Identifying appropriate paths for establishing sustainable irrigated crop based farming business on smallholder irrigation schemes: a case of Ncora irrigation scheme.

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A Dissertation Submitted in Fulfilment of the Requirement for the Degree of Master of Science in Agriculture (Agricultural Economics)

By

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DECLARATION

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DEDICATION

“The work is dedicated to the Glory of God, the spirit of my late parents NO-ANDILE MBIZANA and SIPHIWE MBIZANA”.

ABSTRACT

The study examined the impact of small scale irrigation technology in crop production under Ncora areas of Cofimvaba. To achieve the objective of the study, data were collected from 212 farmers engaged in various crop enterprises under the Ncora. The farmers were randomly selected. Descriptive Statistics, DEA model, linear regression model and gross margin analysis were used to analyse the results obtained from the survey. The descriptive results showed that Ncora farmers are small-scale farmers cultivating small hectare of land and using simple farm tools, mainly using furrow irrigation. Furthermore, they produce more than one crop enterprises. The gross margin Analysis shows that Ncora cultivation is profitable. The most profitable crop was found to be maize than potatoes. Farm production function revealed that land, labour and purchased inputs had a positive relationship with the output of the enterprises. SPSS was used to run data for linear regression model (OLS). It was suggested that extension services and private organizations assist farmers especially the emerging ones via provision of training, processing and storage facilities. Furthermore, continuous monitoring of soil and water quality as well as ground water table was recommended, in order to ensure sustainability of Ncora irrigation in the area.

Keywords: homestead food gardeners, smallholder irrigators, DEA approach, linear regression model, crop production, profitability, food security and employment

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Acronyms and abbreviations

CRS - Constant Returns to Scale

DEA - Data Envelopment Analysis

DMU - Decision Making Unit

IFAD- International Fund for Agricultural Development

IMT -Irrigation Management Transfer

GM - Gross Margin

HTFCDP- Horticultural and Traditional Food Crops Development Project

MFIs - Micro Finance Institutions

MoWI - Ministry of Water and Irrigation

NIB -National Irrigation Board

NGOs- Non Government Organisations

OLS -Ordinary Least Squares

WUA -Water User Association

SFA -Stochastic Frontier Analysis

SPSS- Statistical Package for Social Science

SSI -Small-Scale Irrigators

SIS -Smallholder Irrigation System

CHAPTER 1: INTRODUCTION

1.1 Background of the study

It is especially in the rural areas of South Africa that people live in vicious cycle of poverty that perpetuates underdevelopment. The country's former president Thabo Mbeki has observed in this connection that "the rural areas of the country represent the worst concentrations of poverty (Sishuta, 2005). No progress can be made towards life of human dignity for the people as a whole unless the researchers ensure the development of these areas (Pycoft, 2002). Clearly there is a need to fast track the development of the rural areas. The government faces massive backlog in promoting and stimulating sustainable rural livelihoods created first by apartheid and second by the lack of a clear-cut rural development policy. The most recognised province in South Africa to suffer from poverty has been Eastern Cape Province.

With approximately 60% of the total population of the Eastern Cape Province living in the rural areas of the former Transkei and Ciskei, improving agricultural productivity, especially small-scale farming, is a crucial but not a sufficient condition for the eradication of poverty (Vink and Kirsten, 2005).

But, with the world's population set to increase by 65% (3.7 billion) by 2050, the additional food required to feed future generations will put further enormous pressure on freshwater resources (Bembridge, 1999). This is because agriculture is the largest single user of fresh water, accounting for 75% of current human water use. At present 7% of the world's population live in areas where water is scarce (Crosby *et al,*2000). This is predicted to rise to a staggering 67% of the world's population by 2050. Because of this water scarcity and because new arable land is also limited, future increases in production will have to come mainly by growing more food on existing land and water. This paper looks at how this might be achieved by examining the efficiency with which water is used in agriculture.

Globally, in both irrigated and rain fed agriculture only about 10–30% of the available water (as rainfall, surface or groundwater) is used by plants as transpiration (Bembridge, 1999). In arid and semi-arid areas, where water is scarce and population growth is high, this figure is nearer 5% in rain fed crops (Niewoudt and

Groenewald, 2003). There is, therefore, great potential for improving water use efficiency in agriculture, particularly, in those areas where the need is greatest. This may be achieved by increasing the total amount of the water resource that is made available to plants for transpiration and/or by increasing the efficiency with which transpired water produces biomass. Thus, irrigated agriculture sector is facing increasing challenges in the face of rapid population growth, decreasing availability of land, and competition for scarce water resources. Due to decreasing investments and declining performance of many large scale irrigation schemes, interest has been developing in recent years for seeking ways to improve the productivity and livelihoods of the world's small-scale farmers – farmers who typically cultivate less than five hectares of land (Moris, 2008). Comprising the majority of the farmers in developing countries, small-scale farmers should be perceived as key players in increasing global agricultural production and achieving food security. Thus, improvement plans to overcome less productivity among farmers must be developed.

Since the late 1990's, provincial governments have set up rehabilitation and management transfer programs across the country (Eastern Cape Restructuring Authority, 2001; NP-DAE, 2000), although the approaches have been very diversified in each case. For provincial departments, the underlying idea is undoubtedly to curtail the heavy financial burden of SIS, as most of them are not contributing to the commercial agriculture stream. On the other hand, departments would like to promote the emergence of small-scale commercial farmers (which is also the motto of the National Department of Agriculture), as well as maintaining the community subsistence function of the schemes.

Then in 1994, the South African Government has undertaken massive reforms aiming to address rural poverty and inequalities inherited from the past apartheid regime. Amongst other programs, it has adopted an ambitious new water legislation that promotes equity, sustainability, representativity and efficiency through water management decentralization, new local and regional institutions, water users' registration and licensing, and the emergence of water rights' markets to improve food security (Perret, 2002).

On the other side Carvalho (2006) cited that agrochemicals were also introduced aiming at enhancing crop yields and protecting crops from pests. Due to adaptation and resistance developed by pests to chemicals, every year higher amounts and new chemical compounds are used to protect crops, causing undesired side effects and raising the costs of food production. Eventually, new techniques, including genetically modified organism (GMO) resistant to pests, could halt massive spread of agrochemicals in agriculture fields. Biological chemical-free agriculture is gaining also more and more support but still not able to respond to the need for producing massive amounts of food. The use of agrochemicals, including pesticides, remains a common practice especially in tropical regions and south countries (Zeller, 2004). According to Tripp (2002), cheap compound, such as DDT, HCH and lindane that are environmentally persistent, are today banned from agriculture use in developed countries, but remain popular in developing countries. As a consequence, persistent residues of these chemicals contaminated food and disperse in the environment. Coordinated efforts are needed to increase the production of food but with a view to enhanced food quality and safety as well as to controlling residues of persistent in the environment.

Most schemes were developed for social and food security purposes during the apartheid era, in the early 1960s. From the early 1980s, management agencies (corporations) were faced with such financial and social problems that they encouraged farmers to make cash profits, in order for them to pay back production costs and services. However, food security remained the major objective and crop production patterns remained the same along with weak market opportunities and poor agribusiness environment. At the same time, due to infrastructure degradation, consultants were hired to set up rehabilitation plans. Thus resulted to the introduction of more sophisticated technologies (pumps, sprinkler irrigation) in certain schemes and which require even higher capital, operation and maintenance costs.

The challenge of producing food for a rapidly increasing population in semi-arid agro-ecosystems in Southern Africa is daunting. More food necessarily means more consumptive use of so-called green water flow (vapour flow sustaining crop growth). Every increase in food production upstream in a watershed will impact on water user and using systems downstream. Intensifying agriculture has in the past often been carried out with negative side effects in terms of land and water degradation. Water legislation is increasingly incorporating the requirement to safeguard a water reserve to sustain in stream ecology.

The dominant water resources management challenge over the coming generations is how to secure water to cover food demands of a rapidly expanding world population. This applies especially to developing countries where 95% of the world's population growth occurs, and most particularly to sub-Saharan Africa, hosting the largest proportion of water scarcity-prone areas as well as the highest levels of malnutrition (Rockstrom et al., 2003). The preconditions to sustainable livelihood improvements are dynamic. The world is continuously experiencing social–ecological changes (van der Leeuw, 2000; McIntosh et al., 2000) that can alter the capacity of ecosystems to generate goods (including food) and services on which society depends (Daily, 1997). Furthermore, it is becoming increasingly clear that diverting more water for agriculture may have serious implications for other water users and water using activities and systems. As shown by Conway (1997) no less than a new Green–green revolution is required, which not only (at least) doubles food production particularly among resource poor rural societies hosted in ecologically vulnerable and degraded landscapes, but also achieves large production increases in agriculture without compromising essential ecological functions. Compared to the previous Green Revolution, which in the 1950s and 60s lifted large parts of Asia and Latin America from imminent risks of large scale food deficits, the challenges at present are even more daunting. Not only will food production have to increase as fast or faster than the first Green Revolution, now the production increase has to occur among poor farming communities often depending on unreliable crop water supply (generally rainfall in semi-arid and dry sub-humid savanna agro-ecosystems) (Falkenmark and Rockstrom, 2004).

In light of the enormous potential to successfully harness smallholder production, existing irrigation strategies need to be re-evaluated to include approaches that are effective in reaching smallholders as a potential market. When planning for irrigation expansion, small farmers need to be considered from the outset, rather than trying to figure out how to incorporate them when large systems begin to fail. One approach that should be considered is a *market-driven product development strategy* that has been successfully implemented in Asia since 1984 (Frausto, 2011). This strategy has resulted in over 1.3 million irrigation pumps purchased by farmers, with array of benefits and profits to smallholders, private sector entrepreneurs, and manufacturers (Jari, 2011). The process has also stimulated the identification of additional income-generating technologies and their demand among farmers. This paper will look at the evolution of the irrigation schemes to reaching small farmers (homestead food gardeners), the technologies that stimulate their effectiveness.

1.2 Problem statement

It is no longer thought tolerable that hundreds of thousands of South African peasants should die from drought-induced famines and loose on their farming businesses. However if the problem has been recognised adoption techniques and solutions can be stimulated, , material and organizational technologies which seem self-evidently suited for dealing with problem needs can also be identified (Sishuta, 2005). The answers seem to lie at hand, and what matters is simply to find the resources and will to act.

Rampokanyo (2012) stated that there is a concern about future agricultural water requirements, water availability under the combined effects of climate change, growing population demands, and competition from other economic sectors under future socio-economic development. Renewable water resources are being increasingly recognized as essential to the sustainability of human societies in coming decades, just as increasing numbers of people live in water-scarce conditions.

All too frequently the problem of improving food security in Africa is being addressed, both by the governments and agricultural research institutes by programs aimed at increasing the production of subsistence crops by food insecure small holder farmers (Gladwin *et al*, 2001).

With respect to agriculture, considerable research has investigated the impacts of socio-economic development, climate change, and variability on global crop production. Yet a much smaller body of work has investigated implications for irrigation water use, both regionally and globally. On one hand, most of such studies have focused solely on the local and regional aspects of irrigation water demand. On the other hand, global analyses to date have largely focused on water availability – for both agriculture and other sectors. Studies have specifically addressed future regional and global changes in irrigation water for agriculture (Fischer, 2006).

For smallholder farmers in rural areas, several factors promote more food insecurity, relative to the general population of older adults. Rural elders have lower incomes and poorer health than their urban and suburban counterparts (Glasgow, 1993; Van Nostrand, 1993). Costs for food purchase are often higher and selection more limited in rural areas (Crockett, Clancy,&Bowering, 1992). Formal assistance programs are more unevenly distributed in rural areas than in urban or suburban areas, and access to those that exist may be limited by distance and by lack of public transportation (Krout, 1994, 1998). Thus, It is worth noticing that the gradual shift in the underlying paradigm of Smallholder Irrigation Schemes in South Africa (i.e. from subsistence purposes to productivity, economic performance and financial autonomy), continues to lack clear institutional environment, the means to achieve the objectives, and actual people participation.

In Africa, irrigation projects have often enjoyed a privileged status among some policy-makers. They recognised solution for modernizing production, minimizing food imports, removing food deficits, and ameliorating the impact of drought. Therefore this explains why the farming enterprises need to continue to invest in modern irrigation despite its high costs and poor performance. In the light of these explanations it is clearer that irrigation schemes do mitigate the problem of drought in crop enterprises but it also has its shortcomings. Thus, this paper focuses on ways in which the shortcomings can be prevailed over in order to establish a sustainable crop enterprise and to increase food security. Smallholder farmers suffer from low incomes and living standards, poor nutrition, poor housing and health (FAO, 1997).

In the Eastern Cape and Kwazulu-Natal, most schemes are also facing major infrastructural and institutional problems, along with local political power games that have characterized those schemes from the outset, and that hinder effective problem solving.

Findings reveal that beneficiaries of irrigation schemes may face formidable challenges in terms of capacity (human and financial) if small-scale irrigation farming is to become a viable sector. No doubt, the viability and sustainability of the irrigation scheme projects demands a comprehensive package of interventions that address various issues of markets and marketing, capital investment and access to finance, technology, education and training, support and extension services.

Eastern cape is a rural province with its proportion of the population contributing to 13,5% of the nation's total population and it has the highest poverty levels in the whole of South Africa with the majority of the households living below the poverty line as cited by Statistics SA (2003). The factors underlying persistent poverty in the province are socio-demographic indicators that are strongly related to the incidence of poverty, official and broad unemployment, level of education and urbanization (ECSECC, 2009).A survey carried out by The General Household Survey (GHS) indicated that during 2008 food access problems were mostly serious in three provinces which are Free State where 33.5 % of the households have inadequate food access, Kwazulu- Natal with 23%, Eastern Cape 21, 4 %. The province also experienced an unemployment rate 28.9% which increased by 2% and therefore was rated to be one of the provinces with the highest unemployment rate between the first and second quarters of 2011 (Statistics SA, 2011). With evidence of food insecurity, high unemployment rate and poverty rate in the country particularly in the Eastern Cape Province there is great need and attention to be given to the research. Considering the findings by the FAO report (2004) which emphasised that agriculture is a key to food security in many parts of the world, poverty alleviation by reducing food prices, creating employment, improving farm income and increasing wages. Making agriculture work must be central component of policy approaches to food insecurity reduction and increasing economic growth. Increased investment in agriculture will help redress the current inequalities. Thus, knowledge about how that transition can be achieved is not available in the face of failures of several programmes to deliver the much needed livelihoods improvement since 1994. Therefore, obstacles such as scarcity of agricultural land, technological adoption, availability of agricultural inputs and inadequate use of irrigation schemes should be investigated and the best practices that need to be scaled up.

1.3 Objectives of the study

The overall objective of this paper is to examine the pathways for establishing sustainable farming businesses with crop enterprises to increase food security on smallholder irrigation schemes. In order to achieve this broad objective, the study attempted to address the following specific objectives:

- To understand farming system in existence in the project area with regard to use of irrigation schemes
- To identify the alternative pathways for successful farm operation
- To make recommendations on policies

1.4 Hypotheses

- The behaviour of smallholder farmers is diverse and is reflected in the way in which they view farming and engage in agricultural practices.
- Smallholder irrigation farmers are feeling the full impact of the withdrawal of government assistance from the irrigation schemes, which have deteriorated to a state of partial collapse.
- There is a positive relationship between water use efficiency and quantity produced
- Irrigation farming in communal areas enhances household food security and profitability.

1.5 Justification of the study

Promoting agriculture remains the core economic activity of the Intsika Yethu Municipality's mandate in its strategy to alleviate poverty so the study is going to come up with recommendations that are going to promote agriculture in the district. Economically profitable and sustainable livelihood sources for rural households which are able to reduce poverty and the pressure on the available resources need to be identified (the study is going to identify them).

A good understanding of the irrigation schemes such as Ncora and Qamata irrigation schemes will be discussed and their efficiency in establishing a sustainable crop business. This will be done by comparing the homestead food gardeners to those who are part of the irrigation scheme (smallholder irrigators).

1.6 Delineation and limitations

The case study has been limited to one of the 9 provinces in South Africa, Eastern Cape specifically in Cofimvaba town (Ncora village). The study only focused on smallholder irrigation farmers who have benefited from the irrigation schemes and homestead food gardeners. An irrigation participant is defined as a farmer who is developing land for irrigation or in the process of installing irrigation equipment on their plot. Irrigation rehabilitation and development refers to any activity that seeks to make an irrigation system functional, either through rehabilitating or new irrigation infrastructure development.

1.7 Outline of the study

The study is comprised in five chapters. The second chapter presents the literature review of the study with respect to smallholder irrigators and factors affecting it. The third chapter gives an overview of the study area, including its location, the main agricultural activities and the methodology. The chapter explains the sampling procedure, data collection procedure and the variables considered. It further clarifies the method of data analysis, pointing out the reasons for choosing such analytical methods. Chapter four present the research results, where it gives descriptive results and the model results. Finally, chapter five presents the summary and recommendations.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

This chapter reviews various aspect of smallholder irrigation schemes in South Africa covering issues such as the theoretical background of the study, South African agricultural production and productivity, land reform and irrigation in South Africa, national water act policies and water use for irrigation, climatic conditions in South Africa, historical approaches on smallholder irrigation scheme, definition of key terms in the South African context, management and production issues in smallholder irrigation and constraints on smallholder agriculture.

2.2 Terminology

(a) smallholder irrigation

Smallholder irrigation involves the diversion of water from one area into a relatively small area for the purpose of supplementing available water for crops (FAO, 2001). The techniques of diverting the water include use of gravity through canals or pipes and lifting water through the use of pumps for application in the fields through various irrigation methods (FAO, 2001) with the objective of increasing crop production.

Smallholder irrigators in South Africa have been categorised into four groups (Crosby *et al.,* 2000; Du Plessis et al., 2002; van Averbeke, 2008), explicitly farmers on irrigation schemes; Independent irrigation farmers; community gardeners; and home gardeners. According to Backeberg (2006), there are 200 000 to 250 000 smallholder irrigators contained in these four groups. In the search for a definition of a smallholder farmer within the South African context, the point of departure is that smallholder farmers are black farmers most of whom reside in the former homelands.

(b) Difference between small-scale, smallholder and subsistence

In South African context the colloquial meaning small-scale farmer is the producer who is black and distinct from the large scale commercial sector (Lahiff, 2004).They can also be defined as black farmers most of whom inhabit in the former homelands. Smallholder recognises a characteristic of small farm size and a partially developed link to the larger economic system. Smallholder farmers are usually affected by prices, subsidies and markets, but the input and output markets, which are not fully formed, remain localised to some extent. This distinguishes smallholders from commercial enterprises, both large scale and family farms, which have access to fully formed external markets (Ellis, 1998). Subsistence farming in agriculture is the growth of crops predominantly for self consumption. Farmers focus on growing food and keeping animals to feed their families rather than growing crops for sale. This kind of farming reduces the cost and expenses of a household. Thus, it is basically farming that provides for the basic needs of the farmer without surpluses for marketing.

(c) Production efficiency

Is the ability of farmers to produce an output at minimum cost and achieve the combination of outputs that produces maximum profit (Bembridge, 2000).

(d) Difference between allocative efficiency and technical efficiency

Refers to the realization of the maximum profit with fixed resources under different combination of inputs and outputs whereas technical efficiency means that the farmer produces the maximum output possible from a fixed input and technology mix.

2.3 Theoretical background

The neoclassical economists had earlier indicated that technical change and institutional reform were exogenous to the system. However, the development of the induced innovation model by Ruttan and Hayami (1984) established a firm basis for considering technical change as endogenous to the system because internal pressures exerted from the constraints imposed on the system by changing resource endowments are the major factors driving change. The induced innovation model has informed the development and use of new technologies like irrigation technology to bring about rapid improvements in agricultural development.

Due to its ability to increase agricultural productivity, there is strong evidence that inadequate supply of water leads households to shift from traditional self-sufficiency goals to profit/income-oriented decision-making and resource allocation where farm output becomes more responsive to market trends (Chirwa & Matita, 2011). According to the econometric study carried out by Dillon (2011), irrigation technology causes a shift of cropping patterns in favour of high value cash crops, culminating in increased value of crop production, greater investment in farm equipment and durable assets, with overall positive impact on socioeconomic status of smallholders. The positive impact can be observed through improved household incomes, nutrition and health. Therefore increased adoption of irrigation technology reduces poverty and inequality. Irrigation also increases physical output and the value of 43 productions through intensification of cropping and innovation in crop choice (IPTRID, 1999).

Furthermore, the introduction of irrigation most commonly improves the overall level of quality and leads to less variation in quality between producers and from year to year (Riddell, Westlake & Burke, 2006). According to Riddell, Westlake and Burke (2006), the concentration of inputs around irrigated production offers means to service specific export-market demand. Hanji (2006) asserts that with the common belief on the important role of irrigation in agricultural growth, many developing Asian countries have promoted irrigation development over the last five decades to achieve such broad objectives as economic growth, rural and agricultural development. In addition, irrigation boosts total farm output hence, with unchanged prices, raises farm incomes. Achieving such non-inflationary growth in output is particularly attractive in an era of dwindling real incomes as a result of general increases in prices that have ignited intense protests some of which have turned deadly as was witnessed in the North-West Province of South Africa (SABC, 2012).

2.4 South African agricultural production and productivity

Agriculture can make a major contribution to overall development because most of the resources are available at relatively low opportunity cost (World Bank, 2008). Therefore, the major task of agriculture in development was recognized as being the mobilization of resources and increasing efficiency in production. An increased production is needed because any increase in the population and per capita income leads to an increased demand in food of a better quality. A FAO report (2004) accentuated that agriculture is a proper response to food security in many parts of the world and it indicates that agriculture contributes to poverty alleviation by reducing food prices, creating employment, improving farm income and increasing wages. Even establishment of a non-agricultural sector requires a high input of resources, which mostly comes from agriculture.

Thus agricultural productivity is therefore one of the key determinants of high and sustained agricultural growth, and in fact a key determinant of its growth over the longer term, Faster agricultural growth has put countries on the path of a much broader transformation process: rising farm incomes raising demand for industrial goods; lowering food prices, curbing inflation and inducing non-farm growth, and creating an additional demand for workers. Rising on-farm productivity also encourages broad entrepreneurial activities through diversification into new products, the growth of rural service sectors, the birth of agro-processing industries, and the exploration of new export market (Harvey, 2006; World Bank, 2008). Gollin, Parente and Rogerson (2002) further stated that rising agricultural productivity releases farmers for other activities, leading to structural transformation needed for Africa's income to catch up with more advanced economies.

The government in all its recent policy statements and strategies identified irrigation as a key element for the intensification and expansion of agricultural production, for achieving national food security and for increasing the country's market share on the international markets.

The overall responsibilities for irrigation with all its facets lie with the MoWI (Ministry of Water and Irrigation) whose activities are governed by the Water Act 2002 (Agricultural Information Resource Centre, 2006). The operations of the National Irrigation Board (NIB) and its activities in the large-scale schemes of the country are being governed by a specific act. The area under the jurisdiction of the NIB currently accounts for less than 10% of the irrigated land in the country. An irrigation policy is presently under preparation by the government. The adoption and implementation of the irrigation policy is expected to lead to 'improved performance in the agricultural sector arising from expansion of the irrigation and drainage subsector leading to improvement of food self-sufficiency, generation of incomes, creation of employment opportunities and improvement of the socio-economic status of the rural population with pronounced impact on poverty alleviation. Thus, the government attaches high importance to the realisation of these strategic goals. It is therefore of paramount importance that the government finalizes the regulatory framework (irrigation policy) for guiding irrigation development in the country.

Hence, this chapter will stipulate based on ways in which the problem identified above can be addressed or overcome. The conceptual framework drawn below explains the interaction of the factors discussed above.

The diagram below illustrates the conceptual framework that is going to be discussed later on this chapter.

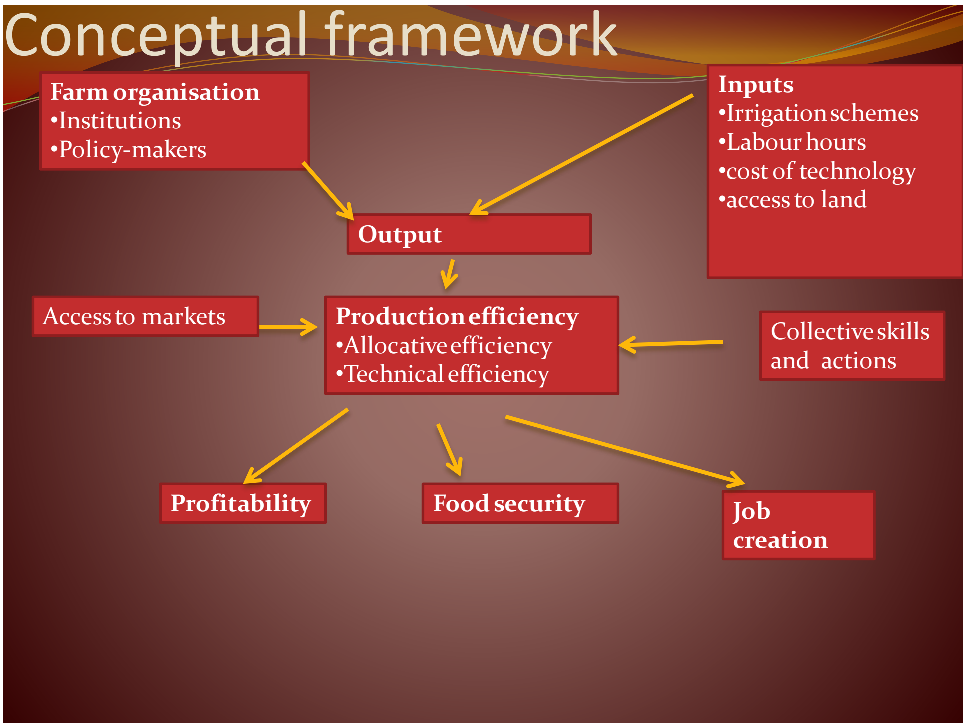

Figure 2.1 Conceptual framework

This stipulates that if there could be interaction between the farm organisations, inputs (irrigation schemes, labour hours, cost of technology and access to land) this could result to more outputs being produced. This therefore leads to appropriate alternatives which can further improve the smallholder irrigation farmers.

Evidence exists in the literature that the application of improved technology is one sure way to lift people quickly out of poverty and restore livelihoods to acceptable levels. One of the improved technologies particularly relevant for semi-arid settings such as South Africa is irrigation and several authors have confirmed its efficacy.

