APPROPRIATE ENTREPRENEURIAL DEVELOPMENT PATHS IN THE TRANSITION FROM HOMESTEAD FOOD GARDENING TO SMALLHOLDER IRRIGATION CROP FARMING IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

Report to the
THE WATER RESEARCH COMMISSION

by

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with contributions from

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EXECUTIVE SUMMARY

Background and Motivation

The case for research to explore the circumstances surrounding the slow pace of the transition from homestead gardening to commercialized farming rests on several interrelated theories and notions. As the problem of poverty and food insecurity have been joined by rising food prices to exacerbate an already desperate humanitarian crisis, policy and academic research has incorporated analytical procedures that involve programme evaluation as well as investment analysis where concern is often about how to allocate scarce resources to meet ever-expanding needs. Again, when such questions are raised, they are accompanied by discussion as to what constitutes the optimum paths to implement an affirmative action policy.

Without doubt the most sophisticated economy on the continent as it is described by the Economist (2011), South Africa presents many contradictions that continue to pose policy nightmare. Despite a well-performing macroeconomy, the country has now gained the unenviable reputation of being the most unequal society in the world. With democratic rule in South Africa, policies were introduced to redress the extreme inequalities in income, wealth and livelihoods engendered by apartheid rule. There was the expectation that enhanced access to productive resources such as land and technical support would translate into increased agricultural productivity for the black farmers who make up the bulk of the smallholders in the country (Obi and Pote, 2011). Earlier research as the reform measures got underway, notably Makhura and Mokoena (2003) were of the opinion that the country's poorer sections would experience increased incomes, which would contribute to poverty reduction. But recent studies suggest that this goal has not been realized and that there has rather been a growing pauperization of the citizens, especially the black population, manifested in deteriorating unemployment rates and poverty levels (Klasen, 1997; May et al., 1998; Klasen and Woolard, 2005, UNDP, 2003; UNDP, 2007). Some of the indicators that have pointed to the deteriorating situation include the unemployment rates, the poverty rates, the Gini Coefficient, and Consumption Expenditure Growth. For instance, while the broadly defined unemployment rates in the country stood at about 31% in 1993 (on the eve of the inception of majority rule in 1994), they had deteriorated to about 38% by 1997, rising to about 39% in 2005. Whereas, nationally, the government had hoped to lower unemployment to about 14%, it still hovered around 25-40% in 2011 (The Economist, 2011). The provincial data are equally disturbing, according to studies conducted in the late 1990s and early 2000s which suggested that provincial unemployment rates in the Eastern Cape may have been in the order of 30-70% (May *et al*., 1998; Department of Labour, 2003).

Poverty has been shown by many studies to be closely related to unemployment, among other factors (Klasen, 1997). It is therefore not surprising that the Eastern Cape Province which has the highest unemployment rate in South Africa also has the highest poverty rates. Data going back to the mid-1990s make this point strongly, showing figures as high as 71% in 1998 (May *et al.*, 1998). Data generated by the Department of Labour (2003) and the Development Bank of Southern Africa (2005), suggest that the situation could be worsening. According to available data, this high poverty rate in the country is accompanied by the highest levels of income inequality in the world (HSRC, 1996; Klasen, 1997; Lam, 1999: UNDP, 2007). According to the UNDP (2007), the Gini coefficient estimated for South Africa for 2006 stood at about 0.59. The South African Presidency's Development Indicators Report published in 2009 showed that the Gini Coefficient has risen to between 0.66 and 0.68, depending on whether it is computed on the basis of the All Media and Products Survey (AMPS) or the Income and Expenditures Survey (IES) of the Statistics South Africa (The Presidency, 2009). In 2012, this index has worsened further to 0.69 (Westaway, 2012). In 2015, Oxfam suggested that South Africa could have the highest official unemployment rate in the world, at 25%, and, with a Gini Coefficient of 0.69, one of the most unequal countries in the world (Oxfam, 2015).

This situation shows that nothing much has changed since 2004 when, in presenting the Budget for that year, the South African Finance Minister at the time, Mr. Trevor Manuel, bemoaned the emergence of a "…*second economy* characterized by poverty, inadequate shelter, uncertain incomes and the despair of joblessness…"(Manuel, 2004). According to the Minister, many South Africans were "trapped" in that "second economy" (Manuel, 2004). The National Plan released in 2011 by a Commission now chaired by Mr Trevor Manuel in his new role as Minister in the Presidency, observes that, "for many poor South Africans, there is still much that looks the same…" as South

Africa in the pre-1994 era (National Planning Commission, 2011). As the reform measures gathered momentum about 10 years post-liberation, a vicious circle of poverty was clearly evident, being fuelled by the extreme disparities that put the greater proportion of national wealth in the hands of a small minority (Pauw, 2005).

In 2011, the Department of Agriculture, Forestry and Fisheries (DAFF), conducted a review of studies and methodologies used for the estimation of agricultural productivities in South Africa in order to improve the quantitative basis for its policy formulation for the agricultural sector (Ramaila *et al.,* 2011). As might be expected, the former "independent homeland" areas, namely Transkei, Ciskei, Venda, and Bophuthatswana, which were granted "independence" by the apartheid regime (Berry, 1996; Raeside, 2004), have exhibited these problems much more than any other part of the country. According to Van Zyl *et al.* (1996), these former "homelands" were characterized by inadequate market access, poor and deteriorating infrastructure and support services for smallholder farmers. Westaway (2012) has provided an interesting recent sketch of the philosophical and strategic considerations that informed the creation of these "homelands" or "reservations", and probably explain the sharp differences in conditions between them and what used to be "South Africa".

Problem Statement and Research Objectives

Current research on small scale irrigation schemes are now asking questions about how these schemes impact on livelihoods. The schemes entail considerable investments of resources to improve the livelihoods of the poor. The emphasis of the United Nation's Millennium Development Goals (MDGs) of reducing poverty and improving livelihoods has often meant that considerable attention is paid to the outcomes without as much attention being paid to the extent to which the process might be constrained by availability of resources and even the nature of the resources at the disposal of the recipients of the support services under these schemes. The observed slow pace of the transformation in many contexts, and the fact that in many cases, negative results have been realized, are forcing researchers to re-think the whole basis of the research and policy work that inform interventions. A major driver of this new thinking draws support from the theories on poverty and access to benefits from resources as elaborated by Sen (1981) and Ribot and Peluso (2003), among others, to compel consideration of whether access to resources plays a crucial role in whether livelihood benefits are realized. There is now growing interest on sustainable management of the natural resource base of the community as well as their relationships and interactions with other resources and assets in the environment of the small farmer.

The main issue around which the project is prepared rests on the fact that nearly two decades of implementation of various reform measures, the small-scale farming practised in the Eastern Cape Province remains virtually stagnant at best. In a recent study, Muchara *et al.* (2011) observed instances of sub-optimal water utilization regimes on irrigation schemes as well as individual plots, suggesting that the problem is not solely one of insufficient access. There may be differences in the intensity of entrepreneurial spirit and management abilities (human dimensions) that explain the current situation. In addition to the role of social capital, the literature is pointing to a possible role for psychological capital. With climate change, these problems are exacerbated and the vulnerabilities will become even more pronounced. A crucial question is why landholdings are stagnant or not increasing fast enough? The FAO (2009) report has highlighted the lack of private exchange for land which, while raising several questions, may be only a part of a bigger problem.

That these questions have not been asked in a systematic manner to date in the context of small farming in the Eastern Cape Province is a significant gap because they are crucial for formulating appropriate post-settlement support to speed up the pace of agrarian restructuring and integrate the black farmer into the economy in a meaningful way.

The broad objective of the project was to review and evaluate appropriate development paths for expansion from homestead food gardening to smallholder irrigation farming, increased water use productivity of crop production and improved livelihoods on selected smallholder irrigation schemes in the Eastern Cape of South Africa. More specifically, the project aimed:

1. To evaluate natural, physical and financial assets with specific attention to irrigation farming potential.

2. To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organizational structures.

3. To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains.

4. To determine the aspirations and goals of farmers to expand irrigation crop production from homestead gardens to irrigation plots and/or from one to more than one irrigation plot.

5. To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

Approach and Methodology

The Terms of Reference for this study indicated that the preferred research method to be followed was participatory learning and action research in conjunction with whole farm budgeting and modelling. At the time of the research, the participatory method of choice was the Agricultural Research for Development (ARD) which the University of Fort Hare has partnered with the International Centre for development-oriented Research in Agriculture to promote in South Africa. It was therefore natural that the ARD was adopted for purposes of designing the research, selecting sites for the study and collecting and analyzing the data for which it was appropriate. Several studies have employed the Agricultural Research for Development (ARD) concept to generate more participatory, inclusive, and meaningful research outcomes (Hawkins *et al.,* 2009).

A multistage stratified sampling technique was used to select a predetermined number of respondents using a structured questionnaire. The model and the variables fitted in them with their a priori expectation were clearly stated in the chapter. Descriptive statistics and inferential statistics and econometrics were liberally applied wherever necessary.

Results and Conclusions

The expectation was that the research would yield insights into the factors that would motivate and enable cash-strapped homestead gardeners in the rural areas of the Eastern Cape to transform into smallholder irrigated farming that emphasizes enhanced productivity and leads ultimately to improved livelihoods. Coming to that sort of information required diverse approaches in the true nature of science to seek evidence and test alternative scenarios before an optimal path can be confirmed. As might be expected, it was necessary to first understand the true nature of the problem and establish its theoretical and conceptual foundations. In order to this, a comprehensive literature survey was conducted. This was important for purposes of selecting the appropriate sites, unit of analyses, samples, data, and methods of analyses for each of the specific objectives. The various studies and support activities have been reported in the 14 previous deliverables produced under the project from its inception. In addition to the deliverables, the study has provided inputs to three PhD theses and several MSc and Honours dissertations, information from which have been collated in articulating the following empirical results.

The study began with a profiling of the sample households enumerated, focusing largely on their demographic and socioeconomic characteristics. These included Age, Education, Household Size, Experience, Farm cultivated, Land inequality, Irrigated land intensity, Family labour to total labour, Total labour intensity, Total quantity fertilizer, Total cost of fertilizer, Total cost of land, Total cost of labour, Total cost of seed, Total cost of production, Output Value, Total Income and Per capita income. The discrete variable among the demographic and socioeconomic characteristics are Gender, Marital status, Association membership, Access to credit, Extension services, Main occupation, Irrigators, Restitution, Amalahila municipality, Ngqushwa municipality and Redistribution.

Pushing back the frontiers of poverty are the greatest global challenge and it is one of the three affronts to human lives in South Africa, the other two being inequality and unemployment (Nicolson, 2015). According to Townsend (2006), poverty is any condition that exposes an individual or household to social discrimination, lower personal self-esteem and deprives them access to essential commodities of life. Going by the preceding, it is important to assess the poverty status of respondents in the study. A poverty line was defined. Any household head with a mean income lower than the poverty line is considered poor. Using Foster Greer Thorbecke (FGT), the poverty status of irrigators and homestead gardeners was determined, tabulated and presented in the consolidated report as well as a number of relevant deliverables and student theses and dissertations. Lorenz curves were also plotted and presented to depict the extent of rural inequalities in the study areas.

In the penultimate year of the project, an empirical analysis was conducted to address the following five hypotheses:

- A smallholder's socio-cultural contexts such as village level institutions, especially village governance as well as household circumstances including age, education and gender compositions of the household membership as well as household income can determine a smallholder's ability to transform.
- Alternative economic activities, especially alternative farming activities such as livestock and tree crop productions as well as off-farm economic opportunities which are open to a household can influence a smallholder's willingness to transform from homestead gardening to food crop production under government irrigation programme. Specific tests can be conducted of the hypothesis that employment opportunities within and outside agriculture are limited in the areas due to poor development of value chains for principal crops and at both producer and consumer/retailer levels.
- A smallholder's assessment of available market for the products of his food crop irrigation farming is an important consideration in his willingness to transform. An alternative formulation is that while market outlets for farm output are not limited, farmers often find it difficult to market their produce.
- Entrepreneurial skills are lacking, in particular the ability to search for opportunities and the willingness to do something different than the masses and take risks in that process. There is insufficient drive and persistent efforts to take actions to improve farming, and local people rely disproportionately on government support/hand-outs.
- The government irrigation scheme governance will determine the attractiveness of the scheme and thereby influence the willingness of a

smallholder to participate. The legal and regulatory environments are very restrictive and not conducive to effective value and job creation in the villages and for the principal crops and enterprises.

Among other issues, the results were outlined around the effect of sociocultural contexts, the role of alternative economic activities, the assessment of available market opportunities, the role of entrepreneurial skills and whether or not governance of government irrigation schemes play a role in the attractiveness of schemes. In the case of socio-cultural factors, the study examined a range of demographic and socio-economic characteristics of the survey households, including gender, age of household head, the occupational category to which the household head belongs, the educational level attained by household head, the size of the household and the fertility rates observed, asset ownership patterns and the nature and extent of access to basic amenities. The overall finding in respect to these factors indicated that there are important differences in behaviour regarding the transition from homestead gardening to irrigated farming. There was also evidence that involvement in alternative economic activities influenced the choices made by the households which have implications for transforming to more commercialized farming. Again, gender played an important role in the activities undertaken and how these influenced the possibility of transformation. There was evidence that the households cared a lot about whether or not they could sell their produce and actively sought opportunities to market profitably. It was clear that for both livestock and crops, households made efforts to produce above subsistence needs and there was positive intention to expand production and sales. Entrepreneurship and how it influences the transition possibilities was explicitly examined and the indication is that the survey households possessed entrepreneurial skills to a reasonable extent and this was manifested in intention to expand hectarage cultivated and animal numbers for value storage and sales. To test whether governance of the scheme influenced their attractiveness, a series of technical efficiency estimates were conducted and the indication was that the system operated at reasonably high technical efficiency which was influenced by a wide range of factors.

Without prejudice to the important differences between the main geo-political/administrative divisions in the province, namely former Ciskei and former

Transkei areas, the study found that livestock has a special place in the study area. It is without doubt a key enterprise as substantial exchange of livestock takes place in the rural areas, albeit informally. People seek livestock for rituals and a wide-range of other socio-cultural reasons. Those who do not own livestock have to obtain them from their neighbours in exchange for cash. To that extent, livestock transactions might be the only activity with a reasonable chance of injecting wealth into the village and keeping such wealth there. Where households keep chickens, sheep, goats and cattle, it would invariably be for socio-cultural reasons rather than as a source of income. But since the livestock are there, they constitute a potential source of income and can be a source of diversification of farming and rural enterprise. As long as the local people hold their beliefs in which livestock are the only inputs, demand for livestock will always be in excess of available supply and will create the need for exchange.

A supplementary survey was implemented separately towards the end of the research to determine the extent to which local market development was feasible. It was hypothesized that differences in the costs of marketing farm produce in the village and town markets would hold the answer to the choice local farmers make as to where to profitably sell their produce. The approach was to provide rural farmers with understanding that town market comes with high cost ranging from labour, packaging and transport. Encouraging farmers' market participation in the village will equally lead to poverty reduction and shared prosperity since local consumers will save cost of traveling to buy from the town. Again, farmers themselves will save cost and time of selling in town which can be invested into producing more crops which will produce more favourable spin-offs on local food prices. Such information would be vital to the formulation of explicit policy on possible local market development to service the needs of smallholder producers and resource poor rural residents.

In the light of the foregoing, smallholder farmers were interviewed using a questionnaire structured into two phases. The first phase of the interview determined farmers' willingness to sell in the village or town markets. The result showed more farmers willing to sell in the town outside the village precincts compared to village market. The main reason given by the smallholders who chose to sell in town markets was that it gave them the opportunity to receive higher prices for their produce relative to what prevails in the villages around them. The farmers also indicated that they were more likely to be owed by consumers in the villages than those in the towns, and such debts are often never recovered and could sometimes lead to additional problems within the community. The marketing cost difference for labour, packaging and transport between village and town market was also estimated. The result indicated that cost of selling in the town exceeded those associated with village sales. These results were then presented in a focus group meeting in phase two of the survey to allow the respondents to see the implications in terms of cost of the decisions they had previously expressed. They were then asked to re-consider their earlier decisions in the light of the information available on costs and time savings of alternative scenario. It was observed that more farmers indicated willingness to sell in the village market since it resulted in more cost and time saving for them. At this stage, the farmers suggested that selling in the village market would release substantial time which could be invested into producing more crops or engage in order remunerative activities to earn extra income to reduce their poverty. Interestingly, despite the huge cost saving and time saving regarding local marketing, a relatively small number of farmers still indicated interest in selling in the township market because they stood to earn higher income through higher produce prices and also avoid credit sales, and higher produce rejection by neighbours.

To determine the impact of the irrigation technology on smallholder livelihood as proxied by extent of market accessibility, a semi-parametric matching technique was applied to the data. The analysis revealed that irrigation technology has a positive impact on livelihood through boosting farm output much of which the household can sell for profit depending on the condition of the infrastructure and the extent to which the households can access the market. It was also indicated that a number of socio-economic and demographic characteristics mediate the impact of irrigation technology, which is understandable. These results also provide insights to address the question as to the appropriate development path for the transition from homestead gardening to smallholder irrigated farming. It is clear that support to small farmers to apply irrigation technology within an environment that is conducive to free exchange of farm produce will guarantee the most credible and sustainable path to smallholder transformation in the study area.

In the light of the foregoing, a set of specific recommendations are made in respect to effective use of the revitalized irrigation systems to optimize crop production, enhancement of the food value chains through vertical integration via agro-processing linked to school feeding schemes, and market development to encourage profitable produce sales within the village. Specific plans were proposed to establish a feed mill at Qamata to supply the Bilatye piggery with crushed maize as well as linkage with soup-making enterprise to supply nearby schools and supermarkets. But all these require specialized governance arrangements involving a multistakeholder engagement in the form of the Innovation Platforms being promoted by the Forum for Agricultural Research in Africa (FARA).

