used. Variable definitions and hypothesized effects are also presented in this chapter.

5.2 Analytical Model

In this study a binary choice model called logit model was used to investigate factors affecting farmers' willingness in participating in a proposed irrigation scheme. The model is designed to model the 'choice' between two discrete alternatives. Logit regression, also called a logit model, is used to model dichotomous outcome variables. Logit model has been widely applied in adoption studies (Bagi, 1983; Polson and Spencer, 1991; Adesina and Sirajo, 1995). According to Verbeek (2004), the binary choice models essentially describe the probability that:

Equation 1

$$Y_i = 1$$

directly, although they are often derived from an underlying latent variable model. In general, we have as shown in equation 2:

Equation 2

$P(Y_i = 1|X_i) = G(X_i,\beta)$ for some function $G(.)$.

This equation says that the probability of having $Y_i = 1$ depends on the vector $\mathrm{X_i}$ containing individual characteristics. The function $\mathrm{G}(.)$should take on values in the interval (0, 1) only. Usually, one restricts attention to functions of the form in equation 3:

Equation 3

$$G(X_i,\beta) = F(X_i',B)$$

As $F(.)$ also has to be between 0 and 1, it seems natural to choose F to be some distribution function. Common choices are the standard normal distribution function given by equation 4 which leads to the probit model. The standard logit distribution function given by equation 5 results in the logit model which is used in this study. The difference between the logit and the probit models lies in the distribution of errors. In logit models, errors are assumed to follow standard logit distribution while the errors of the probit models are assumed to follow the standard normal distribution (Indiana, 2006).

Equation 4

$$F(w) = \emptyset(w) = \int_{-\infty}^{w} \frac{1}{\sqrt{2\pi}} \exp(-\frac{1}{2}t^2)dt$$

Equation 5

$$F(w) = L(w) = \frac{e^w}{1+e^w}$$

In this study, farmer participation was estimated through a logit model. The model explored the relationship between the farmer's choice to participate or not based on the explanatory variables which described the farmer from a socioeconomic point of view, his attitudes towards the proposed irrigation scheme, the social context and other situational factors.

Boisvert et al. (1998) mentioned a key feature of these models is that individuals are assumed to evaluate the monetary benefits and costs of participation, and also the less tangible benefits and costs. This implies the participation decision has a subjective component because it is difficult to compare intangible benefits and costs with tangible benefits which can be

measured in monetary terms. Socio-economic characteristics of farmers are also important in determining the decision to participate in irrigation.

Farmers are assumed to be rational and looking to maximize utility. The assumption made here is that the household chooses the alternative that yields highest utility. So the underlying expected utility model drives the observed choice. The rural households are confronted with two separate choices: the decision to participate or not in the proposed irrigation scheme. This decision involves a binary choice by comparing the expected utility of participation (U_a) with that of non-participation (U_b) as shown in 2 sets of equations under equation 6:

Equation 6

$$U_a = X_a' B_a + \varepsilon_a$$

$$U_b = X_b' B_b + \varepsilon_b$$

Where X_i'= is a vector of socioeconomic and other characteristics that affect utility. The utility maximizing household will participate as shown in equation 7 or not only if:

Equation 7

$U_a > U_b$ Or if

$$(U_a - U_b) = X_i' B + \varepsilon_i > 0$$

$Y_i = 1; 0\ else$ is observed. The logit model assumes that while we only observe the values of 0 and 1 for the variable Y, there is a latent, unobserved continuous variable Y* that determines the value of Y.The probability of observing the data is shown in equation 8:

Equation 8

$$P(Y_i = 1) = P(U_a > U_b)$$

$$= P(y_i^* > 0)$$

$= P(X_i' B + \varepsilon_i > 0)$ Or

$$P(Y_i = 1) = P(\varepsilon_i < X_i' B)$$

This leads to equation 9:

Equation 9

$$P(Y_i = 1) = F(X_i'B)$$

$$P(Y_i = 0) = 1 - F(X_i'B$$

Logit regression is a linear probability model for binary response where the response probability is evaluated as a linear function of the explanatory variables (Maddala, 1983).The coefficients in the logit analysis are estimated using maximum likelihood and serve the purpose of indicating a direction of influence on probability. The marginal effect of each of the independent variables is calculated and indicated by the calculated changes in probabilities (Maddala, 1983). The Logit model was estimated by a maximum likelihood method using the statistical package called STATA 11.

5.3 Empirical Model

5.3.1 Hypothesized effects and variable definitions

5.3.1.1 Participation

Participation is the dependent variable in our logit regression. The qualitative dependent variable is participation, which takes on the value of 1 if the farmer is willing to participate in the proposed irrigation scheme and 0 if he is not willing to participate. According to Siebert et al. (2006), farmer willingness and ability refers to the personal disposition of the individual farmer, his or her internal disposition, on the one hand, and the structural characteristics of a given personal situation on the other. Willingness is the combination of subjectively perceived factors that influence the farmer, such as interests, values, norms, problem awareness and self-perception. The term attitude' is frequently used to describe these factors (Siebert et al., 2006). Willingness to participate in the proposed scheme differs among farmers according to their socioeconomic and demographic backgrounds. The variables listed

below are the independent variables. Table 5.1 gives a list of variables included in the logit equation model and the expected signs on the coefficients. The expected relationships are derived from economic theory.

Table 5. 1: Definitions of variables included in the logit equation model

Dependent variable	**Definition**	**Value**	
Participation	Willingness to participate or not in the proposed irrigation scheme	Coded 1 if farmer is willing to participate and 0 otherwise	
Independent Variable	**Definition**	**Value**	**Expected sign**
Age	Respondent's age in years	continuous	unknown
Education	Respondents' years of education, 1 if primary school, 0 otherwise	0 = no; 1= yes	Positive
Gender	Farmers' gender	0= female; 1=male	Positive
Investagric	Farm investments (machinery, fence and other inputs) in the past 2 years	0=no; 1=yes	Positive
Household size	Respondent's household size	continuous	Positive
Labour	Total labour supply (15-64 years of age)	continuous	Positive
Knowledge	Knowledge about proposed irrigation scheme	0=no;1=yes	Positive
Income	Total household income after tax	continuous	Positive
Mlocalgroup	Respondent is a member of a local group	1 if member of local group, 0 if not	Positive

5.3.1.2 Age

Age measures the age of the farmer at their last birthday. According to Boisvert et al. (1998), age is certainly related to one's planning horizon for the farm business, but could also affect attitudes toward participation in any government programs. According to Siebert et al. (2006), the relevance of age varies among the studies. Rodgers (1983) mentioned that there is inconsistent evidence on the relationship between age and innovativeness because of the several studies reviewed: half show no relationship, while 19% and 33% support the hypothesis of younger and older people, respectively, favoring adoption of innovations. Therefore, the apriori expectation on the coefficient of age is either positive or negative.

5.3.1.3 Education

Education is a dummy variable that indexes the educational level of the farmer. It takes the value of 1 if the farmer has at least primary education and zero otherwise. It was hypothesized that education is positively related to participation. According to Siebert et al. (2006), the significance of education for participation is confirmed in many studies. If a willingness to participate exists then, it has been argued, the farmer with a higher level of education may be more likely to take advantage of the training and information, and be better able to surmount the bureaucracy related to successful participation than one with less education (Siebert et al., 2006).

5.3.1.4 Knowledge

Knowledge is a dummy variable that indexes the awareness of the farmer about the proposed irrigation scheme. Awareness in this context refers to having full information that an irrigation scheme is planned to be put in the study area. It takes the value of 1 if the farmer is aware of the proposed irrigation scheme and zero otherwise. If the farmer has never had about the planned irrigation scheme, a value of zero is given to the respondent on knowledge. Local government officials that have a keen interest in promoting development and livelihood could try to increase a farmer's knowledge of the intended program and encourage their interest in participation. In this study, households were asked if they had any knowledge about the proposed irrigation scheme. Most households had some idea about the scheme. The

apriori expectation based on knowledge, is that the more knowledge you have the better the chance of making a decision whether to participate or not. According to Deffuant (2001), knowledge increases awareness which in turn could influence households to participate hence a positive coefficient is expected on knowledge.

5.3.1.5 Mlocalgroup

Mlocalgroup is a dummy variable which indicates if the farmer is a member of a local group, farm or farmers' association. It takes the value of 1 if the farmer is a member of a local group and zero otherwise. The local farm community, neighbouring farmers and social networks in the local farm community play a significant role in technology adoption (Deffuant, 2001). According to Vehkala and Vainio (2000), the influence of neighbours is important both with regard to opposition to a measure and to the decision to start negotiations. In this case, the local group is water users association (WUA).

Some households in the study area indicated that they were part of the WUA. Therefore, a positive coefficient is expected on mlocalgroup. According to Adessina et al. (2000), a community or farmer-groups' approach to dissemination of information on farming to farmers has advantages. It allows increasing returns to scale in information dissemination. Farmers that join farmer associations may be those generally more receptive to new innovations or interventions in the community which may affect their attitude to the adoption of new technologies.

5.3.1.6 Investagric

Investagric is a dummy variable which indicates if the farmer has invested in agriculture (machinery, buildings etc) in the past 5 years. It takes the value of 1 if the farmer has invested in agriculture and zero otherwise. According to Hohfeld and Waibel (2012), non-investors in agriculture tend to be potentially marginalised households with female or older household heads. Factors that positively affect the probability of investment in agriculture are farm size, household wealth and income. The investment volume is influenced by farm size, household wealth, education of the household head, savings, additional off-farm income and the number of household members working in agriculture. Farm investments are only made by a few wealthy households with the consequence that the already existing inequality in wealth is likely to increase further. A farmer who has been investing in agriculture in the past years is

expected to be willing to participate in the proposed scheme. Therefore, a positive relationship is expected to exist between participation and Investagric.

5.3.1.7 Gender and labour

Gender is a dummy variable that indexes the sex of the farmer; it has a value of 1 for men and 0 for women. Some studies have argued that women may be less likely to adopt a technology because of either lack of rights or secure land rights (Tonye et al., 1993). It was hypothesized that gender is positively related to participation. The labor available to a farmer depends on the amount of household labor that is available (and which can be mobilized) for agriculture and by the availability of non-family labor (Doss, 1999).

Female-headed households may have a harder time gaining access to labor because they have less male labor within the household and they may have fewer resources for hiring non-family labor. Increasing opportunities for men and women, both within the agricultural sector and in other sectors of the economy, affect the allocation of labor within the household. Access to labor may affect the adoption of technology and the distribution of its benefits. Therefore, a positive relationship was expected to exist on the coefficient of labour. The number of people aged between 15 and 64 were used as proxy for labour. The main reason being that they are eligible to put their labour into use once the proposed scheme has been introduced.

5.3.1.8 Household size

Household size measures the size of the household. Since family labor is the major source of labor for households, larger families with more labor supply would be expected to be willing to participate in the proposed irrigation scheme. Large families are also more likely to face lower per-capita land availability and high dependency ratios for food requirements (Adesina et al., 2000). They may thus prefer to extend cultivated area to meet food requirements. Therefore, household size was hypothesized to be positively related to participation. Studies on agricultural production and technology adoption use household size and composition as important explanatory variables. These factors are endogenous to agricultural production. Household size and composition are affected by the demand for agricultural labor. Similarly,

the structure of households is both a response to agricultural opportunities and a factor that affects the agricultural opportunities of individuals in the household (McMillan, 1987).

The prediction equation is expressed as shown in equation 10:

Equation 10

$$log\left(\frac{p}{1-p}\right) = b_o + b_1 * Age + b_2 * Householdsize + b_3 * labour + b_4 * male + b_5 * Education + b_6 * mlocalgroup + b_7 * investagric + b_8 * Knowledge + b_9 * totincome + \varepsilon$$

5. 4 Conclusion

The analytical and empirical models used in this study were explained in this chapter. The binary choice model used is the logit model. It is used to model the factors that affect the farmers' willingness to participate in a proposed irrigation scheme. The expected response form a farmer is either 'willing' or 'unwilling' to participate and this is a binary outcome which can be modelled by a logit regression model. The variables used in the logit equation model are also defined and expected relationships hypothesized. A positive relationship is hypothesized to exist between the variables and participation.

CHAPTER 6

FIELD SURVEY RESULTS AND DISCUSSION

6.1 Introduction

This chapter reports specifically descriptive results of the study. The results presented in this chapter are on demographic characteristics of the respondents, livelihood and expenditure patterns; land and farming; water sources, uses and management; and perception about the proposed irrigation scheme. Some of the results presented include age, education, gender, marital status, income sources, land tenure and access to land. Results on farmer perceptions about the proposed irrigation scheme are also presented.

6.2 Demographic characteristics of study households

6.2.1 Analysis of age of respondents

Figure 6.1 shows that age distribution of respondents has a normal distribution which is skewed to the right. The majority of the respondents were above the age of 40 years because most of the respondents were household heads who would answer survey questions on behalf of the household. The majority of people below the age of 40 years normally leave rural areas in search of jobs in the urban areas so the sample frame has few people below 40 years. Most of the respondents are between 40 years and 70 years. The above age distribution bar graph shows that the majority of the respondents are aged between 61 and 70 years of age. These are the elderly people who stay at home most of the time throughout the year.

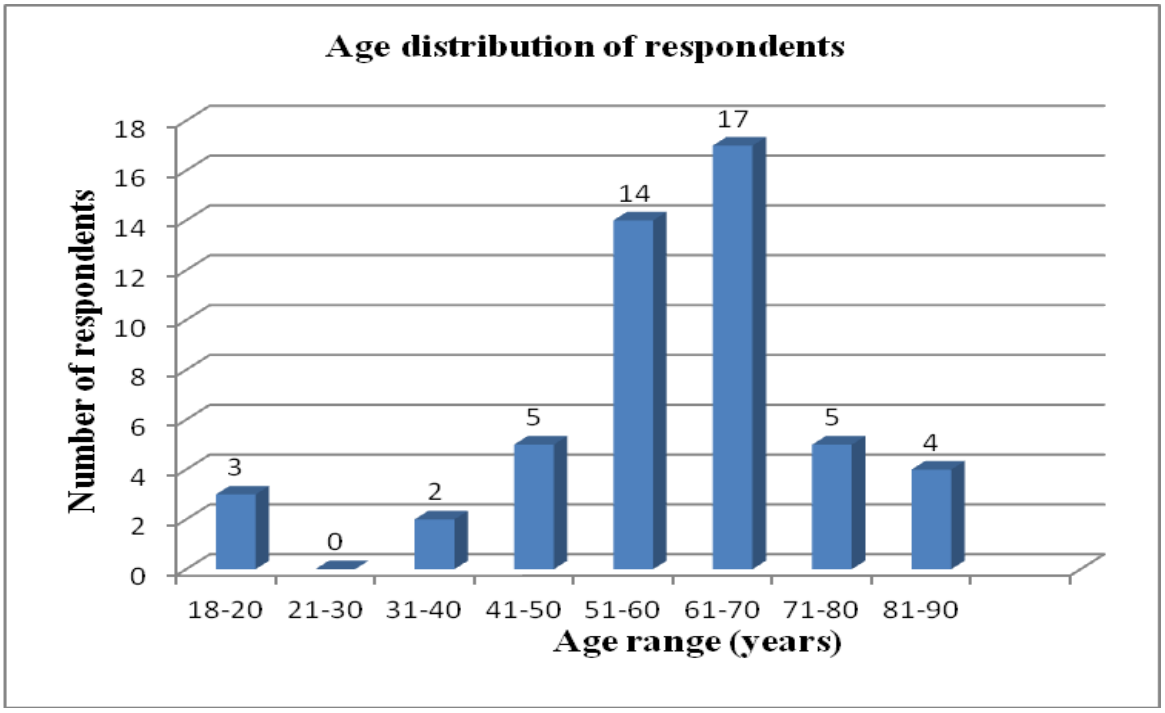

Figure 6.1: Age distribution of respondents (n=50) (source: author's data)

6.2.2 Gender of respondents in the study

Figure 6.2 shows that 66% of the respondents were female and 34% were male. The result is not surprising since most household heads in most rural areas are female. Males usually go to cities and mines in search of opportunities. Women remain in rural areas as household heads. As a result, women were interviewed as household heads thereby contributing a much higher percentage compared to males. This result is also confirmed in the study by Kehler (undated) which shows that majority of black women continue to live under extremely poor conditions in rural areas. These areas are characterised by lack of socio-economic development and infrastructure, lack of opportunities for employment and income generation. Similar results are found in a study done by Mtshali (2002) who mentions that sickness and death from HIV/Aids have reduced male populations in Sub Saharan Africa resulting in more female headed households.