Furthermore evidence of sup-optimal use predominates and there are issues of poor skills to use available technologies as well as access constraints due to physical, economic and institutional challenges. Thus, the existence of the technology does not guarantee that local people can access them or use them to improve production and productivity. The existing models for investigating these issues have drawn largely from the neo-classical traditions and rational choice models which have proved inadequate in explaining the large number of imponderables. Work done by several development organizations, including ICRA, suggest that more holistic approaches are needed to gain deeper understanding of the problems that people face in rural areas in their struggle to utilize knowledge developed by research and transform these into innovations that can help change their situations for the better (Bembridge, 2000). The notions of bounded rationality as promoted by the New Institutional Economists allow for more flexible modelling of the circumstances of the small farmers to reveal the constraints they face and the opportunities on offer. When traditional approaches of technical and allocative efficiencies are used within those frameworks, there are better chances of coming up with more policy relevant conclusions that contribute to sustainable improvements in rural livelihoods. Below therefore ways to improve farmers' efficiencies will be articulated;

2.5 Land reform in South Africa

A key issue in debates on agrarian reform in South Africa is the potential for small-scale farming, in conjuction with redistributive land reform, to make a significant contribution to employment creation and poverty reduction. Obi (2006) stated that the exclusion of a large segment of the population from meaningful economic participation was preventing the emergence of entrepreneurship in the small scale sector and within the rural economy. The development of such entrepreneurship would go a long way in addressing employment creation and stimulation of the rural economy.

2.6 Smallholder irrigation schemes in South Africa

The agricultural potential of most land in South Africa is limited, with over 60 per cent of the country receiving less than 500mm of rain per annum on average, and with only 10 per cent receiving more than 750mm (World Bank, 1994). Rainfall is unreliable, droughts are common and crop production in most of the country is inherently risky, making irrigation important for a range of field and tree crops. About 1.3 million hectares, or under 10 per cent of all arable land, is under irrigation at present (van Koppen *et al*, 2009). In the past, the distribution of irrigation water was inequitable as the distribution of land, with white commercial farmers holding rights to over 90per cent of the water supply, supported by massive state investment in irrigation infrastructure. Around 7.7 per cent of irrigated land,or 100,000 hectares, is used by smallholder farmers, mostly in the former Bantustans (Van Averbeke and Khosa, 2011). Around half of this consists of small home gardens, and the other half is located on smallholder irrigation schemes, of which there are 317 in total (Denison and Manona, 2007). Further, he estimated that there are about 33,000 plot holders on these schemes, each cultivating an average of around 1, 5 hectares.

2.7 Constraints on smallholder irrigation schemes in South Africa

Performance of smallholder irrigation around the world has been reported to be below expectations (Svendsen *et al.,* 2009). Ownership and responsibilities were transferred from governments to farmers (Garces-Restrepo *et al*., 2007) in a bid to enhance resource-use. But several factors, among them were dysfunctional infrastructure and lack managerial know-how among the farmers, have been reported to influence performance at scheme level (Bembridge, 2000). Different authors and international organisations developed various performance indicators (Rao, 1993), which could be used for identification of malfunctioning components of different schemes. The performance indicators relate to the various disciplines of irrigation performance – technical, socio-economic and institutional set up. The technical performance indicators relate mainly to water conveyance, delivery and use and they include delivery performance ratio, discharge capacity of ratio, output per unit irrigation supply, and output per unit water consumed by crop, among others.

2.7.1 Capital formation

Farm capital formation is expected to affect the productivity of land and labour—the technical efficiency of the farm. Increasing farm capital should also make farm labour and land allocation more flexible and responsive to changes in incentives and diverse land conditions (Savadogo et al., 1995). Hence, one could expect farm capital formation to increase allocative efficiency as well.

These changes in farm productivity in general translate into changes in farm household incomes, asset holdings, and food security. Thus, there are hypothetical links between agricultural commercialization and income diversification (manifested in cash cropping and non-farm activity), farm productivity, and household income and wealth. Cotton and maize require more fertilizer and manure than millet and sorghum, and cotton production responds better to, and for certain operations relies on, animal traction (Matlon, 1990).

The influence of cash cropping and non-farm activity on farm capital formation would differ over zones—as a function of agro climate, of access to infrastructure, and of input credit arrangements. It would also differ over households according to individual incentives and capacity.

2.7.2 Land tenure, access rights and land management

The uncertainties regarding land tenure and the inadequate access to land have been a critical challenge to smallholder farming in South Africa. These problems can be examined from different perspectives. The constraints related to the tenure system, such as insecurity of land tenure, unequal access to land, lack of a mechanism to transfer rights and consolidate plots, have resulted in under-developed agriculture, high landlessness, food insecurity, and degraded natural resource (Salami *et al,* 2010). Furthermore, the available land in South Africa is overly subdivided into small and uneconomic units, resulting generally in fragmented production systems and low productivity. Specifically, households in the highest per capita land quartile in East and Southern Africa control 5 to 15 times more lands than households in the lowest quartile. In Kenya, for example, mean farm sizes for the top and bottom land quartiles were 6.69 and 0.58 hectares, respectively, including rented land (Jayne et al., 2006). The land ownership issues go well beyond small sizes of plots. In practice, traditional land tenure arrangements prevail as an outcome of subsistence agriculture, with peasant associations responsible for allocating land to residents (Kamara, *et al* 2004). According to Kebede (2002), privatization of land would seem to be the most effective way to reduce insecurity associated with the tenure schemes and uncertainties created by state ownership. Equally important, in terms of access to additional land, is proper management of the existing one.

2.7.3 Financing agriculture and access to credit

For investment, smallholder farmers in most of the developing countries depend on savings from their low incomes**,** which limits opportunities for expansion. Seminal work showed that half of total rural household income came from farming, 46.6 per cent from nonfarm employment (wages and self-employment) and less than 4 percent from remittances (Salami *et al,* 2010). Because of the lack of collateral and/or credit history, most farmers are bypassed not only by commercial and national development banks, but also by formal micro-credit institutions. In addition to own sources, farmers thus rely on incomes of friends and relatives, remittances, and informal money lenders. In all countries studied, the share of commercial banks' loans to agriculture has been very low compared to manufacturing, trade, and other services sectors, hampering expansion and technology adoption (Anríquez & Stamoulis, 2007). The lack of capital and access to affordable credit is cited by smallholders as the main factor behind the low productivity in agriculture. Access to formal credit in South Africa is mainly confined to large urban centres, where collateral requirements are available. While more recently micro-finance institutions have taken financial services to millions of previously un-bankable clients due to innovative instruments, they have so far largely failed to reach poorer rural areas and/or smallholder agricultural producers whose livelihoods are characterized by highly seasonal investments, risks, and returns (Peacock *et. al.,* 2004).

2.7.4 Access to input and output markets

Improved access to input and output markets is a key precondition for the transformation of the agricultural sector from subsistence to commercial production. Smallholder farmers must be able to benefit more from efficient markets and local-level value-addition, and be more exposed to competition. The studied East African countries are still grappling with marketing of both agricultural inputs and outputs, with markets not adequately equipped to serve the needs of the poor. According to the 2005/2006 household survey conducted in South Africa, 30 percent of communities surveyed did not have access to roads that were passable even in the dry season and two-thirds of communities lacked any bus or taxi connections (Ariga et al, 2006). In most East African countries, more than half the population lives five hours or more from a market center. *On the input side*, the average application rates of fertilizer for arable crops in four countries are estimated to be 30 kg/ha/year in Kenya, 14 kg/ha/year in Ethiopia, 5kg/ha/year in Tanzania and1 kg/ha/year in Uganda – far less than the world average of 100kg/ha/year (Smaling et al, 2006 and Ariga et al, 2006). There is also the problem of high cost and waste of key inputs such as seed and fertilizers. For this reason, farmers have substantially reduced use of quality inputs such as seed, fertilizer, and pesticides. *On the output side*, since the majority of smallholder farmers in the country are in subsistence production, marketing is underdeveloped and inefficient. Adequate storage facilities constitute another constraint to both marketing and food security: In Africa, large quantities of agricultural commodities produced by farmers tend to rot away unmarketed, while the smallholder farmers do not have the technology for timely consumption (Kamara, *et al*, 2002). An additional key constraint on the output side to raising productivity of smallholder farmers in Africa has been the inability of most them to get linked into the supermarket chains. Che *et al* (2006) noted that the main barrier is that they cannot meet the high quality and safety demands as well as delivery schedules that international value chains require, preventing them to compete in such markets.

2.7.5 Infrastructure

Poor infrastructure continues to impede agricultural activities in Africa (Ellis & Bahiigwa, 2003). The key challenges are inadequate and poor conditions of the market facilities and transportation systems, including road and rail. Infrastructural investments that have been done are often ineffective as a result of poor design and poor maintenance, sometime due to stop-go practices of donors funding these investments (Key & Runsten, 1999). The road system, which is the most important for market development in terms of distribution of inputs and output to and from farms, is the most serious infrastructural bottleneck facing agricultural development. As a result of poor road network, smallholder farmers depend on inefficient forms of transportation including use of animals. In addition, irrigation facilities are poor as less than 4 percent of all agricultural output is produced under irrigation in South Africa, compared with about 33 percent in Asia (AfDB/IFAD, 2009). In sub-Saharan Africa, including East African countries, average post-harvest losses are estimated to amount to over 40 percent, and even up to 70 percent in some fruits and vegetables) – (UNIDO, 2007). In South Africa especially in the rural areas of the Eastern Cape underdeveloped rural roads and other key physical infrastructure have led to high transport costs for agricultural products to the market as well as of farm inputs, reducing farmers' competitiveness. In addition, electricity in rural areas is expensive and often not available; which has reduced investment including in cold storage facilities, irrigation, and processing of farm produce. Lack of storage and processing facilities constrains marketability of perishable goods such as fish, dairy products, and vegetables (Kitinoja & Kader, 2002).

2.8 Strategies to mitigate the shortcomings of smallholder irrigation schemes

2.8.1 Investment opportunities

Tatnell (2009) suggested some of the ways which on-farm irrigation efficiency can be improved include:

- adopting technology that better matches irrigation water application to plant water requirements;
- reconfiguring irrigation layouts;
- installing infrastructure, such as recycling systems and piping, to improve on-farm storages and delivery systems; and
- Installing new infrastructure, such as drip or spray systems, to improve in-field applications systems.

2.8.2 Water resource use

Due to climate change that has resulted in frequent droughts and erratic rainfall, irrigation farming is increasingly becoming the cornerstone to ensure global food security. Water usage varies between crops and between the different stages of growth of a particular crop. Thus crop co-efficients for evapo-transpiration vary between crops and also according to the stage of growth of the crop (Sharma, 2006). One of the modern techniques developed to estimate water usage in agriculture involves the use of the CROPWAT model. This is a decision support system developed by the Land and Water Development Division of FAO for planning and management of irrigation (Marica, 2006). It assists with drawing up national water budgets and forecasting future requirements.

CROPWAT is a practical tool to carry out standard calculations for referencing evapo-transpiration, crop water requirements and crop irrigation requirements, and more specifically the design and management of irrigation schemes (Marica, 2006). It allows the development of recommendations for improved irrigation practices, the planning of irrigation schedules under varying water supply conditions, and the assessment of production under rain fed conditions or deficit irrigation (Marica, 2006).

Crop water productivity is the amount of water required per unit of yield and a vital parameter to assess the performance of irrigated agriculture (Sharma, 2006). It will vary greatly according to the specific conditions under which the crop is grown (Fao, 2007). The productivity of water used in agriculture increased by at least 100% between 1961 and 2001, with a corresponding increase in crop yields (Sharma, 2006). Improving water productivity requires, first, an increase in crop yields or values (i.e. the marketable yield of the crop for each unit of water transpired). Also necessary are a reduction of all outflows or "losses" (e.g. drainage, seepage and percolation) except crop transpiration, and more effective use of rainfall, stored water, and water of marginal quality (Dhar *et al*., 2001).

Achieving higher water productivity requires changes in crop, soil and water management and strategies including selection of appropriate crops and cultivars, use of improved planting and cultivation practices (e.g. minimum tillage), synchronisation of water applications with the most sensitive growing periods, and improved drainage for water table control (Sharma, 2006). Techniques and practices that reduce water evaporation (e.g. mulching) will also improve water productivity, while improved nutrient management will increase yields at a greater rate than it increases evapo-transpiration (FAO, 2003).

2.8.3 National water act

During the apartheid era most land was allocated to white minority this changed in 1994 after the abolishment of apartheid, the mission of the State changed radically from serving mainly the well-organized white minority, to serving an entire nation of over 40 million citizens (Van Koppen, 2008). After such a radical change from apartheids influence and past inequities an amendment or change in the water management, water laws was required and new water policy and legislation was written down also as to balance water use by both white and black farmers (De Lange, 2004). National Water Act is one of the acts which was passed in the year 1999 as a means of regulating water resources management, protect the quality of water resources and aims at the integrated management of the water resources (Pollard *et al.*, 1998).It deals with water in rivers, lakes and groundwater and acknowledges that water is a natural resource that belongs to all people and that the national government and the Minister of Water Affairs and Forestry, acts as a public trustee for the people (NWA, 1998). The state is responsible for enforcing the public interest in its water sources and water is a social (equity) and economic (productivity) good (Butterworth *et al.*, 2001). A water use right describes the different water use rights that are determined by the NWA. At rural community and smallholding farming levels, all farmers are approved to utilise water for domestic use, gardens and stock watering without registration, licensing or payment. The Act however also stipulates that farmers and rural communities should form Water Uses Association (WUAs), especially in smallholding irrigation schemes. They must apply for a license, which will determine their collective rights to the water resource and their obligations. It may also concern the community as a whole when a WUA is to manage water beyond irrigation purposes.

However, to date, the implementation of this legislation has been slow and problematic (Funke *et al*., 2007). The problems that have arisen are caused by high staff turnover and lack of institutional capacity in numerous government departments, this result in the government departments being overburdened (Hattingh *et al.*, 2004, Funke and Nienaber,). There tend to be a disconnect between water supply and water resource management and (Pollard and Du Toit, 2005); the inability of many municipalities to treat domestic sewage and industrial effluent to enable this to be safely discharged into rivers and streams (Ashton, 2010); a serious backlog in setting up South Africa's Catchment Management Agencies (Hattingh *et al*. 2004).

2.8.4 Irrigation management transfer

The fight to greatly reduce food insecurity and poverty continues at the forefront of mankind's priorities. Irrigated agriculture is to play an important role in achieving this goal by securing innovative approaches that lead to higher productivity per unit of water, unit of labour, unit of investment or combinations thereof. This can only be accomplished through appropriate reaction and adjustments to emerging worldwide political and development realities concerning the sustainability and increasing competition for the water resource (Maritz, P.J.,n.d) . Irrigation Management Transfer is one of the most important reforms within the irrigation sub-sector. It is the process of devolvement of authority and responsibility from government agencies managing irrigation systems to farmers' organisations and has been utilized as a tool for irrigation sector reform in more than 60 countries (FAO, 2006). Analysts have suggested that irrigation management transfer (IMT) works provided certain preconditions are met, namely; supportive legal policy framework, secure water rights, local management capacity building, and an enabling process to facilitate management transfer (Tushaar *et al,* 2000). Although this is unlikely to work in the African smallholder context it further suggests that institutional alternatives most likely to work in this context are those that are successfully deal with the entire complex of constraints facing African smallholders and help them move to a substantially higher trajectory of productivity and income from where they can absorb the additional cost and responsibility of managing their irrigation systems. In developing such institutional alternatives, rather than focusing only on direct transfer of irrigation management, African governments need to begin by enhancing the wealth-creating potential of smallholder irrigated farming by strengthening market access, promoting high value crops and improving systems for providing extension and technical support to smallholder irrigators (Morris, Bellinger,&Haas, 1990).

2.8.5 **Water rights**

The creation of the Union of South Africa in 1910 paved the way for the first nationally applicable water legislation- The 1910 Irrigation Conservation of Water Act (Bembridge, 1999). The riparian principle was the central feature of water law and State involvement in water resource management was limited to irrigation related works. Post World War II industrial development in South Africa required water legislation to be adjusted, giving birth to the 1956 Water Act. The act consolidated control, conservation and use of water for domestic, agriculture, urban and industrial purposes and perpetuated the riparian principle in terms of “normal” flow and “private” water, which granted exclusive use but not ownership (Hamann & O’Riordan, 2000). In practice, the system of riparian rights resulted in commercial white land-owning farmers having essentially unconstrained access to water, due partly to a tenuous distinction between private and public water and streams (Hamann & O’Riordan, 2000). Furthermore, much of South Africa’s past water legislation had been largely oriented towards irrigated commercial agriculture (Gildenhuys, 1998). Despite certain legal restrictions, the riparian owner could in effect do and take as much as he/she needed. In commercial agriculture areas, the irrigation boards that administrated the allocation of water were generally heavily biased towards the needs of farmers. In theory, rural black communities and SIS could benefit from the same conditions. However, the lack of proper infrastructure, of property rights regarding resources, and the subsistence nature of their productive activities strongly limited the potential for improvement and intensification. Most black populations were not only deprived of access to water and land for irrigation purposes but also of adequate and clean water for domestic use (Magadlela,1997).

2.8.6 Use of high agricultural potential inputs

The bulk of treadle pumps are being used in areas with high agricultural potential characterized by fertile soils and comparatively high rainfall, where crops require mainly supplementary irrigation. The extent of available water resources lead to a high concentration of farmers in a given area. This proofed very attractive to produce traders, because they can buy the required produce in a cost saving manner in a geographically confined area. Large suppliers maintaining their own extension staff and buying centres in a production zone can operate more efficiently and with less overhead costs.;

2.8.7 Commercially oriented smallholders

Most farmers in South Africa are already used to cultivate major cash crops such as tea and coffee and have know-how in yield increasing production techniques. These ‘anchor’ crops have specific (monopolistic) marketing channels through their respective cooperative societies who buy the crops from farmers, and provide inputs in advance (AFRACA, 2006). The technical competence of the farmers to produce quality products is a valuable asset for further crop diversification and intensification and especially when entering the very competitive horticultural market.

2.8.8 Access to individual loans

It is a big advantage that commodity-based financial cooperatives extend loans to their individual members to address other financial and investment needs. Crop producers are small entrepreneurs who need various loan products (especially seasonal loans but also term finance) tailored to their individual business plans which can complement their own resources (Grimm & Richter, 2000).

2.8.9 Availability of affordable and suitable ssi technologies and related equipment

The equipment is adapted for different local conditions and more affordable than imported equipment. Further strengths of these low-cost technologies are that they are owned by individual farmers, can be easily operated, maintained and repaired and can be used to irrigate from a variety of water sources.

2.9 Social factors

2.9.1. Age

The ability to adapt new technologies for use on the farm clearly influences the adoption decision. Most adoption studies attempt to measure this trait through operator age, formal education, or years of farming experience (Fernandez-Cornejo *et al*., 1994). More years of education and or experience is often hypothesized to increase the probability of adoption whereas increasing age reduces the probability. Factors inherent in the aging process or the lowered likelihood of payoff from a shortened planning horizon over which expected benefits can accrue would be deterrents of adoption (Barry *et al*., 1995; Batte & Johnson, 1993). Younger farmers tend to have more education and are often hypothesized to be more willing to innovate.

In addition, young farmers tend to be resource-poor with a 75% non-adoption rate overall and none adopted in the first season. Thirtle *et al*. (2003) conclude that older groups have a much higher percentage of adopters suggesting that the more established farmers were regarded as better credit risk by financial institutions. Normally age and experience are positively correlated and the survey reported that a lower proportion of the least experienced farmers were under irrigation scheme.

2.9.2. Household income

The empirical evidence shows that crops grown under irrigation scheme in particular can have significant income-increasing and poverty-reducing effects. Farmers in developing countries sometimes benefit more than farmers in developed countries, which is partly a result of weaker intellectual property rights protection and, thus, lower seed prices (Qaim, 2009). This all implies that higher household incomes will be realised.

2.9.3. Landholding

The most common asset in rural areas is landholding and this is a good indicator of poverty when income is unobserved (Ravallion, 1989). Households with small farms are prone to food insecurity. In addition, land quality has been found to provide a good amount of yield in communal farms. In most communal areas, farms are of relatively poor quality and require the use of chemical fertilizer (Rutsch, 2003).

2.10. Agronomic factors

2.10.1. Plant biodiversity

The biodiversity of maize is changing due to a number of enabling factors, the most prominent being the availability of genetically modified maize hybrids and their improved qualities which make it a product of choice by the commercial farmer (Haasbroek, 2004). Humans select and propagate plant species with favourable mutations. It is through such processes that a profound effect is being exerted on the genetic landscape. Biodiversity in agro-ecosystems, which reflects not only species richness, but also the diversity of their interactions, is continuously declining due to changes in agricultural practices coupled by plant breeding efforts. Both of which focus on providing high yields demanded by the expanding populations (Lemaux, 2009). These negative effects on biodiversity, sometimes termed genetic erosion, also led to loss of weed species, killing of non-target pests, and destruction of natural habitats for insects and wild animals.

2.10.2. Incidence of pests

The degree of pest infestation is an important factor in the economic viability of pest control strategies (Scatasta, Wesseler & Demont, 2005). Conventional pest control strategies are difficult to manage because a correct timing of insecticide applications is crucial to their effectiveness. Insecticides are effective only when maize stalk borer is in the larval status and before it penetrates the stalk or migrated to neighbouring plants (Demont & Tollens, 2004).

Furthermore, the randomness of the pest infestation leads to varying yield effects over time and, thus, TGVs are also a very valuable source of financial insurance for farmers. The risk-reducing effect of TGVs may benefit mostly farmers who are more vulnerable and who have higher aversion to risk. These tend to be smaller farms and, since TGVs do not have economies of scale, they may hold much promise for the poorer farmers in low-income countries, unlike other modern technologies (Zilberman *et al*., 2007).

2.11. Institutional factors

This section focuses mostly on rural financing, input supply channels and lastly price and market liberalization which all encompass agrarian reform. Besides that, it is important to note that strengthening the tenure security of smallholder farmers can act as a catalyst towards achieving farm improvements and a more effective use of local land resources. The existing land tenure situation is a major impediment to investment and farm development; it needs to be reformed so that smallholder farmers can compete equally with their commercial counterparts for additional resources.

Problems of financing range from a lack of adequate financing for medium and operational purposes, to exceedingly high interest rates where financing is available. Considerable efforts have been made to make financing available to the smallholder sector, mainly through state enterprises. However, very limited security is available for loans to smallholders. The credit granted by state enterprises has been almost entirely on a short-term basis for the purchase of seasonal inputs, with very little being made available for medium and long-term productive investment. This means that no meaningful development has taken place in terms of land improvement and other capital projects required in order to increase productivity.

2.11.1. Rural finance

According to van Zyl *et al*. (2005) rural finance and its limitations are very closely linked to agricultural finance. Smallholder farmers need sustainable financial services the same way large-scale farmers need them. Van Zyl *et al*. (2005) go on further to note the following challenges that face both agricultural and rural finance in the South African context:

- Inappropriate macroeconomic policy, distortions caused by rigid financial policy and legal and regulatory limitations;

- Government policy that favours urban inhabitants

- A history of poor subsidised interventions in rural areas that resulted in a lack of incentives for the development of rural financial markets,

- Rural agricultural markets are characterised by features such as poverty, low population density, high covariant risk and limited opportunities for risk diversification. There are also fewer economic opportunities in rural areas compared to urban areas.

To contribute to sustainable poverty reduction through increasing outreach, MFls (micro finance institution) themselves must be viable, sustainable, and growing. Microfinance is business, not charity. This means: MFls must offer attractive interest rates or profit-sharing margins on savings with positive real returns (preventing the erosion of the value of savings) and mobilize their own resources; rural MFls must charge rural market rates of interest on loans (which are considerably above commercial prime rates of interest) and cover all their costs from the interest rate margin; MFls must make a profit and finance their expansion from their returns.

Governments, with the support of donors, should be encouraged to provide an adequate legal framework for the upgrading of informal to semiformal and semiformal to formal MFls; and for the establishment of networks and their apex organizations for guidance, training, consultancy services, self-regulation and supervision, liquidity exchange and refinancing (IFAD, 2001).

2.11.2. Price and market liberalization

Problems in marketing range from high input costs, low producer prices due to unfair grading by commodity buyers to push down prices, to limited processing capacity which would have added value and reduced transport costs of bulk raw materials. In the Eastern Cape Province the majority of smallholder farmers live in areas with poor road networks which render transport services not only unavailable, but also highly priced.

Widespread production and consumption of crops planted under irrigation could reduce micronutrient deficiencies, improve health outcomes, and provide economic benefits. Although there are many documented benefits on irrigated crops, it is uncertain whether they command higher market prices as the poor who supplement their food requirements may not possess the financial wherewithal to pay a quality premium (Qaim *et al*., 2009). Besides that, privatization of marketing boards in places like Zimbabwe, and the market liberalization occurring in most commodities, smallholder farmers have become vulnerable to traders preying on their weaknesses. These weaknesses include: inadequate pricing information, lack of storage facilities and reliable transportation, and the need to repay high interest bearing loans.

The situation puts big buyers in a position to dictate prices, as well as employ manipulative grading systems to their advantage. Farmers function as individuals and therefore they do not have bargaining power. It is logical to conclude that under the circumstances described above, poverty is certainly not being eradicated through agriculture. Since the majority of the population in the developing world, lives in rural areas and is directly dependent on agriculture for its livelihood, Africa is doomed to poverty unless long-term sustainable interventions can be developed.

2.11.3. Intellectual property rights

Mugo *et al*. (2005) note that, it is imperative to analyze the intellectual property rights (IPRs) that are involved before engaging in developing new technology. Intellectual property rights are designed to protect one‟s investment into intellectual property and the products that are derived from these advances so as to provide economic returns to research to stimulate additional investment in research and product development.

Companies usually increase the cost of using the technology as a way to cover both defending intellectual property claims and development costs.

With the use of irrigation schemes, developing countries have been obliged to adopt protection of plant varieties, by patents or by other means, without any serious consideration being given to whether such protection would be beneficial, both to producers and consumers, or its possible impact on food security. New technologies need to be controlled by guidelines or regulations so as to maximise benefits and minimise risks to humans and the environment (ITPGRFA, 2002).

Historically, systems for the protection of intellectual property were applied principally to mechanical inventions of one kind or another, or to artistic creations. The assignment of IPRs to living things is of relatively recent origin in developed countries (ITPGRFA, 2002). This section focuses on the practical and economic consequences of patenting in agriculture and how this affects the livelihoods of poor people and the implications for policy. One way to keep costs lower is to promote standards that are accepted not just in one country but in the entire region where growth of the crop is predicted.

2. 11.4 Public-private partnerships

Baiphethi and Jacobs (2009), highlight the importance of 35 research and development in bolstering subsistence agriculture. In Eastern Cape Province, substantial or improved investments and support into, extension, other agricultural services such as access to credit, markets and retooling of extension officers. For the developing world, the key would seem to be to find ways to make field trials responsible but as low in cost as possible; otherwise, no public-sector effort will be able to participate (Delmer, 2005).