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“Water Use Productivity Associated with Appropriate Entrepreneurial Development Paths in the Transition from Homestead Food Gardening to Smallholder Irrigation Crop Farming in the Eastern Cape Province of South Africa”

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ACFODE	Action for Development
AE	Adult Equivalent
AfDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
AHDR	African Human Development Report
AMPS	All Media and Product Survey
ANC	African National Congress
ARAP	Accelerated Rainfed Arable Programme
ARC	Agricultural Research Council
ARD	Agricultural Research for Development
ARDC	Agricultural and Rural Development Corporation
AsgiSA	Accelerated and Shared Growth Initiative of South Africa
ATAI	Agricultural Technology Adoption Initiative
BEE	Black Economic Empowerment
CAADP	Comprehensive Africa Agriculture Development Programme
CASE	Commission on Alternative Source of Energy
CASP	Comprehensive Agricultural Support Programme
CDW	Community Development Workers
CIA	Central Intelligence Agency (of the United States of America)
CIMMYT	International Maize and Wheat Improvement Center
CRLR	Commission on the Restitution of Land Rights
CS	Community Survey
CTA	Technical Centre for Agricultural and Rural Cooperation
DAFF	Department of Agriculture, Forestry and Fisheries
DBSA	Development Bank of Southern Africa
DEA	Data Envelopment Analysis
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DFID	Department for International Development
DoA	Department of Agriculture
DoL	Department of Labour
DoLA	Department of Land Affairs
DRDAR	Department of Rural Development and Agrarian Reform

DWAF	Department of Water Affairs and Forestry
ECA	Economic Commission for Africa-
ECDA	Eastern Cape Development Agency
ECDRAR	Eastern Cape Department of Rural Development and Agrarian Reform
ECOE	Einstein College of Engineering
ECPG	Eastern Cape Provincial Government
ECPROV	Eastern Cape Province
EPWP	Extended Public Works Programme
FANRPAN	Food, Agriculture, and Natural Resources Policy Analysis Network
FAO	Food and Agriculture Organisation of the United Nations
FDH	Free Disposal Hull
GDP	Gross Domestic Product
GEAR	Growth, Employment and Redistribution
GEM	Global Entrepreneurship Monitor
GoSA	Government of South Africa
HDI	Human Development Index
HDRU	Human Dimensions Research Unit
ICID	International Commission on Irrigation and Drainage
IDP	Integrated Development Plan
IES	Income and Expenditure Survey
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
IMF	International Monetary Fund
IMT	Irrigation Management Transfer
IPTRID	International Programme for Technology and Research in Irrigation and Drainage
ISRDS	Integrated Sustainable Rural Development Strategy
IWMI	International Water Management Institute
LM	LEISA Magazine
LRAD	Land Re-distribution for Agricultural Development
MDGs	Millennium Development Goals
MFPP	Massive Food Production Programme

MTEF	Medium Term Expenditure Framework
NEPAD	New Partnership for Africa's Development
NFIF	National Farm Irrigation Fund
NGOs	Non-Governmental Organisations
NTFP	Non-Timber Forest Products
NWA	National Water Act
NWP	National Water Policy
NWRS	National Water Resource Strategies
PGDP	Provincial Growth and Development Programme
PIM	Participatory Irrigation Management
PIPs	Policies, Institutions and Processes
PLAAS	Programme for Land and Agrarian Studies
PLAS	Proactive Land Acquisition Strategy
PTO	Permission to Occupy
RDP	Reconstruction and Development Programme
RESIS	Revitalization of Smallholder Irrigation Schemes
SA	South Africa
SABC	South African Broadcasting Corporation
SADC	Southern African Development Community
SAHDR	South African Human Development Report
SAPS	Structural Adjustment Programmes
SLAG	Settlement Land Acquisition Grant
SLF	Sustainable Livelihood Framework
SONA	State Of Nation Address
SSA	Sub-Saharan Africa
SSI	Smallholder System Innovation
StatsSA	Statistics South Africa
TMS	Tropical Manioc Selection
UBOS	Uganda Bureau of Statistics
UN	United Nations
UNDP	United Nations Development Programme
UN-HABITAT	United Nations Human Settlement Programme
UNWWD	United Nations World Water Day
UPPA	Uganda Participatory Poverty Assessment Process

USA	United States of America
USDA	United States Department of Agriculture
WEF	World Economic Forum’s
WRC	Water Research Commission
WSU	Walter Sisulu University
WUAs	Water Users’ Associations

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CHAPTER 1
INTRODUCTION

1.1 Background of the Study

In recent years, there has been significant progress towards generating new knowledge and technologies to deal with some of the most pressing technical and institutional constraints facing African agriculture, occasioning phenomenal and impressive growth rates of 7% and more per annum in some instances (ACET, 2014; Suttie and Benfica, 2015). But extreme poverty persists on the continent and the African Development Bank (AfDB) estimates that the level of undernourishment in Africa is the highest in the world (AfDB, 2016). For this reason, African governments have made the transformation of the smallholder agriculture the central focus of policy interventions. A number of landmark events can be cited. With the end of the Apartheid regime in South Africa in 1994, investments to support smallholder agriculture began in earnest and constituted a significant proportion of the national budget. Other countries have made similar commitments of resources to build up their smallholder sectors as a response to the strong belief that agriculture will drive much of the economic growth on the African continent over the medium to long-term (Eicher, 1999; NEPAD, 2003). In 2003, African Heads of State and Governments made the landmark declaration in Maputo to increase agricultural budgets to 10% of the national budgets and actively pursue measures across the continent to boost food security through support for smallholder development. In their meeting in Malabo, Equatorial Guinea, in June 2014, the Heads of State and Governments of the African Union made a firm commitment to fast-track the programmes that grew out of the Maputo Declaration largely within the framework of the Comprehensive African Agricultural Development Programme (CAADP) (FARA, 2015).

Sadly, these efforts have not produced the desired results, and in a number of countries, poverty has deepened largely due to governments according low priority to rural and agricultural development (Rukuni, 2011). Where a production system is seemingly unresponsive to supposedly adequate investments of physical, natural and financial assets, it is common to consider the possible influence of the human assets. Among other things, this involves the process by which human beings decide among alternative investment options and the choices they make in relation to the combination of assets in the production process. A vast body of literature has recognised the importance of human dimensions in respect to human capital, social capital, farmer's goals and aspirations, entrepreneurial spirit and positive psychological capital (Steyn, 1982; CTA, 1990; Ostrom, 1998; McElwee, 2005; Djomo and Sikod, 2012). The key role of these human dimensions is to influence decision regarding adoption of new technologies and access to farm production and market information (Djomo and Sikod, 2012). In the case of social capital, increased agricultural productivity is achieved through social networks that ease access to natural, physical and financial resources (Ostrom, 1998; FAO, 2000). Innovativeness and calculated risk taking form part of the entrepreneurial spirit parameters crucial in maximising farm output and profits (Modiba, 2009). According to Robert (2012), farmers with high level of entrepreneurial spirit are more likely to accumulate more social capital and this eases access to production assets and financial assets important for increased productivity. Padilla-Fernandez and Nuthall (2001), Maskey *et al.* (2010) indicated that farmers' goals and aspirations influence farmers' decision making in farm management and this determines the level of productivity.

Expectedly, the focus on human capacity development in the past few years has been on strengthening those skills and building the knowledge base through education and training. While these are essential and crucial, they have tended to ignore the fundamental element of the motivations and the innate drive within human beings to try new things and innovate in ways that support growth and sustainable livelihoods. It has become clear that entrepreneurial spirit is an essential ingredient for the cultivation of such pro-growth capacities and their effective deployment to the available productive processes. But while much work has been done on the industrial sector, dating back to the Schumpeterian era and the seminal work of the Austrian School led by Ludwig von Mises and others, little attention has been paid to the agricultural sector to see the extent to which this concept is applicable. The study turns attention to this aspect and reviews the empirical and policy literature on the subject of entrepreneurship and management capabilities and whether these can be lead the way to alternative paths in the transition from homestead food gardening to smallholder irrigation crop farming oriented to the market.

1.2 Technological Innovations and Farmers' Circumstances

According to Agricultural Technology Adoption Initiative (ATAI) (2014), lack of infrastructure and well-functioning supply chains make it costly for farmers to access markets. Farmers who would benefit from technology adoption may fail to access or pay for the technology due to inadequate infrastructure, missing supply chains or unprofitably high prices. Infrastructure, such as roads and irrigation, plays a key role in facilitating technology adoption, but infrastructure investment is typically left to governments and donors through public-private partnerships. Private sector's goal is to maximise profits through cost minimisation hence it cannot effectively deliver public goods. Cross-country evidence on the effect of infrastructure on agricultural productivity shows a positive relationship between productivity and the development of roads and irrigation. Improved transportation is also associated with diffusion of technology, better use of inputs and better prices for farmers.

A lack of infrastructure drives a wedge between the prices that farmers receive for their output and the market price, lowering the profits associated with certain technology adoption (ATAI, 2014; Gardner, 1992). Landlocked countries such as Zimbabwe and Botswana, in particular, face high costs associated with the import and export of agricultural products, a situation that South Africa does not have to worry about by reason of its favourable location. Transportation can account for half of the cost of agricultural output marketing— which constitutes a sizeable proportion of the value of the final product (Jack, 2013; Chavas, 2001).

Transport and other infrastructure challenges are thought to reduce competition among input suppliers (Chavas, 2001). This leaves individual farmers with little room to bargain, because input suppliers and output buyers face little competition. In these cases, much of the profit from improved agricultural technologies may be captured by market actors other than the farmer (ATAI, 2014). By raising the fixed cost of distribution, poor infrastructure increases the market power of intermediaries. This can lead to a vicious cycle, with low adoption resulting in a few market actors holding a great deal of market power, which lowers profits for farmers and can further depress the adoption of new technologies.

1.3 Assets and Resources

Of late, the concept of assets and resources have been incorporated into the development equation. The important role played by assets and resources in the process of agricultural development, especially through the production process, has long been recognized. The classical economists identified land, labour and capital as the basic production resources which were called factors of production (Smith, 1776; Marshall, 1890). The Second African Regional Conference of the International Commission on Irrigation and Drainage (ICID) held in November 2007 paid attention to the crucial need to clarify the concept of assets and distinguish their different forms and the role each of them plays in agricultural production. The conference identified and distinguished five forms of capital assets that are key to irrigation development, namely natural, social, human, physical and financial capitals (ICID, 2007; Porritt, 2007).The present study afforded an opportunity to systematically examine these productive factors and provide a review of the relevant literature on how they are ddefined, measured and integrated into the models that aim to explain the production environment of smallholder farmers, particularly those operating in circumstances where decisions about optimal water use is necessary.

One element of the role of assets has to do with water resources which helps to set the context for examining the role of the other forms of capital in agricultural water use. From a theoretical standpoint, the need to focus on and evaluate resources cannot be over-emphasized. In her book a few years ago, Moyo (2012) has tried to demonstrate the over-arching role of resources and how much of socioeconomic development of nations depends on how much and what resources they can command. This is true also for individual households as it is for nations and regions.

Current research on small scale irrigation schemes are now asking questions about how these schemes impact on livelihoods. The schemes entail considerable investments of resources to improve the livelihoods of the poor. The emphasis of the erstwhile United Nation’s Millennium Development Goals (MDGs) of reducing poverty and improving livelihoods has often meant that considerable attention is paid to the outcomes without as much attention being paid to the extent to which the process might be constrained by availability of resources and even the nature of the resources at the disposal of the recipients of the support services under these schemes (United Nations, 2000). The observed slow pace of the transformation in many contexts, and the fact that in many cases, negative results have been realized, are forcing researchers to re-think the whole basis of the research and policy work that inform interventions. A major driver of this new thinking draws support from the theories on poverty and access to benefits from resources as elaborated by Sen (1981) and Ribot and Peluso (2003), among others, to compel consideration of whether access to resources plays a crucial role in whether livelihood benefits are realized. There is now growing interest on sustainable management of the natural resource base of the community as well as their relationships and interactions with other resources and assets in the environment of the small farmer.

The main issue around which the project is prepared rests on the fact that nearly two decades of implementation of various reform measures, the small-scale farming practised in the Eastern Cape Province remains virtually stagnant at best. In a recent study, Muchara, Obi, Letty and Masika (2011) observed instances of sub-optimal water utilisation regimes on irrigation schemes as well as individual plots, suggesting that the problem is not solely one of insufficient access. There may be differences in the intensity of entrepreneurial spirit and management abilities (human dimensions) that explain the current situation. In addition to the role of social capital, the literature is pointing to a possible role for psychological capital. With climate change, these problems are exacerbated and the vulnerabilities will become even more pronounced. A crucial question is why landholdings are stagnant or not increasing fast enough? The FAO (2009) report has highlighted the lack of private exchange for land which, while raising several questions, may be only a part of a bigger problem.

That these questions have not been asked in a systematic manner to date in the context of small farming in the communal areas of the country is a significant gap because they are crucial for formulating appropriate post-settlement support to speed up the pace of agrarian restructuring and integrate the black farmer into the economy in a meaningful way.

1.4 Motivation of the Study

The case for this study has been made on the basis of its contributions to knowledge, the overall economy, to environmental sustainability and considerations of health. A key reason for the poor performance of African agriculture has been given as low uptake of improved technologies developed in research stations and agricultural institutes around the world. It has been noted that whatever output increases that have taken place in the agricultural sector have largely resulted from expansion in area cultivated rather than improvements in yield arising from the application of improved practices (Spencer, 1994). Byerlee, Morris, Kopicki, and Kelly (2007) also reveal declines in fertilizer consumption. Socioeconomic conditions have correspondingly deteriorated. There have been civil and armed conflicts across the continent, rising to as many as 15 in 2003 but thankfully down to about 5 at the present time (Binswanger-Mkhise, 2010). Along with those, the region had witnessed several natural disasters both man-made and otherwise, including the devastating cycles of droughts and floods in Southern Africa in the early 2000?s (Obi, 2011). Disease outbreaks, including HIV and AIDS and Malaria have completed this dreary picture (UNDP, 2003), with adverse consequences for human capacity and labour availability for farm work.

Ironically, in the 1970s it was thought that labour would play a key role in African agricultural development (Spencer and Byerlee, 1976) given the notion of a land and labour surplus setting that inspired Arthur Lewis' analysis in the previous two decades (Eicher and Staatz, 1984). Since then, labour bottlenecks have become more severe as a result of the erosion of human capacity by the emergence of HIV and AIDS. At the same time, the land question has become even more contentious than it was in the past and a considerable amount of politics has to be contended with in any programme to redistribute and allocate land to a growing population.

In provinces of, e.g. Eastern Cape, KwaZulu-Natal and Limpopo, farm sizes are small and agricultural production is largely organized around small homestead plots and gardens generally less than 5 ha although a few outliers are present. New farms are now being established under the Land Redistribution and Agricultural Development (LRAD) Programme launched to redress the imbalance in land distribution between black and white populations. The expectation is that by 2014, black ownership of the country's agricultural land would have increased by as much as 30%. But this process is moving so slowly that there is today little confidence in that target being attained. As a result, the substantial investments for restructuring the agricultural economy through such programmes as the AgriBEE (a programme for Black Economic Empowerment in the agricultural sector) have failed to redress the considerable rural inequity in the country. As in all cases of deteriorating welfare conditions, the effect on women and children are quite serious. The sex-stratification theoretical model, as adapted from the more well-known social stratification theory, explains the tendency in many traditional societies to ascribe higher ranking to men over women and assign decision-making roles over valued resources to men (Safilios-Rothschild, 1990). Several studies on equity theory make similar points and justify attention to gender issues in research and development efforts (Rogers and Bird, 1998; Bryant, 2001). But more central to the subject matter of the action, output levels are very low largely because of low and declining productivities arising from limited use of improved varieties and application of recommended management and improved practices. According to available data, this high poverty rate in the country is accompanied by the highest levels of income inequality in the world (HSRC, 1996; Klasen, 1997; Lam, 1999: UNDP, 2007). According to the UNDP (2007), the Gini coefficient estimated for South Africa for 2006 stood at about 0.59, highlighting the unrelenting erosion in welfare and livelihoods so many years after democratic rule was introduced into the country. Such a result is consistent with the fact that, among the Medium Human Development countries to which South Africa is placed by the UNDP, it is one of the few whose Human Development Indices actually deteriorated since the early 1990s, having fallen from 0.735 in 1990 to 0.653 in 2004 (UNDP, 2006). In the current year, rising food prices in line with the global situation have exacerbated the desperate welfare situation among the urban poor and rural dwellers alike and incessant mass protests have become the order of the day.

At the local/rural level, the picture is even more disturbing. Poverty and livelihood studies carried out over the years suggest that the poverty rates may be higher in the Eastern Cape Province than elsewhere in the country. Department of Labour data suggest that unemployment rates in the Eastern Cape in 2003 were in the order of 30-70% probably because the province ranks as the most rural province, with an estimated 63.4% of its population living in the rural areas, compared with a national average of 54% (May et al., 1998; Department of Labour, 2003). As might be expected, these situations have been worse in the former independent “homelands” where the infrastructure profile and services have remained basic and 17 years of democratic dispensation in South Africa have made little difference. In the State of the Nation Address in February, 2011, President Zuma expressed concern over the persistence of unemployment and poverty in the country despite the economic growth experienced in the past 10 years (Zuma, 2011). To deal with this situation, President Zuma reiterated government’s commitment to the implementation of the Comprehensive Rural Development Programme under which it would revive land reform projects and irrigation schemes in the former “homelands” (Zuma, 2011a). At the Freedom Day Celebrations on 27 April, 2011, President Zuma acknowledged that poverty, lack of access to education and basic services, and joblessness were still daily realities, especially for blacks, despite considerable gains since 1994 (Zuma, 2011b). In looking for the reasons for the persistent pauperization of these areas therefore, it is unavoidable to examine the agricultural sector and smallholder farming.