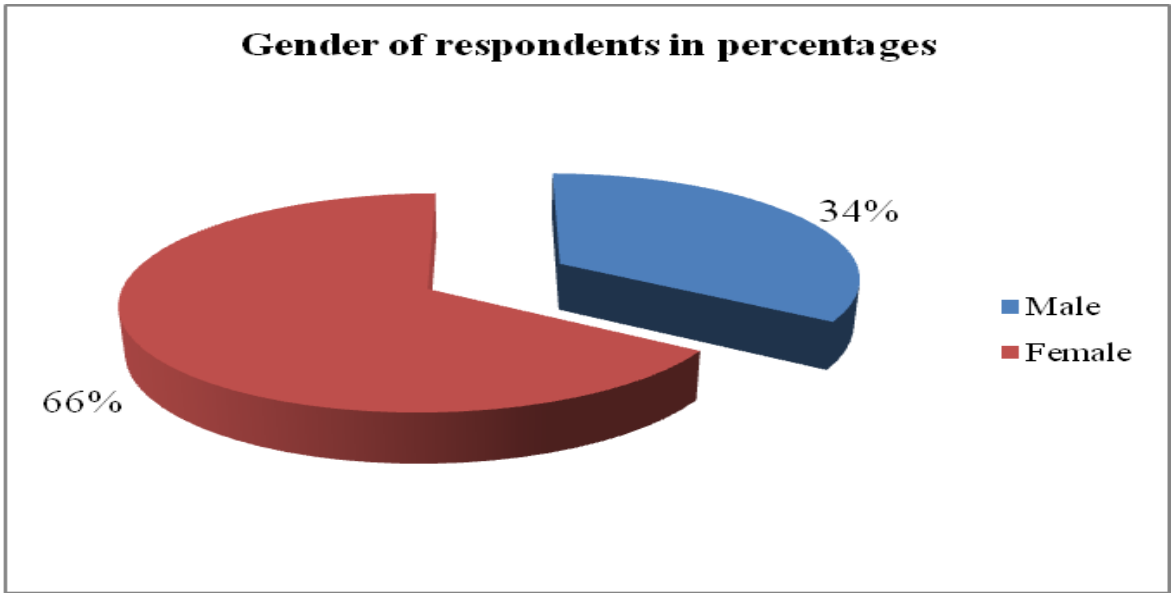

Figure 6.2: Gender of respondents (n=50) (source: author's data)

6.2.3 Marital status of respondents

Figure 6.3 indicates that the majority of the respondents are married. Most of the married couples were staying far away from each other due to migration of men in search of greener pastures as well as mining and cash crop growing areas, thereby relinquishing responsibilities of managing households to women. Twenty eight percent of the respondents are single. The widows/widowers in the study area are 20% of the respondents. This could have been caused by high death rates given high levels of Aids mortality in South Africa which was exacerbated by lack of antiretroviral treatment in public health facilities until recently. A small proportion of 4% from the respondents is reported as divorced. This low rate of divorce could be as a result of many marriages in rural areas being contracted through strong customary rites.

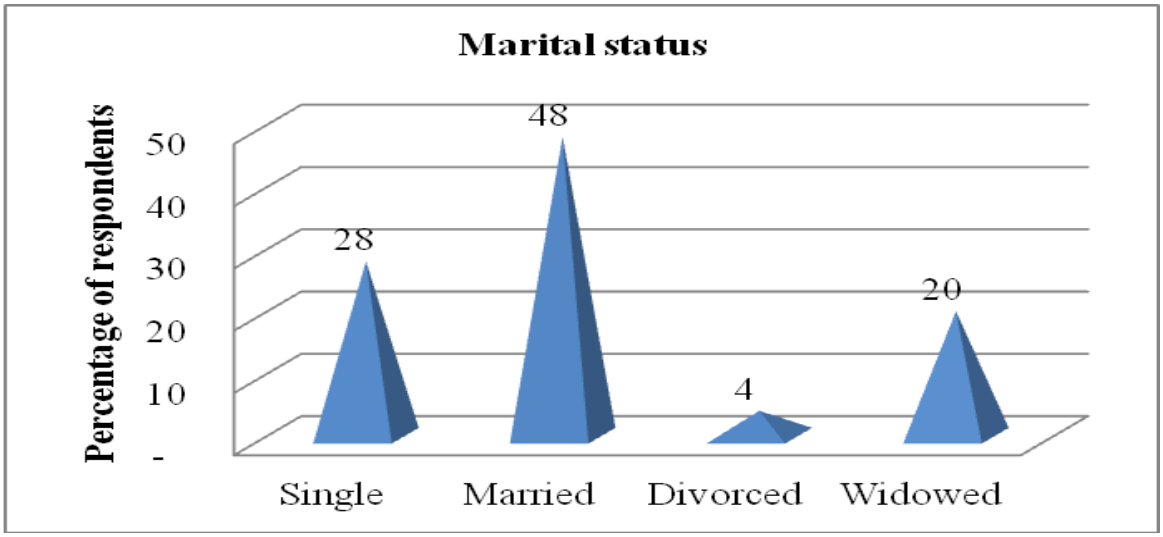

Figure 6.3 : Marital status of household head (n=50) (source: author's data)

6.2.4 Educational level of respondents

Figure 6.4 indicates that the majority of respondents did not attain any formal education with a percentage of 16%. Fifty four percent (54%) of respondents ended their education at primary level. A further 20% ended at junior level, with 8% completing secondary school. Only 2% of the respondents attained tertiary education. This is a reflection of the treatment and challenges that were faced by poor black people during the apartheid era, since most of the respondents went to school during that time. Numerous studies and papers have been published about the education system during the apartheid era. The consequences of lack of education are dire because most households lack knowledge about good agricultural production practices and technology adoption leading to less people engaging in agriculture.

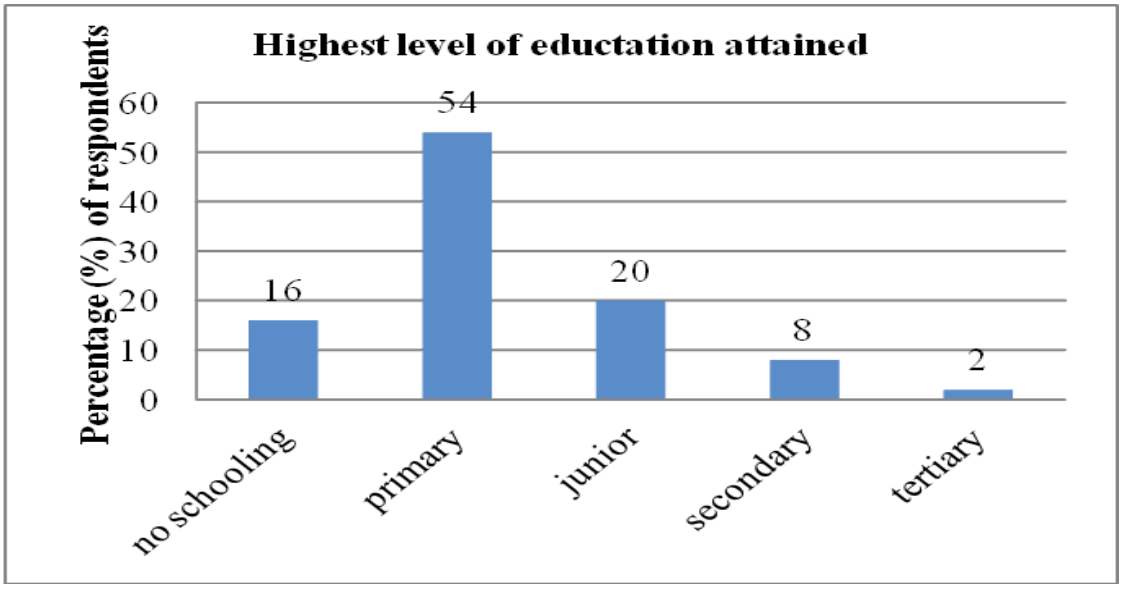

Figure 6.4: Educational level of respondents (n=50) (source: author's data)

6.2.5 Employment status of respondents

Figure 6.5 shows that the majority of 62% of the respondents are unemployed. This is a pressing issue in South Africa which has very high levels of unemployed people especially the youth. This result mirrors trends in studies done by the National Treasury (2011) indicating that 24% of the workforce in South Africa is currently unemployed. The unemployed do not acquire the skills or experience needed to drive the economy forward, which in turn inhibits the country's economic development and imposes a larger burden on the state to provide social assistance. Twenty six (26%) of the respondents are employed on a part time basis with a small proportion of 12% being fully employed.

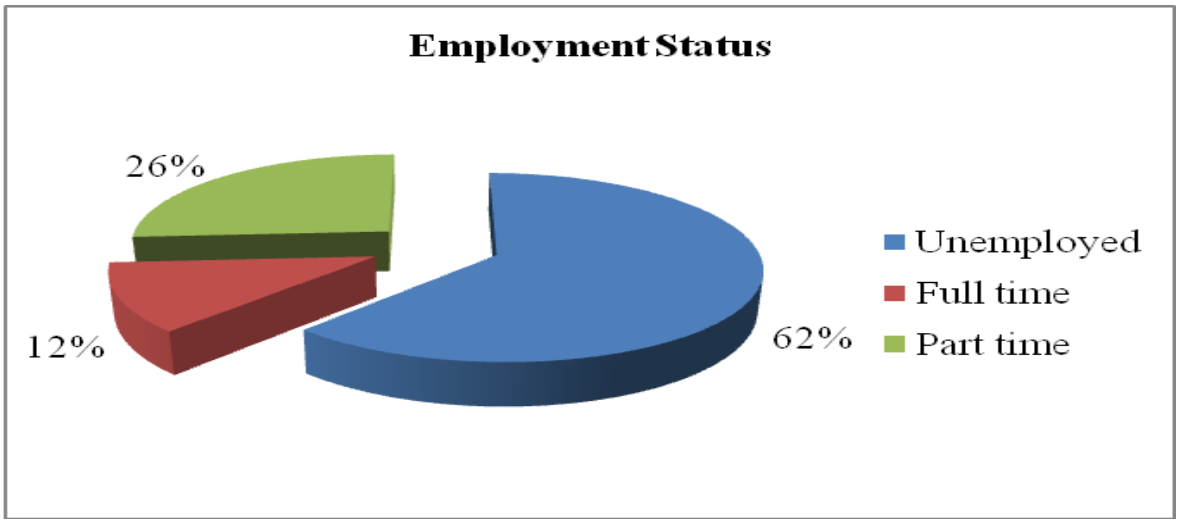

Figure 6.5: Employment status of respondents (n=50) (source: author's data)

6.2.6 Occupation of respondents

Table 6.1 shows that 26% of the respondents reported their occupation as none whilst only 4% are employed in formal employment as teachers. 16% of the respondents are farmers. These include those respondents that were interviewed and considered themselves as farmers as they practice agricultural activities using their home gardens only to produce vegetables for home consumption and those who cultivate their fields. The other respondents constitute 10% and they are involved in jobs that are related to housekeeping, garden boys and some are involved in part time jobs that pay very little. The majority of respondents are pensioners, contributing 34% in occupation in the study area.

Table 6. 1: Occupation of respondents (n=50) (source: author's data)

Occupation	**Number**	**Percentage**
None	13	26
Teacher	2	4
Farmer	8	16
Pensioner	17	34
Housewife	5	10
Other	5	10
Total	**50**	**100.0**

6.2.7 Time spent at home by respondents

Figure 6.6 shows that 87% of the respondents stay in this rural area throughout the year. A large proportion of this 87% are women since the majority of respondents were females.

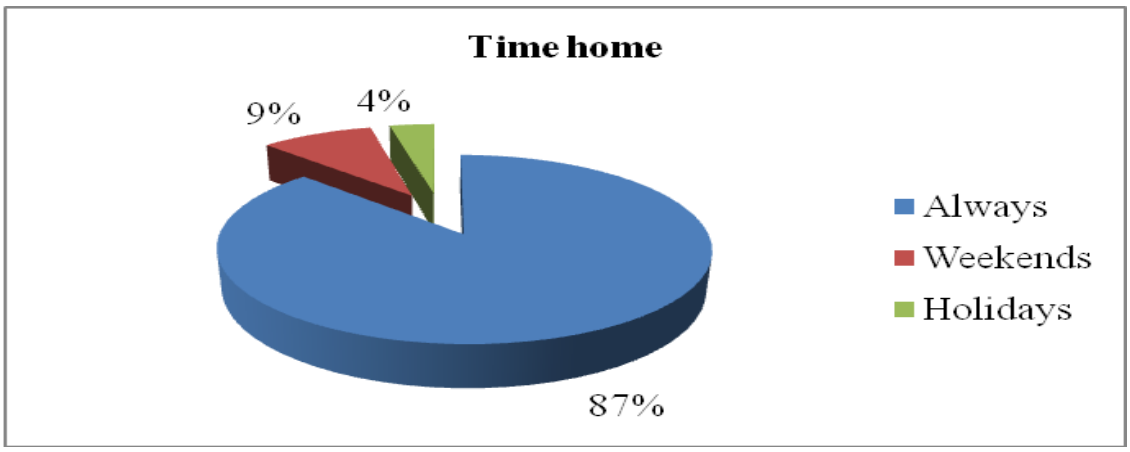

Figure 6.6: Duration of stay at home in a given year (n=50) (source: author's data)

Women have the responsibility of looking after children as well as heading the households whilst their husbands are away in search of greener pastures. Nine percent (9%) of respondents come to their homes in the study area on weekends only and a further 4% come during the holidays. Given the lack of education amongst the majority of respondents, they have limited skills and opportunities in cities and therefore have no choice but to stay in the rural area.

6.2.8 Household size and age distribution of respondents

Household size goes hand in-hand with agricultural production this is because households with relatively large numbers have enough labour to carry out agricultural activities. Hayes et al. (1997) indicated that a larger family size also means that a variety of labour capacity is available in the form of young, middle aged and elderly members. At the same time larger household size discourages selling of farm produce because the household needs to meet its consumption demand before they decide to sell surplus produce for cash. The Figure 6.7 shows that the majority of households have between three to six household members. Few households have less than 2 household members. Also few households have more than 7 household members as shown in Figure 6.7.