Irrigation schemes can contribute significantly to food security and sustainable development in many geographic locations against the background of a gradually diminishing natural resource base and growing demand for agricultural products. This implies that new technologies are crucial for the necessary production increases. Overregulation has become a real threat for the further development and use of irrigation schemes. The costs of regulation in terms of foregone benefits may be large, especially for developing countries. This does not mean that zero regulation would be desirable, but the trade-offs associated with regulation should be considered. In the public arena, the risks of irrigation schemes seem to be overrated, while the benefits are underrated (Qaim, 2009).

2.12 Constraints facing irrigation development

Apart from being associated with household food security, irrigation schemes in the semi-arid areas have some problems associated with their development and management. The problems faced by smallholder irrigation schemes in communal area can be categorized as follows:

2.12.1 Environmental factors

On some irrigation schemes, it has been noted that poor water quality especially as related to sediment concentration has affected the amount of water that can be used for irrigation purposes. This means that farmers experience low crop production and farmers cannot grow crops throughout the whole year (FAO, 1997). Land degradation is also one of the important environmental factors which result from poor operation and management activities leading to siltation of some of these irrigation schemes. This is partly related to inefficient water management resulting in water wastage and water logging as well as land-use regulation (Rukuni, 1993).

2.12.2 Capacity of the farmers

The level of literacy in most circumstances has been a major constraint to communal irrigation schemes. Farmers lack know-how in and access to, the opportunities of irrigation technology (Pazvakawambwa and Van Der Zaag, 2000). The weak economic base of most farmers in communal areas and the relatively high development costs involved in developing irrigation schemes has resulted in some irrigation schemes performing poorly because of not being maintained properly (Makombe & Meinzen- Dick, 1993).

2.12.3 Government policy, institutional and legal support

There has been limited or no priority given to irrigation development during national, local planning and budgeting in sub-Saharan countries. This has led to some irrigation projects failing to sustain themselves. In communal areas of Eastern Cape in Cofimvaba there are poor management structures in place to support farmers and promote irrigation development (Hillel, 1989). For example, the infrastructure (roads, marketing facilities and storage facilities) in Eastern Cape's rural areas to facilitate agricultural development is underdeveloped. The land tenure system does not encourage farmers to invest in permanent improvements on their plots and make improvements which can be used to obtain credits for further development has also contributed to the failures of these irrigation schemes. Also, the issue of unclear water rights and their enforcement has had an impact on both crop production and sustainability (Makombe & Meinzen-Dick, 1993).

2.12.4 Economic and financial constraints

The availability of financial resources for the development of smallholder irrigation is a constraint in almost all the countries. Development costs for small-scale irrigable schemes are high in sub-Saharan countries. The Department of Rural Development and Agricultural Research and Extension (AREX) estimates that the present costs are extremely high per hectare for irrigation engineering works alone (FAO, 1997).

A study carried out in sub-Saharan Africa showed that rehabilitation of irrigation schemes is expensive (FAO, 1997 and Tafesse, 2003). Government schemes were found not to be functioning as efficiently as before, given the government's failure to fund operation and management costs. The cost of borrowing money from credit institutions is high and this makes it difficult for farmers to borrow and pay back the loans (FAO, 2001). Local NGOs and agri-business institutions, which promote certain export crops, for example, in Zambia, are now financing smallholder irrigation schemes. Recently, the Support to Farmers' Association Project (SFAP) through external financing has created a credit line for small-scale farmers. In Kenya, lack of financial resources has led to a decline in share in the volume of exports (Tafesse, 2003).

In Ethiopia, smallholder community irrigation projects are financed either by the government or by NGOs, although beneficiaries contribute about 10% of the investment cost in the form of labour or by providing local materials such as sand, stone and wood (Rogers, 1998). The beneficiaries also cover minor operation and management costs.

However, major maintenance works (e.g. pumps, and head works) are carried out with government assistance. There are various programmes supporting smallholder irrigation development in African countries, which are funded by different financing agencies such as the World Bank, African Development Bank, International Fund for Agricultural Development (IFAD) and donor countries, like Denmark, Japan and

Netherlands, through their respective development agencies, are collaborating with governments in Africa in implementing studies and construction activities geared towards developing irrigation in these countries (Tafesse, 2003).

The FAO (1995) explained these high costs of irrigation schemes as resulting from fairly remote water sources requiring long supply canals. Smallholder irrigation schemes in the semi-arid areas consist of soils of high infiltration rate and thus construction of these canals especially if they are lined add significantly to overall development costs. Communal lands are also said to be far from major supply centres of irrigation building materials. Thus, it is costly to haul construction material.

2.12.5 Marketing

Almost all smallholder irrigation schemes have marketing of produce as one of the most difficult challenges. In Ncora irrigation schemes, most of the produce from irrigation schemes is sold to locals as irrigation farmers are constrained by transport to carry their produce to profitable markets, lack of information and marketing linkages and lack of collection centres in communal areas (Meinzen-Dick, Makombe and Sullins, 1993). Meinzen-Dick, Makombe and Sullins, (1993) revealed that Cofimvaba irrigation farmers had problems with transporting their produce to profitable markets. The transporters were shunning their irrigation scheme because of the poor road service in the communal areas. The transporters were charging expensive fees to get the farmers produce to the market because of the difficulty in using the communal roads (Mupawose, 1984). However, in Kenya, the Horticulture and Traditional Food Crops Development Project (HTFCDP) has been able to offer better marketing opportunities for farmers. It has assisted farmers in exporting some of their produce to international markets such as United Kingdom, France, Netherlands, Germany, Saudi Arabia and South Africa (Bembridge, 2000).

In countries like Zambia, Malawi, South Africa and Zimbabwe, local markets are not well organized and the crops produced by smallholders are sold at low prices (Meinzen-Dick, Makombe, and Sullins, 1993). In South Africa vegetables are produced for local markets in urban centres. Efforts have been made to link farmers to the local chain stores, but this has met with little success because smallholder farmers produce lacks consistency in both quality and quantity. Rural processing is also not well developed and so market linkages remain the biggest challenge among small-scale irrigators (Tafesse, 2003). Marketing has continued to be a big challenge for smallholder irrigators. Most of the farmers produce vegetables like tomatoes, onions, carrots and cabbages; however, because of the perishable nature of the crops and price fluctuations farmers are often forced to sell at low prices. Further, the absence of organized markets has allowed middlemen or tradesmen to take advantage of the situation (FAO, 1995).

2.13 Sustainability of irrigation projects

Despite the myriad of problems facing smallholder irrigation schemes or cooperative societies, they can become more efficient and sustainable by:

- Upgrading smallholder irrigation techniques
- Putting in place a management structure responsive to water users
- Access to (innovative) credit schemes
- Good support services (credit, marketing, transport, storage)

Government's role in supporting irrigation development is therefore important in terms of the policies and regulations formulated and implemented (Msukwa and Kandoole, 1992). The planning undertaken at the macro and micro level, training and provision of services to support development of the agriculture sector requires support from both government and NGOs so that irrigation schemes can be completely be transferred to communal farmers (Bembridge, 2000).

Thus, professionals, academics, research institutions and governments in many countries are in the process of considering or adopting such irrigation management transfer (IMT) reforms because they allow farmers to have a sense of belonging and farmers are able to invest in the irrigation schemes (Bembridge, 2000). Also farmers need tenure rights to the irrigation schemes to be able to run the schemes properly. In South Africa, the government has transferred some irrigation schemes to smallholder farmers and it provides some inputs on credit. Some governments are still unsure about whether to adopt reforms and how to design and implement them (Rukuni, 1994). The reason for this is that irrigation development has been increasingly exposed to new challenges and the changing driving forces. For example, competing demands for water, emerging environmental issues, persistent and even pervasive food insecurity and poverty in communal areas.

2.14 Beneficial use of irrigation schemes by the smallholder farmers

2.14.1 Economic efficiency

(a) Access to markets

The proximity to a market is a precondition. Farmers will only invest in SSI development if they are satisfied that the increased output in crops can also be sold at prices and returns providing sufficient incentives for his/her additional efforts (AFRACA, 2006). Good road and communication infrastructure allows traders to come directly to the farm or the respective settlement.

(b) Profitability

2.14.2 Employment creation

Employment creation arises when there are intensive labour requirements on the farm and where there are post processing opportunities. It also demands that an income cash stream be available to pay labour and supervision which steers up in agriculture enterprises to medium and higher value crops (Denison & Manona, 2007).

Irrigation has also been said to generate income and reduce rural to urban migration by offering the rural population an alternative source of employment and income (Griffith, 1982). Most studies revealed that sustainable irrigations schemes were able to keep farmers in employment and also people open vegetable markets from these irrigation schemes (Moyo, 2003). Apart from creating employment for local farmers, irrigation engineers, extension officers and health officers also get employed on these irrigation schemes (Mutangadura and Jackson, 2001). The majority of the white farm workers who lost their jobs from the commercial farms were absorbed by the fast track land reform and some small scale irrigation schemes. FAO (1997) established that irrigation schemes have a multiplier effect as people from urban centres would open vegetable markets and employ staff to run the vegetable markets in Ncora and Qamata irrigation schemes in the Eastern cape. These irrigation schemes sold their produce to local and distant markets in Tsomo and Cofimvaba town.

2.14.3 Food security

There are determinants that should be addressed for households to achieve household food security in communal areas. Irrigation is one of the key indicators in addressing household food security as it brings a number of benefits to the farmers. The Governments have been reluctant to improve this situation which could actually serve as an important tool to economic growth and development in the communal areas for example in Zimbabwe. This has resulted in non-governmental organizations (NGOs) and other parastatals assisting communal farmers in addressing the food security problem through irrigation development. The problem these farmers are facing is that of finance and accessibility of inputs to maintain and repair these irrigation schemes and to purchase inputs such as seed and fertilizers. The level of infrastructure in the communal areas makes it difficult for irrigation development because of the transport costs that are incurred in communal areas.

2.14.4 Sustainability

According to Pretty (1994) sustainable agriculture and irrigation development is defined as “agriculture” which meets today’s livelihoods needs of neighours or future generation from being met. Thus, this implies a combination of ecological, economic, and social dimensions to be included in development programs and policies focused on the small-scale irrigation farmer.

2.15 Summary of the chapter

In light of these findings the following specific recommendations can be made for urgent interventions to contribute sustainably to crop based farming in Southern Africa: To increases access to fertiliser, consider development of strong input markets at end-user level, Intensification of technology transfer, focusing on capacity building for transfer of existing technologies and much closer collaboration between state and NGO sectors, agronomists and water engineers, Increasing the uptake of soil–water conservation methods, including conservation tillage and weeding, and supplementary irrigation to minimise adverse effects of dryspells, through investments in farmer training, Linking crop development strategies to livestock development practices as they don’t require high cash flows and profitable, Developing non-agro-based livelihood strategies in marginal lands.

CHAPTER 3: DESCRIPTION OF STUDY AREA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the methodology of the study. The aim of this part of the study is to investigate and describe the irrigation practises, which small-scale farmers are using in Ncora location as we as their perceptions, possible reasons why farmers have adopted or rejected the use of irrigation schemes.

This study consists of two phases. The first one is to interview the key-informants to brief the interviewer about the current situation and existing farming. The interviewing of homestead gardeners and irrigators throughout the Ncora comprised the second phase. The questions are aimed at gaining an in –depth understanding of the dynamics of irrigation management and obtaining important feedback about the farm conditions, management practices and farmers' needs.

At the outset of the chapter a brief analysis of the Selection of the study area to the description of the study area - Cofimvaba town (Ncora irrigation scheme). Finally, the Research Methodology will be discussed. Descriptive statistics are used to determine food security level of the individual and also employment creation by both smallholder irrigators and homestead food gardeners. Profitability of the farm is determined by the profit margin.

3.2 Selection of the study area

3.2.1 Locality context of Ncora irrigation scheme

Intsika Yethu is a local municipality situated within the Chris Hani District Municipality in the Eastern Cape Province. The municipality was established in terms of the Municipal Structures Act, of 1998, consisting of two main towns namely Cofimvaba and Tsomo. The rural component of the municipality is composed of 213 villages with 23 wards, including villages extracted from the neighbouring municipalities of Sakhisizwe (Cala), Emalahleni (Lady-Frere), Ngcobo, Mbashe (Dutywa) and Mnquma (Ngqmakwe) during the re-demarcation process. Figure 3.1 below shows the locality of Intsika Yethu local municipality within the Chris Hani District municipal context.

The Ncora or Tsomo River Irrigation Scheme was reported upon in 1975 by the Africa Institute as “the biggest in the Transkei which will irrigate 5 700 ha of the Ncora Flats (Du toit, 2009). The scheme cost R19,5 million at the time. A reduced 3 600 ha of irrigated land was handed over to the Ncora Trust in 1994, and at most only 500 ha is under irrigation today. Basic cash crops are now being produced. The scheme’s dam is only 30% full because 60% to 70% of the water within is leaking into the ground (Umvoto Africa, 2011). The 900mm irrigation pipes leak 24 hours a day, and have been leaking non-stop for years now. Although the authorities have known about the leaks for a long time, nothing is done to repair the holes in the pipes.

The mind boggles at the number of cattle already dead in the 2003/4 drought in other areas of South Africa, many belonging to black farmers who could not find water for their animals. Then there are the Bronkhorstspruit irrigation farmers who were banned in August 2003 from using local river water. The ban came into effect without any warning whatsoever. The farming group McCain had just spent R1,4 million on a new pumping system and center pivots. The system has been standing unused ever since the ban was declared, with interest on the capital investment running at over R200 000 a year (Du toit, 2009).

Originally there were three dairies at Ncora, with three 42-cow turntables. Now none of them work. The back-up generators have been plundered, hit with hammers according to an observer. All the copper wire from the milk cooler tanks has been damaged or stolen. There were originally 20 to 30 milk and dairy product storage tanks, but they do not function now.

The original scheme ran more than 1 200 head of cattle, “the best Holstein genetics in the Southern Hemisphere”, according to a local. After the handover, these cattle were sold off. The dairies were top producers of yoghurt, maas and so forth. “When you go to the dairies now”, a local told us, “it looks like a bomb hit them. Fires have been built in the yoghurt processing section. The lorries belonging to the dairies have been burnt out, and two disparate groups within the Trust are squabbling almost every day.” We are told that the government is planning to spend another R10 million on this project. But if management is poor, the same situation will prevail again after a few years.

Intsika Yethu prides itself of best agricultural resources in the land, with no less than three irrigation schemes viz Ncora, Qamata and Bilatye Irrigation Schenes, which are considered to be the biggest not only in the province but in South Africa as the whole. With its rich biophysical endowments in the form of rivers and plains, its pristine natural veld, valleys and unique landscapes(for tourism), its rich heritage resources and its relatively good potential soils.

The diagram below indicates the map of Intsika Yethu local municipality, where Ncora is found.

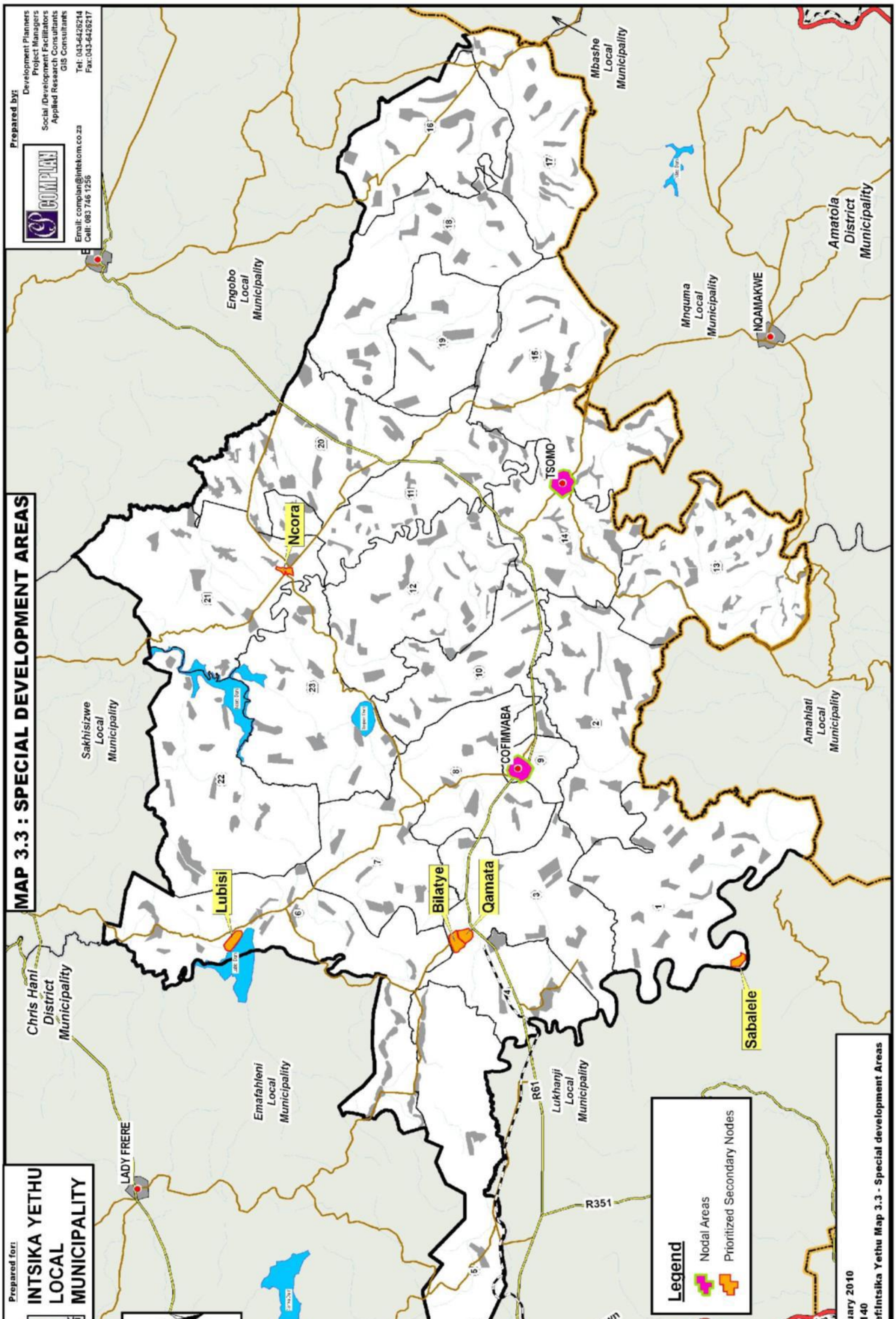
MAP 3.3 : SPECIAL DEVELOPMENT AREAS
Prepared for:
INTSIKA YETHU LOCAL MUNICIPALITY
Prepared by:
COMPLAN
Development Planners
Project Managers
Social /Development Facilitators
Applied Research Consultants
GIS Consultants
Email: complan@intekom.co.za
Cell: 083 746 1256
Tel: 043-6426214
Fax: 043-6426217
Legend
Nodal Areas
Prioritized Secondary Nodes
Date: February 2010
File Ref: G140
Drawing Ref:Intsika Yethu Map 3.3 - Special development Areas
Chris Hani District Municipality
Amatola District Municipality
Engobo Local Municipality
Sakhisizwe Local Municipality
Emafahleni Local Municipality
Lukhanji Local Municipality
Mbashe Local Municipality
Mnquma Local Municipality
Amahlati Local Municipality
LADY FRERE
NQAMAKWE
COFIMVABA
TSOMO
Ncora
Lubisi
Bilatye
Qamata
Sabalele
R61
R351
N6
To Queenstown
To Stutterheim

Figure 3.1: Map of Intsika Yethu local municipality (Source: Microsoft Encarta intsikayethu-municipality.asp)

3.2.2 Agro-ecological potential

The climate in Intsika Yethu varies from mild to warm and humid, with most of the rainfall being experienced in summer. The rainfall is relatively high from November to April (401-500 mm) and low from May to October (151-200 mm). Average temperatures vary; the highest being in January (20-22°C) and the lowest in July (8-10°C). The area is dry with scarce rain during winter and frosty winters with hot summer months.

Intsika Yethu lies in a semi-arid area with generally sandy soils that are red and alkaline. They are very poor for crop production and easily lose moisture especially in summer season. The Nama Karoo is the common vegetation type in Intsika Yethu. The area is mountainous and metamorphic rocks dominate, though granite is found in some parts of the catchment (Cadman *et al.*, 2008). The veld is generally of the sour type which dries up in winter and in periods of less or no rain. This veld is not conducive for livestock though they strive for survival.

(a) Climate

The study area experiences a cool continental type of climate due to its location (Republic of Transkei, 1991) and also an average rainfall of 500mm per annum which is not always reliable in terms of amount and distribution (ARDRI, 1996). High summer temperatures and high run-off reduces the effectiveness of the rainfall in the area. Crop failure in the drylands and recurrent droughts are common characteristics of climatic conditions in the area. The climate of Qamata determines the amount of surface run-off available for irrigation, the types and variety of crops that can be cultivated and types and frequency of most natural disasters. The climates also influence operation and maintenance policies relating crop selection, irrigation scheduling and risks and disaster management in the scheme.

(b) Soils

The total land size of the area is 5 300ha marked for irrigation, unfortunately only 47% is suitable for surface irrigation because the subsoil is less permeable (ARDI, 1996). Consequently, by the late 1980s 390ha of irrigated land was either saline or waterlogged (Maitin, 1990) this reduced the effectiveness of production for irrigated plots. The soils in Qamata area are less leached due to low rainfall and low temperature conditions, and more fertile than those developed under more moist conditions and cooler temperatures (Republic of Transkei, 1991). The overgrazed areas and where the plant cover disappeared during recent drought caused severe soil erosion. Heavy loads of sediments are deposited in the Lubisi Dam and the weir and lei dams, reducing their water storage capacities. The water which rushes down the steep slopes has tunnelled passages under the main canal causing cracking and eventual collapse of segments of the canal.

3.2.3 Economic potential

Intsika Yethu should be what “gold” is to Gauteng, “platinum” to North West, and “coal” in Mpumalanga in so far as economic development is concerned. It is incongruous that the area with such abundance of natural resources (water and land) remains trapped in abject poverty and high levels of unemployment.

3.2.4 General farming system

Crop farming is also at subsistence level within the Ncora village, characterised by backyard gardens and medium sized plots where terrain permits. Studies on land use patterns in Intsika yethu Municipality shows that any crop can be grown in the rich soils given the stable climate that gradually changes from temperate to sub-tropical along the coasts (Gubu *et al,* 2005). Maize however forms the dominant crop grown under rain fed system.

3.2.5 Infrastructure

The Ncora Dam is the main bulk water infrastructure in Ncora village. It supplies water for domestic use to the towns of Seymour and Fort Beaufort, as well as for the irrigation purposes, with citrus being the predominant crop (Magni, 1999). The dam was commissioned in 1991 with the purpose of irrigating alluvial soils on the banks of the Ncora village. According to Motteux (2001), the Ncora dam is a concrete multiple arch dam with a dam wall, which is approximately 55,6m high.

Nel *et al* (1997) highlighted that road development is a challenge in the study area because it is influenced by parallel escarpments. Apart from the road to the market, farmers use poor roads from production areas (orchards, garden and fields) to the loading zones. The roads are slippery during rainy seasons, making it even more difficult to move produce from production areas to market places. The smallholder irrigators and homestead food gardeners lack proper marketing infrastructure (Magni, 1999). For instance, vegetable farmers opt to sell from their homes because they do not have marketing sheds and proper storage facilities.

3.2.6 Irrigation systems

Ncora irrigation schemes pump water from Ncora dam shown in map 1. The irrigation schemes are under sprinkler irrigation system powered by diesel pumps and networked by hosepipes infield and Furrow irrigation, where water is transferred from a head ditch to crop furrows via siphons, is one of the most simple and ancient forms of irrigation delivery . The smallholder irrigators do not pay any water rates and are not affiliated to any Water User Association (WUA). It is the responsibility of project members to hire technicians to attend to any breakdowns on the irrigation systems.

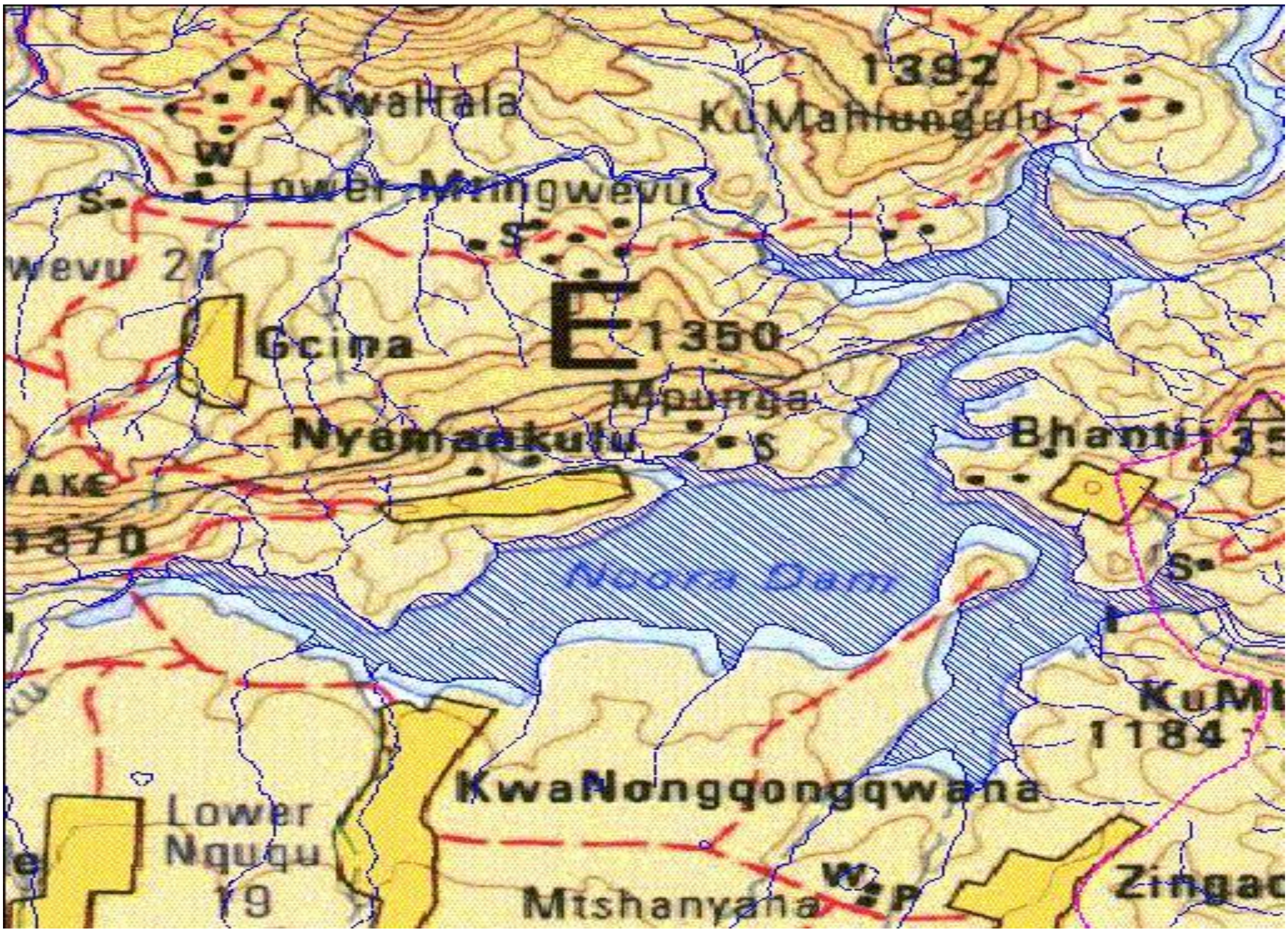

Figure 3.2: map of Ncora damn, South Africa (source: survey and mapping /iwqs3/tmp/dams/tmp/wla500-geo)

3.3 Research methodology

This section gives an overview of the methods used for data collection and analysis. The section commences by describing data collection techniques, sampling procedure and data analysis methods used in the research are also explained. The limitations of the study are also highlighted at the end of the section.