The experiences of small-scale citrus growers in the former Ciskei of the Eastern Cape Province illustrate the declining fortunes of agriculture quite vividly. In the closing years of the Apartheid regime, a programme was launched to establish a black entrepreneurial class in agriculture. Pursuant to this goal, the government of the former Ciskei homeland (now part of the Eastern Cape Province) introduced a scheme in 1988 to resettle a total of 22 black farmers on land expropriated from former white farmers with emphasis on citrus production. This programme has since evolved into a low-equilibrium trap characterized by under-production arising from a wide range of technical and institutional constraints. Of the 22 farmers resettled at the inception of the programme, only about 14 are operational today.

Among the reasons given for this situation, poor fruit quality limiting the market access of the emerging farmers has been mentioned as a major one (Kat River Water Users Association, 2007). In turn, the poor fruit quality on these farms has been attributed to the predominance of aging trees, planting of mixed cultivars, non-uniformity of spacing that hampers the application of plant protection and soil fertility enhancement technologies, among other reasons. The farmers also complain about the poor road network which causes the fruits to deteriorate in quality due to friction during transportation. Another serious problem relates to the fact that these farmers have been waiting in vain to receive title deeds to the land they operate and this means that they are unable to use the land to raise much-needed capital to finance improvements and expand production. Other farmers who are less well-organized than this group of emerging farmers equally face serious challenges in respect to access to land and other productive resources. For instance, despite years of implementation of the land reform programme, a good number of farmers are still unable to secure land for arable farming and several land claims are yet to be resolved in a manner that guarantees the livelihoods of a large majority of the rural population in the area. Within the Kat River Valley area for instance a number of small farmers have been compelled to narrowly focus on semi-subsistence small stock production because they are unable to secure land for arable farming.

There is therefore urgent need to tackle these issues, especially in respect of rural areas where the majority of the population, mostly the previously disadvantaged blacks, still reside. In recent years, this segment of the population has been the target of a large number of policy interventions to redress past wrongs. Among these measures are those that aim to redistribute land to the black population who were previously denied access to this vital asset and were consequently effectively excluded from the nation's agricultural economy. In the time since the all-inclusive elections in 1994, a major land reform programme has been established with complementary programmes for economic empowerment through credit assistance, subsidization of farm infrastructure development, and other forms of support included under schemes like the Comprehensive Agricultural Support Programme (CASP), the Micro Agricultural Financial Institutional Scheme of South Africa (MAFISA), among several others. However, apart from numerous internal contradictions in these programmes that make them ineffective for poverty targeting, the current interventions have continued within existing farming systems which have been developed around the circumstances of the established white farmers. For instance, the conventional farming system is the intensive monoculture system in which single enterprise specializations are the norm. One feature of the intensive monoculture system is its reliance on equipment-intensive technologies and the substantial use of agro-chemicals generally not affordable by small-scale and emerging farmers. This group of farmers who are only just beginning to enter the farming industry therefore experience rising production costs which they are unable to meet due to lack of access to institutional finance for which collaterals are required. At the same time, they are unable to explore alternatives due to lack of experience. The result is that these groups of farmers are unable to compete on price with the established farmers and are therefore effectively excluded from the nation's agricultural economy. While the permanent resolutions of these problems must happen at the political and institutional levels, they traditionally take time to implement and will ultimately require technical solutions to be effective. It is therefore imperative that a sustainable farming system be developed that fits the circumstances of the small-scale and emerging farmers and simultaneously addresses their credit constraints, market access difficulties, profitability, as well as promote sustainable natural resource management practices. While full commercialization may seem too ambitious for this group in the medium term, especially without a massive injection of production capital and far-reaching institutional reforms, including more inclusive land reform strategies, it is possible to introduce transitional schemes, representing a subset of tested farming systems technologies, to more specifically target food security and poverty reduction in the households and provide these poor farmers with diversified options for generating income through access to alternative crops, new varieties with marketing potential, and through organizational and institutional development.

The issues to be addressed in this research have been well described in the rationale that formed part of the terms of reference. The Eastern Cape Province is one of the poorest regions in South Africa. According to Perret (2002), about 71% of the inhabitants were classified as poor in 2002, compared with a national average of 72%. However, the region is endowed with a large share of the country's livestock and crop resources. But poverty persists as a result of a plethora of factors with production losses topping the list. In fact, production losses are easily the most serious problems faced by small producers in developing countries today. The government's broad aim of restructuring the agricultural sector in such a way that opportunities are created for the previously disadvantaged farmers, largely black south Africans who constitute the bulk of the rural population. The main argument relates to water utilization and the situation that is created by the semi-arid situation of the country. Already, the country faces severe water stress on account of the frequent droughts that have occurred in the last decade or so. With climate change, these problems are exacerbated and the vulnerability of the country, especially those farmers whose means have never been comfortable in the best of times, will be even more pronounced. Dealing with these issues will remain major concerns. But the precise nature of the vulnerability of the rural communities to these problems has not been systematically studied in recent years. Studies that have attempted to assess vulnerability have not been linked to the new issues of climate change which are more or less recent phenomena and need to be factored into any new policy strategy in order for such policies to be anchored on factual evidence and not on anecdotes and hunches. What is the evidence of underutilization of resources or inefficient resource use as claimed by official policy statement? In the absence of hard data, this question will be difficult to answer with any precision. But the high rates of unemployment, estimated at over 25% by most agencies, point to gross underutilization of the most important resources at the disposal of the farmer and other producers. The government departments have been notorious for under spending of budget allocation. Many local municipalities which have experienced demonstrations for poor service delivery in recent years have been blamed for not adequately utilizing resources allocated to them by the national government. In many cases, these local municipalities have had to return unspent funds to the treasury at the end of the year, highlighting the extreme lack of capacity for implementation of development programmes under their mandates. It is important to answer a number of important questions in relation to the problems identified in the foregoing:

- Why are landholdings stagnant or not increasing fast enough?

- Why are land reform beneficiaries not experiencing improved livelihoods consistent with the government's substantial expenditures in this sector?

- What explanations can be given for the paradox of worsening rural poverty in the face of some of the most phenomenal improvements in the macroeconomic indices?

- Is there anything in the structure of incentives that explain the apparent unattractiveness of farming or scale enlargement?

- What is the role of social grants and other transfers introduced by the ruling party upon coming to power in 1994 as part of the welfare programme of the new administration?

The Study will fill the gap in knowledge about the development paths through which smallholder farmers expand their operations from the small homestead food gardening to relatively larger and more market oriented irrigated farming and the associated patterns and livelihoods implications of agricultural water resource use in communal farming.

Knowing how smallholders make use of the scarce but essential resource of water for agricultural production is crucial to the formulation of policies to support the millions of smallholders whose sub-optimal water resource use is contributing to the high rates of poverty and food insecurity which must be reversed quickly to forestall the downward spiral in welfare and improve political and civic participation in the new South Africa. What has now become a monotonous refrain in describing the South African policy terrain is that "the problem is not the policy but its implementation". This is probably missing the crucial point that lack of know-how about how to effectively implement a policy is also a policy issue which must be addressed with as much vigour and urgency as the seeming dearth in appropriate policies. This research will contribute in identifying the main issues constraining the evolution of appropriate policies as well as the implementation arrangements necessary to arrest the pauperization of the rural areas and in deed much of South Africa.

Appropriate strategies to improve the socioeconomic participation of the generality of South Africans especially those residing in the rural areas is conditional on deeper understanding of existing patterns of economic activity a major element of which is resource use characteristics. The information about existing patterns of resource utilization and the constraints to more optimal use of scarce inputs, especially land and water, is crucial to formulation of the right economic policies to tackle the poverty problem in the country. At present, nearly half of the labour force is unemployed and nearly as much are underemployed. This is gross abuse of resources and will definitely have a negative impact on growth and broader macroeconomic performance. To this extent, understanding what must be done to improve micro-level productivity will contribute significantly to economic growth and development.

Food insecurity that characterizes smallholder agriculture today is one of the greatest threats to health and the on-going fight against the dreaded disease conditions such as malaria and HIV/AIDs. If people are more food secure, they will be better able to resist debilitating infections and also afford the extra investment in health management. Much of what policy makers say currently about the health implications of socio-economic conditions is based on mere hunches and informed guesses without the benefit of systematic analysis. It is crucial for progress in economic wellbeing of the country that decisions are better informed and linked to more robust analysis. To that extent, the proposed research will make a significant contribution.

Uncoordinated resource use is the major culprit for the deteriorating environment. Understanding the patterns of resource use and contributing to the development of guidelines for their optimization will contribute to a more environmentally friendly utilization of water resources. There is no reason to doubt conclusions of experts about the long term benefits of a conservation culture that manifests in the respectful use of resources with the knowledge that the present generation is answerable to future ones on how the environment is managed. Indiscriminate and inappropriate use of scarce resources is the hallmark of poverty and the link has been very strongly made by experts since the World Summit on Social Development and other fora.

1.5 Objectives

The broad objective of the project was to review and evaluate appropriate development paths for expansion from homestead food gardening to smallholder irrigation farming, increased water use productivity of crop production and improved livelihoods on selected smallholder irrigation schemes in South Africa. More specifically, the project aims:

1. To evaluate natural, physical and financial assets with specific attention to irrigation farming potential.

2. To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organisational structures.

3. To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains.

4. To determine the aspirations and goals of farmers to expand irrigation crop production from homestead gardens to irrigation plots and/or from one to more than one irrigation plot.
5. To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

1.6 Structure of the Report

This report is organized into 11 Chapters. Chapter 1 introduces the subject matter of the research, presenting the problem statement, motivation for the study and the research objectives. Chapter 2 presents the literature review which covers the themes of food security, poverty, livelihoods and entrepreneurship as they relate to the search for appropriate development paths for sustainable farming businesses in the smallholder irrigated agricultural sector. Chapter 3 presents a description of the study area while Chapter 4 presents a description of the methodological considerations which include the description of the model and theoretical framework for the study, the data collected and used for the study, the methods of data collection, and the analytical framework. The demographic and socio-economic characteristics of the sample are presented in Chapter 5. The results in relation to the key project deliverables around which the project objectives are organized are presented in Chapters 6, 7, 8, and 9. In Chapter 6, the key findings in relation to Natural, Physical and Financial Assets and Irrigation are presented. In Chapter 7, Human and Social Assets and Entrepreneurial Spirits and Management Capabilities are presented and discussed. In Chapter 8, livelihoods and opportunities to improve the contribution of farming are presented and discussed, while in Chapter 9 the report turns to Aspirations and Goals and their roles in the transition from homestead gardening to the irrigated smallholder farming.

Chapter 10 covers the alternative economic activities undertaken in the project area, while Chapter 11 draws some conclusions before presenting a set of recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

More fundamentally, this study aimed to evaluate the practicability of the Government's goal under the National Development Plan 2030 to create a mass employment through small-scale irrigation development and small business development. For the goals under the Plan to be realized, the opportunities to benefit from irrigation development must be available and the beneficiaries must have the requisite entrepreneurial spirit to identify and take advantage of small business opportunities. In the light of the foregoing, the literature review began by establishing the problem context in terms of the current and prospective levels of unemployment and underemployment in the country. This is followed by a review of the Plan itself and the broader context that informed the establishment of the commission and associated government programmes and actions. The irrigation schemes are then examined in terms of their history, extent, challenges and prospects. Given the relevance of entrepreneurial spirit on whether or not individuals invest in small businesses, this concept is reviewed along with other relevant motivational characteristics, with special attention being paid to the South African context.

2.2 South Africa's Current Socio-Economic Context

The particularities for southern Africa and South Africa need to be explicitly examined further. According to the Southern African Development Community (SADC), vulnerability to hunger is still high even though a few countries have been experiencing increases in cereal production (SADC, 2011). The indication is that, at the regional level, there are now more people requiring food and non-food assistance than previously, with the number estimated to have increased from 3.3 million persons to about 4.04 million persons in 2011 (SADC, 2011). At some point in the early years of the present decade, the number suffering from extreme poverty in the region was put at about 70% of the population on a regional basis which may actually be understated for many countries in the region while for others it may be overstated. For instance, rural conditions have been worsening in many countries of the region since 2001/2002 when the region as a whole experienced the worst food and humanitarian crises in years (United Nations Development Programme, 2003). While many of the affected countries have since begun to recover, this has not been the case for others, leading to the conclusion that there may be other factors at play.

South Africa continues to be an enigma in many respects. Without doubt the most sophisticated economy on the continent as it is described by the Economist (2011), South Africa presents many contradictions that continue to pose policy nightmare. Despite a well-performing macroeconomy, the country has now gained the unenviable reputation of being the most unequal society in the world. With democratic rule in South Africa, policies were introduced to redress the extreme inequalities in income, wealth and livelihoods engendered by apartheid rule. There was the expectation that enhanced access to productive resources such as land and technical support would translate into increased agricultural productivity for the black farmers who make up the bulk of the smallholders in the country (Obi and Pote, 2011). Earlier research as the reform measures got underway, notably Makhura and Mokoena (2003), were of the opinion that the country's poorer sections would experience increased incomes, which would contribute to poverty reduction. But recent studies suggest that this goal has not been realized and that there has rather been a growing pauperization of the citizens, especially the black population, manifested in deteriorating unemployment rates and poverty levels (Klasen, 1997; May et al., 1998; Klasen and Woolard, 2005, UNDP, 2003; UNDP, 2007). Some of the indicators that have pointed to the deteriorating situation include the unemployment rates, the poverty rates, the Gini Coefficient, and Consumption Expenditure Growth. For instance, while the broadly defined unemployment rates in the country stood at about 31% in 1993 (on the eve of the inception of majority rule in 1994), they had deteriorated to about 38% by 1997, rising to about 39% in 2005. Whereas, nationally, the government had hoped to lower unemployment to about 14%, it still hovered around 25-40% in 2011 (The Economist, 2011). The provincial data are equally disturbing, according to studies conducted in the late 1990s and early 2000s which suggested that provincial unemployment rates in the Eastern Cape may have been in the order of 30-70% (May *et al.*, 1998; Department of Labour, 2003).

Poverty has been shown by many studies to be closely related to unemployment, among other factors (Klasen, 1997). It is therefore not surprising that the Eastern Cape Province which has the highest unemployment rate in South Africa also has the highest poverty rates. Data going back to the mid-1990s make this point strongly, showing figures as high as 71% in 1998 (May *et al.*, 1998). Data generated by the Department of Labour (2003) and the Development Bank of Southern Africa (2005), suggest that the situation could be worsening. According to available data, this high poverty rate in the country is accompanied by the highest levels of income inequality in the world (HSRC, 1996; Klasen, 1997; Lam, 1999: UNDP, 2007). According to the UNDP (2007), the Gini coefficient estimated for South Africa for 2006 stood at about 0.59. The South African Presidency's Development Indicators Report published in 2009 showed that the Gini Coefficient has risen to between 0.66 and 0.68, depending on whether it is computed on the basis of the All Media and Products Survey (AMPS) or the Income and Expenditures Survey (IES) of the Statistics South Africa (The Presidency, 2009). In 2012, this index has worsened further to 0.69 (Westaway, 2012). Such a result is consistent with the fact that, among the Medium Human Development countries to which South Africa is placed by the UNDP, it is one of the few whose Human Development Indices actually deteriorated since the early 1990s, having fallen from 0.735 in 1990 to 0.653 in 2004 (UNDP, 2006). In 2011, this index has fallen to 0.619 (UNDP, 2011), again highlighting the worsening welfare performance.

Other measures of economic welfare have equally presented a dismal picture. For instance, analyses based on comparable consumption aggregates from the Income and Expenditure Surveys of South Africa (IES) have also been presented by government reports and suggest that over the 5-6 year-period between 1994 and 2000, consumption growth slowed to less than 1% per capita per annum (Department of Land Affairs/Department of Agriculture, 2005). This index is now being reported by the newly-created National Planning Commission which was established in the Presidency under the Zuma Administration. More recent figures reported in the *Development Indicators* show some improvement in the numbers which have averaged about 3.7% since 2003 (The Presidency, 2010).Despite this seeming improvement, there is still evidence of growing poverty in the country. According to the *Development Indicators 2010,* while 70% of the GDP is earned by the richest 20% of the population, the poorest 10% of the population is receiving only 0.6% of the GDP (The Presidency, 2010). This picture agrees with the trend in the Poverty Headcount Index which suggests that up to 48% of the population might still be living below a poverty line set at R524 to accommodate the increased uptake of social grants in the rural areas (The Presidency, 2010).

This situation shows that nothing much has changed since 2004 when, in presenting the Budget for that year, the South African Finance Minister at the time, Mr. Trevor Manuel, bemoaned the emergence of a "…*second economy* characterized by poverty, inadequate shelter, uncertain incomes and the despair of joblessness…"(Manuel, 2004). According to the Minister, many South Africans were "trapped" in that "second economy" (Manuel, 2004). The National Plan released in 2011 by a Commission now chaired by Mr Trevor Manuel in his new role as Minister in the Presidency, observes that, "for many poor South Africans, there is still much that looks the same…" as South Africa in the pre-1994 era (National Planning Commission, 2011). As the reform measures gathered momentum about 10 years post-liberation, a vicious circle of poverty was clearly evident, being fuelled by the extreme disparities that put the greater proportion of national wealth in the hands of a small minority Pauw (2005).