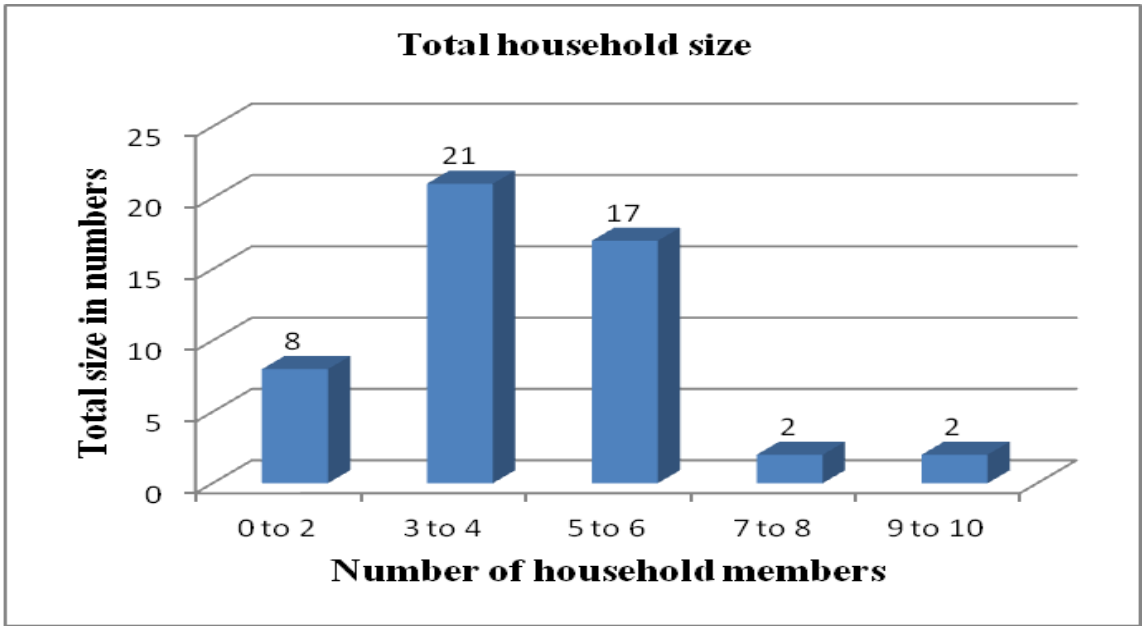

Figure 6.7: Total household size (n=50) (source: author's data)

Figure 6.8 shows that 68% of the population is aged between 15-64 years. This is the economically active population which contributes to agricultural production in rural areas of South Africa. The economically active population comprises all persons of either sex who furnish the supply of labour for the production of goods and services during a specified time-reference period. Most of the people belonging to the active population are unemployed. 23% of the total population of the interviewed households was children. This refers to those younger than 15 years of age. Nine percent of the total population of interviewed households consisted of adults and these are people aged from 65 and above.

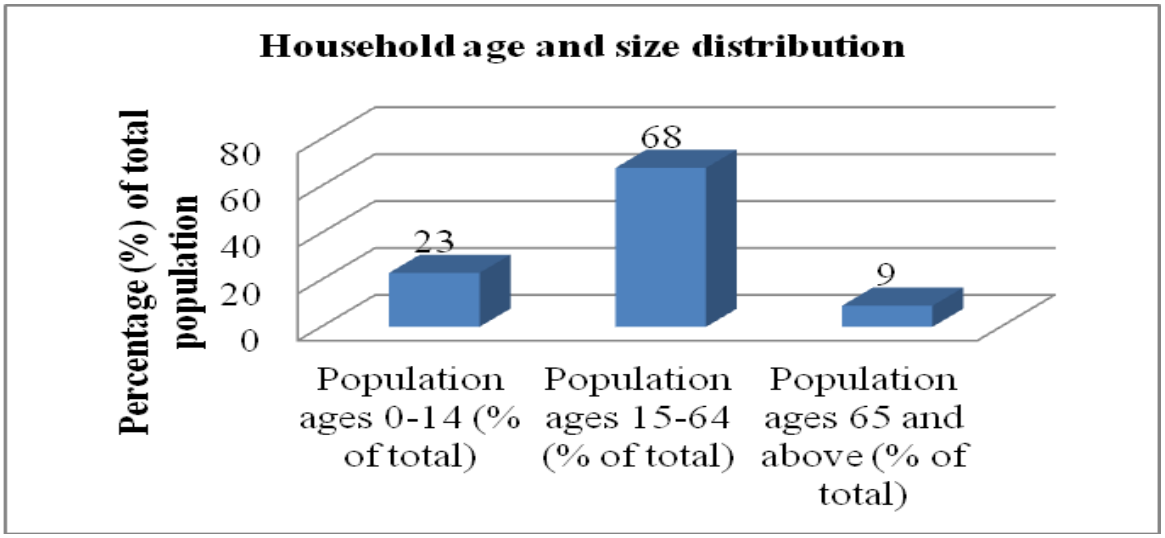

Figure 6.8: Household sizes and age distributions (n=50) (source: author's data)

6.3 Socio economic characteristics of respondents

6.3.1 Livelihoods and expenditure patterns

The following section gives a detailed analysis of livelihoods and expenditure patterns in the study area. Income sources and the mean monthly income of households in Guquka was derived and presented below. The major income source is social grants. The expenditure pattern highlight that the majority of households spend most of their income on food.

6.3.1.1 Income sources and number of households deriving income in cash or kind

Table 6.2 shows the different sources of income in cash or in kind available to households in the study area. A household can have more than one source of income available to it. The information in Table 6.2 shows the number of households using a particular income source. 32 out of 50 households from those interviewed earn income from old age pension. The majority of people in the study area are eligible for old age pension. 20 out of 50 households have access to a child support grant. Thirty four households reported that they earn income from agriculture. Normally households consume their own produce and monetary value is attached to this produce in order to find the income equivalent of such produce. The results show that households try to diversify their income and improve their food security level by engaging in farming.

Table 6. 2: Income sources of respondents (n=50) (source: author's data)

Source of income	Number of households using this source
Remittances	10
salaries and wages	10
child support from outside household	3
old age pension	32
disability grant	4
child support grant	20
Agriculture	34

Remittances, salaries and wages provide a significant amount of income to 10 households respectively. Remittances come mostly from family members and relatives who work outside the village especially in big cities such as East London, Cape Town, Durban and Johannesburg. Household members migrate to urban cities in search of job opportunities in order to help their families in the study area. Salaries and wages provide 10 households with income. This is an indication that there is unemployment in the area since there are less paying jobs available in the study area. This further confirms calls by the government to create employment and the big role that the proposed irrigation can have in the study area. Only 3 out of 50 households receive income from child support from outside household. A further 4 out of 50 households receive income from a disability grant. This grant is received by disabled people and individuals with mental problems. It is evident from the results that the majority of households depend mainly on agriculture and social grants as a source of income. Agriculture as an income source in the study area has to be boosted given its role in household income.

6.3.1.2 Mean monthly income in cash and kind of households at Guquka

Table 6. 3: Mean household income (n=50) (source: author's data)

Source of income	Mean monthly income (Rands)	Mean annual income (Rands)
remittances	91.07	1092.80
salaries and wages	280.02	3360.29
child support from outside household	42.86	514.29
old age pension	940.80	11289.60
disability grant	96.00	1152.04
child support grant	151.20	1814.40
agriculture	63.81	765.72

Table 6.3 shows that old age pension has the highest mean monthly income of R940.80. This is followed by salaries and wages having a mean monthly income of R280.02 The high monthly mean of salaries and wages serves as an incentive for people to get paid jobs. Other

income sources have lesser mean income, therefore individuals prefer to get a job than participate in agriculture, but there are no jobs. The disability grant has a mean monthly income of R96.00, but this income source serves a very small proportion of the population since it is for disabled people. Remittances have a higher mean monthly income of R91.07 compared to agriculture with R63.81. This serves as an incentive for people to migrate in search of work so that they can send money back to their homes. Child support from outside the household has the lowest mean monthly income because very few households have such kind of income in the study area.

6.3.2 Expenditure patterns of the household

Table 6.4 shows total expenditure by household on different items. All households spend a huge proportion of their income to buy food with a mean monthly expenditure of R660 on food. The main food acquisition strategy is through buying from nearby urban markets than own produced food. The second expenditure incurred by all households is on clothing which has a mean monthly expenditure of R143.33. Transport has the third expenditure component with a mean monthly expenditure of 129.22 and it is incurred by all households.

Transport cost is mainly incurred when people travel to town to buy groceries mostly during month ends after getting income from different sources. Education constitutes the fourth largest expenditure with a mean monthly expenditure of R90.94 by households with children going to school. Twenty three (23) households incur this cost. The fifth largest expense is electricity which has a mean monthly expenditure of R70.60. 47 households incur this expense. This indicates that electricity plays an important role in the lives of people in the study area. There has been an increase in the adoption and use of cell phones in rural areas of South Africa like elsewhere in other developing countries. Mean monthly expenditure on telephone and postage is R62.16 and it constitutes the sixth biggest expense by households.

Medical expenses in this context refer to fees charged by doctors for consultation and examination. Public hospitals do not charge any fees to sick people. Therefore, the majority of people prefer to go to public hospitals when they are sick. The above table shows that only 20 out of 50 people incur medical expenses and the mean monthly expenditure for medical

help is R57.50. Most people cannot afford to go to private doctors due to high cost of private doctors therefore, they use public hospitals.

Table 6. 4: Household expenditure patterns (n=50) (source: author's data)

Item purchased	Households purchasing this item	Mean monthly expenditure (Rands)	Mean annual expenditure per annum (Rands)
food	50	660.00	7920.00
electricity	47	70.60	847.20
clothing	50	143.33	1720
furniture	6	30.00	360.00
medical expenses	20	57.50	690.00
educational expenses	23	90.94	1091.22
transport	50	129.22	1550.64
agriculture inputs	30	19.24	230.90
maintenance or building of residence	7	10.00	120.00
hiring of labour	10	33.00	396
telephone and postage	40	62.16	745.92
subscription and membership fees	31	57.90	694.80
church contributions	31	35.28	423.40
entertainment	2	4.93	59.20
interest on loans	6	7.07	84.80
Total expenditure (Rands)		1411.17	16934.04

According to Table 6.4 church contributions, subscription and membership fees constitute seven and eight biggest household expenses respectively, and are both incurred by 31 households. These expenses are used to help with the running of the church, helping a family in need especially when there are emergencies such as death in the family. Most families

reported that they do not have funeral cover, so these subscriptions and membership fees are very useful under such unfortunate circumstances. The same information on the Table 6.4 is displayed on the Figure 6.9.

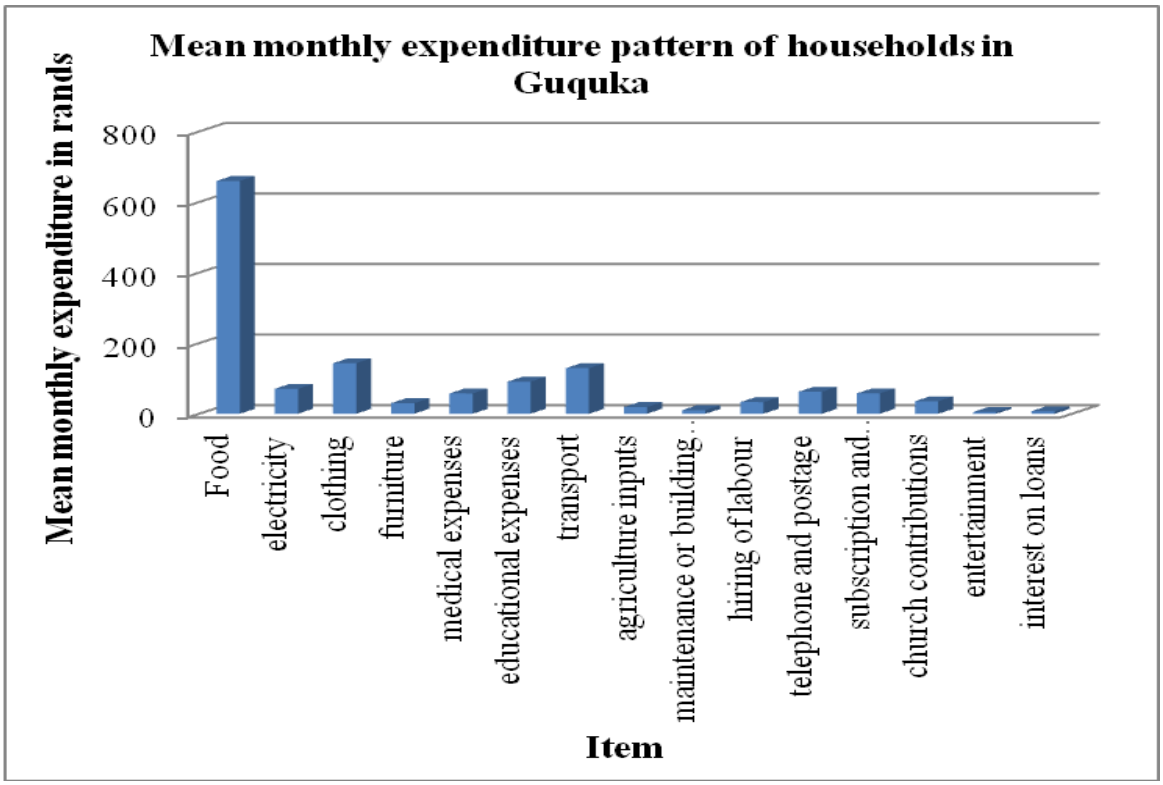

Figure 6.9: Mean monthly expenditure patterns of households (n=50) (source: author's data)

Investment in agriculture is indicated by a mean monthly expenditure of R19.94. This expenditure is incurred by 30 households although it constitutes a very small proportion of total household expenditure. This expenditure is for agricultural inputs such as seeds, implements and tractor costs for tillage purposes. This is worrying because the results show that a huge amount of money is spent on buying food, yet there is very low investment in agriculture. This suggests that agriculture makes a modest contribution in household income and livelihood strategies. A striking feature of the results from Figure 6.9 show that households spend much of their income on necessities which include food, electricity, clothing, transport and educational expenses. Few households incur expenditures on furniture, entertainment and interest on loans.

6.4 Land and farming

6.4.1 Access to home gardens in Guquka

The home gardens are food plots located within the boundaries of residential sites, usually in the backyard. Garden sizes ranged from 100m^2 to 1400m^2, varying considerably from household to household. Figure 6.10 shows that 80% of households have a garden whilst 20% do not.