3.3.1 Data collection

3.3.1.1 Primary and secondary data.

Primary data were collected through the use of questionnaires and secondary data were obtained from government institutions like the Department of Agriculture. Other data were obtained from literature produced by other scholars on work that have been covered so far in the area of study.

A questionnaire was designed as a tool for primary data collection. The questionnaire was designed in order to collect both qualitative and quantitative data. The questionnaire was then administered to respondents (farmers) through face-to-face interviews. There are other ways in which questionnaires can be administered, such as self-administered questionnaires and telephone surveys (Leedy and Ormrod, 2004). However, face-to-face interviews were chosen because they have several advantages over the other methods. According to Bless and Smith (2000), an interviewer administered interview is an important tool of data collection because it reduces omission of difficult questions by respondents. In addition, it reduces the problem of word or question misinterpretation (misunderstandings) by respondents and can be administered to farmers who can neither read nor write. In addition, the presence of the interviewer increases the quality of the responses since the interviewer can probe for more specific answers (Leedy and Ormrod, 2004). In other words, the use of interviewer-administered questionnaires ensures minimal loss of data when compared to the other methods. The heads of the households for the families chosen to be part of the sample were interviewed. In the absence of the head, the spouse or any family member who was directly involved in the farming activities and management was interviewed. The main respondent provided most of the information, but was allowed to consult other household members where necessary.

3.3.1.2 Sampling procedure- unit of analysis (irrigators and non-irrigators), sample size

For this research project, the most suitable sampling procedure was availability sampling method since the respondents were scattered over a wide area and no complete list of the target population was available. This sampling method involves interviewing people at an arbitrary location until the required sample size is met (Bless *et al.*2006). The advantage for using this non-probability sampling procedure (availability sampling) is that it does not require population data, something which cannot be obtained for all the surrounding villages since this would require a census to be carried out. Only those people who were conveniently available were interviewed so as to obtain a large number of completed responses quickly and economically (Monette *et al,* 1998). However, it should be noted that this sampling method has a problem of calculating the sampling errors due to the fact that it is non-random. Generalizations based on such samples are risky because the probability of including each sampling unit in the sample is unknown. This problem can however be overcome by increasing the sample size (Bless *et al*,2006).

The sampling frame, which is the population from which the sample is drawn, is made up of the irrigating farmers and homestead food gardeners from Ncora Village. A sample of 212 households (169 irrigators and 43 homestead food gardeners) was selected and the unit of analysis is the head of household. Due to time constraints, data were collected at a single point in time for all the selected sampling units (households) which make the data cross sectional data.

3.3.1.3 Description of and measurements of variables

Table 3.1: Description of and measurements of variables

VARIABLE	DESCRIPTION	UNIT	HYPOTHESISED SIGN
AGE	Age of the respondent	Years	+/-
GENDER	Gender of the respondent (male=1, female=2)	Dummy variable	+/-
FORMAL EDUCATION	Education level of the respondent (years in school	Years	+
HOUSEHOLD SIZE	Number of people in a household	Number	+
FARMING EXPERIENCE	Farming experience of the respondent	Years	+
MAJOR	Major occupation	Dummy variable	+/-

OCCUPATION	of the respondent (farmer= 1, otherwise= 2)		
TOTAL LAND FARM SIZE	Size of farm land accessed by household	Hectares	+
TOTAL LAND CULTIVATED	Size of land under crop production	Hectares	+
LABOUR	Number of days devoted to farming	Personal days/ ha	+
IRRIGATION WATER	Number of times the farmer irrigate his/ her garden per week	Number	+
AMOUNT OF SEED USED	Amount of crop seed planted	Kg/ ha	+
AMOUNT OF FERTILIZERS	Amount of fertilizer used	Kg/ ha	+
PRICES OF INPUTS	prices of inputs used in production	Rand	-
AMOUNT OF CROP OUTPUT	Amount of output harvested	Kg/ha	+
PRICE OF OUTPUT	Price of the output sold	Rands/Kg)	+
EXTENSION SERVICES	Number of extension services visits received by respondent	number	+
ACCESS TO CREDIT	Where respondent have access to credit (yes=1, no=2)	Dummy variable	+

GROUP MEMBERSHIP	Where respondent belong to farmer group (yes= 1, no= 2)	Dummy variable	+

Further descriptions of the research variables are presented as follows:

Water use: This variable is a dependent variable in the model; it is estimated by using production results. That is the relationship between input used to produce maize and output (quantity of maize produced).

Household size: This variable explains the number of people in a household and is measured in the actual years. The hypothesized sign is positive meaning that the more respondent in a household they will be less labour costs and also if they are employed they will be more income in the household**.**

Sex: This variable measures the sex of the respondents either the respondent is male (1) or female (2) it is expressed as a dummy variable. There are more female involved in smallholder irrigation and also homestead food gardening.

Age: The variable measure the actual age of the respondents and it has a positive impact on the study; the older the respondent the more productive the respondent is considering experience in farming and other related characteristics of the respondents.

Education: Educational level as the number of years spent at school and also the type of education the respondent obtained is explained by this variable. This means that the more years spent at school by the respondent the more efficient and productive he/she is.

Occupation: This variable measures the type of job the respondent is doing and also years spent in that job. It assists in measuring the income earned in the household to measure food security and also employment levels**.**

Group: variable shows which group the respondent belongs either smallholder irrigator or homestead food gardener and it is a dummy variable

Land under irrigation: This variable measures the size of that are under irrigation or also utilised by homestead food gardeners

Input used: Variable measures the quantity of input used by the respondent such as fertiliser, seeds and agrochemicals. It has a positive impact on the research meaning that the more inputs used the higher the output produced.

Price of input: This variable measure the price of the input that is used by the farmers**.**

Output produced: This variable measures the quantity of output produced by the farmer such as maize, cabbage and potatoes.

Price of output: This variable measure the price of the output that is produced by the farmer per kg

Household expenditure: Variable measures the household spends on food.

3.3.2 Data analysis

The Statistical Package for Social Scientists (SPSS version 21) was used to run the data collected from smallholder irrigators and homestead food gardeners in Ncora village (Cofimvaba town). To analyze data, descriptive and OLS were used to test the hypotheses. The main descriptive indicators that were employed were frequencies and mean values. These are useful in analyzing household characteristics . Two main methods can be used to estimate technical efficiency of the respondents. These are the non-parametric method known as Data Envelopment Analysis (DEA) and the parametric method known as the Stochastic Frontier Approach (SFA) (Coelli, 1996). Non-statistical methods such as DEA tend to be deterministic, whereas statistical methods, such as SFA tend to be stochastic, allowing for statistical “noise”. Several studies have sought to compare DEA and SFA. There is no consensus on whether DEA or SFA is the best tool for efficiency measurement (Folland, 2001). Thus this study used Data Envelopment Analysis (DEA). These are discussed below.

3.4.2.1 Estimation of factors affecting technical efficiency

To estimate the determinants of technical efficiency, ordinary least squares method was used. This method minimizes the sum of squared vertical distances between the observed responses in the dataset and the responses predicted by linear approximation. Determinants of the level of technical efficiency were estimated by establishing the relationship between farm/farmer characteristics and the computed technical efficiency indices. Following Bravo-Ureta and Rieger (1990), Bravo-Ureta and Pinheiro (1997) second step estimation adapted from the relationship between technical efficiency and the different farm/farmer characteristics are determined. To estimate these factors, a linear model is used with estimates. An OLS regression is performed and Durbin-Watson statistic is estimated to determine the extent of autocorrelation problem (Obi and Chisango, 2011). The linear model is estimated as shown below for each farmer.

$T.E = \alpha + \beta X + e$………………………………..…………………………….. (1)

Where TE = level of technical efficiency; α = is the constant; β = coefficient parameters to be measured; e = error term; and X is a vector of explanatory variables that include farm/farmer characteristics like X1 = Household size, X2 = Age, X3 = Education level (years), X4 = Farming experience, X5 = Amount of land owned, X6 = Training on input use, X7 = Use agro-chemicals, X8 = Use of tractor, X9 = Gross margins,X10= cropped area and X11= crop incomes.

3.4.2.2 Data envelopment analysis (DEA)

Data Envelopment Analysis (DEA) is a non-parametric technique to measure technical efficiency at a point in chain. Observed input and output quantities are used to construct a production possibility space with which individual decision making units (DMUs) are compared to determine their relative efficiencies (Bowlins, 1998). DEA requires that DMUs be relatively homogeneous with the same inputs and outputs in positive amounts (Bowlin, 1998).

The model presented in this study recognised that each of the farms use inputs to produce a given output. For the farm, input and output data are represented by the column vectors and, respectively. The input matrix or (where = Land acreage, number of irrigations/ha/season, amount of seeds planted, fertilizer, pesticide, herbicides, capital) and the output matrix, or (value of output of farm & crop enterprise) represent the data for all N farms in the sample.

Following Speelman *et al.* (2007) and Lemba *et al.* (2012) the DEA model was estimated to generate technical efficiency (TE) using linear programing equation as shown below.

$Min_{\theta}\ \lambda\ \theta$………………………………………………………………… (2)

Subject to: $-Y_{ij} + Y\lambda \geq 0$,

$\Theta X_{ij} - X\lambda \geq 0$,

$N1'\lambda = 1$,

$\lambda \geq 0$

Where Ɵ is a scalar, N1 is a N x 1 vector of ones, and λ is an N x 1 vector of constants. The value Ɵ of obtained is the technical efficiency score for the farm and these scores normally lie between zero and one. If Ɵ = 1 then the farm is said to be efficient and lies on the frontier, thus, the more tends to zero the more less efficient the farm becomes. The ($N1'\lambda = 1$) is referred to as Variable Returns to Scale (VRS) with some specification as a convexity constraint. Without that constraint ($N1'\lambda = 1$), then efficiency estimates are calculated under Constant Returns to Scale specifications (CRS). Further, Färe *et al.* (1994) used the sub-vector efficiency to estimate the technical sub-vector efficiency for the variable input k like irrigation water for each i^{th} farm by solving the linear programme problem as shown below.

$Min_{\Theta\,\lambda}\ \Theta_k$……………………………………………………………………(3)

Subject to: $-Y_{ij} + Y\lambda \geq 0$,

$\Theta_k X_i^k - X^k \lambda \geq 0$

$X_i^{n-k} - X^{n-k} \lambda \geq 0$

$N1'\lambda = 1$

$\lambda \geq 0$

Where Θ_k is the input k sub-vector technical efficiency scores for farm i. The second constraint with terms X_i^k and X^k includes only the K^{th} input and in the third constraint which contains terms X_i^{n-k} and X^{n-k} it excludes (thus, n- k) the K^{th} input. Other variables in this equation are defined in equation 3.

3.3.2.3. Descriptive statistics, non parametric correlation and cross tabulation

Descriptive statistics are used to describe the basic features of the sample households by means of simple summaries and measures of central tendency. These are useful in analyzing household characteristics as well as analyzing the relationship between variables. This means that they describe what is being shown by the data. Therefore, descriptive statistics are used because they present quantitative data in a manageable form. In this study there are three major characteristics of a variable that were employed, namely; the distribution, central tendency and dispersion.

For the purpose of estimating whether farm size, education level and farming experience affect adoption of irrigation schemes non parametric correlation was employed.. Spearman‟s analyses was computed which gives correlation coefficients that indicate the strength and direction of the linear relationship.

Although it is closely related to correlation, cross tabulation is a type of bivariate analysis that involves testing whether a relationship or an association exists between two categorical variables to make sure that the direction of association is made obvious. Hence, in this study it was employed to cross check the systematic relationships inferred by correlation.

The data that were collected included:

- Demographic data (age, sex, highest educational level attained, family size and farming experience),
- farming system data (types of crops grown, cropping patterns tenure, irrigation facility used, type of seed variety grown, and use of pesticides)
- Marketing and harvesting activities data (quantity of output both sold and consumed, price of inputs, marketing costs)
- Institutional data (challenges encountered)
- Performance data (gross income, total variable cost, gross margin)

3.4.2.4 Estimating the gross margins of maize and potato enterprises

When acquiring new technology, it is important to consider the economic value of the new practice. As a rule of thumb, an enterprise with higher or positive gross margin is deemed viable. Hence, gross margin analysis was used to assess the viability of B*t* maize seed. 45

According to Barnard and Nix (1999), gross margin (GM) of a farming enterprise is its output less the variable costs attributed to it. Erickson, Akridge and Barnard

(2002) define gross margin as the money that is available to cover the operating expenses and still leave a profit. However, this study employs the definition preferred by Visagie and Ghebretsadik (2005), that sees gross margin as the difference between the gross income (GI) derived from each enterprise (maize production activities) minus the total variable costs (TVC). In maize production, the variable cost consists primarily of expenses on seed, fertiliser, sprays, contract work and casual labour hired. These are aggregated to obtain the total variable costs. The enterprise output is the total value of the production of the enterprise. It also includes the value of any produce consumed on the farm such as green mealies consumed by the household.

Gross margins were evaluated by identifying and quantifying the Total Variable Costs (TVC) incurred by the farmers, and the Total Revenues (TR) realized in the production Revenues (TR) realized in the production of maize and cabbage enterprises per season. The *TR* is estimated as the prevailing market price of a given output (*Py*) multiplied by quantity of output sold (*Qys*) (*Py* * *Qys*). Total variable costs is a summation of all input variable costs incurred by a given firm, and the input variable cost is estimated as the prevailing market price of a given input (*Pxi*) multiplied by quantity of the input used (*Qxi*) (Pxi * Qxi). Thus, TVC $=\Sigma_{i=1}^{n}$ (Pxi * Qxi) Gross margin for each enterprise is calculated as:

GM= (*Py* * *Qys*)- $\Sigma_{i=1}^{n}$ (Pxi * Qxi) ……………..……………….……………..(4)

To determine which enterprise is more profitable than the other information such as type of crops, quantity produced, unit price of the output, quantity sold, quantity consumed, livestock sold and consumed and the unit price of the livestock will be used.

The mathematical equation shown below will be used to estimate profitability:

Π= Q y P y - Σ Q x P x ....(5)

Π= Profitability

Q y =Quantity of output produced

P y = Price of output

Q x = Quantity of input used

P x = Price of input used

Where:

Q y P y = Farm income

Σ Q x P x = summation of the variable total cost

For each enterprise the mathematical formula will be as follows

Q y = Quantity of output (Maize, Potatoes)

P y = Price of output (Maize, Potatoes)

And

Q x = Quantity of input used (Fertiliser, seeds, machinery, labour, pesticides, herbicides)

P x = Price of input used (Fertiliser, seeds, machinery, labour, pesticides, herbicides

In order to capture maize production data from each farmer, the gross margin model was used. In addition, equations 4 to 5 indicate the steps taken to arrive at the actual gross margin for each farming unit. Table 3.1 below illustrates the format for summarizing the results of gross margin analysis for a typical agricultural enterprise.

Table 3.2: Format for summarizing results of GM analysis for maize and potato enterprises

	HOMESTEAD FOOD GARDENERS				**SMALLHOLDER IRRIGATORS**			
Item	**Unit**	**Quantity**	**Price**	**Amount (R/ha)**	**Unit**	**Quantity**	**Price**	**Amount (R/ha)**
Income (GVP)								
Crops sold in 50kg	Kg							

Crops consumed at home	Kg							
GROSS INCOME								
VARIABLE COSTS								
Seed	Kg							
Fertilizer	Kg							
Herbicides	Litre							
Pesticides	Litre							
Tractor hire	Day							
Costs of harvesting								

3.4.2.4 Justification of the econometric model

Data Envelopment Analysis (DEA) provides the basis for measuring farm-level technical efficiency (TE). It construct a piecewise linear production surface using linear programs and computes an efficiency score for each decision making unit (DMU) along the lines suggested by Farrell (1957).

Although it is advantageous to use DEA approach it suffers from the same criticism as the deterministic methods in the sense that it takes no account of the possible influence of measurement error and other noise in the data. On the other hand, it has the advantage of removing the necessity to make arbitrary assumptions regarding the functional form of the frontier and the distributional form of the error. Over the last three decades, Farrell's methodology has been applied widely, while undergoing many refinements and improvements. The model used in this paper is based on an extension advanced by Charnes et al. (1978) and further modified by Banker et al. (1984).

According to Mohammed and Ortmann (2005), several methods can be used to explain the relationship between dependent and independent variables. Such methods include linear regression models, probit analysis, log-linear regression and discriminant analysis. However, linear regression (OLS) has been chosen because it has more advantages, especially when dealing with qualitative dependent variables.

Linear regression model (also known as Ordinary least squares regression (OLS)) is the most widely used modelling method for data analysis and has been successfully applied in most studies (Montshwe, 2006). However, Gujarati (1992) pointed out that the method is useful in analysing data with a quantitative (numerical) dependent variable but has a tendency of creating problems if the dependent variable is qualitative (categorical). Amongst other problems, the OLS can be used in this study because it can violate the fact that the probability has to lie between 0 and 1, if there are no restrictions on the values of the independent variables. On the other hand, multinomial logistic regression guarantees that probabilities estimated from the logit model will always lie within the logical bounds of 0 and 1 (Gujarati, 1992). In addition, OLS assumes that the rate of change of probability per unit change in the value of the explanatory variable is constant. With logit models, probability does not increase by a constant amount but approaches 0 at a slower rate as the value of an explanatory variable gets smaller.

3.5 Chapter summary

In this chapter, the methods that were used to analyse data were reviewed. Data was collected from 169 smallholder irrigators and 43 homestead food gardeners in the Ncora village. The research was mainly focused on the farmers who are involved in crop production specifically maize and potatoes. To collect the data, a questionnaire was administered to the respondents through face-to-face interviews. The advantages that are associated with face-to-face interviews have been highlighted within the chapter. For analyzing data, DEA, Linear regression model and gross margin analysis were chosen and its advantages have been highlighted. The results of the research are presented in the next two chapters.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 Introduction

This chapter discusses and analyses the results of the field survey that was carried out in IntsikaYethu in 2013 at NCORA Irrigation Scheme. The data under analysis was collected from 212 rural households that are involved in homestead food gardeners and small-scale irrigation schemes. The determinants are specified as household socio-economic characteristics and selected technical variables that are known to influence farm-level efficiency. The chapter begins with brief explanations of the demographic characteristics of the sampled households, which is then followed by an overview of households' assets ownership. It goes on to discuss socio-economic aspects of households, giving special attention to aspects related to agricultural production and marketing and factors influencing them. Within the chapter, descriptive statistics such as mean, maximum and minimum values, frequencies and standard deviation is used.

4.2 Demographic analysis of household variables

Most studies found that household variable such as household size, gender, and education level positively influence farm-level efficiency through availability of labour and its productivity (Tchale, 2009). Furthermore, Makhura (2001) stated that these aspects are important because the main household activities are coordinated by the household head and the head's decisions are most likely to be influenced by such demographic aspects and also play a pivotal role in determining the behaviour of household farmers. The section further presents and analyses results of the household sizes and dependency values. Household demographics, as such, a set of household variables (and these are description of household by size, sex, marital status, age, years spent in school or level of education and occupation) were analysed and quantified for Ncora village.

4.2.1 Description of household by household size

The total number of respondents in the study area was 212, 169 were smallholder irrigators and 43 were homestead food gardeners. The mean household size for homestead food gardeners was found to be 5.186 family members and 5.112 members for smallholder irrigator and the mean size for the overall sample was 5.127. The median for the two groups was found to be the same which is 4 and the maximum number of homestead food gardeners' household members is 12 and the minimum being 2 and for smallholder irrigators the maximum is 13 members and a minimum of 1 member. These results are represented on table 4.1.

Table 4.1 Distribution of households by size

	Smallholder irrigators (n= 169)	**Homestead foo gardeners (43)**	**Overall sampl (n =212)**
Mean	5.112	5.186	5.127
Median	4	4	4
Standard deviation	2.1532	2.9135	2.3199
Minimum	1	2	1
maximum	13	12	13
Range	12	10	12

Source: survey data 2013

4.2.2 Description of household by sex of the respondents

The results that are presented in figure 4.1 show that the sample had a larger proportion of male respondents as opposed to females. A small difference between the number of female and male farmers, imply that any development strategy for the farmers in the area will benefit males and females almost equally (Jari, 2009). Figure 4.1 shows the results of homestead food gardeners, smallholder irrigators and for the overall sample. Males dominate in homestead food gardens represented by 60.5%, whereas females dominated in smallholder irrigators with 39.5%. Large family size may have large supply of labour to work on the farm and this may increase the size of farm land cultivated (Ohikere *et al,* 2012).

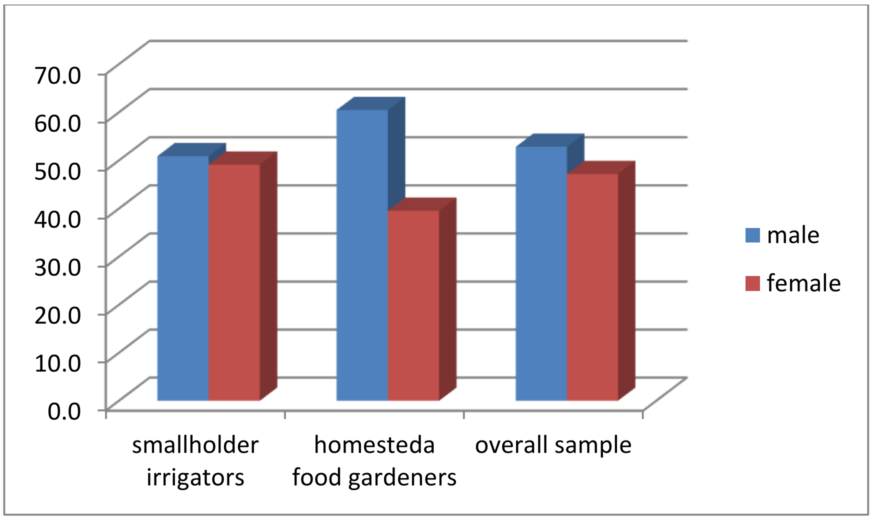

Figure 4.1 Distribution of household by sex (Source: survey data 2013)

4.2.3 Description of household by age of the respondents

Age of the household head is a very crucial factor since it reflects whether the household benefits from the experience of the older person or has to base its decisions on the risk taking attitudes of younger farmers (Makhura and Mokoena, 2003 in Mkhori, 2004). Table 4.3 presents the mean age of homestead and smallholder irrigators which are 57.14 and 49.609 respectively. It also shows the minimum and the maximum ages of the respective respondents were 17-78 and 25-78 respectively.

Table 4.3 Distribution of household by age

	Smallholder irrigators (n= 169)	**Homestead food gardener (n=43)**	**Overall sample (n= 212)**
Mean	49.609	57.14	51.137
Median	52	56	52
Standard deviation	14.4836	16.1032	15.0948
Range	61	53	61
Minimum	17	25	17
maximum	78	78	78
Mode	55	25	55

Source: own survey data 2013

Figure 4.2 presents the age range of the respondents for smallholder irrigators, homestead food gardeners and for the overall sample. It shows that the smallholder irrigators have the youngest individuals involved in farming who are 17 years and also the oldest age in the sample is 78 unlike the homestead food gardeners where the youngest is 25 years. This indicates that younger individuals are not interested in farming especially if they are no resources available. Further, results indicate that the age distribution between 77-78 is similar between the two groups.

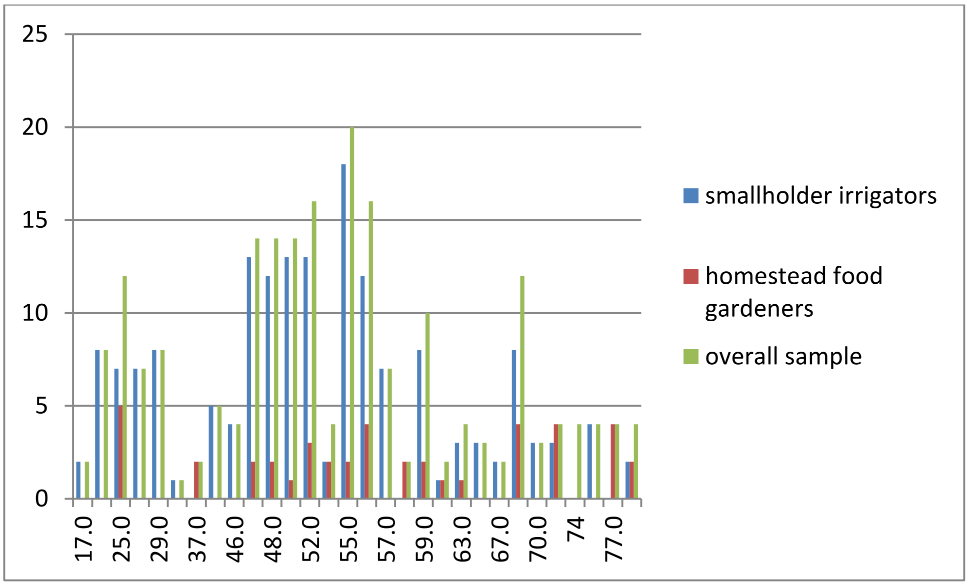

Figure 4.2 Age of the household respondents

4.2.4 Distribution of household by marital status of the respondents

The marital status of the respondents is presented in figure 4.3 and the four main groups are single, married, widowed and divorced. Homestead food gardeners had more married people involved in farming represented by 55.8%, than smallholder irrigators with 53.3%. Given the results in Figure 4.3 it can be suggested that, married people are able to share and divide responsibilities such as land preparation, planting, fertilizer application and ploughing which can be done by males and weeding and harvesting can be done by women that is rather uncommon with single, widowed and divorcees who only have themselves to do most of the work especially if they don't have children. The trends in marital status of household head are very critical in African societies, where it determines stability of families

(Muchara, 2011). It is believed that married household heads tend to be more stable in farming activities than unmarried heads, and consequently affect both agricultural production and marketing patterns (Musemwa, 2008). However, further scrutiny of the relationship between marital status and farmers ‘participation in agricultural activities is required.