In 2011, the Department of Agriculture, Forestry and Fisheries (DAFF), conducted a review of studies and methodologies used for the estimation of agricultural productivities in South Africa in order to improve the quantitative basis for its policy formulation for the agricultural sector (Ramaila, Mahlangu and Du Toit, 2011). As might be expected, the former "independent homeland" areas, namely Transkei, Ciskei, Venda, and Bophuthatswana, which were granted "independence" by the apartheid regime (Berry, 1996; Raeside, 2004), have exhibited these problems much more than any other part of the country. According to Van Zyl, Kirsten and Binswanger (1996), these former "homelands" were characterized by inadequate market access, poor and deteriorating infrastructure and support services for smallholder farmers. Westaway (2012) has provided an interesting recent sketch of the philosophical and strategic considerations that informed the creation of these "homelands" or "reservations", and probably explain the sharp differences in conditions between them and what used to be "South Africa". In some way, it would seem that the fact that these former "homelands" consistently represent some exceptional spaces where attitudes and circumstances have such mythical similarities is actually not random but has resulted from careful planning by the National Party that created Apartheid about how the economy was to be managed to guarantee the supply of its productive resources and channel these to the achievement of scientific and technical progress (Westaway, 2012). The incisive analysis provided by Acemoglu and Robinson (2012 and 2013) emphasize this point and draw attention to the morbid calculations that preceded the enthronement of the apartheid regime of separate development and how that has produced the sharp divisions that currently exist between and within the races in South Africa today. In 2015, Oxfam suggested that South Africa could have the highest official unemployment rate in the world, at 25%, and, with a Gini Coefficient of 0.69, one of the most unequal countries in the world (Oxfam, 2015).

2.3 Government Response

In response to the foregoing issues, the Government of South Africa set up the National Planning Commission in 2011 to formulate the National Development Plan 2030 (National Planning Commission 2011). The plan defined six priority focus areas as follows:

- Uniting all South Africans around a common programme to achieve prosperity and equity.
- Promoting active citizenry to strengthen development, democracy and accountability.
- Bringing about faster economic growth, higher investment and greater labour absorption.
- Focusing on key capabilities of people and the state.
- Building a capable and developmental state.
- Encouraging strong leadership throughout society to work together to solve problems.

The third priority focus area, namely “bringing about faster economic growth, higher investment and greater labour absorption” aligned with one of the 9 challenges it identified for the economy, namely “unsustainably high unemployment” which was seen to be higher in the rural areas and was becoming worse as time passed (NPC, 2011). The Plan aimed to increase the national food trade surplus, with the small scale farmers and households generating at least a third of this surplus. Attaining food and nutrition security was also a crucial goal.

In other to operationalize the plan, the Government developed a business plan for the revitalization of the irrigation schemes in the rural areas (DAFF, 2012). Practical steps in this direction included the adoption of the Medium-Term Strategic Framework to drive activities over the period 2009-2014 within 10 Strategic Priorities in the programme of action of the Presidency, among which were three key ones that had important implications for smallholder development. These are:

- Outcome 4: “Decent Employment through Inclusive Economic Growth”
- Outcome 7:”Vibrant, Equitable, Sustainable Rural Communities Contributing Towards Food Security for All”
- Outcome10: “Protect and Enhance our Environmental Assets and Natural Resources”

Outcome 7 was particularly significant in its strong links with the key aspects of the land and agrarian reform and entailed the revitalization of the small-scale irrigation schemes, receiving a boost following the President’s State of the Nation Address of 2012 (DAFF, 2012). An initial plan to revitalize a mere 2% of the existing schemes, totalling no more than 1000 nationwide, was escalated and became incorporated in the National Agricultural Development Strategy (DAFF, 2012).

Making irrigation development and use a key part of the government’s strategy calls for a review of the sector as it exists at present and the main issues around its operation and development.

2.4 Water Resources and Assets in Irrigation Schemes

The biological nature of agricultural production processes means that water is a vital resource in the sectoral activities. A large part of South Africa is semi-arid with an annual average rainfall of about 500mm, making irrigation a vital part of the South African agricultural production system. In irrigated agriculture, the water needed for production must be provided for through artificial means. Thus, successful implementation of any irrigation project would require careful planning among other things taking stock of the available water resources that will be combined with other natural, physical and financial resources for a successful irrigation project implementation. The Department of Water Affairs and Forestry (DWAF) documents that the water resources of South Africa comprise 77% surface water, 14% return flows and 9% groundwater. Agriculture and afforestation make up the major water resource user in the economy, accounting for as high as 65% of total water use. This calls for strategic management approach and utilization for sustainable growth and development.

Water use in South Africa is dominated by irrigation, which accounts for around 62 per cent of all water use in the country. Domestic and urban use accounts for about 27 per cent, while mining, large industries and power generation account for some 8 per cent. Commercial forestry plantations account for a little less than 3 per cent of total use by reducing runoff into rivers and streams (Sonjica, 2004). An analysis by the DWAF revealed that in the year 2000, ten of the 19 water management areas in the country were facing a water deficit. In other words, in these catchments people are using so much water that either the ecosystems have been placed under severe stress or other users cannot rely on getting their fair share. Sonjica (2004) maintains that this calls for balancing the demand for water with supply to bring water use back to within sustainable availability levels through increased water use efficiency, removal of infestations of invasive alien vegetation, the development of additional infrastructure such as dams and inter-basin transfer systems to store water and bring it from areas of surplus to areas experiencing shortages, promotion of water trading and the reallocation of water use by compulsory licensing as part of strategic measures for water resource management. In a comprehensive assessment of water use practices within the farming systems of the Eastern Cape Province, Mnkeni *et al.* (2010) have demonstrated the feasibility of best management practices in smallholder irrigated farming within the study area.

Water resource constraints are a major impediment to the growth of irrigation agriculture where small scale irrigation makes up 4% of the total irrigation in South Africa (Schreiner and Naidoo, 2000). They maintained that in the mid-19th century, some of the most successful farmers of the Eastern Cape were black. However, years of dispossession and alienation during the apartheid era have robbed many of the descendants of black farmers of their knowledge and skills. Schreiner and Naidoo (2000) also identified that underlying the potential success or failure of a number of the domestic and irrigation water provision projects in South Africa is the question of financial sustainability which operates on two levels: the structure and affordability of tariffs as well as the provision of subsidies or targeted financial assistance to farmers. They noted that the Department of Land Affairs makes a grant of R16 000 ($2 666) available to emerging black farmers for the purchase of land while the Department of Water Affairs and Forestry offers a subsidy scheme which finances a percentage of off-farm water infrastructure development costs for these group of farmers. The new water pricing strategy also makes allowance for lower tariffs for emerging farmers (Schreiner and Naidoo, 2000).

2.5 Trends in Agricultural Development in the Eastern Cape Province

One of the key policy goals for development institutions as well as governments throughout Africa is to promote the transition of more farmers from subsistence production to more market-oriented production. The aim is to achieve commercialization as speedily as possible since small farmers can only alleviate, or at best reduce, poverty by selling what they produce at a profit. Yet in South Africa, after 22 years of democratic rule and considerable expenditure explicitly targeting the rural sector, there has been very little commercialization of rural production. Not too long ago, in 2002, Paterson (2002) suggested that as much as 86% of the agricultural land was still run commercially mostly by white farmers and 14% was being farmed at the subsistence level by black farmers and resource-poor households.

AgriSETA (2010) provide evidence that there has been a clear downward trend in the number of commercial farming enterprises which underscores the needs to grow the commercial agriculture sector to maintain South Africa’s food sustainability potential and support interventions to develop skills across the agricultural sector, especially for transformation and development of the small and emerging agricultural sector. In Table 2.2 below it has been shown that there has been a decline of 10.97% in the Eastern Cape Province. This indicates that instead of an increase in the commercialization the continent as a whole is seeking for, the commercial farms are declining over much of South Africa where it was shown that only one province registered a positive growth over the 5 year period reviewed.

Table 2.1: Commercial farming enterprises by province - 2002 and 2007

PROVINCE	2002	2007	Growth/decline
Eastern Cape	4 376	3 896	- 10.97
Free State	8 531	7 515	- 11.91
Gauteng	2 206	2 378	7.80
KwaZulu-Natal	4 038	3 560	- 11.84
Limpopo	2 915	2 657	- 8.85
Mpumalanga	5 104	3 376	- 33.86
North West	5 349	4 692	- 12.28
Northern Cape	6 114	5 226	- 14.52
Western Cape	7 187	6 682	- 7.03
Total	**45 818**	**39 982**	**- 12.74**

Source: AgriSETA (2010)

StatsSA (2004) has presented results of the Census of Agriculture that show that there were 45 818 active commercial farming units in South Africa in 2002, the number having fallen by as much as 12 162 farming units since the earlier Census of Agriculture conducted in 1993. This decline seems to be continuing as evidenced by latest results that show that the number of commercial farms has fallen further to 39 982 in 2007. This indicates the downward trend in a number of active commercial farming units in South Africa. Figure 2.9 illustrates the downward trend of commercial farming units in South Africa.

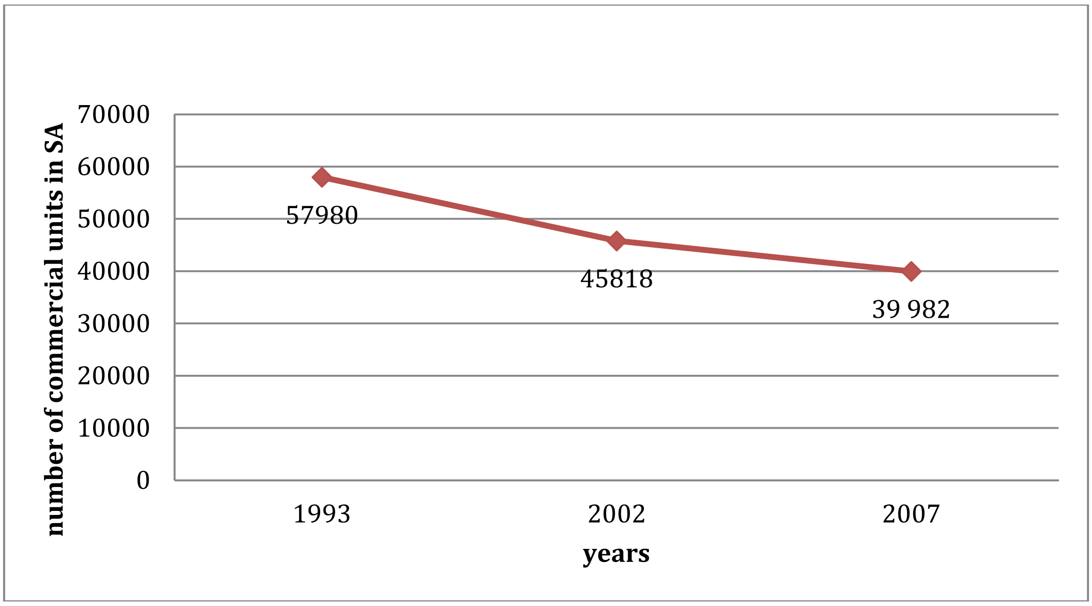

Figure 2.1: Commercial farming units in South Africa since 1993 to 2007
Source: StatsSA (2004)

According to Paterson (2002) the possible reason for this maybe that subsistence farmers do not want to farm commercially, a situation that seems to mirror the experiences elsewhere on the African continent. Most of them would rather have a good job in industry. Because of the lack of interest in commercialization by subsistence farmers Paterson (2002) further indicate that commercialization can only be brought about in the presence of a business spirit that is apparently lacking at this time. It is very clear that unless people are exposed to business they cannot be expected to have an entrepreneurial spirit.

2.6 Agricultural Decline in the Eastern Cape Province

Many reasons have been adduced in the literature for the declining trend in agricultural employment in the Eastern Cape Province. A dominant view is that the slow progress in the transfer of land from white owners to the black farmers is the key cause of the decline. Recent studies by Catholic (2010) and AgriSETA (2010) suggest that from 1994 to 2009 only 6.9% of agricultural land had been transferred to beneficiaries through both the redistribution and restitution programmes. This rate obviously falls far too short of the rate required to achieve the government's goal of transferring 30% of previously white owned farms to black ownership by 2014. Tshuma (2009) associated such slow progress to the fact that there is not much land available for farming in the country (due to the current land tenure system which has not addressed the inequalities created by the apartheid government) with the result that the majority of South African smallholder irrigation schemes being multi-farmer irrigation projects with individual plots not being larger than 5 ha in size. This means that small-scale irrigators in South Africa and other developing nations still do not have enough land for farming purposes.

A second cause result from government failure to support productive use of transferred land. Hall & Aliber (2010) reported that it is a matter for concern that in the Eastern Cape, most black farmers cannot access production loans meant for small farmers as a result of the disbursement practices of the main channel for farmer infrastructure support, namely the Comprehensive Agricultural Support Programme (CASP). The study by Hall and Aliber (2010) reviewed data from 322 projects which revealed that about 80% of the CASP funds go to a mere 20% of the beneficiaries as a result of the eligibility criteria that include the presence of fixed infrastructure and that the beneficiary owns the land in question (Hall & Aliber, 2010).Thus, the terms and conditions applying in this case effectively excludes the majority of farmers in the former Ciskei and Transkei regions.

A third reason advanced is the effect of the withdrawal of government from the management of the existing small-scale irrigation schemes. As the history of the schemes will show, after the establishment of the small-scale irrigation schemes, they were run and managed by government through its agencies on behalf of small-scale farmers. Tshuma (2009) revealed that all the schemes under the Agriculture and Rural Development Corporation (ARDC) were fully subsidized, meaning that the government was majority owner of the schemes' capital resources such as the machinery, water through the Department of Water Affairs and Forestry (DWAF) and even the working capital used in the schemes. This left the farmers to play only the role of casual labour for weeding and harvesting. The scope for the farmers to acquire skills in management of these schemes was therefore limited. This is probably why, despite huge investments on them by the government, the performance of most of these small-scale irrigation schemes has been poor and falls far short of the expectations of all stakeholders, be they engineers, politicians, development agencies and the participants themselves.

In explaining the declining rate of investment in water resource development in sub-Saharan Africa, Riddell *et al.* (2006) have suggested that the disappointing performance of past investments may be the main reason. It will not be surprising if the concern over poor results in respect to returns to investment sustainability could be the major factors influencing official decisions regarding investment in the sector.

2.7 Concept of Entrepreneurship

While the term "entrepreneur" originated much earlier in 1755 when the French Economist Richard Cantillon coined that term to describe "a person who undertakes to do a job", it was Adam Smith's seminal works in both the earlier To the extent that entrepreneurship involves economic action undertaken in the interest of the individual undertaking it, it builds on the notion of self-interested behaviour of mankind first put forward by Adam Smith. As he put it, “It is not from the benevolence of the butcher, the brewer or the baker that we expect our dinner, but from their regard to their own interest.” (Smith, 1776). It is this decision and set of actions made on the way different resources are managed and utilized, out of pure self-interest for self-improvement that Schumpeter (1942) more formally defined as entrepreneurship. Whereas Schumpeter (1942) viewed the entrepreneur as an agent of change who innovates new products or production processes or new sources or goods ("gets new things done"), Hayek (1937) opined that an entrepreneur is an agent who adjusts his/her production based on new information or knowledge of facts, or newly-perceived changes in the plans of other market participants (Learning). According to Hayek (1937), the old ideas are not completely destroyed as suggested by Schumpeter (1942) but rather the ideas are improved based on factual information or future market forecasts. A related view is put forward by Kirzner (1973) who asserts that an entrepreneur explores the undiscovered opportunities to gain by changing the existing production or creating a new product and creates a future image in his mind and acts to bring it about. Other contributors to the knowledge of entrepreneurship include Mises (1963), Shackle (1968), Knight (1971), and Lachmann (1979), whose theories of entrepreneurship also focused attention on future market forecasting.

Although entrepreneurship has no clear-cut definition, it can be explained based on the entrepreneurs’ activities or as a person endowed with knowledge, skills, initiative and spirit of innovating to achieve his/her set goals. Some of these activities include initiation, risk calculation, resource mobilization and setting up new businesses through innovations to meet clearly-defined market demands (Einstein College of Engineering, 2011). An entrepreneur is an economic agent who combines resources by all means of production to maximize profit. An entrepreneur recognizes an opportunity, sets a goal, and takes advantage of the prevailing situation (Einstein College of Engineering, 2011). Sudharani (2010) defined entrepreneurship as a continuous process which aids the entrepreneur to cause changes and innovation in production, mobilize and create new production methods, and new markets, among others. The LinkedIn Discussion Group on Austrian Economics defined the concept of “Active Entrepreneurship” as “a state of alertness where opportunities are easily discerned to be acted upon”

Entrepreneurial spirit is a key element of the human dimension of development and can be described as the quality or attribute of a person that allows him or her to show creativity in constantly looking for opportunities to improve or expand businesses for increased profits. Entrepreneurs have ability to calculate economic risks and mind about profits and losses, and they are innovative in nature to catch-up with growing global competition (LEISA Magazine, 2009; McElwee, 2005; Masaviru, 2011). They are goal-oriented, persistent hardworking and energetic, willing to take initiative, and have a strong sense of commitment. Smallholders' low agricultural production may be attributed to low entrepreneurial spirit.

2.8 Entrepreneurs and Positive Psychological Capital

A growing body of literature attests to the importance of positive psychological capital and its contribution to improved productivity and future anticipated returns (Luthans, Luthans and Luthans, 2004; Carver *et al.,* 2005; Judge *et al.,* 2007; Luthans *et al.,* 2007; Ryan and Caltabiano, 2009; Pepe *et al.,* 2010). In the world of business, especially when considering entrepreneurial spirit as a critical factor of production, this type of capital has been reported to be of great importance. According to Sudharani (2010), related concepts essential for a successful entrepreneur include self-confidence, confronting uncertainty (optimism), hope and perseverance. Luthans, Luthans and Luthans (2004) provide a guide to understanding the term "positive psychological capital" by suggesting that it is the sort of answer that is given to a question such as: "*who are you?*". More specifically, and technically, the term refers to the positive and developmental state of an individual as characterized by high confidence (self-efficacy), optimism, hope and resilience. Some empirical studies have attempted to define each of these four concepts as presented below.

Confidence: Confidence and self-efficacy are interchangeably used to reflect the ability to achieve a specific goal in a specific situation or to take on and put in the necessary effort to succeed at challenging tasks (Luthans *et al.,* 2007). According to Luthans, Luthans and Luthans (2004), confidence can be defined as the "individual's conviction……about his or her abilities to mobilize the motivation, cognitive resources, and courses of action needed to successfully execute a specific task within a given context". Moreover, Judge *et al.* (2007) cited Bandura (1994) who defined "self-efficacy" as the individuals' beliefs about their capabilities to produce designated levels of performance. The concept can be of great relevance in adoption of new technologies for increased agricultural productivity and enhancing farm business.