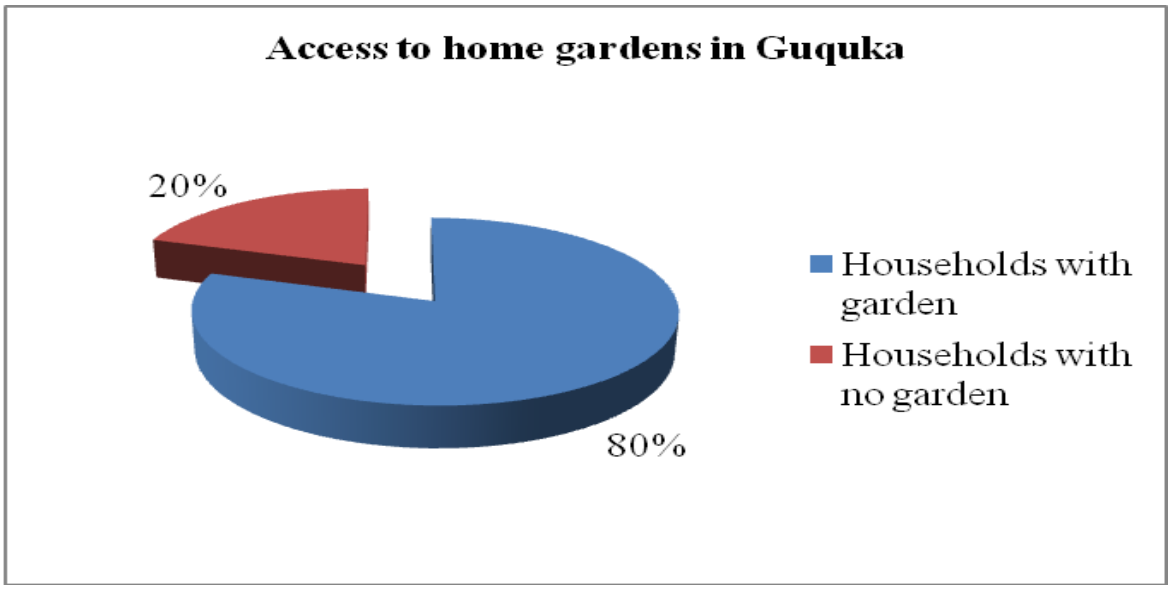

Figure 6.101: Households' access to home gardens (n=50) (source: author's data)

The average size of the household gardens in the study area is 300m^2. The majority of home gardens are big in size and those belong to people who became residents of Guquka before 1960. Those who became residents after 1960 have smaller gardens due to betterment planning which was introduced in South Africa aiming to control soil erosion and land degradation. The betterment planning resulted in smaller arable land allocations.

6.4.2 Participation in home garden production in 2011/2012

Figure 6.11 gives the participation status of household in home garden cultivation. Sixty eight (68%) of households who have access to gardens cultivated their gardens in 2011/2012 whilst 32% did not. Those who cultivated their gardens indicated that they preferred home gardening to field cropping because in the fields there is drought, lack of financial capital and poor soils. The participants highlighted that carrying out home gardening was easy since

there is access to water tanks and tap water. Despite the majority of household having access to home gardens, food is still acquired from nearby urban centres. As a result home gardening does not contribute a lot to food security in the study area.

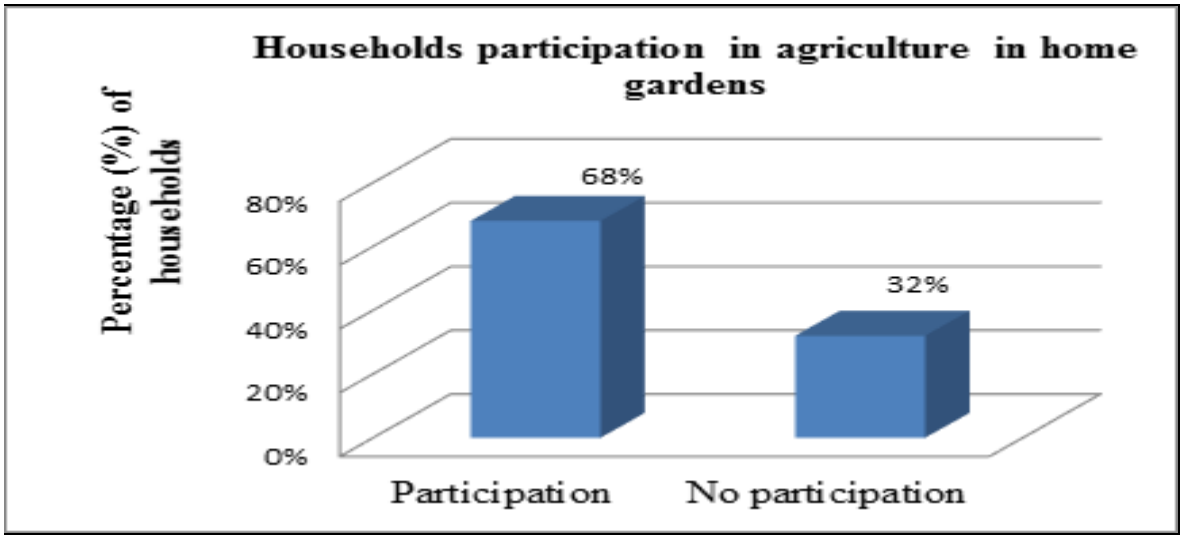

Figure 6.11: Household participation in home gardening (n=50) (source: author's data)

Those who did not cultivate their gardens indicated that they faced a number of constraints. The constraints faced included limited access to water, included lack of money to buy fence and other inputs. The elderly stated that they did not have anyone to help them conduct agricultural activities in the garden since they are old. 37.5% of the people who did not cultivate their gardens stated that they had never cultivated their gardens whilst 25% said they last did more than 10 years ago. Twenty five (25%) said they last cultivated their gardens five years ago and 12.5% last cultivated their gardens a year ago.

6.4.2.1 Source of irrigation water

Households participating in home gardening indicated that they sometimes irrigate crops. When there is drought, they irrigate the crops using, river, rain water tank and tap water. The Figure 6.12 shows the various sources of irrigation water used by households.

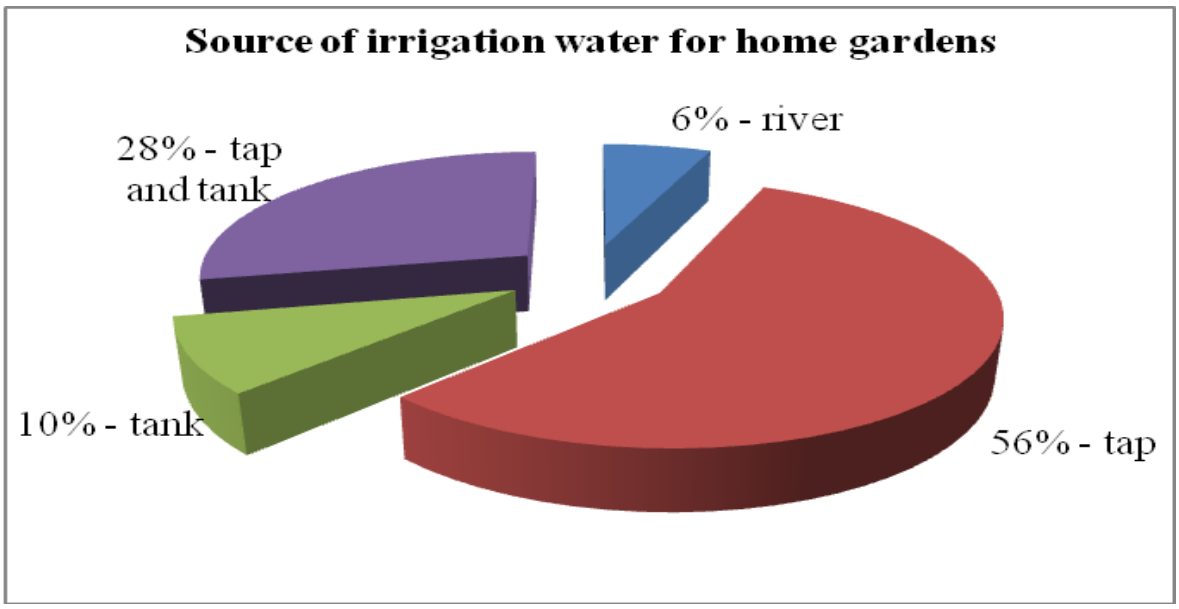

Figure 6.12: Source of irrigation water (n=50) (source: author's data)

The proportion of households who use tap water for irrigation is 56% the tap water was installed by the municipality under rural development programme (RDP) a few years back. The taps are located a few metres from the household residential sites. The taps are easily accessible though there are regulations demanded by the Water User's Association (WUA) preventing people from over using this water source for large scale farming. 10% of households use rainwater tank for irrigation purposes. This water source is unreliable because water runs out during dry seasons and in times of drought. 28% of households use both tap water and rain water tank for irrigation. Use of river water for irrigation is unpopular in the study area and it has been abandoned by most households since the introduction of rainwater tanks and tap water. Only 6% of households indicated that they sometimes use river water since they stay far away from the tap water.

6.4.3 Crops grown in home gardens

Table 6.5 shows the crops grown, area and total income received from different agricultural crops. The common crop enterprises are maize, cabbages, beetroot, potatoes, butternut, pumpkin, onions, dry beans, tomatoes and carrots, because they are the most popular crop and vegetables in Guquka.

Table 6. 5: Average yields and area planted in 2011/2012 cropping season in home gardens (n=50) (source: author's data)

Main crop	Average area (m^2)	Average yield (kg)	Price (Rand/kg)	Total income (Rands)
Maize	75	35	5	175
Potatoes	55	25	6	150
Dry beans /peas	50	15	8	120
Pumpkin	30	20	5	100
Butternut	30	20	8	160
Cabbage	20	15	6	90
Spinach	10	10	5	50
Onions	10	10	5	50
Carrot	5	5	5	25
Tomatoes	10	15	6	90

The prices reflected here are the prices at which the product was sold at local level. The prices were calculated per kilogram for a particular crop. This information on prices is useful in calculating the income derived from home gardening. The staple food crop is maize and it is the highest income earner as shown in Table 6.5 having an average total income of R175. The least income earner among crop types is carrots with an average total income of R25.

Table 6.6 shows the reason and proportion of people growing a particular crop in their home gardens. Twenty five (40%) of the participants in home gardening indicated that they grow crops for food. They believe that their own grown food is better in terms of quantity and quality compared to food bought in nearby towns which is also considered expensive. A proportion of 19% practise home gardening for consumption and marketing. The sold surplus brings revenue which can be used for other household expenses, though a small proportion of the population do sell their produce. Sixteen (16%) of households produce crops for consumption and donations. Donations in this context refer to neighbours sharing with each other when their produce is ready. A further 25% of the households indicated they consume, donate and market their produce. Households mentioned that they engage in home gardening

in order to feed their animals too. The stalks that remain after harvesting are fed to animals and maize is mainly used in chicken production.

Table 6. 6: Reasons for growing the mentioned crops in home gardens (n=50) (source: author's data)

Reason	Percentage
consumption	40%
consumption and marketing	19%
consumption and donations	16%
consumption, marketing and donations	25%

6.4.3 Method of cultivation used in the home gardens

Table 6.7 shows the method of cultivation used by the households in the study area. Hand ploughing is the most used form of cultivation in the study area with 51% of households employing it. This is considered cheap as most households employ their own family labour during tillage. 18% of households use tractor traction to till their home gardens. The tractor is usually hired and most of the households do not afford to hire one. As a result they resort to hand ploughing which is demanding and tiring.

Table 6. 7: Method of cultivation (n=50) (source: author's data)

Method	Percentage
Hand ploughing	51%
Tractor traction	18%
Hand ploughing and animal traction	6%
Hand ploughing and tractor traction	25%

A proportion of 6% use both hand ploughing and animal traction. This is the least form of tillage used in the study area. The reasoning was that most households do not own cattle. A combination of hand ploughing and tractor traction is used by 25% of households.

6.4.4 Role played by different household members in home gardens

Table 6.8 clearly indicates that women engage in labour intensive tasks such as planting, weeding, collecting water for irrigation and harvesting. These activities are carried out by women 80% of the time, while men do these activities 30% of the time. Women are also involved in pruning in the fields, processing, sorting, wrapping and packaging ready for sale or consumption. Men undertake activities that require strength such as ploughing and land preparation. These are tasks that involve machinery and maintenance of equipment. The results show that men carry out ploughing and land preparation 80% of the time as these activities require strength. Women carry out tasks that require care and patience and they tend to be flexible in terms of work hours.

Table 6. 8: Role played by different household members in home gardening (n=50) (source: author's data)

Activity	Role player
Ploughing and land preparation	Men (80%) Women (20%)
Planting and weeding	Women (80%) Men (20%)
Collecting water and irrigating	Women (80%)
Harvesting	Women and children (80%) Men (20%)

6.4.5 Access to fields and ownership

Land is one of the most important resources in agriculture (Stockbridge, 2007). Therefore access and ownership of this resource determines the people's ability to perform agricultural practices.

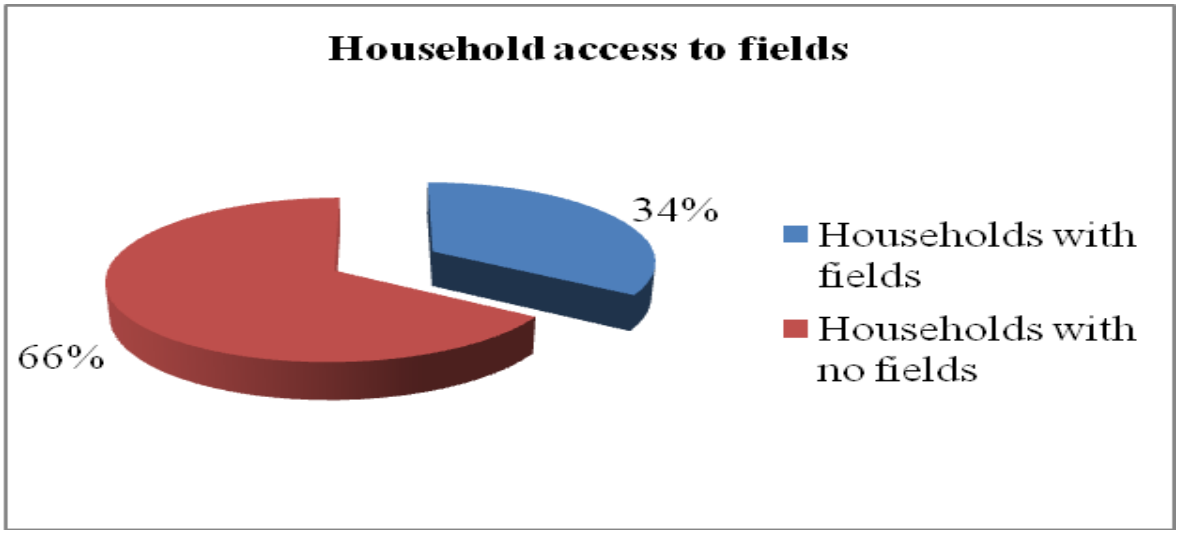

Figure 6.13: Household access to fields (n=50) (source: author's data)

The average size of the fields in Guquka is 1.4 ha. Most of the fields are found close and along the Tyume River. Figure 6.13 shows that the majority of 66% of households has no access to fields. This shows that productive land is very scarce in rural areas. This is a result of apartheid system which forced black people from their land of origin into homelands. Recently, there have been efforts by the government to reverse the wrongs of the apartheid system which dispossessed black people of their land through the land reform programme. A proportion of 34% of people have access to productive land. The people who have access to fields are those who became residents in the study area before 1960. Those who came after 1960 were not allocated land for farming because land was scarce due to the introduction of betterment planning described above in home gardening. Only 9 out of 50 women have access to fields which in most cases are owned jointly with husbands. This result show that women lack access and control over economic and productive resources.