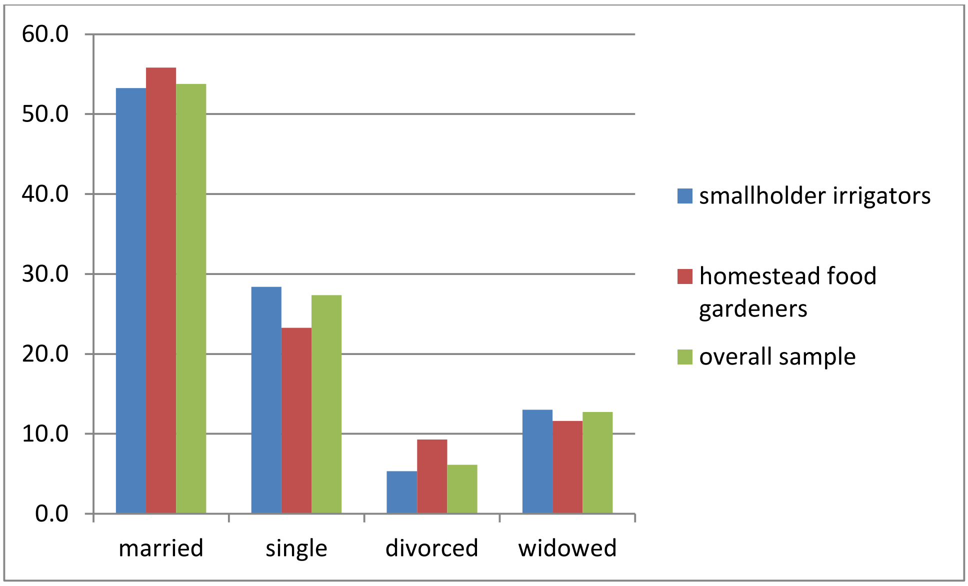

Figure 4.3 Marital status of the respondents

4.2.5 Educational level of respondents.

Education and training are important aspects in rural households as they contribute to the knowledge acquired by households which they can use and apply for improved livelihoods. Education has long been recognised as a central element in the socio-economic evolution of less developed countries (Bembridge, 1987). Thus it is important to analyse the education level of the households. Figure 4.4 presents education levels of the respondents which are divided into four groups which is primary education, secondary education, the respondents with tertiary qualifications and those who are illiterate. Mather and Adelzader, (1998) noted that people with higher educational attainments are more able to interpret agricultural information. This therefore is an important characteristic because the higher the educational level the easier for the respondents to adopt and use modern technology since they understand technology better. The results showed that 24 were not educated for smallholder and 10 for homestead food gardeners meaning that most farmers in the smallholder group are not educated as the other group. In the study 12 of the homestead farmers attended secondary education and only 57, attended secondary education for smallholder irrigators and there are only 2 people who with tertiary qualification in homestead food gardeners whereas they are 12 in smallholder irrigators this is illustrated in Figure 4.4.

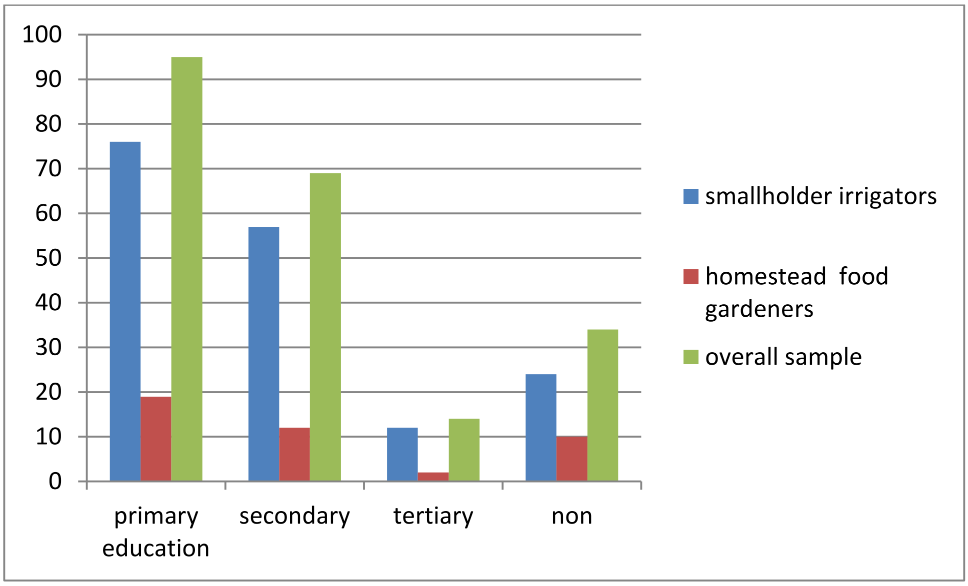

Figure 4.4 Levels of education of the respondents

4.2.6 Employment status of respondents

In this study the employment status of the respondents is divided into farmer, farm labourer, trader, casual worker and student. Homestead food gardeners have got more farm labourers of about 83.7% and 1.8 % for smallholder irrigators.83.4% of smallholder irrigators were farmers whereas only 4.7% of homestead food gardeners were farming. Only 9.3% and 2.4% of the sampled size were traders in homestead food gardeners and smallholder irrigators respectively these are all illustrated in figure 4.5. Occupation of the respondents is very crucial since income they earn helps the respondents to achieve household food security.

The majority of the subsistence farmers and smallholder farmers consider farming as an additional income source as part of their multiple livelihood strategy, independent irrigators are often bona fide farmers, aiming to make a living out of farming, and as such many are shopkeepers or other entrepreneurs who develop irrigation as an added dimension (NDA, 2006).

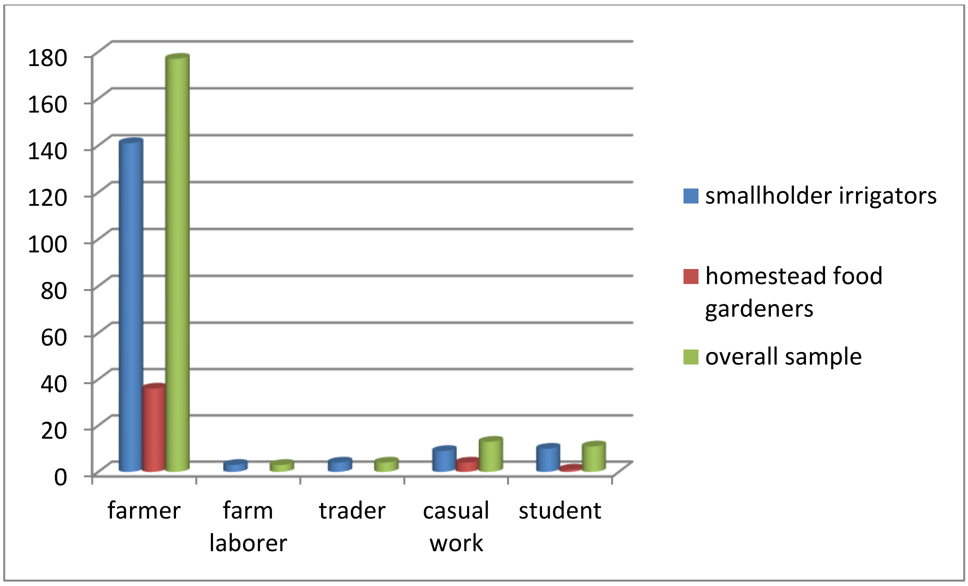

Figure 4.5 Employment status of the respondents

4.2.7 Farming experience

A positive relationship was observed between years of farming experience and smallholder irrigators, from the sample data, the higher the farming experience, the higher the extent of which farmers are involved in irrigation. This agrees with literature findings which state that smallholder farmers with more experience have interest in irrigation schemes more due to the knowledge attained over the years of how to bring the most out of their farming practices. Figure 4.6 show that 27 smallholder irrigators have 11 years whereas only 5 of the homestead food gardeners have that much experience. Furthermore it shows that 4 of the smallholder irrigators have up to 30 years experience in farming.

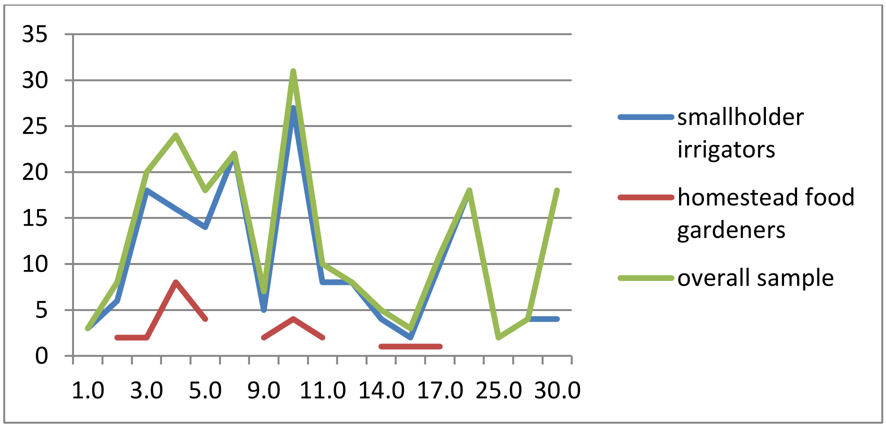

Figure 4.6 Farming experience of the respondents

4.3 Household assets ownership

The availability of agricultural related assets influences production and marketing decisions among smallholder farmers (Stroebel, 2004). That is, farmers who own farming related assets are more likely to produce and market their produce than those who lack assets. In this section, the household asset ownership results for homestead food gardeners and smallholder irrigators in Ncora village are presented and analysed. The main aspects that are discussed include land utilized for crop production, land ownership, inputs used for production, sources of labour, crops grown, sources of water and type of irrigation used.

4.3.1 Land size utilized by respondents for crop production

The amount of land a farmer owns is associated with the amount of produce obtained in a season. It should, however, be acknowledged that it is not always the case that the available land will be fully utilised for farming. The average land sizes households owned in this sample was 2.1293 hectares for smallholder irrigators and 1.8116 hectares for homestead food gardeners ranging from 0.5 to 6 hectares for both farmers. The results show that smallholder irrigators have the highest mean value than homestead food gardeners which substantiate the fact that smallholder irrigators practice crop production on a larger scale.

Table 4.4 Land size utilized by respondents for crop production

	Smallholder irrigators (n= 169)	**Homestead food gardeners (n= 43)**	**Overall sample (n= 212)**
Mean	2.1293	1.8116	2.0649
Standard deviation	1.37266	1.05429	1.31828
Minimum	0.5	0.5	0.5
maximum	6	6	6

4.3.2 Land tenure

Land tenure system in this study was divided into four groups which is restitution, redistribution, inherited and none. Table 4.5 indicates the number of responses and the percentages given by the respondents. From the results obtained it is evident that most of the farmers in Ncora village inherited their plots where 74.6% smallholder irrigators and 83.7% of homestead food gardeners inherited the land. Some of them obtained land by means of redistribution which intended to raise total output by combining underused labor from small farms and the landless work force with underused land on large farms as it is the case in Ncora village some individuals who were interested in farming but couldn't due lack of land had obtained it by means of redistribution by the community leader about 21.9% of them whereas only 14% of homestead food gardeners obtained by means of redistribution. This is substantiated by Randela *et al,* 2000 who stated that ownership of land can influence agriculture productivity, because farmers who do not own land can be reluctant to develop and maintain the land.

Table 4.5 Land tenure system

	Smallholder irrigators (n= 169)		**Homestead food gardeners (n= 43)**		**Overall sample (n= 212)**	
	frequency	percentage	frequency	percentage	frequency	percentage
Restitution	5	3	1	2.3	6	2.8
Redistribution	37	21.9	6	14.0	43	20.3
Inherited	126	74.6	36	83.7	162	76.4
Non	1	0.6			1	0.5
Total	169	100	43	100	212	100

4.3.3 Inputs used for production

Both groups utilize inputs like seeds, fertilizer, herbicides and pesticides these are bought from a local shop, and also most of them are sold in other shops in town. Farmers in Ncora area do not get assistance from the governments when it comes to input sourcing hence they purchase inputs using their own money.

4.3.4 Sources of labor for crop production

For the poor, labour is often the only asset they can use to improve their well-being. Hence the creation of productive employment opportunities is essential for achieving poverty reduction and sustainable economic and social development. It is crucial to provide decent jobs that both secure income and empowerment for the poor, especially women and younger people (Poverty social policy and development division, 2007).

Table 4.6 present the results of sources of labor for crop production of a sampled population. They were divided into three which is family labor, hired labour and both. It shows that 97.7% of homestead food gardeners use only family labor since according to them they cannot afford the cost of hiring labor whereas 66.9% of smallholder irrigators use family labor, 11.8% hires labor and 21.3% use both hired and family labor. The overall results show that family labour is commonly used which agrees with literature.

Table 4.6 Sources of labor for crop production

	Homestead food gardeners (n=43)		**Smallholder irrigators (n=169)**		**Overall sample (212)**	
	frequency	Percent %	frequency	Percent%	frequency	Percent%
Family labour	42	97.7	113	66.9	155	73.1
Hired labour			20	11.8	20	9.4
Both	1	2.3	36	21.3	37	17.5
Total	43	100	169	100	212	100

4.4.5 Crops grown by the respondents

The two groups grow different type of crops namely maize which is the common cash crop, cabbages, potatoes, carrots, beetroots and spinach either for their own consumption, for the market or both. Even though they grow all these types of crops they are not consistent in growing them and they do not sell the produce often. The produce in large quantities is maize, cabbage and potatoes.

4.4.6 Reasons why smallholder farmers grow specific crops

Community gardening and irrigated food plots can provide the poorest of poor people the opportunity to improve their standard of living, and participants are mostly women (Muchara, 2011). This has been indicated in figure 4.7 where the farmers mostly grow crops due to high profit they make. The profit they obtain from selling their output is being used for household expenditures and paying school fees for their children. They also grow crops for food security. Figure 4.7 present that 46.2% of smallholder irrigators and 46.5 homestead food gardeners grow crops to enhance profitability.

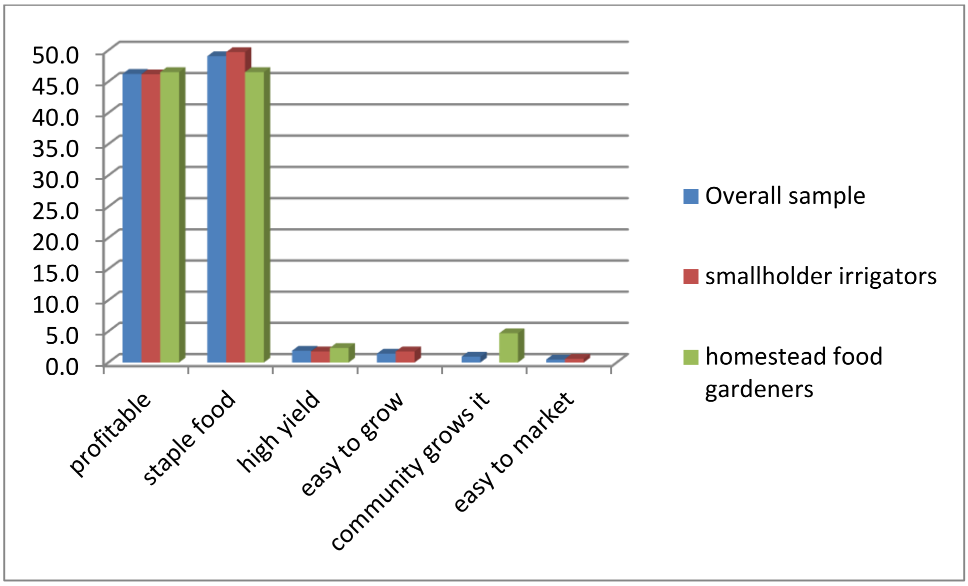

Figure 4.7 Reasons why smallholder farmers grow specific crops

4.5 Water use

4.5.1Sources of water for crop production

Figure 4.7 presents farmers' responses to question about the source of water for crop production. Smallholder irrigators were provided about 68% of water mostly from dams and 51.2% of homestead food gardeners which the data conveys that it is the most availing source of water for both farmers. Rainfall is the second water source for farming which 14.8% of smallholder irrigators and 32.6% of homestead food gardeners depend on.

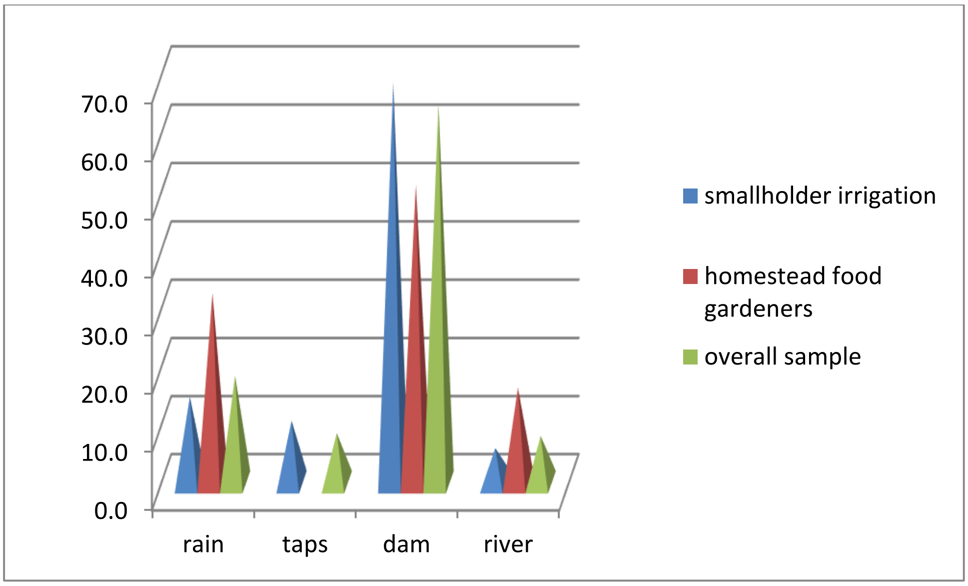

Figure 4.8 Sources where respondents obtain water for irrigation

4.5.2 Types of irrigation used by smallholder farmers

The most commonly used irrigation system in Ncora is the furrowing system with 65.1% of homestead food gardeners and 50.9% of smallholder irrigators. Furrow irrigation is the dominant method of irrigation in South Africa, accounting for 90% to 95% of all irrigated crops (Purcell, 2006). Furrow irrigation, where water is transferred from a head ditch to crop furrows via siphons, is one of the most simple and ancient forms of irrigation delivery (Hansen *et al.*, 1980). It can achieve reasonable crop WUE; but is very variable and is limited. Furrow irrigation involves a balance between field slope and length, water infiltration rates, and the rate of irrigation application for uniformity of applied water in the profile and reduction of drainage beyond the root zone (Hansen *et al.*, 1980). Due to the nature of the system (inundation of furrows), water logging is common. Furthermore, a greater amount of water will be supplied to the upper end of the field, thus increasing deep drainage beyond the root zone in this region or depriving plants at the lower end of the field from a fully recharged root zone. A high rate of application and a long run time can result in excessive runoff, whilst low rates of application results in slow water advance, cause poor water distribution and deep drainage losses.

Sprinkler type of irrigation system was mainly used by smallholder irrigators though water flows by gravity. The other types of irrigation systems for example flooding, and pivot requires larger volumes of water hence limiting its use by homestead food gardeners and irrigators. Overall, furrowing (53.8%) was the most used followed by sprinkler (28.8) and drip irrigation (14.2). The full range of irrigation systems is found on various schemes across South Africa, namely flood, sprinkler, centre pivot, and micro and drip irrigation, with sprinkler irrigation being the most common (DWAF, 2006).

Drip irrigation is one of the most efficient forms of irrigation technology currently available. It is a technology by which water can be conserved and yields increased for farmers, especially those who are cultivating in semi-arid conditions of the world or in areas where competition over water resources is escalating (Bamoun, 2011). According to FAO (1984), drip irrigation offers many advantages over conventional flood irrigation including water savings, reducing labor required for irrigation, reducing soil erosion and increasing crop productivity. Despite these advantages, drip irrigation is being applied less than one percent of global irrigated acreage and adoption of the technology by smallholders in developing countries has been negligible. Reasons for the lack of uptake among small farmers includes the fact that drip irrigation technologies are expensive, complicated to operate and maintain, and not configured to fit small plots (Conaty, 2012).

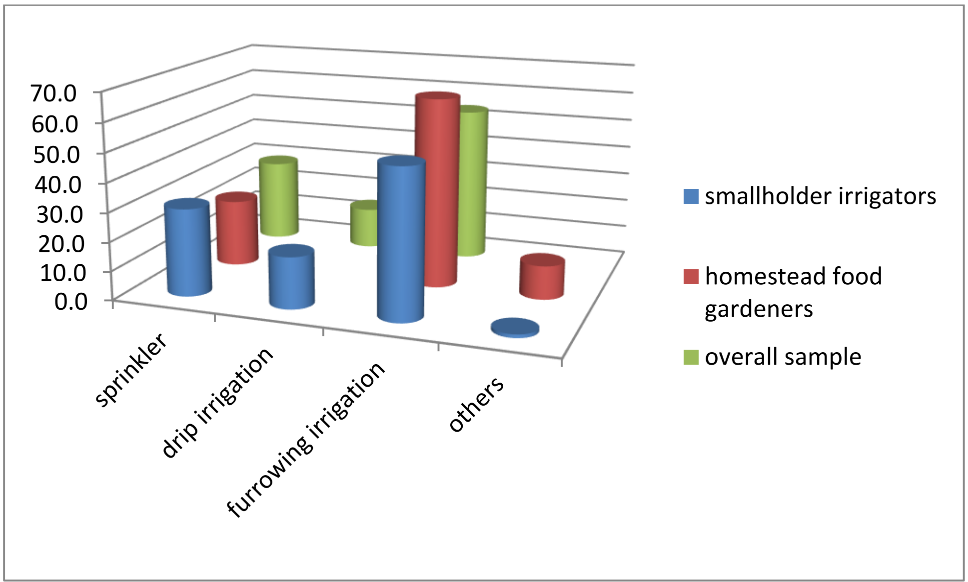

Figure 4.9 Types of irrigation system used by smallholder farmers

4.5.4 Types of crops irrigated

Most existing smallholder irrigation schemes worldwide were developed for the purpose of crop production yet integrating animal and crop production offers potential advantages (FAO, 2003).

Table 4.7 Types of crops irrigated

		Crops grown on irrigation scheme					
		potatoes	cabbage	spinach	maize	butternut	carrots
type of farmer	irrigators	124	69	21	139	18	22
	gardeners	32	4	4	43	0	1
Total		182	73	25	156	18	23

4.5.5 Factors impeding farmers' access to irrigation schemes

Figure 4.10 shows the factors impeding farmer's access to irrigation scheme. The respondents stated that the major challenge is lack of funds 78.1% of smallholder irrigators meaning that the majority of them are interested in irrigation schemes but they don't have funds whereas only 34.9% of homestead food gardeners complained about that as they said that (44.2%) have no knowledge about the schemes. 7% of homestead food gardeners were not interested at all.

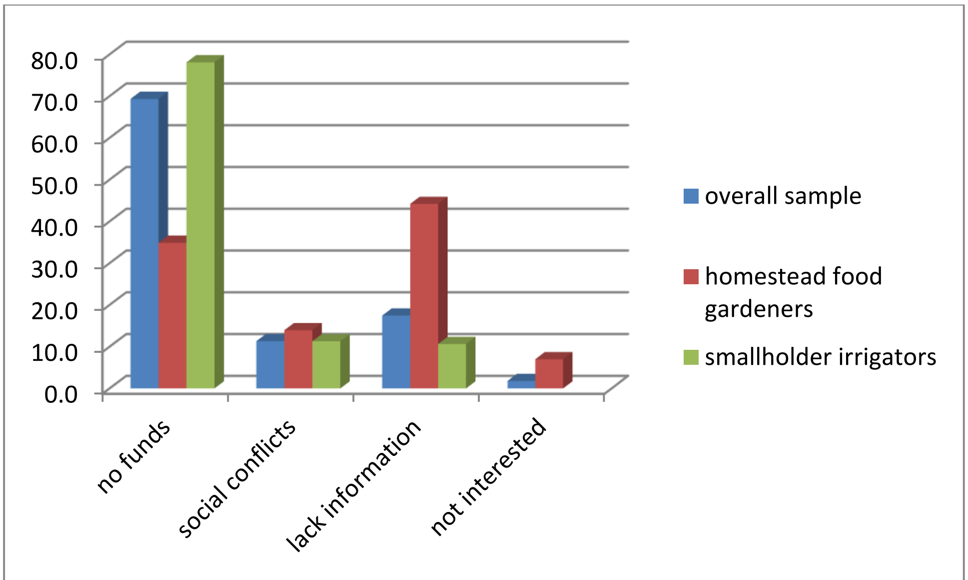

Figure 4. 10 Factors impeding farmers' access to irrigation schemes

4.5.6 Challenges faced by smallholder irrigators at the irrigation schemes

Figure 4.11 presents the results given by the respondents about the challenges they face at the irrigation scheme. The majority of the respondents (46.5% homestead food gardeners and 58.6% smallholder irrigators) stated that it is hard to operate the machines especially the sprinklers and they cannot fix pipes when broken. This substantiate the suggestion given by DWAF (2006), which noted that the successful sharing of water resources requires that the group of farmers be well organised and equipped (trained) to control, operate and maintain their infrastructure and manage their finances.