Optimism: This can be defined as individuals' future expectation. Optimists always expect good outcomes. The concept can also be defined as a positive attribution about present success and in the future (Carver *et al.,* 2005; Luthans *et al.,* 2007). The concept is mainly based on the expectancy oriented value model which speculates that, unless there is a valued goal, no action occurs (Carver *et al.,* 2005). The opposite of optimism is pessimism, and pessimists nurse negative thoughts and possess bleak expectations about succeeding now and in the future. Optimists have a sense of confidence and persistence in confronting tough situations (Carver *et al.,* 2005). Moreover, optimists interpret unfavourable events as being only temporary while pessimists interpret unfavourable events as being permanent.

Hope: There are two components that define hope. The first component entails an individual's perception of the existence of pathways that are needed to achieve his or her goals and the second component dwells on the individual's level of confidence to manipulate those pathways to achieve the goals (Carver, 2005). In addition to the ability to redirect paths to goals, Luthans, Luthans and Luthans (2004) and Luthans *et al.* (2007) indicated that persevering or goal oriented determination also contributes to the definition of the hope concept.

Resilience: According to Ryan and Caltabiano (2009) the concept of resilience can be defined as the ability to maintain or regain positive levels of functioning or bouncing back despite adversity and even beyond to attain success. Resilience can also be defined as a positive way of coping with danger or distress (Luthans, Luthans and Luthans, 2004). The Montpellier Panel has recently raised the notion of resilience to the level of a crucial concept in agricultural development given the frequent shocks and stresses to which the system is exposed on a continual basis and requires that well-considered interventions have a chance to make the desired impact (The Montpellier Panel, 2012). Figure 2.11 presents their recommendations on this notion.

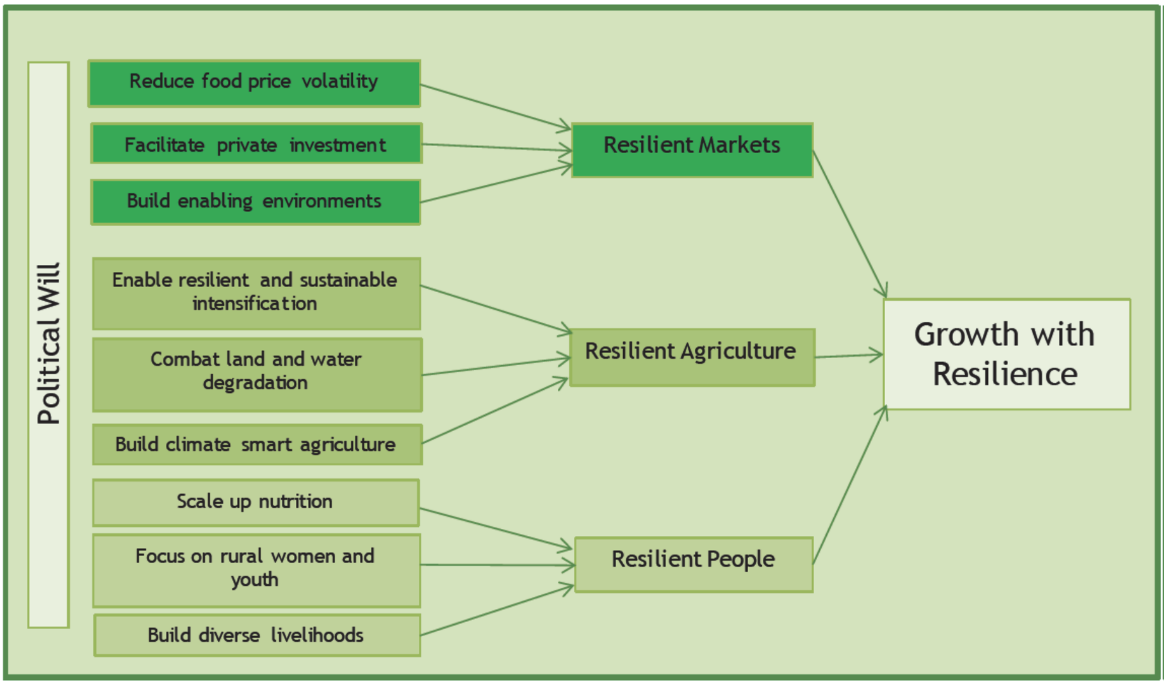

Figure 2.2: Montpellier panel recommendations on agricultural growth with resilience

According to Sudharani (2010), entrepreneurs can be fitted into four categories, namely, aggressive/innovative, imitative/adoptive, Fabian and the drones. Aggressive/innovative entrepreneurs are individuals who use knowledge, skills and formulate a product out of a new combination of inputs. They sense opportunities and develop new technologies, new markets, and set-up new organizations to satisfy a given need. They are very important in the development of communities and nations. Imitative/adoptive entrepreneur are individuals who adopt and imitate enterprises innovated by other people. They are treated as economic development agents because they adopt already tested technologies that create employment opportunities. The Fabian entrepreneurs are always cautious and timid in adopting technologies and skeptical to change their age-old (time-tested, at least to them) production styles, unless their businesses fail or are at the verge of collapsing and they do not attempt to adopt new technologies. Drone entrepreneurs are always stuck in their traditional way of doing business and feel more comfortable in such antiquated business operations. They use the same technology and management style throughout the business or project life cycle. They are laggards and are resistant to change.

Also, entrepreneurs can be classified based on ownership mode, and can be illustrated by the distinction between the private and public entrepreneur. The private entrepreneur is mainly driven by profits and does not invest in ventures that promise less than substantial monetary gains. On the other hand, the public sectors represented by the government invests in enterprises with the goal of promoting re-distribution and forging partnership between the public sector and rural resource-poor population in developing countries as a way of alleviating poverty. To that extent, monetary gains may not be the over-riding goal of the investor in that case.

Entrepreneurs can also be classified based on the scale of the enterprise and this includes small and large scale. Small scale entrepreneurs normally operate small businesses, lack skills and are resource poor and commonly found in developing countries whereas large scale entrepreneurs have relatively better endowed with finances and skills to invest in new technologies. In most cases they run multinational companies and are mainly located in developed countries (McElwee 2005; Sudharani, 2010).

Another important concept introduced in intellectual and policy discussions on entrepreneurship is that of “entrepreneurial values”. Venter (2012) identified three types of entrepreneurial values, namely, the Western values, and non-Western or African values, and the hybrid values shaped by a combination of the western and the African values. The Western values include individualism, materialism, industriousness, need for achievement and risk taking, while African values include communalism, caring and sharing, and compassion. Although, much of the literature considers the Western values as the only key to entrepreneurial success, Venter (2012) urges that both the African and Western values need to complement each other (hybrid) to achieve a meaningful entrepreneurial capital. Promotion of either value, say, the Western values may encounter resistance to some communities especially those with strong beliefs of own cultural values (Venter, 2012). Therefore, one needs to first understand the indigenous entrepreneurial values before integrating them in the hybrid values. African values strengthen social bonding and networks in communities, and are important in providing access to resources like economic capital while adoption of the Western values enhances acceptance in the formal institutions (Venter, 2012). Without a doubt, the implications for choice of methodology and for the correct specification of analytical and empirical models measuring entrepreneurship are enormous.

2.9 Entrepreneurship in Small-scale Farming

There are several steps involved in the process of starting a smallholder farming enterprise (McElwee 2005; Sudharani, 2010; Einstein College of Engineering, 2011). Typically, the steps include idea generation which depends on the vision, insight, observation, experience, education, training and exposure of the entrepreneur. The farmer thinks about farm as an enterprise to run. When selecting, the famer should consider the commercial viability of an enterprise and his/her management capabilities. Goals/objectives are set for the selected enterprise based on the nature and type of business. The entrepreneur seeks information regarding sources of funding; he/she identifies cheap and regular sources of supply of raw materials that favour low costs of production; he/she identifies cheap and appropriate farm implements/machinery to be used in production; identifies networks and markets of the input/output; establishes sources of labour needed, and lastly implements the idea/innovation.

2.10 Factors affecting Entrepreneurship Development in Smallholder Agriculture

Economic environment is one of the major factors influencing entrepreneurship. Environment in this context includes availability of capital, labour, farm inputs and implements, and markets. Most rural smallholder farmers in Sub-Saharan Africa lack capital to invest in commercial farming. This prevents them to invest in new businesses that have high production risks yet such may be a potential for capital formation and entrepreneurship development. Also farmers lack access to labour saving technologies and skilled labour (quality). They also lack credit access and are too poor to afford purchase of agricultural inputs. Market structures in most rural areas are poor and lack access to market information. Lack of capital, labour saving technologies, low farm input use, and markets and market information negatively affects the entrepreneurship drive and spirit (McElwee 2005; Sudharani, 2010).

Social environment also affects entrepreneurship. The social environment in which an individual grows, shapes his/her attitudes, norms, values and beliefs. For example, cultural beliefs can shape a person towards adoption or not adopting a certain technology or through family inspiration an individual adopts a given style of management, innovation and expansion of business. Social mobility can be an instrument of sourcing for more information helpful for innovation or access to better markets (McElwee, 2005). If there is no social mobility, then the population forms part of cheap labour and market for produce. Rural smallholder farmers in developing countries are less mobile due to poor infrastructures and thus, creating more barriers to access knowledge, skills and information, and hence low innovations and low entrepreneurial spirit (McElwee, 2005).

The compelling factor affecting entrepreneurship emphasizes use of prevailing situations like individual's strong desire to do something independently or differently. Smallholder farm entrepreneurs need to use government incentives like free inputs/input subsidies, extension services, regulations and policies on smallholder land and irrigation water utilization, farmer-private sector market and technical linkages to improve on their businesses (Sudharani, 2010; Einstein College of Engineering, 2011). Also, entrepreneurs should make use of their technical and professional skills, business experience, and technical know-how to innovate, plan and produce goods that are market appealing.

2.11 Promoting Smallholder Enterprise and Entrepreneurship

Rural farmers often confront high levels of poverty. As has been noted, this may dampen their enthusiasm to invest their scarce resources, thus killing their entrepreneurial spirit. Therefore, for improved rural smallholders entrepreneurship, there is need to encourage accumulation of human and social capital through farmer groups and cooperatives (McElwee, 2005; LEISA Magazine, 2009; Tahmas, Hekmat and Davodi, 2012). Farmer organizations need to stimulate entrepreneurship through systems that allow free information flow and sharing, organized extension trainings and advisory services, promotion of collective marketing and improved coordination among producers, shared production and management costs/risks, and always presenting farmers' interests in policy negotiations.

Furthermore, producers, business associations (other rural entrepreneurs investing in market intelligence, technologies, products and services, and organization reforms) and government need to agree and put in place rules, norms and regulation, and institutional environment that enhance coordination of rural businesses. This reduces business risks, transaction costs, improves market accessibility and entrepreneurship growth (LEISA Magazine, 2009). Rural smallholder farmers need government support to stimulate entrepreneurship growth. Support like provision of information on quality standards, and input and output markets in the agricultural sector and may include provision of capacity building services such as business planning, marketing and book/record keeping, quality control and post-harvest handling of agricultural goods may be of great importance in promoting entrepreneurship. Other support may include demonstration sites and farmer learning and interaction centres, and other infrastructures should be put in place to help farmers solve their technical problems, promote social cohesion, reliable information flow and increased social networks (McElwee, 2005; Einstein College of Engineering, 2011; Tahmas, Hekmat and Davodi, 2012).

Agricultural credit/loans at low interest rates for long payback periods need to be availed to farmers to speed up the entrepreneurial drive. Conditions needed to boost entrepreneurial growth, may call for more agricultural linked activities such as agro-processing produce units (maize mills, decorticating mills); agro-produce manufacturing units; and agro-input manufacturing. Access to improved seed and fertilizer and agro-service and workshop centres are also essential for entrepreneurial growth (Sudharani, 2010).

Entrepreneurship is an inevitable ingredient of rural economic development especially in Sub-Saharan Africa (McElwee, 2005; Masaviru, 2011; and Ndou, 2012). A few studies carried out in Western and Central Europe indicate the importance of smallholder farm enterprises in economic growth (McElwee, 2005). During the periods of high levels of underemployment and unemployment in India and other Asian countries, many people resorted to innovation and created new businesses including smallholder farming. The government rendered support to the small-scale enterprises through farmers, traders and manufacturing industries linkages, and provided extension services and market oriented technologies. Government efforts stimulated economic growth in these economies (Sudharani, 2010; Einstein College of Engineering, 2011). In Sub-Saharan Africa, there are pockets of successful smallholder farmer entrepreneurs along value chains of high value crops and horticulture products (Africa Human Development Report, 2012). Using a Cobb-Douglas production function, Masaviru (2011) reported a positive and significant relationship between entrepreneurship and Kenya's economic growth.

According to Global Entrepreneurship Monitor (GEM) (2011), entrepreneurial spirit can be enhanced through improved infrastructure development, quality of the population in terms of skill building, research and development, and technology advancement. Entrepreneurship can also be enhanced through availability of flexible labour markets and inputs/output markets, and financial market flexibilities within the location of operations. For someone to be identified as a successful entrepreneur, one has to be more efficient in utilizing the available resources and ensure product quality enough to fetch more profits. However, entrepreneurs are faced with increasing challenges in input/output prices, changes in trade policies and stiff environmental regulatory policies. These challenges call for innovativeness, taking risks and recognizing opportunities, and striking a balance between people, policies and the natural environment for a sustainable farm business (Modiba, 2009).

2.12 Entrepreneurship and Innovation in Communal Agriculture

Schumpeter and other members of the Austrian School spearheaded the bulk of the theoretical work on the subject of entrepreneurship and innovation. In his *Theory of Economic Development,* Schumpeter (1949) viewed the entrepreneur as an agent of change who approaches the creative process through destruction of existing myths and stereotypes (so-called "creative destruction"). The concept of creative destruction has been widely used in the theory of economic innovation and the business cycle. Creative destruction is instrumental to the founding of new product lines, new markets and new forms of organization and ultimately leading to growth in the economy (Schumpeter, 1949). For example, farm mechanization through innovation of tractors and combining harvesters is thought to reduce farm costs thereby increasing farmers' profits and reducing consumer food prices. Despite its positive contributions, creative destruction exhibits negative impacts like farm job losses. In 1790s in the United States of America, over 90% of the population was employed in agriculture, and by 1990s, only 2.6% of the population was engaged in farming due to innovation of labour-saving technologies. This implies that over 87% of farm jobs were lost.

Innovation was defined by Schumpeter (1937) as the setting up of a new production functions (Hagedoorn, 1996). Based on the notion of new production functions, Hagedoorn (1996) citing Schumpeter (1937) indicated that entrepreneurship can be considered as a third basic factors of production in addition to land and labour.

Using the Schumpeterian entrepreneurship theory, Braguinsky *et al.* (2009) established the impact of individual talent coupled with working experience and education level in job creation (self-employment). Findings of this study indicated that individual's talent, hands on experience (both technical and managerial), human capital (level of education) and age of an individual had a positive relationship with entrepreneurial spirit. Wealth (incomes) and access to credit or financial resources are also crucial in advancing the entrepreneurial spirit (Braguinsky *et al.,* 2009; Hagedoorn, 1996). To achieve the new production functions, someone has to be bold and willing to get rid of the old myths or beliefs (Swedberg, 2007). According to Swedberg (2007), the obstacles to an individual's entrepreneurship progress can be both sociological and psychological in nature. Sociological obstacles are those related to social norms and beliefs which resist development while psychological are those related to individual's negative attitude towards development (Swedberg, 2007).

In the agriculture sector, Lwakuba (2011) perceives the term 'farmer entrepreneurship' as related to 'treating farming as a business'. This suggests a business-like approach to farming activities quite apart from its importance as a source of food for subsistence. Farmers' positive psychological capital/positive thinking is a driver to innovativeness important for increased production. Therefore, the focus is on changing the mindset of farmers from subsistence to a more commercial farming operations' orientation. A number of agricultural innovations have been introduced as an effort to improve resilience and livelihoods within the community, primarily through the Smallholder System Innovation (SSI) and Land Care projects (Sturdy, 2008). Furthermore, in Uganda and the world over, farmers' and nations' options for survival and for sustainably ensuring success in changing their respective economic environments has become increasingly critical due to the changing socio, economic, political, environmental and cultural dimensions (Lwakuba, 2011). It is also worth noting that the emergence of the free market economies globally has resulted in the development of a new spirit of enterprise and the increased individual need for responsibility for running their own businesses (Lwakuba, 2011).

Apart from land reform programmes to develop agriculture, South African government, in particular, initiated a number of irrigation schemes soon after the 1994 elections with the aim of developing small-scale agricultural production (Riddell *et al.* 2006). These low-cost micro-irrigation technologies are largely promoted to poor farmers because of their competitive pricing and compatibility with smallholder farming systems. It is one of government's responses to low agricultural productivity and the 'absence of commercial agriculture' in many provinces to what was attributed to be perceived lack of entrepreneurial and managerial ability among black farmers (Sishuta, 2005). Farmers become more entrepreneurial as economies grow, and this trend is triggered by rapid technological change, improved rural infrastructure, and diversification in the patterns of food demand (Von Braun, 1995). McElwee (2005) agreed that farmers are becoming more entrepreneurial and developing new skills and functional capabilities to enhance their competitiveness. This phenomenon was particularly visible in Poland where it was noted that entrepreneurship is a relatively recent phenomenon.