The results above confirm the way in which traditional societies treated women in terms of allocation of land. Women traditionally did not have independent rights to land and were eligible for allocation through men either husbands or sons. Most of the land is under communal tenure and inheritance operates through sons. A widow without children is particularly vulnerable since the land she worked will probably be taken by her parents in law or her late husband's brothers. As a result, very few women have access to fields in the study area. These are the people who can contribute significantly in crop production if they have access to fields and improve their food security status. Table 6.9 shows how households with fields gained access to them.

Table 6. 9: Land acquisition by households with fields (n=50) (source: author's data)

Form of access	Frequency
Inherited	16
Given by Chief	2

In the study area, the respondents had access to land acquired mainly by inheritance or land given by the chief. Table 6.9 indicates that inheritance plays a major role in land acquisition. Sixteen out of 18 people indicated that they inherited the fields while only one person indicated that they were given by the chief.

6.4.5.1 Field ownership status by household with access to fields

According to Figure 6.14 field ownership statuses differed among the households with access to fields. 81% of households with access to fields indicated that the field belonged to the household. 19% indicated that although the household had access to the field, the field did not belong to the household. They got access to the field through sharecropping arrangements with field owners. The agreement is to share the produce when it is ready. The sharing agreement is marred with misunderstandings and conflicts. This is calling for institutions to be developed which favour sharecropping in the study area. In the case where fields belong to the households, 46.7% of the fields were owned by husbands, followed by 40% owned by wives and 13.3% owned by both parents.

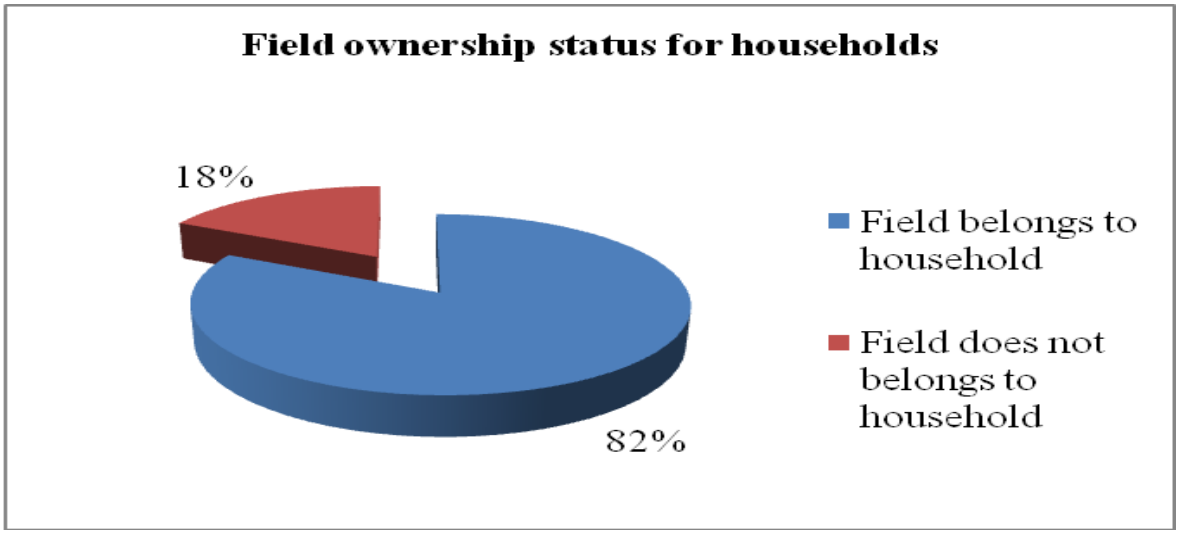

Figure 6.14: Field ownership status of households (n=50) (source: author's data)

6.4.6 Participation in cultivation of crops in the field in 2011/2012

Figure 6.15 shows the proportion of households who participated in crop production in their fields. A proportion of 81% of households with fields in the study area did not grow any crops in the season 2011/2012. Only 19% of households did. Those who did not cultivate their fields stated that they lacked financial and human capital and this is discussed in the next section.

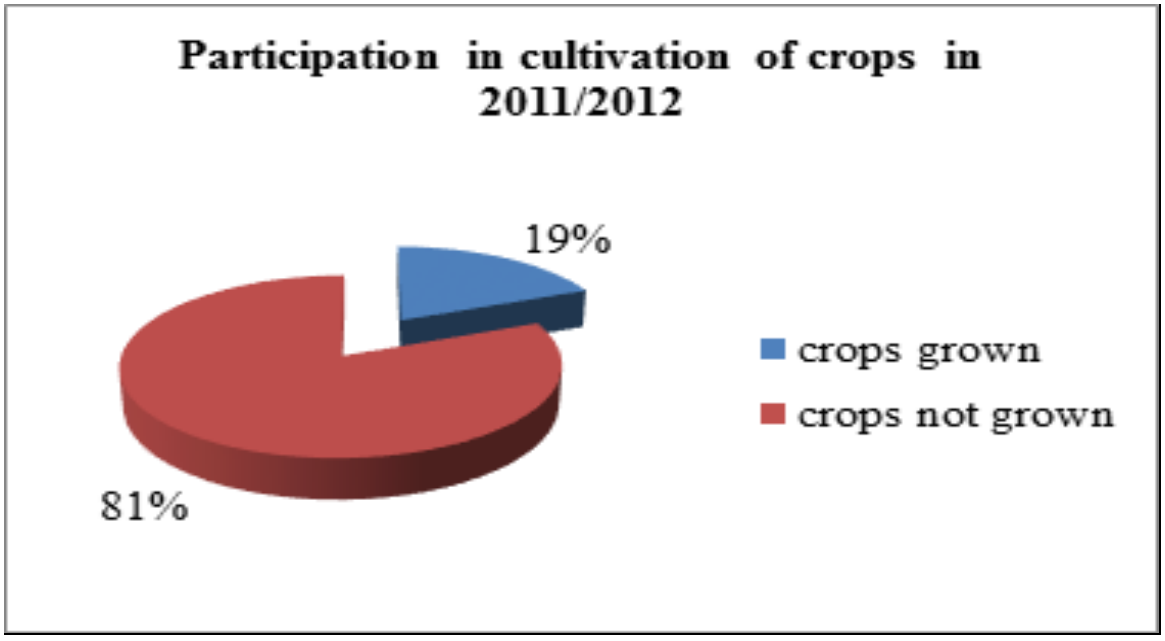

Figure 6.15: Participation in agriculture in 2010/2011 (n=50) (source: author's data)

6.4.6.1 Reasons for not cultivating fields in the 2011/2012 season

Figure 6.16 shows the reasons for not cultivating the fields and percentages of affected people. In this context, lack of financial capital refers to money needed to conduct agricultural activities like buying inputs, support services, buying farm equipment, technical assistance and information. A proportion of 29% of the population indicated that they lacked money for investment in agriculture while 12% lack human capital.

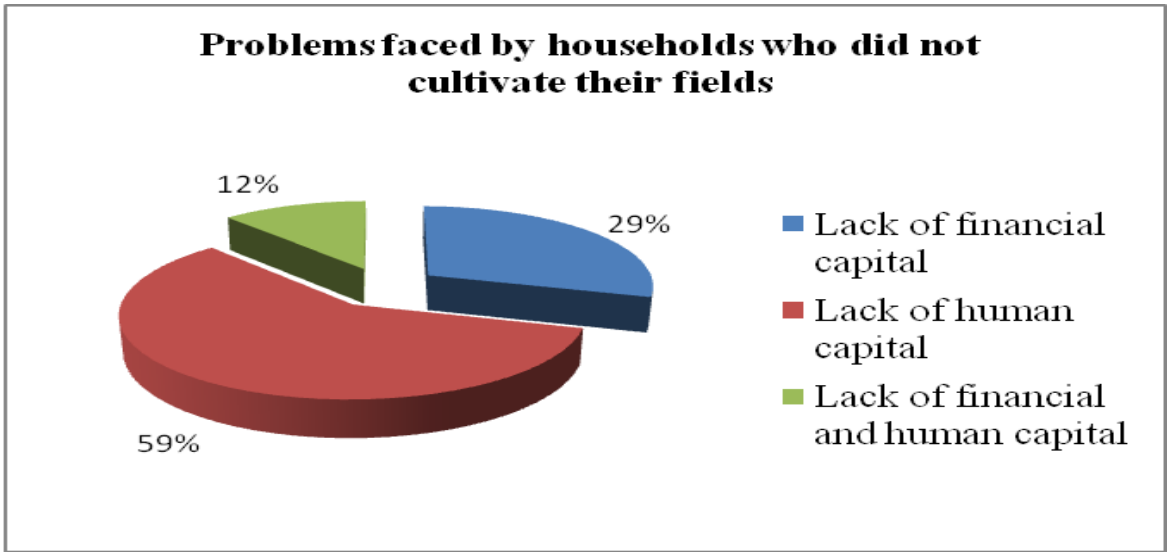

Figure 6.16: Problems faced by households who did not cultivate their fields (n=50) (source: author's data)

Lack of human capital in this context refers to having no one to assist with farming activities. Most women had a shortage of human capital and they indicated that they were forced to abandon crop production in the fields. A proportion of 59% of households indicated that they lacked both financial and human capital in order to cultivate their fields. This has resulted in households suffering from food insecurity and deepening poverty since they did not grow any crops. As discussed above, the majority of household heads have little education and limited exposure to modern financial instruments. Given their limited saving or borrowing options, it is hard for these people to cultivate their fields.

6.4.6.2 Kinds of crops grown in the fields

The study area is suitable for crop enterprises. The crops grown in fields are maize, potatoes, beans and pumpkin. Erratic rainfall limits cultivation in the fields.

Table 6. 10: Kinds of crops grown in the fields (n=50) (source: author's data)

Main crop	Average area (m^2)	Average yield (kg)	Price (Rand/kg)	Total income (Rands)
Maize	150	50	5	250
Potatoes	50	30	6	180
Dry beans	70	40	8	320
Pumpkin	60	20	5	100

Maize is produced for human consumption and also to feed animals. If there is a good harvest some of it sold locally to neighbours and friends. The money obtained can be used for different household expenses, but in most instances it is used to buy other food products. Maize makes the staple food of South Africa and is consumed mostly by poor households who cannot afford to buy rice. Potatoes, dry beans and pumpkins make a huge contribution to the diet of poor households. These commodities make up most of the diet of people in the study area as they earn low incomes. The reasons for growing these crops are shown in the table below. Table 6.10 shows that beans or peas are the main contributor to household income with an average income of R320, followed by maize with an average income of R320. The lowest contributor to household income is pumpkin with an average income of R100. The crops shown in table 12 above are the main contributors to household diets and are paramount in household attainment of food security. The Table 6.11 shows the proportion of households and their reasons for growing the crops shown above in Table 6.10.

Table 6. 11: Reasons for growing the mentioned crops (n=50) (source: author's data)

Reason	Percentage
consumption	45%
consumption and marketing	19%
consumption and donations	16%
consumption, marketing and donations	20%

6.4.6.3 Method of cultivation used in the fields

Table 6.12 shows the proportion of households using a particular traction method in crop production. Methods used for cultivating the fields differ a little from home gardening in that hand ploughing is not used in the fields. Animal traction contributes 56% and tractor traction 30% of cultivation method. Animal traction is favoured because it offers many cost saving opportunities such as in ploughing, planting, weeding and transport. Tractors are hired and most field owners cannot afford to hire as they have low income.

Table 6. 12: Cultivation method employed in the fields (n=50) (source: author's data)

Method	Percentage
Animal traction	56%
Tractor traction	30%
Tractor and animal traction	14%

Tractors are used for power intensive operations such as ploughing in the study area. Tractor and animal traction both contribute 14% as cultivation methods. Animal traction is considered environmental and sustainable by the farming households. They raised concerns that farming done by tractors has increased soil erosion.

6.4.6.3.1 Role played by different household members in fields

Table 6.13 shows the proportion of men and women carrying out a particular activity in crop production in the fields. Women perform the majority of tasks in agricultural production in the study area. Roles played by men and women do not differ from those under home gardens. Women do 80% of all agricultural tasks in the fields and work longer hours compared to men. Women also undertake most of the household chores and also attend to animal production. The result shows that women are the main producers and providers of food in the study area.

Table 6. 13: Role played by different household members in cultivation (n=50) (source: author's data)

Activity	Role player
Ploughing and land preparation	Men (80%) Women (20%)
Planting	Women (80%) Men (20%)
Weeding	Women (80%)
Harvesting	Women and children (80%)

Men play an 80% role in preparing the land and ploughing since this activity requires strength. 73% of the farmers indicated that they had an intention of increasing their scale of production in future whilst 27% have no interest. Of those intending to increase their production, 28% wanted to start a farming business and 11% wanted to meet household needs from own production. A further 61% wanted to fulfil both a farm business and household consumption needs.

6.5 Livestock ownership

Table 6.14 gives the number of livestock, reasons for keeping these livestock types and the number of households owning a particular livestock type in the study area. The study area is suitable for livestock enterprises such as poultry production but has inadequate space for the grazing livestock such as goats, sheep, beef, and dairy enterprises. 38% of the population own livestock whilst 62% do not. Livestock owned include the following: cattle, goats, sheep, and pigs, and chicken.

Table 6. 14: Livestock owned by households (n=50) (source: author's data)

Livestock owned	Number owned	Reasons for keeping these livestock	Number of households owning these livestock
cattle	63	Source of income and food Investment for future Draught power Rituals, ceremonies and bridal price payments	9
sheep	43	Source of income and food Investment for future	3
goats	142	Source of food Investment for future Ritual purposes	11
chicken	157	Source of income and food Investment for future	17
pigs	101	Source of income food Investment for future	10

6.6 Role played by extension services

Extension services are mainly provided by the Department of Agriculture of the Eastern Cape and department of agricultural economics and extension from the University of Fort Hare. 62% of households indicated that they have access to extension services. The extension services are for marketing, pest and disease management, water management, weed control, fertiliser application, conservation tillage and sustainable agriculture. A proportion of 38% of the population indicated that they were not aware of any extension services available in the study area. These are the people who were not engaged in agricultural activities.

6.7 Challenges faced by households in farming

Table 6.15 shows the challenges that are faced by the population in farming. These problems include water, money, land and labour. A proportion of 4% of the respondents indicated that they had a challenge of water in agricultural activities. These are likely to be households staying far away from taps and those without water tanks. The majority of the households have access to water for irrigation purposes in their home gardens. A further 32% of the population highlighted that they lacked money to carry out agricultural production. This is the major constraint since money is used to purchase inputs, implements, hiring of tractors and labour. Sixteen (16%) of the population indicated that land was their biggest challenge in farming. These are people who had no access to land or those who wanted to increase the scale of their farming activities. Four percent (4%) of the population mentioned they had no labour to help them carry out farming as they were too old to be involved in agricultural production.

Table 6. 15: Most important challenges in farming (n=50) (source: author's data)

Challenges faced in farming	Percentage(%) of population affected
Water	4
Money	32
Land	16
Labour	4
water and money	12
water and land	26
Water, money, land and labour	6

Some of the members of the population indicated that they faced multiple challenges. A proportion of 12% of the population highlighted that they lacked water and money. A further 26% indicated that they had a shortage of water and land for agricultural activities. A proportion of 6% of the population mentioned that they lacked water, money, land and labour in order for them to be engaged in agriculture. The result is important as it indicates the multiple challenges facing some members of the community in agriculture. Even if they are

willing to participate in agriculture, they still face these impediments. If they are to be successful in agriculture these constraints have to be removed.