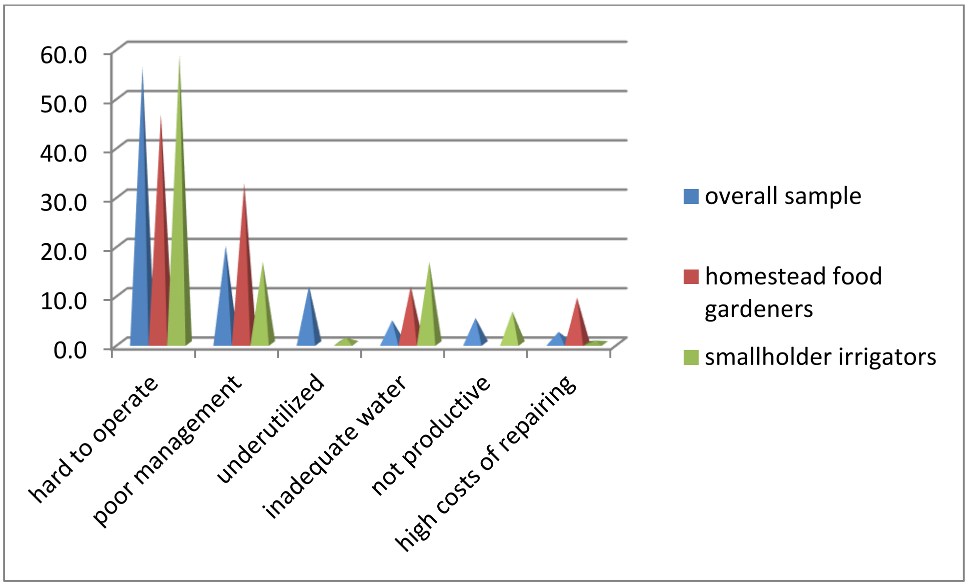

Figure4. 21 Challenges faced by smallholder irrigators at the irrigation schemes

4.5.7 Smallholder irrigators' suggested solutions

Although the government still provides extension services to smallholder irrigators at the Ncora irrigation scheme, farmers seem to be unsatisfied with the services, with 77.1% (smallholder irrigators) and 95.3% (homestead food gardeners) calling for more support from the government especially in respect to provision of inputs, and more extension officers skilled in technical aspects of irrigation systems. Some 13% of the farmers called for the community intervention as many of the homestead gardeners were not interested in participating. Only 1.8% smallholder irrigators and 4.7% homestead food gardeners called for the role of NGOs to be enhanced to support farmers in different aspects of their farming business. This have been substantiated by Love *et at,* (2006) who note that focusing on capacity building for transfer of existing technologies and much closer collaboration between state and NGO sectors must be ensured. In addition they suggested that community authorities should intervene to solve some of these challenges especially the problem of land access and transfer of water use rights for improved operation of the system. The 7.1% of smallholder irrigators said they don't even care as long as they are still using it and are happy with the service rendered by the extension officers.. This information is presented in Figure 4.12.

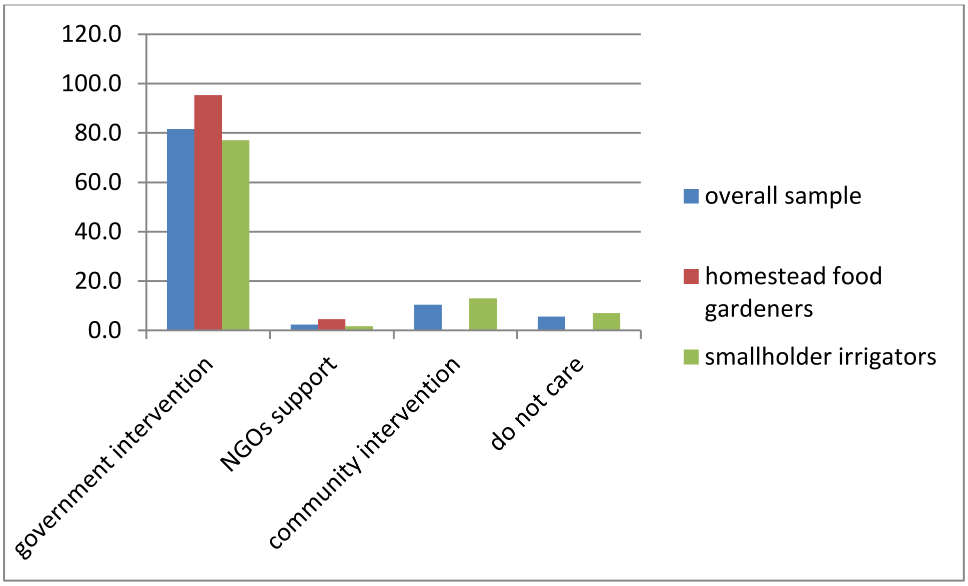

Figure 4.12 Smallholder irrigators' suggested solutions

4.6 Household socio- economic factors

Socio-economic factors involve the social and economic environment under which households operate. Understanding the factors under which smallholder and emerging homestead food gardeners, is useful in understanding their farming participation behaviour. This section looks at factors related to, extension services, market accessibility, farmer organisation and market infrastructure.

4.6.1Access to extension service

Figure 4.13 presents farmers response to access to extension services. 91.1% of smallholder irrigators have access to extension service and they were meeting once every week whilst only 46.5% of homestead food gardeners because many of them were not attending the sessions. Smallholder irrigators recommended that extension services were helpful as they were getting more information and know-how from them. In Ncora village it is found that the majority of farmers have access to extension services (82.1% overall sample) only 17.9% in the sample did not have access.

Extension service in the Eastern Cape Province is a top-down approach rather than a participatory approach (Van Niekerk *et al.,* 2011). This agrees with the results obtained from the respondents as they were complaining that the extension officers only render service but never participate for example during input application basically in hands on practical skills training.

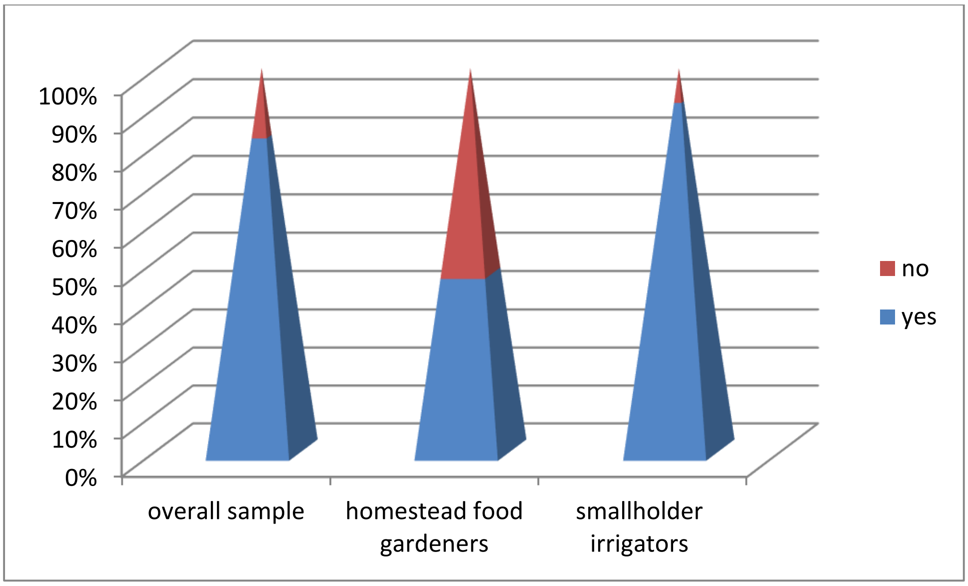

Figure 4.13 Access to extension service

4.6.2 Group membership

According to Randela (2005), farmer organisations are important means of linking producers with markets, where an individual producer cannot individually enjoy economies of scale. In Ncora village homestead food gardeners (74.4%) were observed not to belong to any farming organization and only 25.6 who are members of the organisation. The data illustrate that the organisation existing in the study area were dominated by smallholder irrigators (73.4) and only 26.6% of them were not. This is contrary to what would be expected in that more of those without access to farming organizations should be underutilizing land as opposed to what is revealed by the results. Those who belong to farmer groups in the Ncora village cited that they received financial support, market information and moral support from the organisations. Some farmer organisations go to the extent of insuring their farmers in order to cover for risks and uncertainties. The organisations operating in the area are community farmer associations or farmer cooperatives. Data analysis shows that the farmers belonging to farmer cooperatives had better access to resources and are better supported than those belonging to the other organisations.

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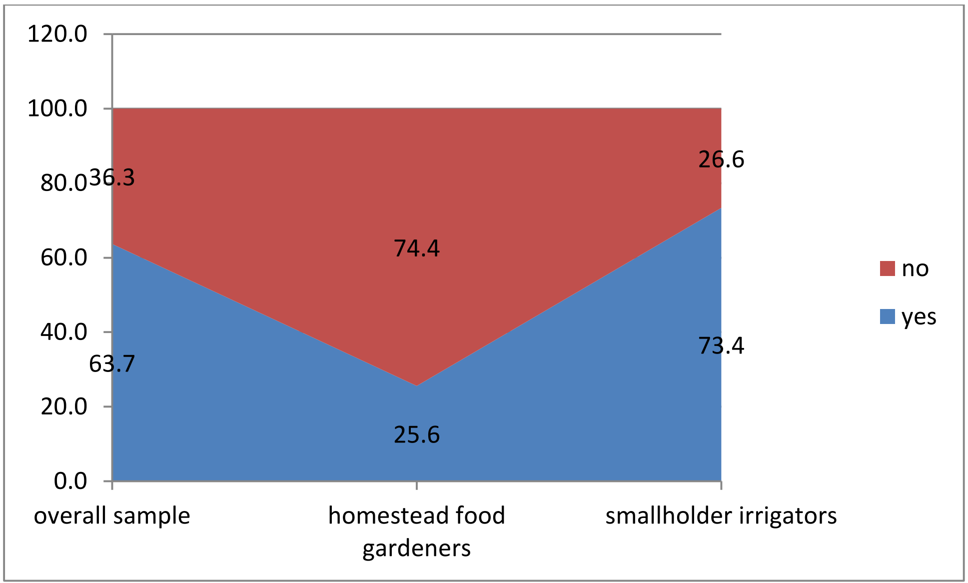

Figure 4.14 Group membership

4.6.3 Farmers benefits from group membership

The figure below indicate that both smallholder irrigators (45%) and homestead food gardeners (74.4%) used groups as a major source of supply of farm labour which makes 51% of the overall sample. Notably, farmer groups provided relatively subsidised farm inputs and collective marketing to smallholder irrigators (14.8% and 20.1%, respectively) whereas homestead food gardeners do not benefit from subsidised input but 7% on collective marketing. Another contribution of farmer groups to homestead food gardeners was access to farm related information and exchanging of views.

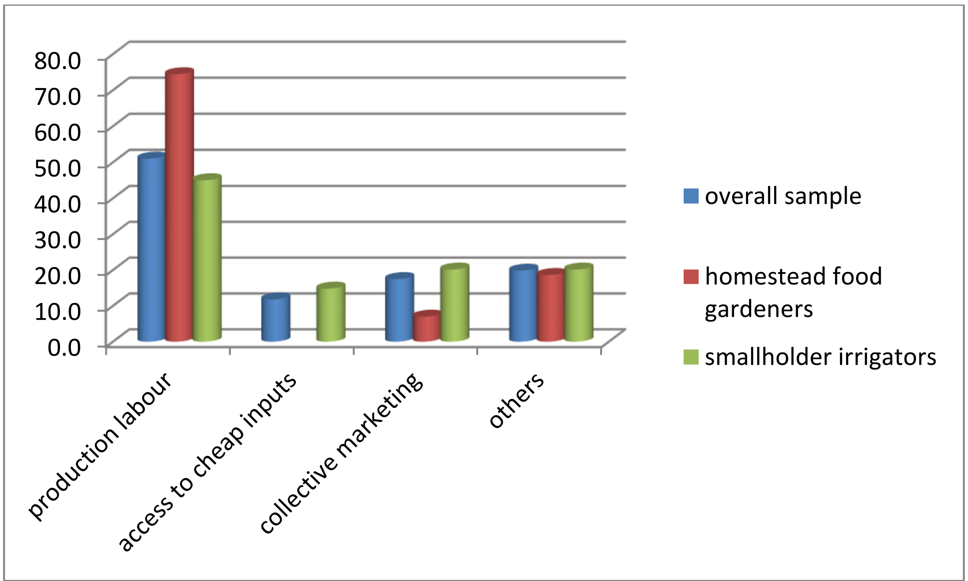

Figure 4.15 Farmers benefits from group membership

4.7.1 Access to output markets

Most households have access to output markets which is 96.4% of smallholder irrigators and 86%of homestead food gardeners. Only 3.6% of smallholder irrigators and 14% of homestead food gardeners who do not have access to output who complained about lack of marketing information and some of them reported that they only produce for their own consumption. This agrees with literature which states that with improved access to markets, farmers have an incentive to increase the amount of irrigation schemes to produce more products for market. This is illustrated on table 4.8.

Table 4.8 Access to output markets

	Homestead food gardeners (n=43)		**Smallholder irrigators (n=169)**		**Overall sample (212)**	
	frequency	Percent %	frequency	Percent %	frequency	Percent %
Yes	37	86.0	163	96.4	200	94.3
No	6	14	6	3.6	12	5.7
Total	43	100	169	100	212	100

4.7.2 Point of sale

Table 4.9 present the point of sale which farmers in Ncora irrigation uses when selling their produce. The majority of farmers use farm gate marketing due to long distance to the supermarkets and some were only selling surplus produced especial homestead food gardeners (86%) and 71% of smallholder irrigators using it. 14% of smallholder irrigators were using middlemen whereas 20.7% of smallholder irrigators. It is only the smallholder irrigators who were also selling their produce to the supermarkets around Cofimvaba. Transport problems remain a challenge to the farmers, resulting in a reduction in rural-urban linkages and an increase in rural-rural linkages, where transportation is unnecessary (Jari,2009) .

Table 4.9 Point of sale of the agricultural produce

	Homestead food gardeners (n=43)		**Smallholder irrigators (n=169)**		**Overall sample (212)**	
	frequency	Percent	frequency	Percent	frequency	Percent

		%		%		%
Farm gate	37	86.0	120	71.0	149	70.3
Middlemen	6	14	35	20.7	42	19.8
Supermarkets			6	3.6	7	3.3
Total	43	100	169	100	212	100

4.7.3 Problems that are faced in production and marketing of agricultural outputs of the respondents

The main objective of the farmers is to produce the highest possible yield for market so as to achieve high profit. However there is a wide array of factors impeding the farmers from achieving those particular objectives. Figure 4.16 indicate the possible problems that are faced by farmers in production and marketing of their outputs in Ncora village. The majority of 37.2% homestead food gardeners reported lack of capital and lack of agricultural input as they reported that they were only using 1 tractor the whole village so they all have to wait for it. 29% of smallholder irrigators also complained about lack of inputs and lack of access to output market (20.7%). Thus the overall sample indicates that the main challenging factor is lack of inputs in the study area (26.9%).

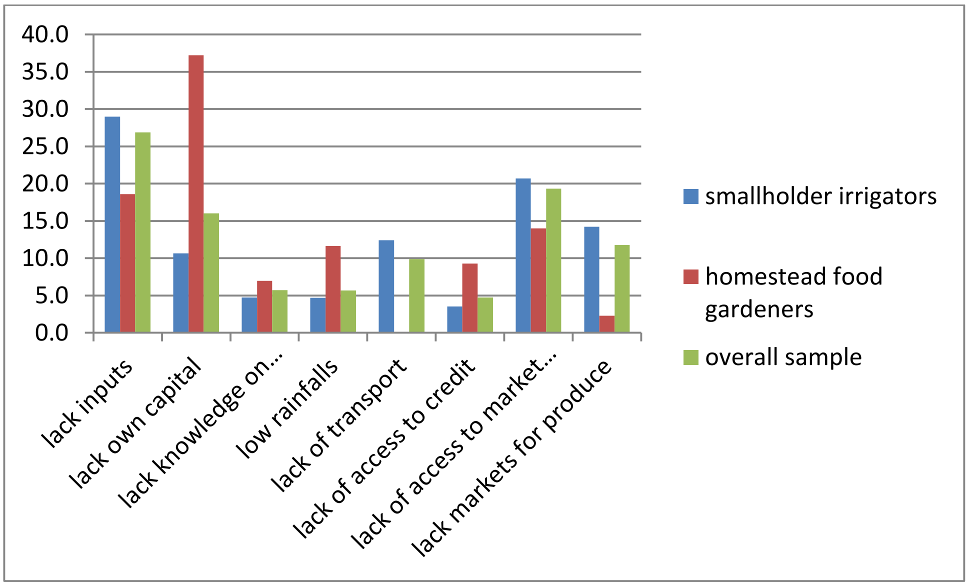

Figure 4.16 Problems that are faced in production and marketing of agricultural inputs of the respondents

4.7.4 Respondents' suggested solutions

In Ncora village, marketing appears to be difficult amongst smallholder farmers, even though successful farming has been pursued. Communication appears to be slow, where the majority of the smallholder farmers depend on the word of mouth for market information (Nel, Binns and Hill, 1997). Figure 4.17 presents the possible solutions suggested by the respondents to problems that are faced in production and marketing of agricultural inputs. The majority of the respondents (48.8% of homestead food gardeners and 25.4% of smallholder irrigators) suggested providing more extension services as they were not satisfied by the service rendered by the current because they were not participating in input application as it was their major challenge. The results show that 21.3% smallholder irrigators and 18.6% homestead food gardeners needed more irrigation schemes. Backeberg (2006) as cited by Denison and Manona (2007) argues that one of the few options available given the historical exclusion of emergent farmers from profitable networks is to engage in contracts with the agri-business sector and enter the higher value markets. Whilst these findings remain valid and beneficial to the smallholder irrigation farmers, it remains a challenge to build a strong and reliable relationship between smallholder farmers and the agribusiness traders and processors.

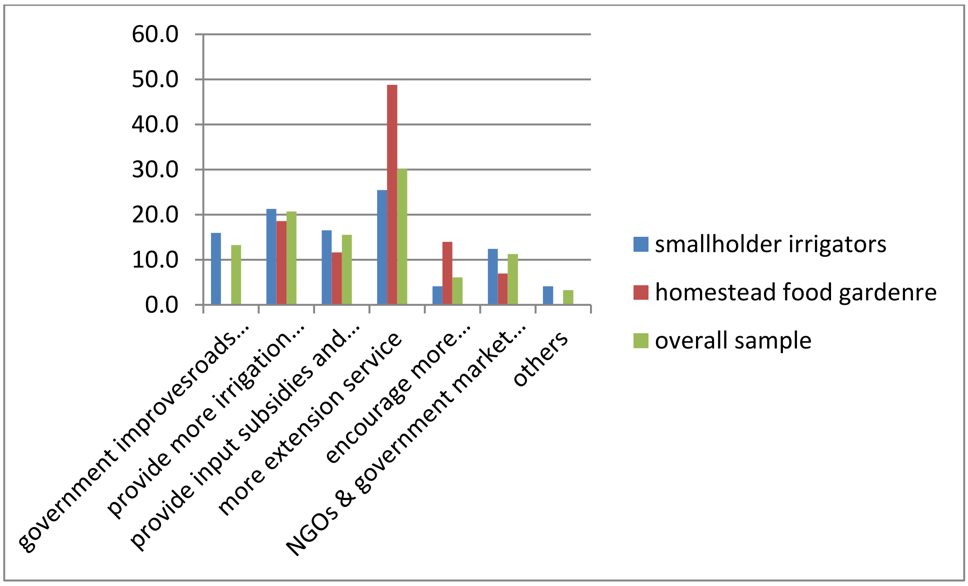

Figure 4.17 Respondents' suggested solutions

4.8 Empirical analysis

The Data Envelopment analysis was applied to estimate efficiency levels, and the Robust regression analysis was used to estimate the factors that affect levels of efficiency. The dependent variable of the estimated model was output from maize and potatoes produced in the previous season. The independent variables used for all the two crops included; area planted for the two crops, seeds, fertilizer, herbicides, pesticides, other expenses such as(transport and labour) and finally the cost of hiring machinery.

4.8.1 Data Envelopment Analysis Results

The DEA results are shown in the tables below with Table 4.10 summarizing the mean efficiencies of the smallholder irrigators and homestead food gardeners. Constant returns to scale refers to those inputs that do not vary whereas variable returns to scale refers to those inputs that can vary and scale efficiency is the overall efficiency for the farm. Table 4.10 illustrate that when measuring efficiency using constant returns to scale both farmers are inefficient homestead food gardeners (maize =0.254, potatoes= 0.380), smallholder irrigators (maize= 0.181, potatoes = 0.169) and for the overall sample(maize= 0.499, potatoes= 0.147) because their mean values are below 90%. In contrary both farmers (homestead food gardeners =0.993 and smallholder irrigators =0.948) have been found to be more efficient in potato production when using variable returns to scale resulting to an overall mean of 0.942 of the overall sample. Furthermore homestead food gardeners maize producers were efficient under variable returns to scale (0.933) whereas smallholder irrigators weren't (0.864). under scale efficiency both farmers were inefficient.

Table 4.10 Data envelopment analysis results maize and potatoes

	HOMESTEAD		**SMALLHOLDER IRRIGATORS**		**OVERALL SAMPLE**	
	MAIZE	**POTATOES**	**MAIZE**	**POTATOES**	**MAIZE**	**POTATOES**
Constant returns to scale	0.254	0.380	0.181	0.169	0.499	0.147
Variable returns to scale	0.933	0.993	0.864	0.948	0.821	0.942
Scale Efficiency	0.264	0.385	0.214	0.179	0.579	0.159

Source: own survey 2013

Table 4.11 shows the results of the input oriented Data Envelopment Analysis for maize crop grown by smallholder irrigators, homestead food gardeners and for the overall sample. In the study 5 homestead food gardeners and 4 for smallholder irrigators producing maize under CRS are fully efficient.

Furthermore 37 homestead food gardeners and 117 smallholder irrigators maize producers under VRS were also fully efficient. However, 30 homestead food gardeners and 136 smallholder irrigators under CRS showed a performance below 0.40. The anticipated technical efficiencies differed, it ranged between 0.40 and 1.00 for homestead food gardeners and for smallholder irrigators ranged from 0.535 to 1.00 from CRS and VRS range was 0.831 to 1.00 for homestead and the smallholder irrigators were fully efficient, with a mean technical efficiency of homestead food gardeners being 0.823 and smallholder irrigators 0.901 under scale efficiency. The results thus indicate that there is still opportunity on improving technical efficiency. Smallholder irrigators can reduce their input costs by 10 % on the average while remaining at the same production level and homestead food gardeners can reduce their inputs costs by 18 %. These few inefficient farms might be inefficient due to the farmers failing to use their inputs properly and also due to the fact that there is a high cost in hiring the machinery such as tractors for ploughing.

Table 4.11 Data envelopment analysis results for maize

Efficiency score	**Maize (homestead)**			**Smallholder irrigators**			**Overall sample**		
	CRS	**VRS**	**SE**	**CRS**	**VRS**	**SE**	**CRS**	**VRS**	**SE**
1	5	37	5	4	117	4	49	158	50
0.90-1.00	0	0	0	1	0	4	3	0	7
0.80-0.90	1	0	1	4	1	5	3	0	5
0.70-0.80	0	0	0	2	3	2	3	2	7
0.60-0.70	0	1	0	4	15	4	10	0	14
0.50-0.60	3	4	3	2	23	3	22	8	21
0.40-0.50	1	1	1	5	10	3	28	0	30

0.30-0.40	3	0	4	11	0	18	40	8	53
<30	30	0	29	136	0	126	55	36	26
Minimum	0.000	0.400	0.000	0.000	0.400	0.000	0.034	0.034	0.067
Maximum	1	1	1	1	1	1	1	1	1
Mean									

Source: own survey 2013

Keys: **CRS-constant returns to scale, VRS- variable returns to scale, SE- scale efficiency**

Table 4.12 shows the results of the input oriented Data Envelopment Analysis for potatoes grown by smallholder irrigators and the homestead food gardeners. In this study the two groups are fully efficient when the variable returns are considered and only 6 farms are fully efficient at CRS for homestead food gardeners and 3 are efficient at CRS for smallholder irrigators and the mean efficiency of smallholder irrigators is 14 % and for homestead food gardeners is 32%. This shows that the two groups are inefficient when it comes to potato crop production it might be due to the fact that they do not have enough labour and capital to enhance production.

Table 4.12 Data envelopment analysis results for potatoes

Efficiency score	**Potatoes (homestead)**			**Smallholder irrigators**			**Overall sample**		
	CRS	**VRS**	**SE**	**CRS**	**VRS**	**SE**	**CRS**	**VRS**	**SE**
1	11	40	11	12	145	12	12	177	12
0.90-1.00	0	2	0	10	2	10	10	2	10
0.80-0.90	0	1	0	0	1	0	0	1	0
0.70-0.80	0	0	3	0	4	0	0	4	0
0.60-0.70	4	0	1	0	6	0	0	17	0
0.50-0.60	0	0	0	0	11	0	0	11	0
0.40-0.50	0	0	0	3	0	3	3	0	3

0.30-0.40	0	0	0	0	0	4	0	0	8
<30	28	0	28	144	0	140	187	0	179
Minimum	0.003	0.857	0.003	0.000	0.505	0.014	0.000	0.505	0.000
Maximum	1	1	1	1	1	1	1	1	1
Mean									

Source: own survey 2013

4.8.2 Determinants of technical efficiency among smallholder farmers of ncora village

Then, a second step analysis (Bravo-Ureta and Pinheiro, 1997; Nyemeck, 1999) is performed where separate two-limit Tobit equations for TE are estimated as a function of various attributes of the farms/farmers in the sample. This study has policy implications because it not only provides empirical measures of different technical efficiency indices, but also identifies some key variables that are correlated with these indices. In this fashion, we go beyond much of the published literature concerning efficiency because most research in this area of productivity analysis focuses exclusively on the measurement of technical efficiency (Coelli, 1995).

Thus, an analysis of the determinants of efficiency in potatoes and maize production was performed using linear regression model.

4.8.2.1 Factors affecting the level of technical efficiency for maize production

Table 4.13 presents variables that were assumed to affect maize production efficiency. The crop production efficiency is characterised by the total value of crops grown at household farm level measured against input cost levels and household socioeconomic factors such as educational level and quantity used of inputs. The T-value shows that the explanatory variables combined, significantly influence changes in the dependent variable. The results for the two tables will be analysed separately in terms of the crops produced which is maize and potatoes.

Table 4.13 : Determinants of technical efficiency among smallholder maize farmers

					95% confidence interval	
Maize harvested (kg)	Std. Error	Beta	T-Values	P-Values	Lower Bound	Upper Bound
(Constant)	3174.004		.692	.490	-4063.551	8458.073
Cropped area	412.681	.385	7.802	.000	2405.509	4033.558
Quantity sold (kg)	.038	.566	11.574	.000	.364	.513
Total cost for maize	.462	.065	1.346	.180	-.290	1.535
Quantity used of seed (Lt)	5.905	.075	1.019	.310	-5.633	17.662
Unit Price of seed	7.921	-.066	-1.124	.262	-24.528	6.720
Quantity of fertilizer used	12.265	.028	.315	.753	-20.326	28.061
Unit Price of fertilizer	1.970	-.037	-.482	.631	-4.835	2.937
Quantity of pesticides used (litres)	100.530	-.073	-.628	.531	-261.438	135.159
Unity Price of pesticides	12.233	.184	1.559	.121	-5.054	43.207
Quantity of herbicides used	190.421	.121	.639	.524	-253.937	497.283
Unity Price of herbicides	20.558	-.223	-1.199	.232	-65.208	15.896
Household Size	241.888	-.004	-.081	.936	-496.632	457.631
Sex	1175.610	-.046	-.804	.422	-3264.204	1373.642
Age (Yrs)	38.463	-.007	-.122	.903	-80.567	71.173
Education Level	444.091	-.030	-.644	.521	-1161.855	590.108
No of Years in Farming	77.762	-.029	-.466	.642	-189.614	117.161

Total Land cultivated	361.501	.030	.649	.517	-478.514	947.628
Type of irrigation facility	587.649	-.030	-.563	.574	-1489.867	828.440
Input Use	1526.616	.119	1.767	.079	-313.192	5709.392
Agronomics	1476.081	-.156	-2.247	.026	-6228.161	-404.939
Marital Status	561.422	.062	1.101	.272	-489.076	1725.765
R-squared =0.658 P-value = 0.000 Number of response (n=212)						

Source of Data: Own survey 2013 significance shown as follows *** (1%),**(5%) ,and *(10%)

Household size, X2 = Age, X3 = (years), X4 =, X5 = Amount of land owned, X6 =, X7 =, X8 = Use of tractor, X9 = Gross margins,X10= and X11= crop incomes.