2.13 South Africa's Entrepreneurial Performance

The Global Entrepreneurship Monitor (GEM) used the World Economic Forum's (WEF) classifications to categorize South Africa among the efficiency-driven economies (Herrington, 2011). But Herrington (2011) has documented a vast array of concerns about the poor state of entrepreneurship in the country, especially among the youth and the black population, a situation which is manifested in few, if any, business start-ups and low entrepreneurial interest as well as lack of confidence in their entrepreneurial ability. According to his important contribution, this situation can be attributed to the stifling atmosphere engendered by the apartheid policies which discouraged property ownership among the black population, thus making it impossible for them to acquire the necessary assets to access institutional capital which is vital to a vibrant entrepreneurial environment (Herrington, 2011).

The GEM (2011) provides additional reasons for South Africa's poor entrepreneurial environment among the black population. According to the report, the South African second economy, a term that describes the largely poor, traditional sector in which the black population operates, is dominated by resource-poor households and can classified as a factor-driven economies (GEM, 2011) as opposed to the efficiency-driven nature of the more modern sector. The factor-driven economy is characterized by mainly subsistence agriculture and extraction businesses with a heavy reliance on unskilled labour and natural resources (GEM, 2011). To improve on the entrepreneurial environment, the government of South Africa has developed policies that emphasize promotion of entrepreneurial activity especially in the informal sector. This has been implemented through allocation of vast financial resources to catalyze the establishment of self-owned or joint ventures businesses (Modiba, 2009; GEM, 2011). A vast body of literature confirms the huge support rendered by South African government to improve on the entrepreneurial activities among smallholder agriculture. The support entailed establishment of small-scale irrigation schemes, subsidization of farm inputs, provision of credit facilities and enacting a number of land reform policies (Ramaila *et al.,* 2011).

Notwithstanding the support from government, South Africa's level of entrepreneurial spirit is reported to be the lowest and lagging behind many countries globally (Modiba, 2009; GEM, 2011). In South Africa, only 1.7% of businesses started do survive after a period beyond three years and six months, and the Total early-stage Entrepreneurial Activity (TEA) rate was reported at 9.1% (GEM, 2011). The prevalence rates for established self-employed business in South Africa were reported at 2.3% (GEM, 2011). Moreover, the country's agribusiness sector is the most underdeveloped yet considered being the most important for economic growth of the second economy (Modiba, 2009). Low entrepreneurial spirit represents a worrying situation for smallholder's agribusiness sector in contributing towards meaningful job creation, and growth of the rural economy (Modiba, 2009).

2.14 Chapter Summary

The chapter presented the literature review whose main focus was the policy issues related to the National Development Plan goal of mass job creation in the rural areas through small business development. The Government has been implementing a large-scale rural transformation which includes revitalization of small-scale irrigation schemes and a wide range of infrastructure projects. But the success or otherwise of these programmes hinges on a number of critical factors such as response of the small farmers to the incentives offered by the irrigation development and assorted farmer support schemes and whether or not the necessary entrepreneurial spirit can be mobilized to invest in small business to invigorate the rural farm and non-farm economies. The review of the problem context established the deteriorating socio-economic profile of the average rural dweller, with poverty and inequality being shown to be worsening. The response of the Government to deal with this problem was reviewed and it was found that, apart from the National Development Plan 2030, a number of other initiatives have been launched and are operational. The scope for successful poverty reduction and job creating strategy depends on the viability of the irrigations schemes and the profile of the farmers in terms of willingness to adopt improved technology. It was found that the literature has quite liberally disseminated information on the irrigation schemes, including those located in the immediate zone of influence of the study area. The final part of the literature review looked at the whole issue of entrepreneurship and other motivational characteristics, with the intention to explore the theoretical and conceptual basis of the expectation that they are crucial to adoption of improved practices. The history of the concept of entrepreneurship was sketched and documented evidence of the important role it plays in socio-economic development of a people were highlighted.

CHAPTER 3
CONSIDERATIONS FOR SITE SELECTION AND SITE DESCRIPTIONS

3.1 Introduction

This chapter reviews the considerations for the selection of the study areas in which the research was carried out. The different sites and irrigation schemes selected are described. In addition, the socio-economic and geo-physical contexts of the surrounding areas are described. As the Terms of Reference specified, the study areas were to be selected to reflect the broad geographical and administrative sub-divisions of the province. The key issues that arise in a study of this nature are the existing land use patterns, local occupational structure, infrastructure profile in relation to the scope for establishment of small businesses, existence of markets and other institutions that support enterprise development, among others. These issues are addressed in this chapter to the extent possible on account of availability of information.

3.2 Site selection

The very first step in a research process is to take a decision on the relevant population to cover. This phase is without prejudice to the nature of the study but is even more crucial in socio-economic investigations where locational considerations are of utmost importance. This has to come before the decisions on the households or individuals to enumerate. As Hardon *et al.* (2004) have noted, this phase amounts to establishing the population from which the sample will be drawn for more focused investigation. According to Hardon *et al.* (2004), the study sites selected for any study is influenced heavily by the study objectives and on such factors as the social and physical settings of the environment that affect the particular attribute of research interest. In a health study, for instance, this would include distance to access services, attitudes of the relevant segments of the population to the testing being contemplated, and how easy it is to gain entry into the community and forge collaboration and partnerships necessary for implementing the research process. Hardon *et al.* (2004) illustrated the importance of the research objective with the example of a malaria study that is best sited in a place with high incidence of malaria. Of course, any other location would be meaningless as there would be no malaria to study.

The original proposal for the larger study envisaged that the first step in the process would be to conduct a situation analysis within two broad geographical areas of the province, namely the former homeland areas of the Ciskei and the Transkei. From each of these areas, two contrasting locations would be selected on the basis of farming types, agricultural water use practices, and demographic structures. This would make such an analysis a form of baseline study that provides the basis for future impact assessment of any interventions that are made in those communities subsequent to the present study. While that would be quite useful, and indeed desirable, and especially for their value to other researchers and research not directly foreseen, it is not the intention at this stage and the purpose of the present exercise is merely to provide a basis for selecting sites that are appropriate for investigation of the issues covered under the present study.

At the time the proposal was written nearly two years ago, it was not possible to decide ahead of more systematic appraisal which locations would be included. However, it was *a priori* assumed that Nkonkobe and Mbhashe Local Municipalities would be the most convenient locations on account of prior experience in those two areas. Since then, the research team has obtained access to documentation and insights that have helped to understand much better the coverage of the irrigation investment programmes of the provincial government as well as those that are being implemented under a number of non-governmental programmes by farmer groups and the commercial agricultural sector, especially the Citrus Industry in the Nkonkobe Municipality. These additional sources of information about what is available have also yielded insights on methodological issues. Further, internal project consultations and the more in-depth examination of the project objectives have revealed that, at least in the case of the fifth specific objective, namely “to formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes”, requires some basic background information about progress to be measured.

3.2.1 Rationale for Situation Analysis and Site Selection Report

As indicated in the foregoing, at least one specific objective of this study requires the testing of an intervention which needs to be tracked in order to arrive at a decision as to whether or not the intervention has produced the desired results. For this reason, sufficiently comprehensive background data are required to place the team in a position to make the necessary judgments in that regard. In its most common definition, a situation analysis is a scoping procedure to ascertain the broad context and wider economic and political (as well as cultural) environment in which a project is to be implemented. It has been defined as "a systematic collection and evaluation of past and present economic, political, social, and technological data, aimed at (1) identification of internal and external forces that may influence the organization's performance and choice of strategies, and (2) assessment of the organization's current and future strengths, weaknesses, opportunities, and strengths" (B*usinessdictionary.com, 2012).* Many organization conduct specialized procedures such as PEST analysis and SWOT analysis, as part of their situation analysis depending on the specific contexts (B*usinessdictionary.com, 2012).* In general, a situation analysis is expected to include three main elements as follows:

(i) An analysis of the existing farming system and the conditions in which the key participants operate and what constraints and opportunities are evident;
(ii) A diagnostic study involving the identification of key issues in the system that afford flexibility around which interventions can be framed;
(iii) A specific look at the key stakeholders in respect to their social and psychological assets, needs and aspirations to determine whether or not expectations for improvements are shared equally.

The International Union for Conservation of Nature (IUCN) (2010) has produced a methodological manual in which they identified three main reasons for conducting a situation analysis. According to IUCN (2010), it is important for ensuring that projects address the "right" issues, are implemented with the right partners, and that the monitoring and adaptation can be effective. In the context of the present study, this will be particularly helpful when the selection of the test sites, communities and partners will be undertaken to ensure that the action research element is carried out successfully. At this stage, the situation analysis is being seen as an opportunity to also test the methodologies and methods proposed for the various components of the approved research. For this reason, the data collection will utilize an amalgam of approaches which are described under the specific component discussed in the sections and chapters that follow. An over-riding approach is the participatory action learning methodology under which a wide range of steps involving direct participation of the local community and interaction with the researchers, are undertaken.

3.2.2 Selection of Study Sites

The geographical location for this study was pre-determined in the directed call as the Eastern Cape Province of South Africa (Water Research Commission, 2011). It was further required that at least two sites where small-scale irrigation schemes were operating should be selected for the study (Water Research Commission, 2011). All the discussions in respect to the site selection will therefore be limited to the Eastern Cape and invariably refer to the areas where the small-scale irrigation schemes were established as part of the so-called Betterment Programme (Van Averbeke and Mohamed, 2006; Obi, 2011; Obi, 2012).

Given this specific requirement in respect to geographical location, the initial approach was to conduct some literature review, mostly analysis of government documents and dissertations and theses developed at the University of Fort Hare. A number of reports completed as part of previous studies sponsored by the Water Research Commission were also available to the team and these were consulted to determine the extent of the small-scale irrigation schemes in the province and where they are located and their feasibility for study based on whether or not they were currently operational and their relative importance based on the number of farmers settled on these schemes.

In the end, the government sources proved to be the most informative sources for the foregoing requirement. A meeting was requested with the Senior Manager for Irrigation in the Province (Mr Nika Kalawe) as well as the Manager in charge of Agricultural Economics (Mr Lawrence Musisi). Both meetings were granted enthusiastically, one being held at the headquarters of the Eastern Cape Department of Rural Development and Agrarian Reform in Bisho while the other was held in the field with Mr Kalawe during his monitoring visit to farmers in Intsika-Yethu Municipality where he met farmers involved with the Qamata and Ncora Irrigation schemes. In this regard, the *Annual Performance Plan (APP) 2012-2013* and the *Annual Operation Plan 2012-2013* of the Eastern Cape Department of Rural Development and Agrarian Reform proved to be a key document for deciding on the government schemes to include. The document primarily outlines the government's priorities for investment and operational support to the farming communities in any budgeting period. Further, the document identifies the major projects to be supported, to what extent, and the timing of such support. In this way, it is the key and quickest source of the information for drawing up a sampling frame of projects and hence sites/areas to be focused on for drawing a sample for more intensive investigation.

On the basis of consultations with experts and specialists working on water resources for agricultural use, it was learnt also that the Kat River Valley Water Users Association had been doing a lot of work in collaboration with the Institute of Water Research and the Catchment Research Group at the Rhodes University. It was therefore decided to expand the search to documentation produced by that group as well as schedule face-to-face meetings with the membership and management of the group. Such a meeting was eventually held and yielded considerable amount of insights (see meeting notes/records inserted as Appendices to this report). Through these consultations, it was also learnt that the municipality is home to several privately-owned and managed irrigation schemes although these principally served the emerging farmers many of whom were already involved in medium to large scale production of export products such as citrus products.

Overall, the active schemes included in the 2012-2013 plans of the government in the province were identified as the following:

- Qamata Irrigation Scheme
- Bilatye Irrigation Scheme
- Keiskammahoek Irrigation Scheme
- Ncora Irrigation Scheme.
- Tsitsa Basin Irrigation project
- Phendu Irrigation Project

- Ntshongweni Irrigation Project

The government's plan is to complete the rehabilitation and settlement of a number of irrigation schemes in the province covering some 200 hectares in 2012/2013. The purpose of this plan is given in the documents as "to increase production levels in the areas where intensive crop production is practiced by the previously disadvantaged farmers". The government had in previous years supported the rehabilitation of other schemes such as Tyefu irrigation scheme and Zanyokwe irrigation scheme which were operational and were also mentioned by the Senior Manager for Irrigation as schemes he expects the research to cover. In the case of the schemes operated and managed by the Kat River Water Users Association, the schemes are located in the fields drained by the Kat River in the Fort Beaufort, Seymour and Balfour area.

3.3 Motivation for Final Sampling Frame

In addition to the foregoing considerations, the team organized a seminar on 15 August, 2012 for the presentation of the PhD proposal under the project. The seminar was attended by a large number of stakeholders including the Senior Manager for Irrigation at the Department of Rural Development and Agrarian Reform and the Manager for Agricultural Economics and Marketing as well as senior academic staff and students in the Faculty of Science and Agriculture and other units of the University. One of the issues raised at the seminar by participants concerned the appropriate sample sizes and units of observation for the various components and the team was asked if the required sample size could be guaranteed on the schemes appearing in the Government's operational plan. The suggestion was made that the team should broaden the study as much as possible, of course not losing sight of the constraints imposed by the budget and the time. On the basis of these suggestions and the ensuing discussion, it was decided that the entire candidate schemes mentioned identified in the Plan and those mentioned by the Kat River Water Users Association should be considered potential sites and that as much as possible those schemes should be covered and enumerated over the life of the project.

3.4 Study Districts and Municipalities Considered

The purpose of this chapter is to describe the candidate study areas where the active irrigation schemes of the government and non-governmental farmer groups are located. The context is set by providing a brief description of the Eastern Cape in terms of its geography. This is then followed by more specific description of the five municipalities where the active irrigation schemes are found. These are Nkonkobe Municipality, the Intsika-Yethu Municipality, the Amahlathi Municipality, Ngqushwa Local Municipality, the Buffalo City Municipality and the OR Tambo District Municipality. While some of the municipalities were included because of the irrigation schemes they have, others were included in order to have a representative enough sample of *Siyazondla* households and food plots to be enumerated

3.4.1 The Eastern Cape Province

The Eastern Cape Province of South Africa lies on the south-eastern coast of the country where the Indian Ocean meets the land of South Africa (see Figure 5.1). The Tourist Guide Books are lavish with praises of its great natural beauty, particularly the rugged cliffs, rough seas and dense green bush of the stretch known as the Wild Coast (Figure 5.1). The province also features diverse climates and landscapes which range from the dry and desolate Great Karoo to the lush forests of the Wild Coast and the Keiskamma Valley, the fertile Langkloof near Port Elizabeth, renowned for its rich apple harvests, and the mountainous southern Drakensberg region around the town of Elliot.

The Eastern Cape Province occupied a total land area of approximately 169 580 square kilometres in 2001 but due to provincial boundary changes since then, the latest Census results gives it a land area of 168,966 km^2 (Statistics South Africa, 2011). This means that the province is roughly 13.8% of South Africa's total land mass. The Eastern Cape Province is divided into 37 local municipalities and two metropolitan municipalities. The province is endowed with mountains, rivers, and savannah grass land with short shrubs and forests (Eastern Cape Department of Rural Development and Agrarian Reform, 2012). It derives its incomes from eco-tourisms, agro industries, livestock and crop production (Eastern Cape Department of Rural Development and Agrarian Reform, 2012).

The provincial population increased modestly over the intercensal period 2001-2011. According to the Census results, the population of the province grew from 6.3 million in 2001 to a little under 6.6 million in 2011 (Statistics South Africa, 2011). Of the 6.3m people, 60% live in rural areas (Statistics South Africa, 2011). The government documents reviewed characterize the province as featuring the following challenges:

- high levels of poverty,
- high unemployment,
- under-employment
- agriculture infrastructure backlog
- poor public health profile
- decline in life expectancy rate
- low literacy rate
- high demand for housing, water, sanitation, social security and electricity.

The need for economic development and improvements in livelihoods of the population is therefore very high and much of the efforts of the government are focused on putting in place measures to reverse this trend as fast as possible. Putting numbers to these pictures in at least two cases, it is suggested that average poverty rate in the province is about 75%, being worse in about 4 Districts namely O.R Tambo, Alfred Nzo, Joe Gqabi and Chris Hani, while unemployment rate was estimated at a whopping 35% (Department of Rural Development and Agrarian Reforms of Eastern Cape Province, 2011). The official documents also put the number of social grant recipients at 2.5 million, representing nearly 40% of the population. Since these social grants are mainly received by elderly, retired civil servants, disabled and children, this means that the province has a very high dependency ratio and confirms its status as one of the poorest in the country (Department of Rural Development and Agrarian Reforms of Eastern Cape Province, 2011).

Figure 3.1: The Eastern Cape Province map showing the study areas

The current policy focus on poverty alleviation, job creation and food security is therefore understandable and in line with what is happening elsewhere on the African continent where the goal of reducing poverty by half in 2014 is being pursued as part of efforts to meet the MDGs. Boosting agro-processing is also being pursued to expand employment opportunities as part of what the provincial government wants to do to demonstrate its commitment "to reduce under-development as outlined in the Millennium Development Goals (MDGs)" (Department of Rural Development and Agrarian Reforms of Eastern Cape Province, 2011). But given that the majority of the population is resource-poor and not in any position to produce sufficient surplus to feed these industries, the government is also focusing on empowering small producers and resource-poor households to operate homestead gardens and subsistence farms. In fact, the province has only few commercially organized large farms that make any appreciable contribution to the rural economy and the bulk of these are white-owned farms that fall outside the units of observation for the purposes of this research. Based on statistics from the Department of Rural Development and Agrarian Reform of Eastern Cape Province (2011), there is a decline in agricultural production and its contribution to GDP of the province. In line with that strategy, as already covered in some detail in the Literature Review in previous chapters, the government has structured its farm support programme into three to form what are known as the *Siyazondla, Siyakhula* and the Massive Food/Commercial Producers.