6.8 Sources, uses and management of water

6.8.1 Water sources available to households

Households in the study area do not pay for any water that they use. They indicated that they would not be willing to pay for water if they are required to do so in future. They believe the water is their natural resource and they do not have to pay for it. There is a water users association in the study area which falls under Amathole Municipality. All the respondents indicated that they were not aware of any rules and regulations regarding the use of river water. These regulations are normally imposed on communities by the municipality and Water Users Association (WUA). The regulations require people to use water efficiently avoiding any wastage. The water users association existing in the community is Amathole Municipality. Women are represented in this structure. A number of water sources are available for the households in the study area as shown in Table 6.16.

Table 6. 16: Water sources available to households (n=50) (source: author's data)

Source of water available to households	Frequency	Percentage (%)
tap water	24	48
rainwater tank	1	2
River	1	2
tap water and river	1	2
tap water and rainwater tank	22	44
tap water, rainwater tank and river	1	2

According to Monde and Aliber (2007) all households relied upon river water and dams as their water source for everyday purposes until the taps were installed. Tap water was installed close to all the households and this has led to a sharp decline in the use of river water. 48% of households use tap water. Rain water tanks were installed in some households as part of Water Research Commission project in 2007. These water tanks are supposed to harness

much water during the rainy season in order to enable crop cultivation during dry seasons and in times of drought. Most households use tap water and rainwater tanks as their water sources. This is indicated by a 44% of households using this water source. A small fraction of 2% of households depends entirely on rainwater tanks, river and tap water as their only available water sources. A further 2% of households use 3 water sources concurrently which are river, tap water and rainwater tanks. Table 6.16 clearly indicates that the use of river water has dwindled due to the introduction of tap water.

6.8.2 Water sources and different uses of water by households

Table 6.16 shows that tap water and rain water are used for all household purposes. A small percentage of the population (2%) uses river water. Livestock including cattle, goats, sheep and pigs drink water from the river. Small livestock like chickens drink water from the tap. The river water is not utilised a lot by the households. As a result, it is earmarked for the proposed irrigation scheme. River water is to be used for irrigating the fields. The above result shows that the river water is rarely used for crop production.

Table 6. 17: Water sources and different water uses (n=50) (source: author's data)

Source of water	Major use
Tap water	Cooking, drinking, washing, irrigating and livestock drinking
Rainwater tank	Cooking, drinking, washing and irrigating and livestock drinking
River	Livestock drinking and brick making

6.8.3 Problems associated with each water source

Most households did not have any problems with tap water. According to Table 6.17 a few respondents indicated that the taps were located far away from their households whilst for some households, the taps were a few metres away from household residential site. Respondents who had rainwater tanks indicated that there was a shortage of water during dry seasons or in times of drought. This is also intensified by multiple uses of water, resulting in

less water available for agricultural activities. River water is considered by all the respondents as dirty. It is used by livestock for drinking purposes and brick moulding.

Table 6. 18: Problem associated with each water source (n=50) (source: author's data)

Source of water	Problems associated with the water source
Tap water	regulations preventing over use of water by WUA
Rainwater tank	shortage of water during dry season
River	Dirty

The river is far from the households residential site about 500 to 800 metres away. Water is fetched from the river using wheelbarrows, scotch carts and in some instances bicycles. Women sometimes carry water on their heads. The water is usually carried in 20 litre water bottles therefore; a significant amount of labour is needed to get water from the river for use at home. As a result, river water is not being used for household uses by the majority of households. It has been replaced by tap water which is considered clean, safe for drinking and is in close proximity to the households' residential sites.

6.9 Perceptions about the proposed irrigation scheme

A proportion of 70% of the respondents indicated their willingness to participate in the proposed irrigation scheme. They welcomed the irrigation scheme as a proper intervention that will bring jobs, business and much needed food in the study area. On the other hand, 35% of the population mentioned that they are not willing to participate in the proposed irrigation scheme. Those who did not want to participate were mostly the elderly who were too weak to participate in agriculture. They were concerned that they do not have enough labour to participate in this intervention. Even though they welcomed the irrigation scheme in the area, they were not going to participate.

Those who showed their willingness to participate in the irrigation scheme had concerns about the tenure of the fields and the type of institutional arrangement under which this irrigation scheme would operate under. Since the field owners agreed to release their land to those who were willing to use them by being compensated with food when the produce is ready, many were sceptical of this arrangement. They were concerns that when fields start

being productive, field owners might want their fields back leading to conflicts. Some respondents were concerned about sharing arrangements, how will it be carried out, when produce has been sold or crops in kind. Some field owners were worried that they might lose their fields if they allow the sharing arrangement to take place. They were cynical that in the long run this might lead to land disputes.

6.10 Management of the project

Management is a very important component of any farm business. The uncertain climate and unstable prices for agricultural products further contribute to the complexity of management. In this component the manager must come up with new ideas of how the production can be increased, establish action plans. A proportion of 66% of the population indicated that the proposed irrigation scheme should be managed by someone from outside the village, that is, a hired manager whilst 34% mentioned that they would like to manage the project themselves as a community. Those who advocated for the hired manager believed that there was no person with proper skills in the community and experience on irrigation scheme management. They believed that a hired manager will reduce failure of the project and people will be encouraged to work harder with a neutral person from outside the community. On the other hand, those in favour of community managed irrigation scheme indicated that they believed they could work together effectively without outside intervention. They indicated that based on trust and the networks in the community the project was likely to flourish without outside influence. They indicated that they had mechanisms such as naming and shaming and guilt in place to keep those who stray from the objectives of the scheme in order making sure they stay in line with the irrigation scheme objectives and vision.

6.11 Conclusion

The discussion of the survey results indicated that the majority of the respondents were married and aged above 40 years. The highest educational level attained by the majority of 54% respondents was primary education and females dominated our survey as respondents. The low educational level among households suggests that they have low skills which might hamper agricultural activities. A proportion of 62% indicated that they were unemployed. The lack of job opportunities and low agricultural contribution in household incomes mean that these households deepen into poverty. The majority of households are dependent on

social grants and they spend a huge proportion of their income on food products. The results of our study show that most households have access to home gardens and few have access to fields. There is division of activities by gender in farming. Activities requiring strength are done mostly by men such as land clearing while activities requiring great care such as weeding are done mostly by women.

Different kinds of livestock are kept in the study area mainly for food, source of income and investment for future. Water sources available in the study area include taps, tanks, dams and rivers. Most households (48%) have access to tap water which is used mainly for household purposes and home gardening. The use of tap water is regulated by the Water User Association (WUA) of Nkonkobe local Municipality. The challenge faced by households in agriculture is mainly financial and physical capital, labour and access to water. A proportion of 70% of households in the study area expressed their willingness to participate in the proposed irrigation scheme. They indicated that the irrigation scheme would solve the problem of unemployment and improve food availability in the study area. Sixty six (66%) of respondents indicated that they would prefer the irrigation scheme to be managed by a hired manager instead of a person from within their community. They believed that they do not have sufficient skills to manage an irrigation scheme.

CHAPTER 7

ECONOMETRIC MODEL RESULTS AND DISCUSSION

7.1 Introduction

This chapter presents empirical results of the study. It begins with a discussion of descriptive statistics, followed by a discussion of logit results and marginal effects. Factors which play a bigger role in influencing farmer's decision to participate in a proposed irrigation scheme are explored here. This chapter gives a conclusion based on the empirical results of the study.

7.2 Summary statistics and discussion

Table 7.1 gives a summary statistics for the variables included in the analytical model. A proportion of 70% of people indicated that they were willing to participate in the proposed irrigation scheme. The mean age of the respondents was 59. These were mainly household heads and the elderly who are always at home all year round. A proportion of 54% of households had at least primary education while 46% had no formal education. The households who belonged to a local community group were 32% while 68% did not belong to any local group. Fifty four percent (54%) of the respondents indicated that they had no idea about the proposed irrigation system. They were hearing for the first time about this planned intervention. Only 46% were aware of the planned irrigation scheme. The results show that 60% of the households have been investing in agricultural production in the past production season of 2010/2011. The average size of household was 4 people. The average labour available in a given respondents household was 3 people.

Table 7. 1: Descriptive statistics of the variables used in the empirical model

Variable	Observations	Mean	Standard deviation	Min	Max
Participation	50	0.7	0.46291	0	1
Age	50	59	15.04144	18	84
Gender	50	0.34	0.4785181	0	1
Education	50	0.54	0.5034574	0	1
mlocalgroup	50	0.32	0.4712121	0	1
totincome	50	19212.86	8123.313	6720	48000
Knowledge	50	0.46	0.5034574	0	1
investagric	50	0.6	0.4948717	0	1
Hoseholdsize	50	4.22	1.94086	1	10
Labour	50	3.24	1.436549	1	7

7.3 Empirical results and discussion

When a logit model is estimated, the estimated coefficients tell us about the relationship between the independent variables and the dependent variable, where the dependent variable is on the logit scale. These estimates tell us the amount of increase in the predicted log odds of participation = 1 that would be predicted by a 1 unit increase in the predictor, holding all other predictors constant. Table 7.2 shows the logit regression results: The coefficients on any variable will help us identify the effect that a given variable has on the latent propensity to participate in the proposed irrigation scheme. The marginal effects indicate the effect that a given variable has on the likelihood of participation. Therefore, the coefficients and marginal effects help us to measure the role that each factor has on the willingness to participate in the proposed irrigation scheme.

Table 7. 2: Logit regression results

Dependent variable = Participation				
Variable	**Coefficient**	**Standard. Error**	**Z**	**P>|Z|**
Age	-0.0956479**	0.0398105	-2.40	0.016
Householdsize	0.1571312	0.4811676	0.33	0.744
Labour	0.1380589	0.5959148	0.23	0.817
Gender	-1.709184	1.101269	-1.55	0.121
Education	3.686339**	1.631007	2.26	0.024
mlocalgroup	3.70088**	1.741794	2.12	0.034
investagric	4.95287***	1.844356	2.69	0.007
Knowledge	1.758922*	1.004009	1.75	0.080
totincome	-0.0001187*	0.0000682	-1.74	0.082
Constant	2.230321	1.841243	1.21	0.226
Number of observations 50				
$LR\ \chi^2(9)$ = 23.73; $Prob > \chi^2$ = 0.0047; Log likelihood = -18.677308; $Pseudo\ R^2$= 0.3885				
*, **, *** Significance at 10, 5, and 1% respectively				

$\boldsymbol{Prob > \chi^2}$**-** This is the probability of obtaining the chi-square statistic given that the null hypothesis is true. It is the probability of obtaining this chi-square statistic (23.73) if there is in fact no effect of the independent variables, taken together, on the dependent variable. The model is statistically significant because it has a p value of 0.0047 which is less than the critical value of 0.5 or 0.1. The model is significant at 1% significance level. A Pseudo R^2 statistic does not mean what R-square means in OLS regression (the proportion of variance explained by the predictors). A Pseudo R^2 between 0.2 through 0.4 is considered highly satisfactory. Therefore the model is satisfactory since it has Pseudo R^2 of 0.3885. The marginal effects (ME) calculated are shown in the Table 7.3 in order to find the effect of predictor variables on the probability of participating on the proposed irrigation scheme.

Table 7. 3: Marginal effects

Y = Pr(participation)
= 0.8570588

variable	dy/dx	Standard error	z	P>|z|	X
Age	-.01171**	0.00561	-2.09	0.037	59
Householdsize	0.01925	0.05688	0.34	0.735	4.22
Labour	0.0169135	0.07405	0.23	0.819	3.24
Gender	-.254745	0.17093	-1.49	0.136	0.34
Education*	0.520032***	0.17716	2.94	0.003	0.54
Mlocalgroup*	0.3395053***	0.11012	3.08	0.002	0.32
Investagric*	0.7425807***	0.16057	4.62	0.000	0.6
Knowledge*	0.2118981*	0.12955	1.64	0.100	0.46
Totincome	-0.000014**	0.00001	-2.05	0.040	07

(*) dy/dx is for discrete change of dummy variable from 0 to 1

*, **, *** Significance at 10, 5, and 1% respectively

Age-For every one year increase in age, we expect a -0.0956479 decrease in the log-odds of participation, holding all other independent variables constant. -0.0956479 is the effect of a unit increase in age on the latent utility of willingness to participate on the proposed irrigation scheme. This result is valid at a level of significance of 5%. The negative association on age and participation indicates that the older the household head, the less willing the farmer is to participate in the scheme. The marginal effect of age on participation is -.01171. This is the effect of age on the probability of participating in the proposed irrigation scheme. This result confirms findings that young farmers have tendency to be more innovative due to their longer planning horizons and lower risk aversion (Bagi, 1983; Gould et al., 1989). The negative

sign on age suggests that younger farmers are likely to participate in the proposed irrigation scheme.

Education -The coefficient for the variable education is 3.686339. This means that for a one-unit increase in education (in other words, going from no education to primary), we expect a 3.686339 increase in the latent propensity to participate in the proposed irrigation scheme, holding all other independent variables constant. This result is valid at a level of significance of 1%. The marginal effect of education on participation is 0.520032. This means that a unit increase in education (in other words, going from no education to primary), increases the probability of participation by 0.520032. The apriori expectations of a positive relationship between participation and education are confirmed by this result. This result confirm findings from other studies that have also shown that education had a positive influence on adoption (Atala, 1984; Jagne et al., 1981 and Barnes et al., 1982; Masangano and Miles (2004), Wang et al. 2000; Cary et al., 2001; Caswell et al., 2001). Therefore, in order to improve farmer participation in new agricultural technologies, there is need to increase access to education and training programs in the study area.

Mlocalgroup **-** A one unit increase in being a member of a local group (in other words, going from non-membership to membership) increases the latent propensity to participate in the proposed scheme by 3.70088. This result confirms our apriori expectation of a positive relationship between participation and education. This result is valid at a level of significance of 5%. A one unit increase in *Mlocalgroup* increases the probability of participating in the proposed irrigation by 0.520032. Being a member of a local group exposes farmers to information, to the technology, provides farmer-to-farmer interactions in technology management, reduces technology demonstration costs, and increases economies of scope for broad-based dissemination of technologies to farmers (Adesina et al., 2000 Atta-Krah and Francis, 1987 and Versteeg and Koudokpon, 1993). In Senegal significant success was achieved by using farmer groups to rapidly spread agroforestry technologies (Caveness and Kurtz, 1991). Access to larger amounts of information through farmer groups is more likely to increase farmer adoption of new technologies (Llewellyn et al., 2005). Therefore, membership in local groups should be encouraged in order to improve willingness to participate in the proposed scheme.

Investagric **-** For every one-unit increase in investment (in other words, going from none investing to investing towards agriculture), a 4.95287 increase in the log-odds of participation is expected, holding all other independent variables constant. This result confirms our apriori expectations of a positive relationship between participation and investment in agriculture and is valid at 1% significance level. The marginal effect of *Investagric* is 0.7425807. This means that a unit increase in investment increases the probability of participation in the scheme by 0.7425807. Therefore, it can be concluded that farmers who have previously been investing in agriculture are likely to participate in irrigation. Low income households are likely to be not investing in agriculture. This result is robust because it shows that farmers who are currently not investing in agriculture are unlikely to participate which might lead them to be marginalised and deepening poverty.