From the table above quantity of fertilizer, unit price of fertilizer, quantity of pesticides used, quantity of herbicides used, household size, age, education level, number of years in farming, total land cultivated and type of irrigation facility were positive between 5% and 10% level. Cropped area and quantity of maize sold were at 0.00 levels. This means that they both have a positive influence on efficiency. However it is not the case

Unit price of pesticides and total costs of maize were significant at 1% significance levels with 1.559 and 1.346 t-values respectively. This means that a decrease in the Unit price of pesticides and total costs of maize will increase production efficiency of maize.

However it’s not the case for other variables being insignificant (Table 4.13) this means that an increase in such variables will have a negative impact on efficiency.

Marital status of the respondents for example in the study has a negative significance on maize production this is shown in table 4.13 P-value 0.272 and T-value 1.101. This means that an increase in the married couples will increase the efficiency of maize production. Crops such Maize is negatively insignificant which means there isn’t much difference if a farmer is married or not. The type of farmer is insignificant meaning being a smallholder irrigator or a homestead food gardener has no impact on efficiency.

In this study age of respondents is a factor that affects maize producers and it negatively affects it. In table 4.13 it shows that the P-Value is 0.903 and the T-Value is -0.122 meaning the older the respondents are the less efficient they becoming.

The years spent at school have a positive impact on production with a positive P-value of 0.521(Table 4.13) this means that the higher the level of education the more efficient the maize producers are.

4.7.2.2 Factors affecting the level of technical efficiency for potatoes production

Data for 212 households that produce potatoes was used to explain the determinants of technical efficiency among smallholder potatoes producers (Table 4.14).

Table 4.14 : Determinants of technical efficiency among smallholder potatoes production

					95.0% Confidence Interval	
	Std. Error	Beta	t-values	p-values	Lower Bound	Upper Bound
(Constant)	9.320		.015	.988	-18.244	18.528
Cropped Area (ha)	16.477	.002	.373	.709	-26.355	38.653
Quantity Sold (Kg)	.003	1.000	367.521	.000	.994	1.005
Unit price (R)	.374	.019	3.649	.000	.627	2.103
Total cost (R)	.003	-.003	-.814	.417	-.009	.004
Quantity of Seed used (Kg)	.027	-.008	-2.342	.020	-.116	-.010
Unit Price of seed (R)	.041	-.002	-.556	.579	-.104	.058
Quantity of fertilizer used	.056	-.001	-.186	.853	-.120	.099
Unit Price	.007	.000	.007	.995	-.013	.013

(fertilizer)						
Quantity of pesticide (litres)	2.459	.085	4.351	.000	5.848	15.548
Unit Price of pesticides	.171	-.017	-1.490	.138	-.592	.082
Quantity of herbicides (litres)	2.482	-.091	-4.569	.000	-16.235	-6.443
Unity Price of herbicides	.118	.007	.853	.395	-.132	.333
Household Size	.709	.001	.911	.364	-.753	2.045
Sex	3.476	-.003	-1.908	.058	-13.491	.224
Age Yrs	.127	-.002	-.871	.385	-.362	.140
Education Level	1.374	.001	.444	.657	-2.100	3.320
No of Years in Farming	.233	-.001	-.505	.614	-.576	.342
Total Land cultivated	1.043	-.001	-.826	.410	-2.920	1.196
Type of irrigation facility	1.868	.003	1.697	.091	-.515	6.854
Input Use	4.753	.007	3.288	.001	6.253	25.004
Agronomics	4.852	-.003	-1.341	.182	-16.078	3.065
Marital Status	1.742	-.002	-1.192	.235	-5.514	1
R-squared = 1.000 P-value =0.000 Number of response (n=212)						

Source of Data: Own survey 2013 significance shown as follows *** (1%),**(5%) ,and *(10%)

The results (Table 4.14) show that the determinants of technical efficiency results from a unit change in each variable. Quantity sold, unit price, quantity of pesticides used, quantity of herbicides used, input use all show significance less than 5%. The form in which potatoes are sold at farm level is positively related to farm efficiency.

4.9 Profitability

To determine the profitability of the enterprises a Gross Margin was used and the formula used was total revenue of each enterprise – the expenses (fertiliser, seeds, pesticides, herbicides, other costs (transport, labour) incurred during production of each enterprise. The results are shown in Table 4.13 and Table 4.14.

Table 4. 15 Profitability of homestead food gardeners and smallholder irrigators for maize production

	HOMESTEAD FOOD GARDENERS				SMALLHOLDER IRRIGATORS			
Item	**Unit**	**Quantity**	**Price per unit**	**Amount (R/ha)**	**Unit**	**Quantity**	**Price per unit**	**Amount (R/ha)**
Income (GVP) (Gross value of production)								
Maize sold in 50kg bags	Kg	2	100	2000		95	120	11400
Maize consumed at home	Kg	30	100	300		3	120	360
GROSS INCOME				2300				11760
VARIABLE COSTS								
Seed	Kg	25	1.50	37.50		200	1.00	200
Fertilizer	Kg	100	3.80	380		250	3.80	950
Herbicides	Litre	25	2.70	67.50		25	2.70	67.50
Pesticides	Litre	25	2.70	67.50		25	2.70	67.50
Tractor hire	Day	2	600	1200		3	600	1800
Costs of harvesting						4	50	200
TOTAL VARIABLE COST				1402.5				5085
GROSS MARGIN				897.5				6675

Source: own survey 2013

Table 5.15 above reveal the average gross margins per hectare for both homestead food gardeners and smallholder irrigators for maize enterprises. On average, the gross income for maize per hectare for both homestead and irrigators is R2300 and R11760 respectively. This amount was made up of sales of maize in 50kg bags and maize consumed by the farmers. However, of these two components of gross income per hectare in both groups of farmers, maize for sales in smallholder irrigators was the largest whereas it was for home consumption which was the largest in the case of homestead food gardeners. This agrees with the literature which states that homestead food gardeners only produce for their own consumption in contrary to smallholder irrigators that want to achieve the highest possible profit from the production and sales of maize. These findings concur with (Delmer, 2005; Keetch *et al*., 2005; Gouse *et al*., 2006; Pray *et al*., 2009; Qaim, 2009) who cited that the low output for groupsof farmers can be attributed to lack of land and credit to obtain some inputs needed in the area. In addition to that, farmers reported that late planting is also a problem that reduces their yields. The total variable costs for the two groups of farmers for maize production differ which is 5085 for smallholder irrigator and 1402 for homestead food gardeners as shown in Tables 5.15 above. The average cost for seed per hectare for smallholder farmers was R200 which was higher than that for homestead food gardeners due to the fact that the former uses more of seeds at lower price (1.00) than the latter. This might have been caused by smallholder farmers in Ncora village affiliated to farmers' cooperatives who get farming inputs inclusive of seed at discounted rates which are at least 90 percent going further below. Therefore, smallholder irrigators will be discounted when buying seeds. On the other hand, the average price of seed per hectare for homestead food gardeners who plant maize is lower compared to the prevailing market prices because in calculating the average price, farmers who use grains from previous harvest do not purchase seed are included as well. This therefore results in the low seed per hectare price of seed (R37.50).

Furthermore, the prices for fertiliser reported by the farmers in Ncora village were the same although the quantity used by the two groups wasn't the same. This is due to fact that homestead food gardeners who used lower quantity than smallholder irrigators because same amounts cattle manure per hectare as a substitute for inorganic fertilisers whereas the smallholder irrigators were only using fertilizer. Smallholder farmers use LAN 28% for side dressing. The cost and quantity used of pesticides and herbicides for control of maize stem borer were the same for both farmer since it was their choice to use them or not to use so there were no discounts when purchasing them. This suggests that, smallholder farmers in Ncora do not apply pesticides a lot as can also be confirmed by the average quantity applied per hectare. This observation is in support of Delmer (2005) who note that smallholder farmers do not apply the required quantity of pesticides when the prices are prohibitive and this leads to low yields when the maize crop is attacked by maize stem borer. Although maize is critical to the growth of maize, no irrigation costs were incurred by the farmers due to the good rainfall pattern.

However, the highest expense recorded for both groups was tractor hire which made up more than 50 percent of the total variable costs for both groups. The average price for tractor hire was below the common prevailing price indicated by most smallholder farmers in the area, which was R600.00 to plough an area of approximately 2 hectares. Therefore farmers incurred the bulk of these costs prior to harvesting. In both groups, major variable costs at pre-harvest stage were seed, fertilizers and land preparation. Since most homestead food gardeners produce for subsistence, they did not incur marketing costs after harvesting. In addition, the average cost for casual labour hired for harvesting was low because hiring labour was not a very common practice.

Land area was measured in hectares. Gouse *et al*. (2006) reported that farmers tend to give over estimates of their plot sizes. In an attempt to minimize collecting extremely inaccurate estimates of plot sizes, a face to face interview with the local headman (*Inkosi*) was done and he indicated that most people have plot sizes of 2 hectares. Unlike the argument noted by Gouse *et al*. (2006), smallholder farmers were able to give an accurate account of their land sizes hence rendering measures on per hectare basis in this valid study. These results suggest that smallholder irrigators were better-off in terms of yield than homestead. Thus it can be concluded that the use of irrigation schemes can contribute positively to household food security for farmers who produce mainly for own consumption and increased incomes for those who sell on the market. The average total variable costs for production of maize were higher than that of homestead food gardeners due to higher quantities of inputs used. This small difference in cost of production can be attributed to the fact that smallholder farmers in obtain subsidised inputs mainly from the co-operatives they are affiliated to. Hence, reflecting the positive role which collective action plays in reducing the cost of production.

However, smallholder irrigators recorded a higher gross margin per hectare of R6675 as compared to homestead food gardeners R897.5. Gross margin was obtained from subtracting total variable costs from the gross value of production. This suggests that planting maize under irrigation scheme is more profitable as compared to planting under homestead food gardeners.

Table 4. 15 Profitability of homestead food gardeners and smallholder irrigators for potato production

	HOMESTEAD FOOD GARDENERS				**SMALLHOLDER IRRIGATORS**			
Item	**Unit**	**Quantity**	**Price**	**Amount (R/ha)**	**Unit**	**Quantity**	**Price**	**Amount (R/ha)**
Income (GVP)								
Potatoes sold in 10kg	Kg	19	80	1520		85	60	5100
Potatoes consumed at home	Kg	20	80	160		5	60	300
GROSS INCOME				1680				5400
VARIABLE COSTS								
Seed	Kg	25	1.50	37.50		200	1.00	200
Fertilizer	Kg	100	3.80	380		250	3.80	950
Herbicides	Litre	25	2.70	67.50		25	2.70	67.50
Pesticides	Litre	25	2.70	67.50		25	2.70	67.50

Tractor hire	Day	2	600	1200		3	600	1800
Costs of harvesting						4	500	200
TOTAL VARIABLE COST				1402.5				5085
GROSS MARGIN				277.5				315

Source: own survey 2013

Table 5.15 above reveal the average gross margins per hectare for potato production for both smallholder irrigators and homestead food gardeners. The indication from Table 5.14 is that smallholder irrigators concentrate more on potato production than the homestead food gardeners. According to the results, smallholder irrigators generate significantly higher potato yield, total revenues and gross margins from maize enterprise which is R3500, R5400 and R315 respectively more than homestead food gardeners. Also smallholder irrigators produce more average marketable surplus of potatoes which is R5100 compared to R1520 average amount per hectare of the homestead food gardeners. This is because homestead food gardeners consume more as much as they want to sell the surplus. However, homestead food gardeners spent more money in purchase of inputs and this may have contributed to their low gross margins (R277.5). Smallholder irrigators incur less input costs probably because they purchase inputs collectively, thereby reducing on the unit costs. Thus,, smallholder irrigators have higher chances of benefiting from price discounts and transport offer by input suppliers than homestead food gardeners. Further, this may be due to, smallholder irrigators have more access to reliable irrigation water supply and modernised irrigation systems compared to the homestead food gardeners who have less access to crop irrigation water and mainly rely on traditional irrigation methods. In South Africa, the potential grain yields that can be obtained under irrigation farming range from 7 to 12 tons/ha (Fanadzo *et al.,* 2009). This indicates that potatoes yields for both smallholder irrigators and homestead food gardeners are far below the expected yields. This suggests that smallholder irrigators are sub-optimally utilizing irrigation schemes. The low yields may be attributed to low fertilizer, pesticides and herbicides applications, among others. Further, the low use of these agro-chemicals may be due to lack of investment capital to purchase these inputs.

Table 4.16 Summary of financial performance comparison

Average per category	Homestead food gardeners		Smallholder irrigators	
	Maize	Potatoes	Maize	Potatoes
Number of farmers	43	43	169	169
Land size (ha)	1.00	1.00	5.00	5.00
Total variable costs/ ha (Rand)	897.5	1402.5	5085	5085
Gross income/ ha (Rand)	2300	1680	11760	5400
Gross margin/ ha (Rand)	6675	315	1402.5	277.5

Source: own survey 2013

Table 5:16 indicate the comparison of financial performance for both maize and potatoes. It can be noted that smallholder irrigation farmers are mainly interested in growing maize for both home consumption and marketing where their average amounts per hector are 360 and 11400 respectively while homestead famers are mainly interested in production of maize mainly for their own consumption with no intentions of achieving high profit. The overall comparison of maize and potatoes seem to suggest that farmers sell more quantities of maize (R11400 average amount for irrigators and R2000 for homestead food gardeners) than potatoes (R5100 average amount for irrigators and R1520 for homestead food gardeners) also maize sales generate more gross margins (R7572.5/ha) than potatoes (R592.5/ha) for both groups. The high gross margin reaped from maize sales clearly indicates that maize is a high value product than potatoes and therefore smallholder irrigators are bound to earn more crop farm incomes than homestead food gardeners. The farmers also stated that they grow maize due to its profitability. Thus, this may need smallholder irrigators to devote more land to maize production to increase their household incomes rather than relying more on potato production that brings in relatively lesser profits but can continue grow it as it serve as staple food.

4.10 Employment

The two groups have got other jobs that they do and also practice farming this makes them have more income to sustain their live hoods. Most of the individual in the household assist in terms of weeding, ploughing and planting. The farmers also employ part time workers to help them in their fields.

4.11 Chapter summary

In summary there are several ways in which farmers use water, they use water for irrigation, domestic use and also for crops. There are also different farming systems that the farmers use and they have access to land, although there is limited access to inputs such as seeds, fertilisers and pesticides. Both groups are technically efficient in water use and they are able to produce maize and potatoes, thus they sell the produce they produce and obtain the highest profits. Most of the respondents obtain highest profit from selling their products whereas the minority was only producing for their own consumption.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Smallholder farmers in Eastern Cape Province have potential to contribute to food security in the rural areas, reduce poverty and income disparity, and hence contribute to economic growth. Farmers have not yet reaped the full benefits potential of technology adoption since due to the small scale of production. It is argued that there is need for smallholder farmers to increase the use of irrigation schemes and venture into commercial farming, if they are to contribute to the economic growth. However, it has been observed that smallholder farmers are restricted by a number of institutional arrangements, technical factors and perceptions, making it difficult for them to commercialise. Technology availability, institutional support and the participation of the farmers in the process of technology generation and transfer provided incentives that enhanced the technology transfer and adoption. However, expansion in production depended on availability and affordability of irrigation schemes.

Thus, the dissertation broadly covered the issues around the use of irrigation schemes with a main focus on smallholder irrigators and homestead food gardeners An attempt was made to review relevant material on the subject matter and apply the findings within the smallholder irrigators and homestead food gardeners context in Eastern Cape Province of South Africa. A background profiling of farmers in Ncora village was done as a means of identifying their major goals in agriculture production and marketing. While irrigation farmers show much market orientation in their production, it is different with smallholder rain fed farming whose major goal of production is household consumption. The determinants of production efficiency at farm–level were analysed.

This chapter summarises the main findings of the study and concludes on the basis of the findings derived from the empirical results. It discusses the extent to which objectives and hypotheses posed at the beginning of the study have been addressed by the analysis. Furthermore it also generates the recommendations on the basis of the results.

5.2 Summary

The main objective of the study was to evaluate the different approaches to water use in the farming system to promote successful transition from homestead food gardening to market oriented small holder irrigation farming in order to achieve multiple production goals of enhancing food security, profitability and employment creation. This first objective was to identify the alternative pathways for successful farm operation; the second one was to understand the current farming systems that farmers in Ncora area use. The last objective was to assess the impact of water use efficiency on the farming system live hoods in respect to food security, employment and profitability and to make recommendations on policies.

All the chapters that were included in the study are summarized in this section, which include the literature review, the methodology and the study results.

5.2.1. Literature review

Seminal work has been done by theorists on technical change who established a firm basis for considering technical change as endogenous to the system because internal pressures exerted from the constraints imposed on the system by changing resource endowments are the major factors driving change. The induced innovation model has informed the development and use of new technologies like irrigation technology to bring about rapid improvements in agricultural development.

Due to its ability to increase agricultural productivity, there is strong evidence that in adequate supply of water leads households to shift from traditional self-sufficiency goals to profit/income-oriented decision-making and resource allocation where farm output becomes more responsive to market trends (Chirwa & Matita, 2011). This reveals how irrigation schemes play a critical role in food security, employment and households' income for many poor households. Although smallholder farmers produce mostly for subsistence, in some instances they fail to meet production levels which guarantee household food security due to inability or lack of knowledge about irrigation schemes.

Even though several authors concur that irrigation is one of the improved technologies particularly relevant for semi-arid settings such as South Africa, evidence of sup-optimal use of irrigation predominates and there are issues of poor skills to use available technologies as well as access constraints due to physical, economical and institutional challenges. Thus, ownership and responsibilities were transferred for government to farmers in a bid to enhance resource-use but several factors, among them dysfunctional infrastructure and lack of managerial know-how among the farmers, The uncertainties regarding land tenure and the inadequate access to land have been a critical challenge to smallholder farming in South Africa have been reported to influence performance at scheme level.

Furthermore, Poor infrastructure continues to impede agricultural activities in Africa (Ellis & Bahiigwa, 2003). The key challenges are inadequate and poor conditions of the market facilities and transportation systems, including road and rail. Infrastructural investments that have been done are often ineffective as a result of poor design and poor maintenance, sometime due to stop-go practices of donors funding these investments.

For investment, smallholder farmers in South Africa depend on savings from their low incomes**,** which limits opportunities for expansion. Seminal work showed that half of total rural household income came from farming, 46.6 per cent from nonfarm employment (wages and self-employment) and less than 4 percent from remittances (Salami *et al,* 2010). Because of the lack of collateral and/or credit history, most farmers are bypassed not only by commercial and national development banks, but also by formal micro-credit institutions. In addition to own sources, farmers thus rely on incomes of friends and relatives, remittances, and informal money lenders.

Improved access to input and output markets is a key precondition for the transformation of the agricultural sector from subsistence to commercial production. Smallholder farmers must be able to benefit more from efficient markets and local-level value-addition, and be more exposed to competition.

Governments, with the support of donors, should be encouraged to provide an adequate legal framework for the upgrading of informal to semiformal and semiformal to formal microfinance institutions; and for the establishment of networks and their apex organizations for guidance, training, consultancy services, self-regulation and supervision, liquidity exchange and refinancing. If this is achieved, it implies that access to credit for smallholder farmers will improve and probably lead to an increase in adoption of irrigation and other improved inputs in production. Furthermore, it is argued that establishment of co-operatives can help facilitate better access to improved inputs.

5.2.2. Research methodology

The study was carried out in Cofimvaba town, which is situated in the Intsika Yethu Local Municipality which falls under the Eastern Cape Province of South Africa. Farmers were divided into two groups (smallholder irrigators and homestead food gardeners). The random sampling method was then used to select 169 smallholder irrigators and 43 homestead food gardeners in Ncora village in order to come up with 212 farmers. A questionnaire was used as the primary tool for data collection and the process of collecting data involved focus group discussions as well as face-to-face interviews with the household head.

Data analysis involved use of descriptive statistics, gross margin analysis, DEA and the linear regression model (OLS). The main descriptive indicators that were employed were frequency and mean values. According to Barnard and Nix (1999) gross margin of farming enterprise is its output less the variable cots attributed to it. This suggests that, to evaluate the economic viability of crops gross margins had to be calculated for each farming unit. The linear regression model was used to test determinants of the level of technical efficiency were estimated by establishing the relationship between farm/farmer characteristics and the computed technical efficiency indices. It was chosen because it is useful in analysing data where the researcher is interested in finding the relationship between dependent and independent variables. And lastly, Data Envelopment Analysis (DEA) provided the basis for measuring farm-level technical efficiency (TE). It construct a piecewise linear production surface using linear programs and computes an efficiency score for each decision making unit (DMU) along the lines suggested by Farrell (1957).

5.2.3. Descriptive statistics results

The descriptive results provided information related to demographic, socio-economic, crop production and institutional arrangements. The results indicate that the average of the sampled household heads is 57 years of age and relatively older farmers were the most in irrigation scheme. The educational levels of all the farmers are generally low, where 19 and 75 percent had primary education both smallholder irrigators and homestead food gardeners respectively and 10% of smallholder irrigators went to tertiary. Most farmers in the sample were males. The majority of the homestead food gardeners had access to relatively small arable land areas of approximately 2 hectares and had no title deeds for the land whereas smallholder irrigator were owning up to 6 hectares. However, the minimum area under maize was found to be 0.5 hectares and the maximum was 6 hectares. Generally, yields are slightly above tonne per hectare. Both smallholder irrigators and homestead food gardeners have average household size of approximately 5 persons where smallholder irrigators were ranging from 1-13 and homestead from 2-12. Overall, 92% of smallholder irrigators and homestead food gardeners considered farming as their major occupation. The farming experiences of smallholder farmers was up to 30 years and majority of them had 11 years experience whereas homestead food gardeners had up to 14 and the majority has 4 years experience in farming.

The results showed that there are different ways in which farmers use water, they basically use water for irrigation and domestic use. The major source of water for irrigation for smallholder irrigators is the dam and for homestead food gardeners they use different sources such as harvested rain water, dam, river and also water from the borehole or tap. Majority of the smallholder irrigators used the furrowing system for irrigation and it tends out to be an efficient and an easy way of irrigating their crops, however homestead food gardeners use sprinklers mostly to irrigate their crops. Major crops that they grow are mostly maize, cabbage and potatoes.

More than half of farmers in both categories indicated that they practice mixed farming and it is common for smallholder farmers to intercrop maize with other crops.

Homestead food gardeners were found to experience relatively low yield loss due to drought as compared to smallholder irrigators.

5.2.4 Major crops grown and input use by smallholder farmers

Overall, there are three major crops grown on the irrigation schemes and homestead food gardens. These include maize, cabbage and potatoes, and others categorised as vegetables. Farmers mainly grow these crops to meet their daily household food needs, generate incomes and can be easily grown. In their farming endeavours, smallholder farmers at Ncora irrigation schemes use most of the important agro-inputs and some degree of mechanisation. The common agro-inputs used include improved seeds, fertilizer, agro-chemicals, and tractor hire for mainly clearing and ploughing of fields/gardens. Smallholder irrigators significantly have more access to improved seeds and tractors than homestead food gardeners and this is mainly attributed to more government support received by smallholder irrigators than homestead food gardeners.

Smallholder irrigators devoted less land and seed in maize production with slightly more fertilizer, pesticide, herbicide and much higher number of irrigations/hectare/season compared to homestead food gardeners. However, homestead food gardeners are significantly higher users of fertilizers and irrigation water in potato production compared to smallholder irrigators. Therefore, smallholder irrigators devote more physical input resources in maize production while homestead food gardeners devote more resources in potato production. However, both smallholder‘s irrigators and homestead food gardeners were using far less amounts of fertilizers, pesticides and herbicides compared to the recommended amounts and thus, leading to low yields. This may call for more provision of input subsidies especially among smallholder irrigators for optimal utilization of the irrigation schemes.

5.2.5 Irrigation water use

Through observations, Ncora areas experience a dry-semi-arid type of climate where farming can hardly be successful without irrigation. In a series of interviews carried out during the pre-survey period, extension officers and scheme managers reported an almost impossible situation to farm without irrigation in these areas. Farmers at Ncora irrigation schemes identified dams, rainfall, rivers, taps and springs as sources of water for crop production, dam, river and rainfall being the most used. Homestead food gardeners mainly depend on rainfall as their major source of water for crop production while smallholder irrigators consider both dams and rainfall as their major source of irrigation water. Furrowing and sprinkler are the major used type of irrigation system by smallholder irrigators while horse pipes connected to tap water and furrowing are the major types of the irrigation systems used by homestead food gardeners. Half of respondents in this study indicated that access to land was a major problem hindering their participation on the irrigation schemes and 30% of challenges faced by irrigators are attributed to inadequate water and high costs of repair and rehabilitation at the irrigation schemes.

5.2.6 Extension services

Although a good number of farmers indicated a direct participation of extension officer in farm field especially in decision making on which inputs to acquire and amounts applied, findings indicate a poor performance in record keeping, financial, marketing and group management trainings. Judging from the poor access to farm management training by farmers, one is inclined to conclude that lack of farmer trainings resulting in low agricultural productivity is a major factor hindering the transition from subsistence farming to smallholder commercial farming at Ncora irrigation schemes.

5.2.7 Gross margin analysis results

The results of the gross margin analysis revealed that smallholder irrigators had R6675 GM for maize whereas homestead food gardeners obtained R897,5 for maize as well, furthermore, smallholder irrigators obtained R315 on potato production whilst homestead food gardeners had R277,5 on the same crop. However, the cost of producing maize and potatoes per hectare under irrigation was R5085 higher than costs of producing by homestead food gardeners (R1402,5) for each crop. Furthermore, co-operatives are important in reduction production costs.

These findings therefore indicate that planting maize and potatoes under irrigation in Ncora is more profitable as compared to as planting under non irrigated gardens. Hence, it is economically feasible to produce maize crops under smallholder conditions in Cofimvaba.