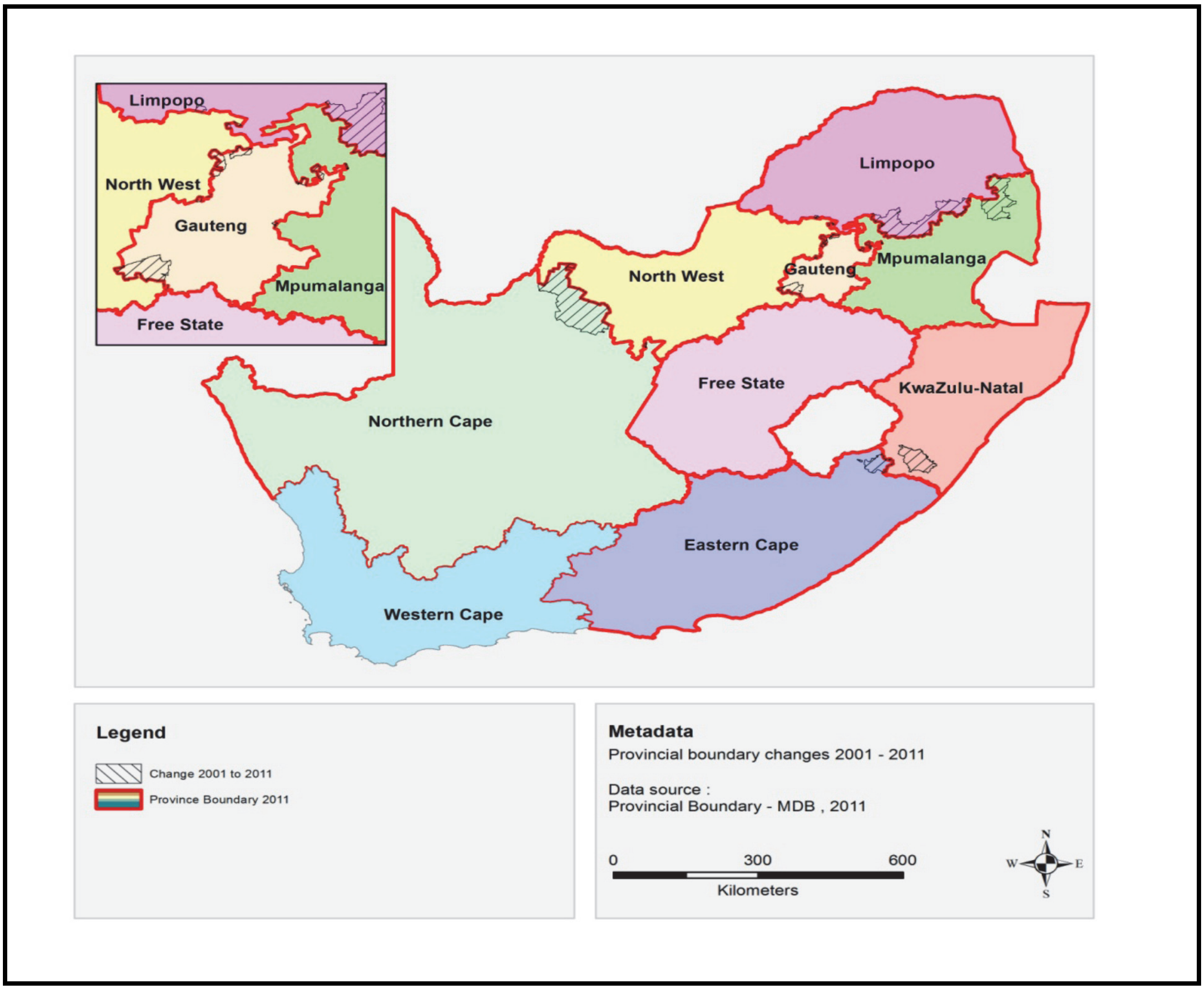

Figure 3. 2: Map of South Africa showing the provinces, 2011

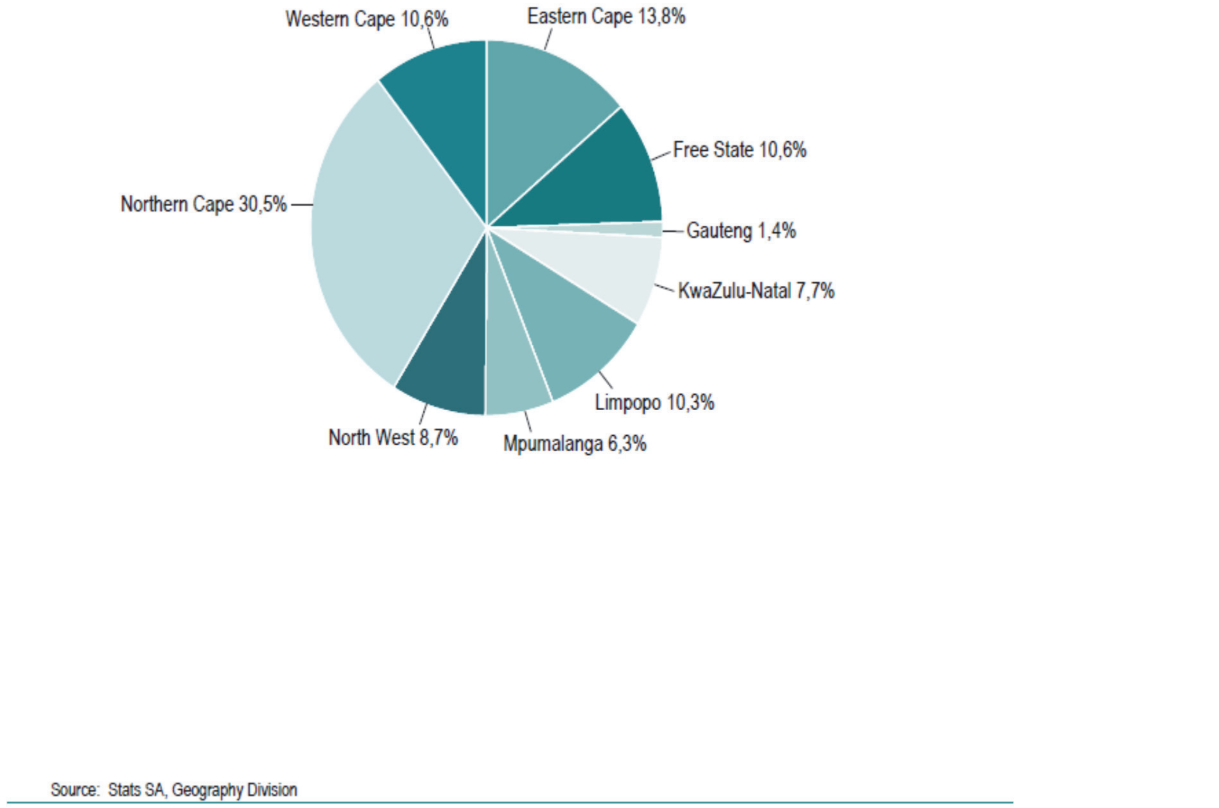

Figure 3. 3: Percentage distribution of land area by province, 2011

3.4.1.1Description of the Nkonkobe Local Municipality

The Nkonkobe Municipality is situated in the Amathole District Municipality, bordering the Nxuba and Makana municipalities on the West, the Ngqushwa Municipality on the South East and the Amahlathi and Buffalo City Municipalities to the East. The municipality's land area measures about 3,724 km^2 and is predominantly rural with most of the population of 128,658 persons being classified as rural dwellers of its twenty-one wards. The major towns are *Alice, Fort Beaufort, Hogsback, Middledrift and Seymour*, with Alice and Fort Beaufort being the more modern urban centres by strict definition and home to about 20% of the population of the municipality. The municipality is host to some of the oldest educational institutions in the country and the continent, namely the University of Fort Hare, Lovedale College and Healdtown College.

Kat River Valley is one of the major irrigation zones of the municipality. The geographic location of the Kat River Valley is defined by two major mountain ranges, namely the Winterberg and the Amatole Mountains around whose foothills it is situated. The Kat

River Valley is divided into three different sub regions, namely: the Upper Kat, Middle Kat and the Lower Kat. Prior to the end of the Apartheid regime in South Africa in 1994, the Upper Kat was part of the Ciskei “independent” homeland. In terms of size, the Kat River Valley is approximately 80 kilometres in length and 1 700 km^2 in area, with three of the main towns, namely Seymour, Balfour, Fort Beaufort, falling within its zone of influence.

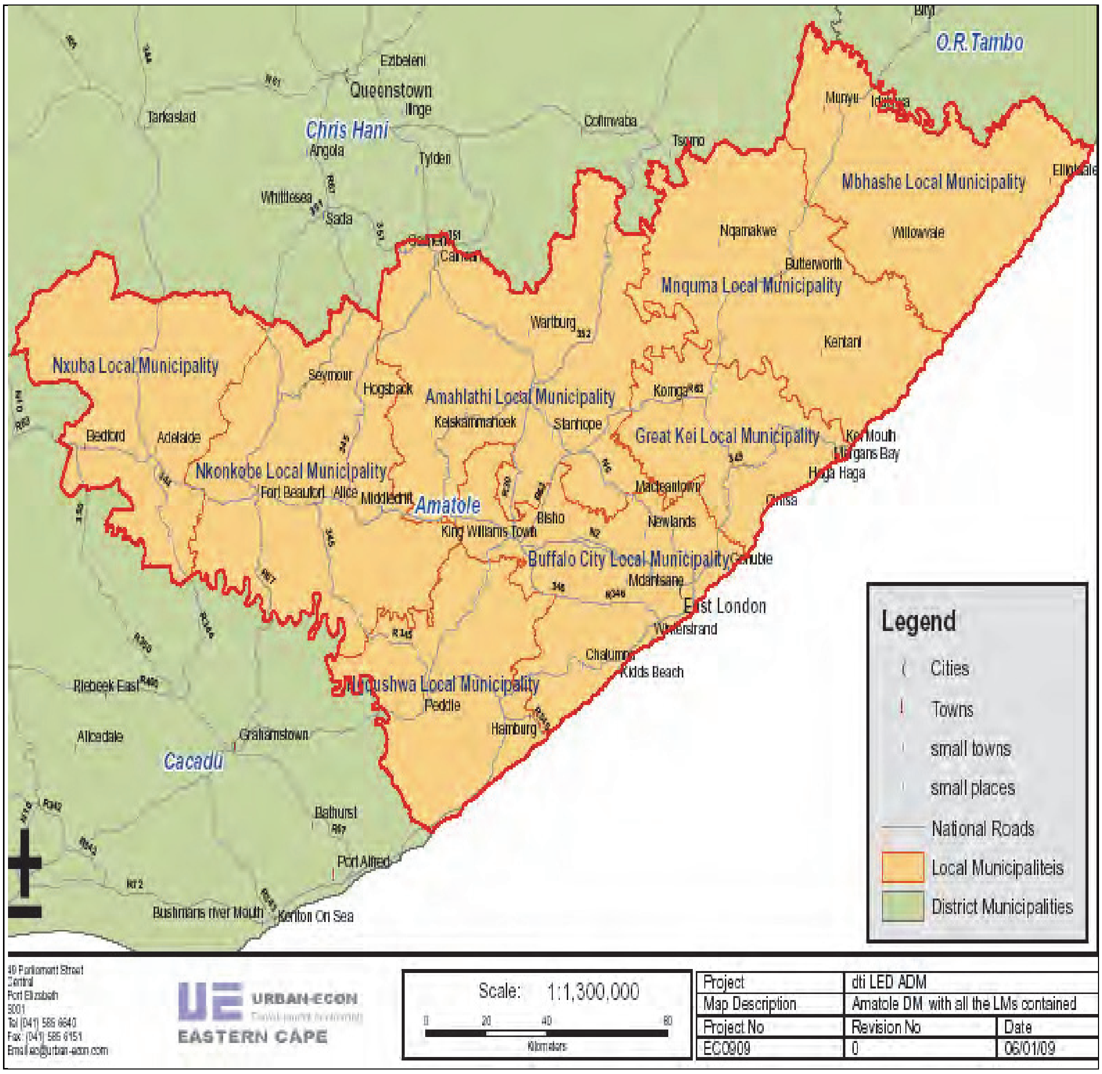

Figure 3.4: Local municipalities in the Amathole District Municipality

Nel and Davies (1999) explain that racial conflicts in the early days of white settlement and ensuing apartheid regime resulted in laws that limited the access of the black population to the means of production, typically agricultural land. This situation has not changed much today (Aliber, 2005). Where the black population has moved out of the traditional villages into the towns, they are more commonly found in new settlements on the fringes where low-cost, poorly-designed housing are being constructed by the new government under the Reconstruction and Development Programme (RDP) (United Nations, 2001). These new settlements are the so-called “locations” where facilities remain basic and poverty is rife, and all the features of underdevelopment are evident.

3.4.1.2 Description of the Amahlathi Local Municipality

The official website of the municipality explains the word “Amahlathi” as “an isiXhosa name that means a place where many trees are grouped together, a forest". In the opinion of the municipality, forests are a key feature of the area and must be part of the development programming for the municipality. It is one of the 8 municipalities constituting the Amathole District Municipality of the former Ciskei homeland area and located in the northern part of the district. It is completely surrounded by six municipalities some of which are in the former Transkei homeland. To the North, it is bounded by Lukhanji Municipality, to the North-West, it is bounded by Intsika Yethu Municipality, to the East it is bounded by Mnquma and Great Kei Municipalities, while in the South and West it is bounded by the Buffalo City and Nkonkobe Municipalities, respectively. The Municipality is strategically traversed by the N6 inter-provincial highway which links it to the major national roads and rail networks. The most important towns in the municipality are Stutterheim, Cathcart, Keiskammahoek, Kei Road and parts of Tsomo. The agriculturally-significant towns of Keiskammahoek and Tsomo stand out and the municipality is best known for the two small-scale irrigation schemes in Keiskammahoek and Zanyokwe.


Figure 3. 5: A view of the mountains and forests of Keiskammahoek

The municipality covers a total land area of 4,266.21 km^2 and the 2001 Census put its population at 139,035 (StatsSA, 2001). But there have been some changes in the ward demarcation and re-districting since then. On the basis of a Community Survey of 2007, the municipality's population distributed in 20 wards was estimated at 112,735 persons, pending the final disaggregation of the 2011 Census results (Amahlathi Municipality IDP, 2012).

3.4.1.3 Description of Buffalo City Municipality

This is a metropolitan municipality that hosts some of the more well-known towns and cities such as King William's Town, East London and Mdantsane and the Provincial Capital Bisho and had a population estimated in 2007 at 724 306. The population is distributed across the municipality but concentrates in the major metropolitan centres, with King William's Town and Surroundings having 184 246, East London dominating at 204 862, Mdantsane with 168 284, while the rural South and rural North have 63 967 and 80 536, respectively. Although this municipality has many industrial and retail businesses that provide sizeable employment opportunities for the residents, there is evidence that unemployment is very high, possibly above 50%; the Mayor's website presents statistics that show that 82,000 persons were employed while 84,000 were unemployed (Buffalo City Municipality's Mayoral website, 2012).

3.4.1.4 Intsika Yethu Local Municipality

Intsika Yethu Municipality is one of the local municipalities constituting the Chris Hani District Municipality of the former Transkei homeland of Eastern Cape Province. The two main towns of the municipality are the administrative headquarters of Cofimvaba and the agricultural hub of Tsomo. The municipality is made up of 213 villages. Based on the latest ward demarcation exercise, the municipality has a total area of 2,711 km^2. While the 2001 Census results put the population at 194 246 persons in 44 768 households, with an average household size of 4.3, estimates in 2007 suggest a reduction of the population to 167 050. The recently released 2011 Census results report the municipality's population at 145,372 persons distributed across 40,448 households (StatsSA, 2011). This reduction in the population is probably due to migration to more urban centres outside the Intsika Yethu Local Municipality. The IDP document of the Municipality provides some information on the demographic structure including the gender ratio and the age distribution. According to the reports, women make up about 55% of municipality's population. The indication is that dependency ratio of the municipality is very high with as much as 60% of the population falling within the school going ages of 0 and 19 years. A troubling statistic is the high rate of unemployment which was estimated in 2008 at 87.1% of the active workforce (Intsika Yethu Local Municipality, 2008).

Topographically, the municipality is located in the Grassland Biome with hilltops of the same altitude and Valley Rivers flowing in between these hills (Kodua-Agyekum, 2009). The municipality is drained by the Lubisi, Xonxa, Ncora and Tsojana rivers which form its major sources of water that are connected to valley water dams for irrigated farming. The municipality experiences both hot summers and cool dry winters with some snowing mainly on the highlands and mountain ranges. The area features low summer precipitations that range between 700mm and 800mm annually. Sometimes it rains heavily during the beginning of summer leading to severe gully erosion (Intsika Yethu Local Municipality, 2008).

The municipality's rocky sandstone of the Clarens Group defines its soils that are categorized as shallow to moderately deep and highly weathered (Intsika Yethu Local Municipality, 2008). Beyond the shallow soils are red and purple mudstones together with shale. The shale soils can be described as fine-grained, clastic sedimentary rock composed of mud made-up of flakes of clay minerals and silt-sized particles of other minerals, especially quartz and calcite (Blatt and Tracy, 1996). The dry winter periods, high water evaporation due to high temperature, low rain falls, gully soil erosion and unpredicted weather patterns are a threat to the general productivity and profitability of the agricultural sector. The major economic activities carried out on land include livestock grazing and smallholder farming. Most land in close proximity of homesteads show signs of heavy degradation due to overstocking, and poor veld management and farming techniques. However, villages still have huge tracts of uncultivated arable land. There is therefore a high rate of under-employment and the Municipal authorities are working hard to improve the access of the general population to productive employment in order to enhance their livelihoods.

The quality of life in the Municipality is also a source of serious concern. One indication of this is the poor quality of housing which mirrors the situation in most rural municipalities in the country. The Municipal authorities provide statistics that show that up to 76% resided in poor quality housing in 2008, and the indication is that the situation is not much changed today with gross monthly income averaging less than R1500 for most of the working population. Thus, innovative ways especially promoting smallholder commercial agriculture to boost the local economy that supports creation of more employment, improved household incomes and rural livelihood in general are urgently needed.