Totincome **-** A one-unit (rand) increase in income decreases the latent propensity to participate in the proposed scheme by 0.000014, holding all other independent variables constant. This result is valid at 10% significance level. The result is not surprising since many studies have focused on the disincentive effects of the social grants on agricultural production. A similar negative relationship was found by It has been indicated in this study that the source of income for majority of households is social grants. The more grants the household have, the less willing it is to participate in agricultural production. The marginal effect of *totincome* is -0.000014. This means that a unit increase in income decreases the probability of participation in the scheme by 0.7425807. Similar negative relationship was found by Masangano and Miles (2004), total income did not significantly influence farmers' willingness to grow Kalima bean. Therefore, in order to increase farmer participation, low income households should be targeted.

Knowledge **-** As expected, knowledge is positively influenced level of participation in the proposed irrigation scheme. For every one-unit increase in knowledge, a 1.76 increase in the log-odds of participation is expected, holding all other independent variables constant. Knowledge increases awareness which in turn could influence households to participate hence a positive coefficient is expected on knowledge. Knowledge is made available to households by extension officers. The marginal effect of knowledge is 0.211. This means that a unit increase in knowledge increases the probability of participation in the scheme by 0.211.

Since irrigation technology will be new in the study area, farmers rely more on extension agents for information on irrigation technology.

Given the high rate of failure of smallholder irrigation schemes in South Africa, improved knowledge dissemination between households and extension agents is critical. This result is similar to the finding that the availability of extension agents has a positive significant effect on probability of adoption of chemical inputs (Jamison and Lau, 1982; Jamison and Moock, 1984). A similar positive relationship was found by Masangano and Miles (2004), reporting that farmers who had prior knowledge about the attributes of Kalima were also more willing to grow it. Efforts must therefore be made by extension service providers to disseminate information to farmers about the proposed irrigation scheme in order to promote participation.

7.4 Conclusion

This study investigated the factors influencing farmer's willingness to participate in a proposed irrigation scheme. Six out of nine explanatory variables tested were significant in explaining participation. The results showed that mlocalgroup, investagric, education, knowledge and totincome are responsible for increasing the probability of participation. The negative relationship on age and participation indicates that the older the household head, the lesser the chances of participation. Education level and Investagric, had a positive association with participation indicating their significance in explaining participation. Institutional factors, such as membership to local group and knowledge had a major influence on willingness to participate in the irrigation scheme.

The main policy implications emerging from this study helps target the recipients of the proposed irrigation scheme. This will make policy makers to be able to stimulate adoption of irrigation scheme technologies by addressing those factors that play a significant role in farmer decision making such as mlocalgroup, investagric, education, knowledge and totincome. Membership in local groups should be encouraged among farmers since it is associated with increased willingness to participate in irrigation. Local groups help farmers share experiences and information. Knowledge dissemination to farmers by extension officers and other stakeholders should be improved since it is associated with a higher likelihood of farmers participating in the proposed scheme. Education increases the

likelihood of farmer participation. Based on these results, assistance needed by farming households to overcome these factors can be provided. Lessons from this study also have broad relevance to irrigated cropped areas in smallholder irrigation scheme in South Africa where performance has been poor mainly due to farmer participation and involvement. Evaluating farmers' willingness to participate, their perceptions about this proposed irrigation scheme was necessary for improving their involvement and participation and information flow to policy makers. The results of this study highlighted the factors that affect farming households' willingness to participate in the proposed irrigation scheme. This study calls for measures to support successful participation of farmers in the proposed irrigation scheme in Guquka.

CHAPTER 8

SUMMARY AND RECOMMENDATIONS

8.1 Introduction

This chapter gives a summary and recommendations of the study. It starts with summarizing the objective of this study which was to identify the factors responsible for influencing farmers' willingness to participate in a proposed irrigation scheme. A brief description of the study area is given with data collection methods and analysis framework used in this study. The major results of the study are summarized and the recommendations are also given.

8.2 Summary

The majority of rural farming households depend on rain fed agriculture. Rainfall is becoming more erratic due to climate change. The water deficit limits rain fed crop production in the study area. Shortage of land among poor households also presents a major constraint in Guquka. The majority of households have lost interest in agriculture due to shortage of water among many constraints that they face. The major income source in the study area is social grants and agriculture makes a modest contribution to household livelihoods. Irrigated agriculture is now served with the role of improving food security and providing livelihoods for the majority of households in the study area.

Many smallholder irrigation schemes in South Africa perform poorly due to a range of factors including farmer participation and involvement. In order to ensure a successful irrigation scheme, this study took a rigorous approach in identifying factors that are responsible for influencing farmer willingness to participate in the proposed scheme. Identifying these factors will help in design of the scheme, institutional context under which this scheme will operate, help identify necessary support needed with the aim of ensuring farmer participation and a sustainable irrigation scheme.

The data for this study was collected in Guquka which is located 30 kilometres from Alice town in Nkonkobe Municipality in Eastern Cape Province using structured interviewer administered questionnaires. The unit of analysis was the household. The sample size was 50 households and the sampling method used was systematic sampling. The proposed irrigation scheme will use water from the Tyume River which runs all year through. The river passes through Guquka and the fields earmarked for irrigation are those close to the river. Descriptive results of the study were obtained using Ms Excel 2010. The main descriptive results were livelihoods, income sources, land and farming; water use, sources and management; perceptions of the respondents on the proposed irrigation scheme.

The model used for this study is logit regression which is a linear probability model for binary response where the response probability is evaluated as a linear function of the explanatory variables. The coefficients in the logit analysis were estimated using maximum likelihood and the marginal effect of each of the independent variables was calculated and indicated by the calculated changes in probabilities. The statistical packages used for estimating the logit regression was STATA 11. The results of the study are robust in identifying the key factors such as mlocalgroup, investagric, education, knowledge and totincome being responsible for increasing the probability of participating in the proposed irrigation scheme. A better understanding of the factors that affect farmer decision making will help in recruiting recipients, ensure farmer participation and involvement, and development of a sustainable irrigation scheme.

8.3 Recommendations

The recommendations that follow are based on the descriptive and empirical results of this study. The aim of identifying the factors which influence farmers' decisions was to create a sustainable irrigation scheme which ensures farmer participation and uplift the whole community. The empirical results of the study showed that age, mlocalgroup, investagric, education, knowledge and totincome being responsible for increasing the probability of participating in the proposed irrigation scheme. The following recommendations are not exhaustive but serve as the basis to ensuring a successful adoption of a sustainable irrigation scheme.

8.2.1 Enhancing support systems to disseminate information, training and knowledge

The results of the study showed that 68% of the respondents had access to extension services which are mainly provided by the Department of Agriculture of Eastern Cape Province, and the Department of Science and Agriculture from the University of Fort Hare. Capacity building and motivating extension workers is of paramount importance in order to effectively support farmers. In order to increase participation of farmers in the irrigation scheme, extension services should target the whole population and make mechanisms of information dissemination to all households possible. Farmers should organise themselves into community groups. Organising farmers into community groups will help them share information, skills and knowledge about different agricultural activities thereby lowering transaction costs.

8.2.2 Improving participation and resource ownership of women

In literature, it is widely accepted that women are marginalised in land ownership and activities and have limited leadership roles in irrigation management. However, gender inequalities in the distribution of assets and opportunities mean that women's choices are severely constrained in farming. An effort needs to be made to tackle these gender issues. Limitations in land ownership for rural women mean they may not have access to productive land to farm, and lack of financial capital means they cannot easily diversify their livelihoods. Gender equality in the distribution of irrigation land should be made possible. Women should be encouraged to participate in the process and given leadership roles in the proposed irrigation scheme. Women should be involved in the development of the proposed irrigation scheme from its initiation stage.

8.2.3 Improving access to education and farmer training programmes

The results of the study showed that a unit increase in education increases the probability of participation in an irrigation scheme. Therefore, the government should invest in education, improve farmer training and encourage information sharing among farmers. Farmers should pass on their knowledge to other farmers who have not received training and advice.

Exchange of ideas should be encouraged between farming households in order to improve agricultural production.

8.2.4 Improving institutional support to farmers

The results of the survey showed that all the respondents are currently not paying for water use. They also indicated that they would not be willing to pay for water at a later date if they are asked to do so. They believed they had a right to use water without incurring charges. As climate change brings erratic rainfall and water shortages, it is a possibility that one day, the households will have to pay for water. Therefore, policy and regulations in water management, land tenure and land lease issues should be favourable for irrigation development as well as promoting environmental conservation.

8.2.5 Protecting the environment

The area proposed for irrigation is undulated. Cultivation in this area can lead to extensive land degradation within the area through soil erosion leading to loss of soil fertility. Use of fertilisers can lead to contamination of water leading to a wide range of health effects. Soil salinity can build up leading to poor yields. Poor sanitation can easily result in water-borne diseases. Therefore, increasing the use of organic manure can result in an increase in production and is less harmful to the environment. Water quality monitoring would assist in understanding its impact on crops and soils. Land conservation protection would ensure a sustainable irrigation scheme and agricultural production.

8.2.5 Improve access to financial services

The results of our study indicated that 32% of the respondents indicated that among the challenges they face in farming, the major one is money. They do not have enough money to invest or carry out agricultural production. This is worsened by the fact that they have a borrowing constraint and they cannot access credit markets, as they do not have enough collateral for them to seek and guarantee repayment of the loan. Therefore, it is important that financial systems are in place to support sustained development. Assistance should be

extended to farmers so that they can access credit at favourable rates. This will help farmers improve their asset base and invest in agriculture.

8.5 Recommendations for further study

8.3.1 A cost benefit analysis of irrigation options to be adopted in the study area

The majority of 70% of the respondents indicated their willingness to participate in the proposed irrigation scheme. They agreed that smallholder irrigation is important to agricultural development and to food security. To be successful, the smallholder irrigation system should be based on the wide participation of the farmers using the bottom-up approach to planning. Irrigation systems come in a variety of forms. These include sprinkler, centre pivot, drip, furrow and floppy irrigation systems. Their applicability and suitability differs according to the ecological region, scale of farming, skills level, availability of water and other resources. Analysis of these irrigation systems justifies this study so as to come up with an irrigation option that will be suitable, sustainable and cost effective and with suited returns for the study area.

Research to develop appropriate irrigation strategies aimed at increasing water productivity and broader rural economy is needed. A cost benefit analysis for a proper irrigation system associated with the on farm water saving irrigation systems is one possible irrigation strategy. The identification of the most suitable irrigation strategy for each irrigation system, in water scarcity conditions, should aim at selecting the most appropriate irrigation system. Economic factors, particularly the cost of water (also relative to energy costs) and some constraints such as equipment maintenance problems have to be explicitly incorporated into the analysis.

Furthermore, the concept of sustainability of the system must also permit the maintenance of a rural population while improving standards of living. This might drive toward a more informed choice of on farm irrigation system. Irrigation projects with the general objective of enhancing food security need to be planned, developed and managed within the context of a clearer programme of capacity building, and with a longer timeframe given to farmers to attain financial sustainability, compared with irrigation programmes for commercial purposes targeted at farmers with some asset base.

8.3.2 An investigation of institutional capacity the study area for the implementation of an irrigation scheme

The field owners agreed to release their land so that it can be put under thes irrigation scheme. Sharecropping is the arrangement that is being made between the field owners and the landless who want to be part of the irrigation scheme. There is concern among the landless that the field owners might want their land back once production starts on the farm. The field owners are also sceptical about the effectiveness of this sharing arrangement. Given the huge literature on problems of sharecropping, marshallian inefficiencies that might result, there is need for careful analysis of these arrangements. All these concerns need a proper analysis of institutions to be put in place before the implementation of the irrigation scheme. Property rights have to be clearly defined and lease agreement and sharing arrangements formalised before any production or investment takes place.

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APPENDICES

Appendix 1: Questionnaire for investigating factors affecting rural farming households' willingness to participate in a proposed irrigation scheme in Guquka

SECTION 1. DEMOGRAPHIC INFORMATION								
1.1. Please provide the following information about your household								
Name	Relation to hh head	Age	Gender (m/f)	Marital status	Highest Education	Employment status	Occupation	Time home
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Codes:

Relation to household head (hh): Head = 1; Spouse = 2; Son/daughter = 3; Grandchild = 4; Niece/nephew = 5; Grandparent = 6; Aunt/uncle/brother/sister = 7; Not related = 8.

Age: Enter number; Gender: Male = 1; Female = 2; Marital status: Single = 1; Married 2; Divorced = 3; Widowed =4

Education: No formal education =00, Primary=01, Secondary=02, Post-Secondary=03

Employment status: Unemployed = 0; Full time = 1; Part time = 2.

Occupation: Teacher = 1; Farmer = 2; Pensioner = 3; Housewife = 4; etc.

Time home: Always = 1; weekends = 2; holidays = 3

1.2. Household size = enter no

1.3. Active population (15 to 64 years) = enter no

1.4. No of children (less than 15 years) *(important when calculating adult equivalent income) =enter no*

1.5. No of Adults (15 years and more) *(important when calculating adult equivalent income) =enter no*

(Note: you don't ask respondents 1.2 to 1.5; you get it from the table above)

SECTION 2: LIVELIHOODS AND EXPENDITURE PATTERNS				
2.1. Please state the sources of income available to your household as well as the amounts received from each source per cycle. **2.1.1. External sources of income**				
Source	Cycle	Income per cycle (R)	No. of cycles per annum	Net income/a (R)
Remittances (Cash)	e.g. Monthly	R500	12	
Remittances (Kind)				
Child support from parent outside household				
Salaries & Wages				
Old age pension				
Disability grant				
Remittances (Kind)				
Child support from parent outside household				
Salaries & Wages				
Old age pension				
Child support grant				
Other government grants, specify				

2.1.2. Local sources of incomes				
Source	**Cycle**	**Income per cycle (R)**	**No. of cycles per annum**	**Net income/a (R)**
Hawking (Food)				
Hawking (Other)				
Spaza shop				
Selling liquor/shebeen				
Taxi business				
Lending money				
Carpentry				
Plumbing				
Building houses				
Crops kinds				
Crops cash				
Animals kind				
Animals cash				

SECTION 3. LAND AND FARMING		
3.1.	Do you have a garden (igadi okanye isitya) on your site?	1 = Yes 2 = No
3.2.	If yes, what is the size of your garden? (Interviewer to pace it)	Enter no
3.3.	Did you grow crops, vegetables and or herbs on it during 2011/12 cropping season?	1 = Yes 2 = No
3.4.	If No, when last did you cultivate your garden? 1=Two years ago 3=More than 10 years ago 2=five years ago 4=never 5=Other, specify	Tick and enter no:
3.5.	What are your reasons for not cultivating the garden? 1 = No money 3 = Not fenced 2 = No one to help 4 = Other, specify	Tick and enter no:
3.6.	If yes to 3.3, which main crops/vegetables/herbs do you grow in your garden? 1 = maize 2 = potatoes 3 = dry beans/peas 4 = pumpkin/ butternut 5 = cabbage 6 = spinach 7 = onions 8 = Other	
3.7	Average yields (kilograms) and prices (rands) in 2011/2012 cropping season by households in their home gardens	Maize = Potatoes = Beans = Pumpkin= Butternut= Cabbage= Spinach= Onions= Other
3.8	Average price (Rand/kilogram) in 2011/2012 cropping season by households in their home gardens	Maize = Potatoes = Beans = Pumpkin= Butternut= Cabbage= Spinach= Onions= Other
3.7.	Do you sometimes irrigate the crops grown in your garden?	1 = Yes 2 = No