5.2.8 Profitability

In light of these findings it can be concluded that participation on the irrigation scheme seem to be more profitable than homestead food gardening. This is probably because smallholder irrigators produce more maize yields and earned more revenues and gross margins from the enterprise compared to homestead food gardeners despite a slightly higher expenses on input purchased by homestead food gardeners. In addition to the higher yield, total revenues and gross margins from maize enterprise, smallholder irrigators also produce more yields and earn slightly more total revenues and gross margins from the potato enterprise. However, most potatoes and maize produced by smallholder irrigators is sold and a small amount is consumed at home compared to homestead food gardeners which are the vise vesa of that. Although smallholders' yields were higher than homestead food gardeners, findings indicate that both farmers' yields for maize and potatoes were far below the expected potential, and thus suggesting big room for increased yields within the existing irrigation technology and other fixed variables. Therefore, these results suggest a transition from homestead food gardening to smallholder irrigation farming aimed at increased marketable output

5.2.9 Linear regression results

The results of the linear regression model revealed that the efficiency of most crops is influenced by input use. The statistically significant predictor variables, below 5% level are the perceptions that; the determinants of technical efficiency results from a unit change in each variable. Quantity sold, unit price, quantity of pesticides used, quantity of herbicides used, input use all show significance less than 5%. The form in which potatoes are sold at farm level is positively related to farm efficiency.

5.2.10 Production efficiency for the overall sample

The non-parametric (DEA approach) method was used to estimate the production efficiency of smallholder farmers at Ncora irrigation scheme. Based on the DEA findings on maize production, smallholder irrigators are significantly more technically efficient (99.6%) than homestead food gardeners (98.3%) when considering the Variable Returns to Scale (VRS). This may be attributed to significantly more efficient use of irrigation water by homestead food gardeners compared to smallholder irrigators. However, smallholder irrigators are more technically and economically efficient in the use of maize seed, fertilizers, pesticides and herbicides compare to the homestead food gardeners. Therefore, smallholder irrigators need to improve on technical efficiency for irrigation water use in order to maximise output within the existing resources and technology in maize production. Further, when using DEA approach, homestead food gardeners are technically more efficient in potato production while smallholder irrigators are more economically efficient and they were efficiently utilizing the irrigation water in maize production. Overall, both smallholder irrigators and homestead food gardeners are more economically efficient in maize production than potato production. This suggests that farmers put more emphasis on maize production for income generation than potato production. The amount of land owned and access to input use training had a negative impact on technical efficiency in maize production. The determinants of technical efficiency in maize enterprise included farming experience, amount of land owned, use of agro-chemicals, group membership and gross margins accrued to maize sales.

5.3 Conclusion

In light of these findings it can be concluded that small-scale irrigation schemes in former Transkei and Ciskei homelands of Eastern Cape Province were established for improved food security, employment and eradication of poverty in rural areas. Despite the apartheid and post-apartheid government‘s efforts through improved access to land, water, farm inputs and implements, and extension services, smallholder farmers‘ productivity is still low and bound to continued decline. Further, the historical and apartheid skewed laws, policies and programmes have been held responsible for the poor performance of rural smallholders. However, these conclusions have dwelt much on literature that focuses more on improved access to tangible agricultural factors as engine for increased agriculture productivity with less devotion on the role of the intangible human dimensional aspects. If improved access to tangible resources is failing, then someone may consider the role of the intangible human dimensions for increased production efficiency and commercialisation of smallholder irrigation farms.

The transition from subsistence homestead food gardening to smallholder irrigation commercial farming for improved incomes, employment and poverty alleviation among the rural poor is inevitable. The findings of this study indicate that smallholder irrigators harvest more output and earn more incomes from maize and cabbage enterprise than homestead food gardeners. Furthermore, smallholder irrigators are more economically efficient and this provides a better future for increased marketable output and household incomes thereby reducing unemployment and poverty. However, the future performance of the smallholder agricultural industry is doomed to collapse due to low participation of youths as the aged generation fades away. This may worsen the situation by increasing food insecurity, unemployment and increased poverty levels in the face of increasing population. Insecure land tenure, rigid land markets and lack of access to farm land especially on the irrigation schemes is also a threat for the transition. Based on the findings extension services especially in terms of capacity building is desperately lacking and may hamper the intended transformation of the sector. In addition, monetization of agricultural production with insufficient provision of input subsides especially among the resourced poor smallholders is another threat for the declining productivity and increased food insecurity in rural communities.

5.4 Recommendations

The primary policy challenges revealed by the empirical results are suggested in this section. A number of options to develop policies and mechanisms that will harness the potential of irrigators and the transition of non irrigators in the Eastern Cape Province and South Africa as a whole to benefit all the farmers are given below. This section gives a series of options that can be considered in South Africa, in an effort to help smallholder irrigators and homestead food gardeners reach their full potential.

This study has established that small-scale irrigation scheme plots are mainly cultivated by elderly persons above 60 years on average and who lack the enthusiasm and have low entrepreneurial spirit important to transform subsistence agricultural to commercially oriented irrigation farming. Therefore, government policies geared towards attracting youth in smallholder irrigation commercial farming are important. In addition to government policies NGOs should also avail packages that are gender inclusive to attract youth in farming venture. Agricultural programmes that target establishment of youth associations and clubs need to be created to catalyse youths' involvement in agricultural activities for improved employment and rural development. Since most youths are dependants and lack capital, they should be provided with financial assistance to avail start-up capital and enhance their economic empowerment.

5.4.1 Improving Acquisition of Farm Land

Land acquisition was cited as a major hindrance for homestead food gardeners' participation in irrigation farming yet findings indicated that a unit increase in farm land result into a significant increase in maize and potato production. Therefore, policies that will ease access to land for the smallholder farmers especially on the irrigation plots and expansion of irrigated farm land should be encouraged. Contrary, the large part of potential arable land on the irrigation schemes especially at Ncora is idle while some families are striving to have access to this land. Managers of the irrigation schemes were of the view to redistribute the land to families who have interests in farming. However, the land problem is still complex due to contradicting interests between the state and the traditional chiefs. Thus, the land redistribution should be a participatory exercise which incorporates all stakeholders' interests.

Increased population at Ncora resulted into more subdivision of land to small plots (0.25ha) which can hardly produce enough farm output to cater for the household food requirement and marketable surplus. Therefore, more land should be availed to smallholder irrigators to induce the desired agricultural transformation and development. This can be done by re-organizing the land size holdings to make smallholder farming more economic through catalysing the programme of land redistribution or resettlement. Due to the land acquisition problems, farmers are encouraged to expand their farming activities by utilizing both the homestead food gardens and irrigation plots. Caution should be considered that improved access to land as a single entity may not automatically result into increased marketable surplus but rather farmers need to be supported financially for acquisition of capital and build their capacity in farm management and marketing.

5.4.2 The enterprise selection

Maize enterprise is clearly more profitable than potato production as expected because maize is considered to be a high yield crop. Despite the low commercialization of the potato output compared to maize output, findings indicate that more total revenues and gross margins were earned from the maize enterprise. Therefore farmers are encouraged to allocate more land and other agro-inputs to maize production for increased household incomes. Furthermore, the enterprise (maize production) calls for more farmers' training in production for increased output and assured quality control acceptable in most restricted large supermarkets. For assured quality, storage facilities suitable to handle fresh vegetable are needed at both irrigation scheme and these can be provided by the government or other development partners. Given that maize is the main staple food in Cofimvaba communities, efficient food production and food security can be enhanced through policies that improve access to more resources like land, revitalisation of irrigation schemes, financial related programme, tractor acquisition and input subsidies.

5.4.3 Production efficiency

Smallholder farmers at Ncora are technically efficient with regard to maize production based on findings but are allocative inefficient. The technical efficiency partly is attributed to the direct extension officers' engagement in application of farm inputs in farmer fields. Allocative efficiency mainly deals with maximizing profits but most farmers lacked access to farm business trainings which entails record keeping and financial management important in calculating business profit and losses. According to the findings, farmers need a discount on fertilizer costs per hectare and increase use of improved seeds, pesticides and herbicides in order to maximize profits both in maize and cabbage enterprises. Use of agro-chemicals is important for increased technical efficiency therefore its use should be increased for increased maximization of maize and cabbage output. For increased efficient allocation of these resources and economic efficiency among smallholder farmers, extension services should be improved through capacity building of extension officers to equip them with farm business skills and appropriate methods for transferring this knowledge to farmers for self-sustenance.

5.4.4 Encourage collective action through formation and consolidation of producer organizations.

Literature has revealed that agricultural produce are being distributed through organised marketing channels, away from spot markets. On the other hand, the study has shown that homestead food gardeners and smallholder farmers have problems in accessing the formal markets individually, partly because of relatively small marketable surpluses, high transaction costs and problems in meeting grades and standards. Given such information, it is important to establish the suitability of collective action as an institutional vehicle for linking smallholder farmers to agribusiness supply chains. Collective action is encouraged because it strengthens smallholders' market position, bargaining power and lobbying power. In addition, fixed transaction costs can be spread, resulting in a decrease in individual costs. In addition, through shared knowledge, farmers can ensure market grades for produce, within the producer organizations. However, it is worth noting that the farmer groups should be based on trust, honesty, mutual respect and commitment in order to be successful. This brings out the suggestion that when choosing group members, farmers working towards the same goal should be grouped together. In addition, rules and roles within the group ought to be specified from the beginning.

5.4.5 Ensure the availability of market information to homestead food gardeners and smallholder farmers

It has been highlighted in the findings that access to timely market information is still a problem among the smallholder farmers. As such, market information should be consistently supplied to the farmers through the help of both private and governmental organizations. In an effort to make information available, it is important to know the types of market information that is necessary for different markets, such as specific rules, pricing, grades and standards; and educate the farmers on how to use the information. Of equal importance, is devising the ways of disseminating the information, in order to reach all the smallholder farmers. When devising these ways, it is important to consider the non-homogeneity of smallholder irrigators and homestead food gardeners in terms of goals, education, location and the availability of communication assets. Radio programs conducted in different languages and farmer workshops can be considered for information dissemination.

5.4.6 Promote contract farming

Contract farming is important to both the farmers and the contractors because it ensures a market for produce and supplies to the contractors. However, to get contractual deals, farmers should be able to provide a relatively larger output. When smallholder farmers operate in producer groups, they may be able to increase their output and be part of the contractual deals. The public and private sectors can help facilitate contractual arrangements, but the farmers have to be willing to cooperate. Once they get contractual agreements, an entrepreneurial culture can be developed, where farmers produce for marketing, rather than trying to market what they have produced. Again, it is critical to develop trust between the farmers and the contractors, even though it should be supported by legal compliance. Farmers can gain trust by delivering the required produce and contractors can develop trust by having confidence in the producers. Such an environment encourages marketing and is advantageous to both parties.

5.4.7 Invest in rural infrastructure

The government can support the homestead food gardeners and smallholder farmers through technical innovations. These may be in the form of investments in public facilities such as improved roads, telecommunications and market places. Development of such facilities can induce farmers to move towards a commercial agriculture system. The smallholder and homesteads farmers still have to play a role in order to ensure that the infrastructural facilities are provided for them. They have to form an association and choose a lobby that has to represent them.

5.4.9 Stimulate government support policies in the rural areas

The farmers in South Africa are facing unfair competition from the formerly supported commercial farmers. In addition, they are facing competition from internationally imported produce. For example, cheaper produce, due to subsidy policies in developed countries is imported into South Africa. In order to withstand both local and international competition, the South African government needs to consider support policies and regulation that are necessary to stimulate growth among the smallholder irrigators and homestead food gardeners.

5.5 Suggestions for further studies

This section presents gaps in the research exposing areas of further research with the implicit goal of closing current gaps in literature, towards proving the necessary economic evidence in sustainable irrigated crop enterprises.

Most of the sampled farmers in the studied area do not have title deeds for the land they use. Therefore, there is need for further research, in order to ensure the influence of land ownership on agricultural production and marketing. That is, there is need to ensure whether land ownership will result in improved production and greater levels of marketing.

For a more focused research, this study mainly dwelt on production efficiency as a measure of smallholder farmers' performance leaving out other proxy of performance and determinants of both technical efficiency and commercialization level of smallholder agriculture. It is therefore necessary to conduct further research using other evaluation tools to unearth more factors that hinder the development of smallholder farming industry and also in-depth analysis of other factors such as soil type, water quality and other physical factors which have an impact on technical efficiency and commercialization of smallholder agriculture in Ncora irrigation schemes. It also mainly focused on social, political and technical factors in smallholder and irrigators and homesteads. There is need for further research on the influence of other factors, such as economic and institutional factors, and their influence on transition of farmers.

In addition, it has been identified, under the policy recommendations that farmer co-operation can improve market participation. Future research which involves identifying the methods of introducing successful farmer groups can be beneficial, because the past farmer co operations had their own challenges. In addition, the ways of linking the farmer groups to contractors needs to be researched.

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APPENDIX

Appendix 1: Questionnaire

UNIVERSITY OF FORT HARE, DEPARTMENT OF AGRICULTURAL ECONOMICS

IDENTIFYING APPROPRIATE PATHS FOR ESTABLISHING SUSTAINABLE IRRIGATED CROP BASED FARMING BUSINESS ON SMALLHOLDER IRRIGATION SCHEMES: A CASE OF NCORA IRRIGATION SCHEME.

Questionnaire number……… Name of Interviewer ……………………
Contacts………

Local Municipality ………………………Ward………………… Village………………

Do you farm on any Small scale irrigation schemes 1) Yes [ ] 2) No [ ]
Do you own a homestead food garden 1) Yes [ ] 2) No [ ]
Both Homestead garden and Irrigation plot [ ]

A) BACKGROUND INFORMATION

1) Respondent's Name……………..……..
2) Household size ……………………………

3.0 Household Characteristic

	Qn.3.1 Position in home	**Qn. 3.2** Sex 1 = Male 2=Female	**Qn.3.3** Marital Status 1= married 2=single 3=Divorced 4 =widow 5= separated	**Qn.3.4** Age (yrs)	**Qn.3.5** Education level & Grade 1=Primary 2=Secondary 3=Tertiary 4= Non	**Qn.3.6** No. years in School /Grade	**Qn.3.7** Type Occupation 1=Farmer 2=Farm laborer 3= trader 4=casual work 5=civil service 6=private firm 7= student	**Qn.3.8** No of year employed in the named occupation
1	Husband							
2	Wife							
3	Child							
4	Child							
5	Child							

B) LAND UTILISATION

4. What is the average price of land in this area……………….R/ha

5. What is the average cost of renting land in this Area………………….R/ha

6. Who set the rules concerning land acquisition? 1) Traditional/Community [ ] 2) Government [ ] 3) Both [ ] 4) No rules [ ]

7. How did you access the land you are cultivating on? 1) Restitution [ ] 2) Redistribution [ ] 3) Inherited [ ] 4) N/A [ ]

8. Land allocation (all in ha)

2nd season of 2011 July - December				1st season of 2012 January - June			
Land owned [ha]	Land hired [ha]	Land rented out [ha]	Total land cultivated [ha]	Land owned [ha]	Land hired [ha]	Land rented out [ha]	Total land cultivated [ha]

(9) What crops do grow in order of preference 1)…………………….….. 2) …………………..……. 3)…………….……… 4)……………………

(10) Land allocation to crops by order of preference

2nd season of 2011 July – December							1st season of 2012 January - Jur			
Qn.10.1 Crop	**Qn.10.2** Cropped Area (ha)	**Qn.10.3** Qty produced	**10.4** Qty sold	**Qn.10.5** Unit 1 =Kg 2=suck 3.Heads	**10.6** Unit price	**10.7** Total cost	**10.8** cropped area (ha)	**Qn.10.9** Qty Produced	**10.10** Qty Sold	**10.11** Unit 1=Kg 2=suc 3.hea s
1)Maize										
2) Cabbage										
3)spinach										
4. Carrots										
5.Butternut										
6. Potatoes										

C) PRODUCTION INFORMATION

INPUT UTILISATION

11. Do you use the following inputs in your gardens?

Qn. 11.1 Improved Seeds	**Qn. 11.2** Fertilizers	**Qn. 11.3** Agro-Chemicals	**Qn.11.4** Oxen-draught	**Qn.11.5** Tractor

1 = yes 2 = No	1 = yes 2 = No	1 = yes 2 = No	1 = yes 2 = No	1 = yes 2 = No

12. Do you access inputs [refer to Qn. 11] from government agencies 1) Yes [ ] 2) No [ ]

13. If yes, how much was received *[in Rand*]

Qn. 13.1 Improved Seeds	**Qn. 13.2** Fertilizers	**Qn. 13.3** Agro-Chemicals	**Qn.13.4** Oxen-draught	**Qn.13.5** Tractor

14. Input utilization in Production for past 2 seasons

2nd season 2011							1st season 2012		
Qn. 14.1 Type of crop	**Qn. 14.2** Input type	**Qn. 14.3** Quantity used (Kg or liters)	**14.4** Unit Price(R)	**14.5** Distance to source (Kms)	**14.6** Source/ Provider indicate C for cash and L for credit	**14.7** For credit amount to be repaid	**14.8** Quantity used (Kg or liters)	**14.9** unit Price (R)	**14.10** Distance to source (Kms)
Maize	Seeds								
	Fertilizer								
	pesticide								
	Herbicides								
Cabbage	Seed								
	Fertilizer								
	Pesticide								
	Herbicides								
Potatoes	Seed								
	fertilizer								
	pesticide								
	Herbicides								

15) Have you received any form of training on input use, agronomic practices, record keeping, and financial management, and marketing?

Qn. 15.1 Input use	**Qn. 15.2** Agronomic practices	**Qn. 15.3** Record keeping	**Qn.15.4** Financial management	**Qn.15.5** Marketing	**Qn.15.6** Group formation
1 = yes 2 = No	1 = yes 2 = No	1 = yes 2 = No	1 = yes 2 = No	1 = yes 2 = No	1=yes 2=No

16) If yes, who provided the training? 1) Extension agent [ ] (2) NGO [ ] (3) Farmer [ ] (4) other specify……..

17) Please mention the number of times they rendered service per season ……………………………………………..

D. (18) WATER USE

Qn.18.1 Community Sources Water 1= Rain 2=Taps 3=Borehole 4=Dam 5=River	**Qn. 18.2 Source of water for crop production** [*use same codes in column 1*]	**Qn. 18.3 Who provided the Water Source** 1 = Government 2=NGOs 3=Municipality 4=Community 5=Others	**Qn. 18.4 Are you a member of any Irrigation scheme** 1= yes 2=No	**Qn.18.5 Who provided the Irrigation Scheme** *[Use codes in Column 3]*	**Qn. 18.6 If not member why** 1= no funds 2=social conflicts 3=lack information 4=not interested	**Qn. 18.7 crops grown on irrigation scheme** 1=maize 2=Cabbage 3=butternut 4=carrots 5=potatoes	**Qn. 1 Numb of tim you irriga week** [actua No.]

19. What type of irrigation facility are you using? 1) Sprinkler [ ] 2) Drip irrigation [ ] 3) Furrowing irrigation [ ] 4) Others (specify)

20. Mention challenges faced with irrigation 1) Hard to Operate [ ] 2) poor management [ ] 3) Underutilized [ ]

4) Inadequate water [ ] 5) Not profitable [ ] 6) Not productive [ ]

7) High costs of repairing and rehabilitation [ ]

8) Others [ ]

21. What are the possible solutions to the above mentioned challenges? 1) Government intervention [ ] 2) NGOs support [ ]

3) Community intervention [ ] 4) Do not Care [ ]

E) LABOUR INPUTS IN CROP PRODUCTION

22) What is the main source of labour? 1) Family labour [ ] (2) Hired labour [ ] (3) Both [ ]

23) How many labour units or number of times in total worked in the field in the last two seasons of 2011/2012?

2nd season 2011					1st season 2012			
Type	Men	Women	children		Men	Women	children	
Family labour								
Hired labour								
Total								
Oxen/Tractor (No. of Times								

24) Activity labour demands in crop production for last Season

Activity	Type of Worker									
	Men			Women			Children			Oxen/
	No.	Days	Cost	No.	Days	Cost	No.	Days	Cost	No.
Land prep 1st.										
2nd ploughing										
Planting										
Fertilizer application										
1st weeding										
2nd weeding										
Spraying										
Harvesting										
Post-Harvest (drying, packaging)										
Transport to market										

Key: men/ women = > 18yrs, children <18. 1 Man- day = 6 person hours for a man = (0.75*6) person hours for woman = 12 child hours.

F) CROP OUTPUT AND MARKETING

25) Do you sell any produce from your farm 1) Yes [ ] 2) No [ ]

26) If yes, please fill the table below.

Qn.26.1 Crop 1=maize 2=Cabbage 3=Potatoes	**26.2** Water System 1= Rain 2=Irrigation 3=Both	**Qn. 26.3** Season 1=Summer 2=Winter	**Qn.26.4** Harvested area (ha)	**Qn.26.5** Quantity harvested (Kg, Sucks, Heads)	**26.6** Quantity sold (Kg, suck, Heads)	**26.7** Price/ Kg (R)	**Qn.26.8** Point of sale 1= farm gate 2=middlemen 3= Supermarkets 4.Others	**Qn.26.** Cost of sale (tax, transpo t) (R)

27) What problems are faced in production and marketing of agricultural produce?
1) Lack Inputs [ ] 2) Lack of own capital [ ]
3) Lack knowledge on agronomic Practices [ ] 4) low rainfalls [ ] 5) lack transport [ ] 6) Lack access to credit [ ]
7) Poor soil fertility [ ] 8) lack of access to market information 9) lack markets for produce [ ] 10) Others (specify)

28) What are the Possible Solutions to the above mentioned problems? 1) Government improves on roads and financial agricultural institutions [ ]
2) Provide more irrigation schemes by Government and NGOs [ ] 3) Provide input subsidies and farm implements [ ]
4) More extension services [ ] 5) Encourage more cooperatives and farmer groups [ ] 6) NGOs & Government provide Market
Linkage services to farmers [ ] 7) Others (Specify)

G) GENERAL INFORMATION

29) Do you belong to any group or association? 1) Yes [ ] 2) No [ ]

30) If yes, what service do you receive from such association? 1) Production labour [ ] 2) access to cheap inputs [ ] 3) collective marketing [ ] 4) others [ ]

32) if yes in Qn. 29, how many times did you meet last month…………………

33) Please estimate your total seasonal income (Rand) from the following source.

Crop farming	Livestock farming	Non –Farm income	Remittances

34. Do you have access to extension services 1) Yes [ ] 2) [ ]

35. If yes which organization renders the services 1) Government [ ] 2) NGOs [ ] 3) private Companies [ ] 4) others [ ]

36. Where do you mostly access information about farming and marketing? 1) Radio [ ] 2) Television [ ] 3) phone [ ] 4) fellow farmers [ ] 5) Others

37. Do you have access to credit [*Check Question 27. 6*] 1) yes [ ] 2) No [ ]

Qn. 37.1 Source (s) of credit	**Qn.37.2 Amount received**	**Qn.37.3 Interest rate**	**Qn.37.4 Total Amount paid**	**Qn.37.5 Payback period**	**Qn.37.6 Use of cred received**

Code Challenges. 1) Bureaucracy in terms of administration, 2) takes long to get the loan, 3) too much paper work, 4) lack knowledge about credit.

38. Scaling Level of entrepreneurial Spirit and Positive Psychological Capital

Description	**Please rate/Rank as indicated belo tick [√]**			
	Strongly Disagree 1	*Disagree 2*	*Agree 3*	*S A*
Not Afraid to try a new technique				
Irrespective of any challenges I continue trying till the solution is got				
You have the ability to organize available resources to achieve a goal				
If there is a change in supply and demand, you take action faster before any government response				
Take action always on the basis of what you perceive profitable				
Do not wait for subsidies before applying new technology				
You take your own judgment about the new technology before consulting friends				
Not afraid to be different when adopting new technologies on your farm				
Spend more time on new technologies where you anticipate				

profits				
You are not afraid of investing more money in new technologies				
Risks of new technologies isn't your first priority to take a decision				
I prefer group marketing				
Can supply produce on credit				
Will to pay for any farm related trainings				
Will to source for information wherever possible at a cost				

39. Farmer's Perspectives, Aspiration and Goals of an Enterprise

Qn. 39.1 Which crops do you grow most 1=maize 2=Cabbage 3=Potatoes 4=Carrots 5=butternut 6=Spinach	**Qn.39.2** Why grow mostly the crop mentioned 1= profitable 2=staple food 3=high yield 4=easy to grow 5= community grows it 6=easy to market 7=others (specify)	**Qn.39.3** Which crop takes most of your time ***Use codes in Column Qn.40.1***	**Qn.39.4** If you're to expand farm which crop is consideration first ***Use codes in Column Qn.40.1***	**Qn.39.5** Why choosing to expand production of mentioned crop ***[Use codes in column Qn.40.2]***	**Qn.39.6** Why do you farm 1= market 2=consume 3. both 4.Others	**Qn.39. 7** Are you Willing to expand your farm 1= Yes 2= No	**Qn.39.8** If No why 1=hard land acquisition 2=No markets 3=lack capital	**Qn** Ha you co ed qui far 1= 2=

40. Scaling Farmer's Goals and Behaviors

		Ranking from 1 = No to 4 = Very Importa Tick]		
		1	**2**	**3**
1	Self-employed and independent			
2	Like farming life			
3	Have more leisure time			
4	Be recognised as top producer			
5	Be recognised as a leader in the technology adoption			
6	Be recognised as a specialist in growing these crop			

7	Be recognised as owner of the land			
8	Involve family in decision-making			
9	Leave business for the next generation			
10	Provide employment to rural people			
11	Belong to farming community			
12	Inherited the farm			
13	It is part of culture (Artefacts and adornment)			
14	Communications experience: contacts with people, transfers of information			
15	Social participation: meetings and rituals			
16	Avail time to spend with my family			
17	Increase standards of living			
18	Increase maximum farm income			
19	Expand the business			
20	Keep debts as low as possible			
21	Accumulate wealth			

Adapted from Padilla-Fernandez M. Dina and Nuthall Peter (2001) and Harwood (1979) though some questions are restructured to suit Rural farmers in Eastern Cape and ranked from 1 = not important to 4 very important to the farmer.

41. Scaling Social Capital related issues

	STATEMENT	**Ranking fr to 4 = Ver Tick]**	
		1	**2**
1	Working with government departments improves production & market access		
2	Working with Private companies improves production & access to markets		
3	Working as farmer groups/cooperatives improves production & access to market		
4	Attending group meetings regularly improve production & access to marketing		
5	group membership ease access to farm labour, and improves production & marketing		
6	Can easily access farm inputs like fertilizer when connected to groups, company, Gov't		
7	Can easily access farm implements when belonging to farmer group, company, Gov't		
8	Access to information from fellow famers is vital in production, and output marketing		

9	I support others (fellow farmers) and they support me in times of hardships		
10	Group membership ease access and adoption of new technologies		
11	Can contribute money towards a common goal in my community		
12	Farmer groups/cooperatives with constitution/rules perform better than others		
13	Culture rules and norms are vital in group formation, farm production and marketing		
14	Trust among community members is a key factor for successful farmer		
15	Participation in voting village committees is crucial for equitable access to resources		

THANK YOU AND GOD BLESS