3.8.	If yes, what is the main source of irrigation water? 1=River 2=Stock dam 3=RDP water 4=Underground water 5=Rainwater tank	Tick and enter no:		
3.9.	What are your reasons for growing crops mentioned above? 1=Home consumption 4=1 and 2 2=Marketing 5=1, 2 and 3 3=Donations 5=Other, specify	Tick and enter no:		
3.10.	What method of cultivation is used in your garden? 1=Hand ploughing 2=Animal traction 3=Tractor traction	Tick and enter no:		
3.11.	Who in the household undertakes the following activities in your garden? <u>Activity Who (e.g. wife, husband, children, hired labour, etc.)</u> 1=Ploughing / Land preparation 2=Planting 3=Weeding 4=Collecting water 5=Irrigating 6=Harvesting	Who	Gender	Age
3.12.	Do you have access to a field?	1 = Yes 2 = No		
3.13.	If Yes, does the field you have access to belong to this household?	1 = Yes 2 = No		
3.14.	If the field does not belong to your household, how did you get access to it? 1=Rent 2=Borrowed 3=Sharecropping			
3.15.	If it belongs to the household, who in the household owns the field? 1=Husband 2=Wife 3=Brother 4=Father 5=Other, specify			
3.16.	How did s/he get the field? 1=Inherited 2=Bought 3=Given by Chief	Enter no:		
3.17.	How big is the field you own or have access to? Size in Morgans / Acres / Hectares	Enter no:		
3.18.	Did you grow crops on it during 2011/12 cropping season?	1 = Yes 2 = No		
3.19.	If not, please provide an explanation (s). 1= No money to cultivate 2= Drought 3= No one to assist with farming activities 4= Field is not fenced 5= Other, specify			
3.20.	If yes, which of the ff crops did you grow on your field?	Enter no:		

	1=Maize 2=Pumpkins 3=Beans/peas 4=Potatoes			
3.21.	What are your reasons for growing the crops identified above? 1=Home consumption 2=Marketing 3=Feed animals 4=1 and 2 5= 1, 2 and 3			
3.22.	Who in the household undertake the ff activities in the field? (E.g. wife, husband, children, hired labour, etc.) 1= Ploughing 2=Planting 3= Weeding 4=Harvesting	Who	Gender	Age
3.23.	What method of cultivation is used in the field? 1= Tractor traction 2= Animal traction	Enter no:		
3.24.	Which of the following implements / equipment do you use when undertaking farming activities? Please state whether owned, borrowed or hired.			
	Implement (tick) Tractor drawn plough Planter Cultivator Disc plough Tractor Bakkie Animal drawn plough Garden tools	Owned=1	Borrowed=2	Hired=3
3.25.	Do you have any intentions of increasing your scale of production in future?	1=Yes 2=No		
3.26.	If yes, please provide reasons for wanting to do that. 1= Want to take farming as a business and make money from it 2=Want to obtain household food needs from own production 3=Other, specify			
3.27	Do you have access to extension services?	1=Yes 2=No		
3.28	If yes, what kind of advice do you get from extension officers? 1= Marketing 2= Pest and disease management 3= water management 4= Weed control 5 = Fertiliser application 6= Other, specify			

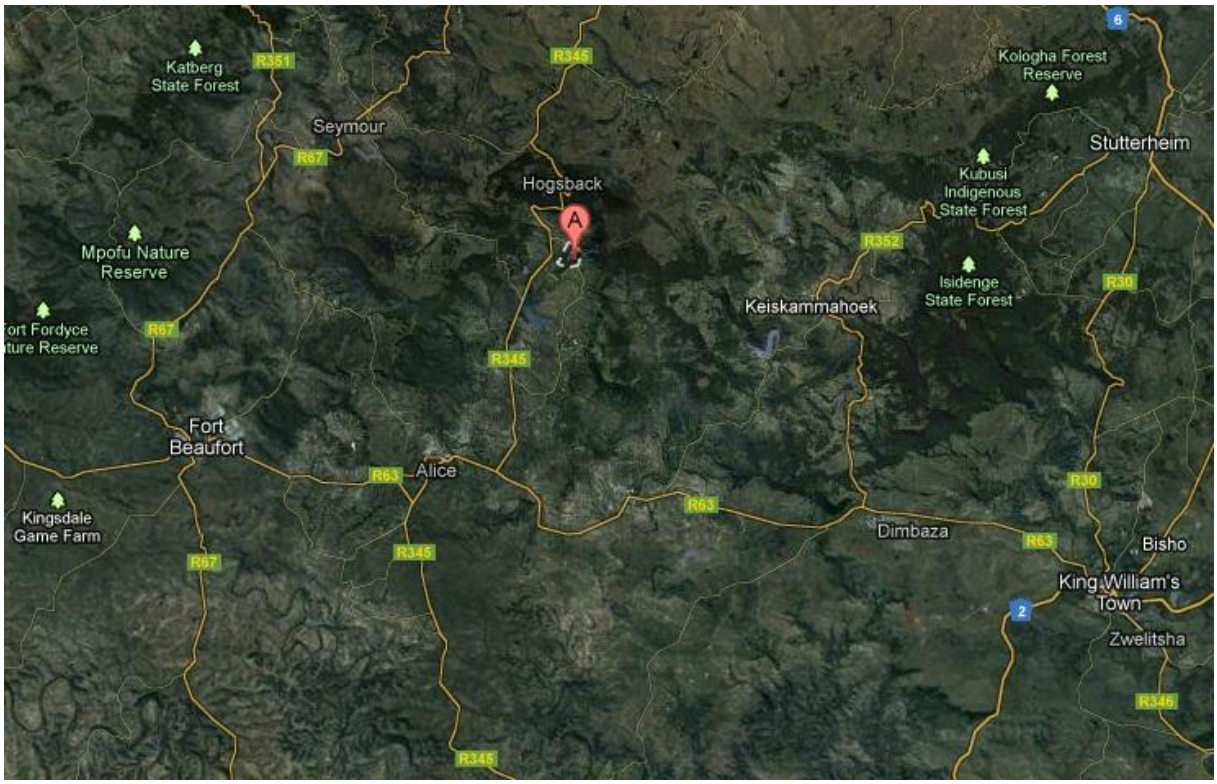
3.29.	Which of the following livestock do you own? State number as well. 1= Cattle 2= Sheep 3= Goats 4= Pigs 5= Dual purpose chickens 5= Broilers 6= Layers 7= Geese 8= Ducks 9= Horses 10= Donkeys	Animal	No	
3.30.	What are your reasons for keeping the animals identified above? (reason for each animal mentioned above) 1=derive an income 2=source of food 3=investment for future 4=ritual purposes 5=Other, (combination of two or more of the above)		Animal	Reason
3.31.	What are your most important challenges in farming? (in order of importance Water 4. Labour Money 5. Other, specify Land		Enter no:	

SECTION 4. WATER SOURCES, USES, MANAGEMENT AND PERCEPTIONS ON IRRIGATION		
4.1	What are the sources of water available to your household? River 4. Stock dam RDP 5. Spring Rainwater tank 6. Other, specify	
4.2	Which of the water sources identified above are used for the following? Cooking 4. Irrigating Drinking 5. Livestock drinking Washing 6. Brick making	
4.3	If the River water is sometimes used for irrigation purposes, can you estimate the amount of water used for irrigation per month? 200 liters (One drum of water) 2 to 5 drums of water More than 5 drums	
4.4.	If River water is used for washing clothes, can you estimate the amount of water used for washing per month? 200 liters (One drum of water) 2 to 5 drums of water More than 5 drums	
4.5.	What are the problems associated with each water source identified above? Dirty Shortage of water during dry season Other, specify	
4.6.	Are you aware of any rules and regulation regarding the use of River water?	Yes = 1 No = 2
4.7.	If yes, what are the rules and regulations?	

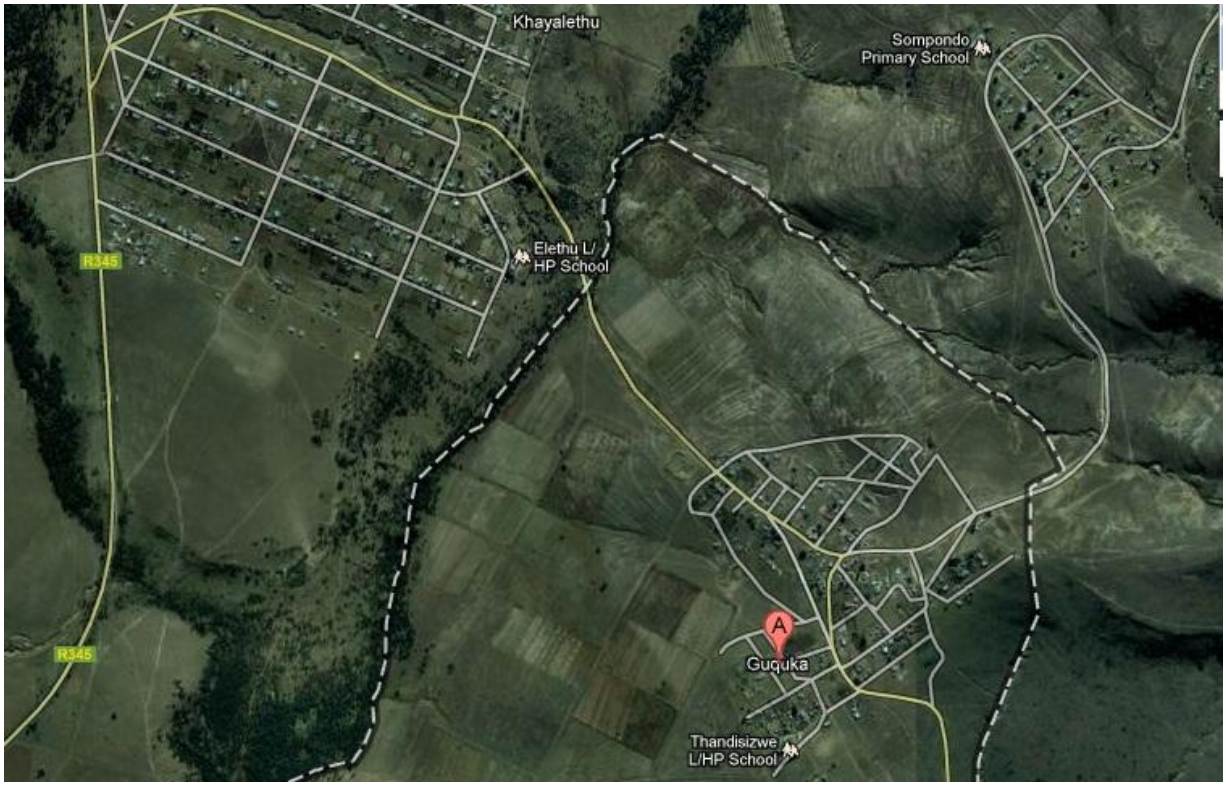
4.8.	Who in the village makes these decisions? Community 3. Chief Residence Chair 4. Other, specify		
4.9	Do you pay for any of the water you use	Yes = 1 No = 2	
4.10	If yes, which water do you pay for and how much do you pay?	Water Source	Amount
4.11	If you are not paying for any of the water you use, would you be willing to pay for it if required to do so in future?	Yes = 1 No = 2	
4.12	If yes, how much would you be willing to pay?	Enter figure	
4.14	Is there any water users association in this community?	Yes = 1 No = 2	
4.15	If yes, what is it called (name)?	Enter name	
4.16	Is your household a member of this water users association?	Yes = 1 No = 2	
4.17	If there is WUA, are women represented in this structure?	Yes = 1 No = 2	
4.18	If no, how can the participation of women be enhanced in WUA?		
4.19	What are the roles and responsibilities of WUA?		
4.20	Would you be willing to participate in the irrigation project planned for your community?	Yes = 1 No = 2	
4.21	Do you have any concerns for this irrigation project?	Yes = 1 No = 2	
4.22	If yes, what are your concerns?		
4.23	How can these concerns be addressed?		
4.24	Who should manage this project? 1= community 2. hired manager from outside the village		
4.25	Reasons for your choice in 4.24		

Appendix 2.1 Topography maps of the study area

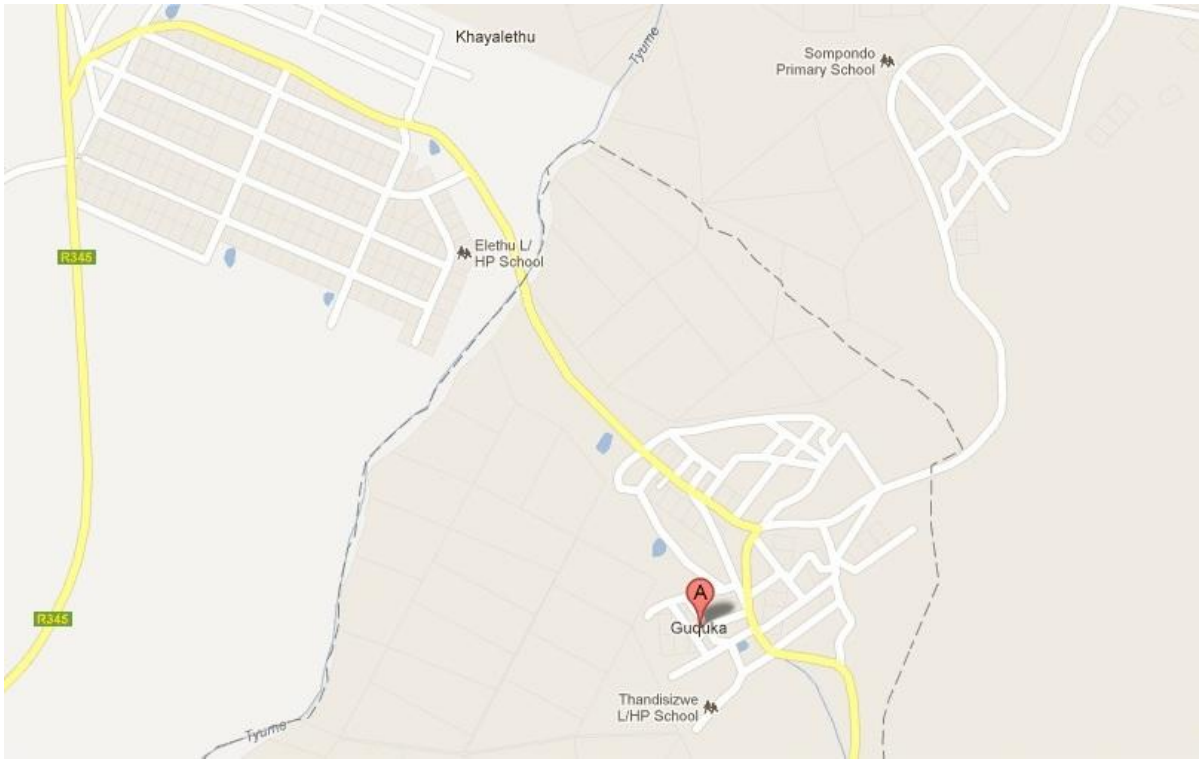
2.1.1 Map of Guquka and surrounding areas



2.1.2 Map of Guquka showing the fields along Tyhume River which are earmarked for irrigation



2.1.3 Tyhume River passing through Guquka and Khayalethu villages will be used for irrigation purposes in Guquka



2.1.4: Tyhume River that will be used for irrigation purposes in Guquka