The municipality is faced with low public and private investment in trade, tourism and agriculture; low literacy levels and lack of economically viable productive skills in agricultural production, poor natural resource management, entrepreneurship innovation, and lack access to credit. Poor and dilapidated infrastructures like irrigation facilities, feeder roads, housing and markets are also contributing to the poor performance of the municipality's economy. Moreover, a restrictive land tenure system that is still heavily influenced by customs and traditions, acts as a hindrance to potential investments in this area. It is understood that traditional rulers are not allowing farmers to expand their holdings beyond the erstwhile 1.5 ha each household obtained from the Apartheid administration.

Figure 3.6: A typical homestead in the Intsika Yethu local municipality

3.4.1.5 Ngqushwa Local Municipality/Peddie Area

Ngqushwa Local Municipality is the home to the Tyefu Irrigation Scheme located in the Peddie area and is one of the 8 local municipalities in the Amathole District Municipality of the Eastern Cape Province. This local municipality is bounded by the Great Fish River to the West, the Keiskamma River to the East and the coastline of the Indian Ocean to the South. Over 95% of Ngqushwa local municipality's population resides in rural areas and only 5% resides in urban area. Although there is some developmental improvement observed in the municipality, the rural areas still lack basic essential services such as water, sewerage, electricity, and inadequate community facilities. The 2011 Census results estimates the population of the municipality as 72,190 settled in a total area of 2,241 km^2, giving it a population density of 32.2 persons per km^2 (StatsSA, 2011). The number of households in the municipality is estimated as 21,384 residing in 13 wards (StatsSA, 2011). About 40%

of the population still depends on natural sources of water like rivers and rainfall. Literacy rate seems quite low with more than 50% of the population having less than 7 years of schooling. Local Municipal authorities provide the disturbing statistics of the very high poverty and unemployment rate in the municipality; with as much as 91% of the population of the municipality falling under the poverty line and 78% being unemployed (Ngqushwa Local Municipality, 2012).

The major sources of livelihood among people in this municipality include agriculture, small and micro enterprises, wage labour, pensions and disability grants, remittances, work parties, savings clubs, unpaid domestic labour and non-monetized activities such as barter and exchange of gifts. The municipality has a potential of improving its incomes through exploration of the livestock, horticulture and field crops, fisheries and tourism recreation beaches especially in the Hamburg area on the coastline (Ngqushwa Local Municipality, 2012).

3.4.1.6 The OR Tambo District Municipality

The OR Tambo District Municipality of the Eastern Cape Province. The District is situated on the eastern side of the province and covers an area of about 12 857 km^2. It is composed of five local municipalities, namely: Nyandeni, King Sabata Dalindyebo, Port St Johns, Ingquza Hill and Mhlontlo as shown in Figure 5.10. The population of the District is estimated at 1 397 724 inhabitants living in 328 716 households (ECSECC, 2012).

The OR Tambo District is predominantly rural, with most of the population concentrated in the west, around Mthatha which is situation in King Sabata Dalindyebo Municipality and the District covers most of the Wild Coast and Pondoland[1]. The District has a sub-tropical coastal belt, especially from Port St. Johns northwards. The hills beyond the coast rise to high levels of up to 1,500 metres beyond Mthatha. The District has many rivers and is well-watered, with an average of 700mm of rainfall per year. Pondoland, being nearly the most fertile areas in South Africa, has warm

[1] Pondoland is a name used to refer to Port St Johns and Ingquza Hill municipalities

temperatures and good soils with frost-free conditions. Some of the other major towns in the District are Mqanduli, Port St. Johns, Qumbu, Lusikisiki and Bizana.

Tourism in the District is centred on the breath taking Wild Coast, which is host to many resorts and nature reserves. Port St. Johns is developing as a tourism destination. The Pondoland coast is one of the most spectacular eco-tourism destinations in South Africa and is going to be host to an expanded nature and marine reserve. The Nelson Mandela Museum, in Mthatha and Qunu, houses the history of the struggle against Apartheid and the life of Dr Nelson Rholihlahla Mandela.

In the OR Tambo District Municipal area, agriculture plays a major role in the well-being of the local community. The economic structure depends greatly on the prosperity of agriculture. Although small, agriculture does still contribute to the total Gross Domestic Product (GDP) of the Municipality. Most people in the District practice agricultural activities, whether at subsistence level or at commercial level, but only a few are formally employed in the agricultural sector.
The Eastern Cape Province had a GDP growth rate of 1% with a GDP per capita estimated at R7793. Economy in the District is mainly driven by Government, both in terms of employment and economic growth. Community services contribute 47% of the District GDP, followed by finance and trade at 20% and 18% respectively. The agricultural sector in the OR Tambo District contributes 4% to employment generation in the District and 5% to the GDP (ECSSEC, 2012).

Agriculture's contribution to the Gross Geographic Product of the O.R. Tambo District Municipality was R189.5 million or 3% (ECSECC, 2002). However, agriculture carries a very big importance in terms of the improvement of food security, as there are a large number of subsistence farmers in the District (SA LED network, 2010). The rural area consists of basic settlements, which are either dispersed, unplanned settlements or in consolidated villages. Administrative areas are consolidated into the five Local Municipalities. Local Tribal Authorities are still acting as the grassroots administrative authority, which sometimes doesn't go along with local government arrangements.

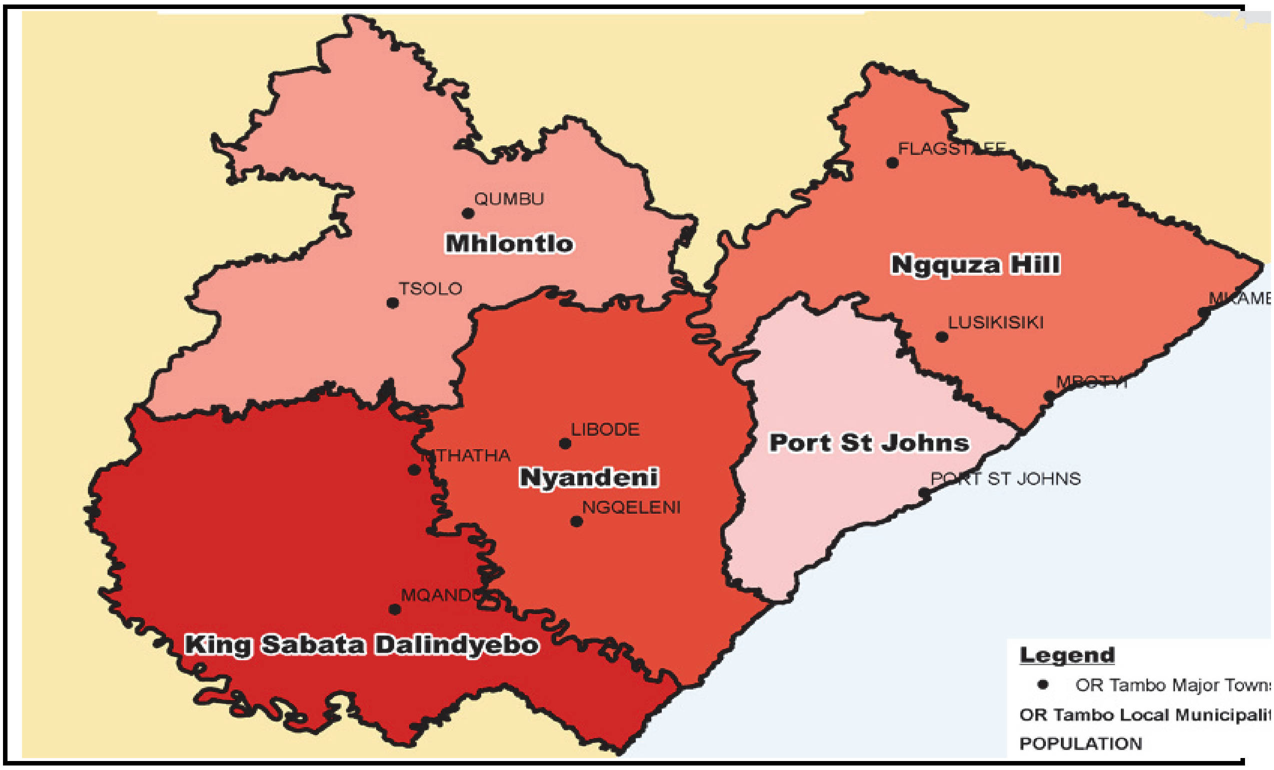

Figure 3.7: Map of OR Tambo district (source: ecsecc, 2012)

The land owners comprise 84% subsistence farmers and 16% emerging farmers. The subsistence farmers may become emerging farmers with the necessary progress. Emerging farmers are individuals who have the potential to become commercial farmers (ECSECC, 2012). The OR Tambo Municipality has a very high level of illiteracy and unemployment. Unfortunately there is a very low level of industrial and entrepreneurial motivation, which contributes to the high level of unemployment. The high level of migration to the cities indicates the lack of job opportunities in rural areas (SA LED network, 2012).

Low education levels correspond with a low skills level, which to a large extent contributes to the high unemployment rate. According to Eastern Cape Socio Economic Consultative Council (ECSECC), 2012, the District's average unemployment rate is estimated at 41%. The District also experiences a literacy rate which is indirectly proportional to the unemployment rate, whereby each of the local municipality has a literacy rate of 48.3%, 61.9%, 37.9%, 43.6% and 51.0% respectively (ECSECC, 2012). In the OR Tambo District Municipality, 88% of the households live below minimum poverty level, 71.5% of the economically active population is unemployed, 47.5% of the population is under 15 years of age, 93.3% of inhabitants live in rural conditions and 75% of the population do not have formal Reconstruction and Development Programme (RDP) standard water supply (ECSSEC, 2012).

OR Tambo is largely mountainous and characterised by rolling hills as well as rivers. Households are mainly located in the valleys and along the ridges, where the land surface is flat. Rivers rising at the edge of the escarpment are comparatively short and have formed deeply eroded canyons with steeper slopes (SA LED network, 2010). Approximately one third of the district consists of high rainfall plateau areas with slightly broken to rolling topography. These are covered with relatively deep apedal, favorably structured, porous soils with favorable water retention characteristics. The organic matter content may be relatively high, positively affecting nutrient supply and stability. Notable adverse factors are slight to moderate soil acidity and relatively low natural soil nutrient supply. The other two-thirds of the district consists of strongly undulating or broken topography, covered by various shallow to moderately deep soil types, mostly with moderate to high erodibility (SA LED network, 2010).

OR Tambo District experiences a temperate to sub-tropical climate with plenty of rainfall during the summer months and hot humid weather. Average daytime temperatures during the summer range from 21-26°C. The coldest time of the year is the night during winter months when the temperatures drop below 10 degrees. Average rainfall is relatively high along the coast at about 1000-1300mm per annum, decreasing towards the interior at about 700mm per annum and finally increasing in the upper catchment areas of the escarpment (ECSSEC, 2012). Frost occurs in the higher lying lands with a frost season length ranging from 1 to 11 days as altitude increases. The frost starts in the mountainous regions during the month of May, but only in the beginning of June in the mid- altitudes regions. The frost season comes to an end during the month of July in the mid- altitudes regions, but only ends in the beginning of September in the high altitudes regions (ECSSEC, 2012).

3.5 Description of selected irrigation schemes

3.5.1 Introduction

This chapter is devoted to the presentation and description of the irrigation schemes selected for this study. As indicated in the section on methodology for this situation analysis, the site selection was carried out in a step-wise manner, with the local municipalities being selected purposively on the basis of the existence of the small-scale irrigation schemes meeting the definitions for the target groups of the present study. From within each Municipality, the specific irrigation schemes were then selected on the basis of the information provided by the Department of Rural Development and Agrarian Reform as well as the judgment of the research team.

3.5.2 The Zanyokwe Irrigation Scheme

The Zanyokwe Irrigation Scheme is located in the Amahlathi local municipality of Amathole District Municipality, at the foot of the Amathole Mountains, about 30 km west of King William's Town in the Eastern Cape Province of South Africa (Tshuma, 2009). It is one of the three largest irrigation areas in the upper Keiskamma and Tyume river catchments and occupies 635 ha of land. According to Yokwe (2005), 'the scheme comprises 66 individual small farms ranging from 0.5 to 10 hectares' which directly benefit about 402 households settled around the irrigation scheme. As noted by Tshuma (2009), these small farms are in the six villages namely; Zingcuka, Kamma-Furrow, Nqumeya, Zanyokwe, Lenye and the Burnshill villages, out of which one village, namely Kamma-Furrow, is located in Nkonkobe municipality while the rest are in the Amahlathi municipality. Of the 635 ha of land under the scheme, only 534 ha are irrigated and this irrigated land is intended for crop production and consists of relatively small plots scattered between lower Nqumeya in the east to Kamma-Furrow in the west (Tshuma, 2009). The scheme also includes an additional 78 communal plots (Ntsonto, 2005). As of 2005, according to Ntsonto (2005), 42 communal plots in Lenye were occupied while 36 located at Burnshill were not occupied and had never been irrigated. This situation may have changed somewhat today although the latest WRC report (Mnkeni *et al.*, 2010) does not explicitly elaborate on the extent of current utilization of the communal plots except to mention that most of them are under "quitrent and freehold tenure" while some of the land in Lenye are situated on trust land. An additional detail provided by Mnkeni *et al.* (2010), drawing from earlier work by Van Averbeke *et al.* (1998), is that the scheme land is sub-divided into 174 food plots each measuring 0.2 ha and 64 farms each measuring 6 ha.

3.5.3 Qamata Irrigation Scheme and Environs

Qamata is located in the subtropical high-pressure belt, at latitudes ranging between 31° 45′ 30″S and 32° 00′ 15″S and longitudes 27° 15′ 00″E and 27° 30′ 00″E (Kodua-Agyegum, 2009). Qamata area is in the rain shadow of the Drakensberg Range and therefore suffers severe rain-deficits and may be too dry for agricultural production without artificially facilitated water provision (irrigation). The literature indicates that the land morphology of the Qamata area also features mountains and wide valleys that permit mechanized agricultural production (Kodua-Agyegum, 2009). It is suggested that this type of topography facilitates gravitational flow of water from rivers through the canals to dams and to crop fields without energy costs incurred. This makes the canal-furrow irrigation more appropriate and suitable for the resource-poor farmers who predominate the area.

Figure 3.8: Water led to homesteads for irrigation of gardens in Qamata

Figure 3.9: Ncora Irrigation Scheme

Qamata Irrigation Scheme is served by two main dams, namely Lubisi and Xonxa, which are supplied by the Indwe River and Great White Kei River, respectively. The scheme is categorised as a smallholder canal scheme which uses gravity-fed surface irrigation technology as means of water supply into the dams and fields. The water canal that supplies the irrigation scheme is about 15 km long from the main Lubisi Dam. The Xonxa Dam supplies the western portion of the scheme. In all, the scheme covers 2 601 ha of total surface irrigated area (Kodua-Agyegum, 2009).

According to Kodua-Agyegum (2009), the idea of establishing the Qamata Irrigation Scheme started as far back as the 1940s at the instance of the District Magistrate of St. Marks at the time and was welcomed by the Paramount Chief of Western Thembuland, Chief K. D. Matanzima. The construction of the Lubisi Dam was finally completed in 1968 to serve the irrigation scheme with financing from the Apartheid regime in South Africa to support the homeland administration of Kaizer Matanzima. The Qamata irrigation scheme management, planning and implementation were generally centralized (top-bottom management approach) with less participation of the beneficiaries (farmers). Among the organizations that participated in the management of the scheme included Xhosa Development Corporation under the department of Bantu Development of former republic of South Africa; Department of Agriculture and Forestry under the former Transkei government; the Transkei Agricultural Corporation (TRACOR); and the Inter-Science (Pty) Ltd., under Loxton, Venn and Associates enterprise respectively (Kodua-Agyegum, 2009).

Initially the scheme was divided into two portions, namely, the individual food plots and farms. The individual food plots generally measure 0.25 ha to 2.5 ha of land based on the size and the household land rights before the establishment of the irrigation scheme. For each household that joined the scheme, their land tenure had to be transferred into communal land tenure system under the traditional leadership. The farmlands under the second category are regarded as more commercial undertakings with the farmers being allocated land of more than 5 ha. In addition to the small-scale plots and fields, a highly mechanized commercial farming programme was initiated under which two farms, namely the Lanti Farm measuring 225 ha of land and the Presidential Farm measuring 77 ha, were established to contribute to employment creation and generation of incomes purportedly to subsidize on-farm input for food plot owners to ensure constant food supply to the households and address food security goals (Kodua-Agyegum, 2009). The major crops grown on this commercial farm included maize, lucerne and Cabbage, making use of a vertical integration approach, where most produce harvested is sorted, graded and carefully packed ready to be sold in formal markets (Kodua-Agyegum, 2009). However, the scheme failed to realize its objectives of reducing poverty, increasing employment and improving the general livelihoods of farmers at the scheme and nearby villages. With the coming of democratic rule in 1994, the commercial farms were re-allocated to food plotholders most of whom were unable to manage the plots and quickly abandoned them.

The PhD thesis of Kodua-Agyegum (2009), along with a number of anecdotal evidence provide the basis for summarizing the major reasons for the failure of the agricultural development programme formulated around the Qamata irrigation scheme as including:

i) Distribution of plots was carried out on tribal lines rather than focusing on the economic viability and sustainability of the scheme for community development and improved livelihoods.

ii) Land allocation excluded community members who had other alternative sources of livelihood like wages, salaries and old age pension and thus limiting the scope for investing such incomes in farming for increased farm production.

iii) Allocated garden plots were too small to yield marketable surplus especially among the resource poor who could not afford to purchase improved seeds, fertilizers, herbicides, pesticides or meet the high costs of hiring equipment such as tractors for cultivating larger hectarages. This led to farmers' abandonment of over 40% of irrigated plots in search of better livelihood opportunities elsewhere.

iv) Other major factors that led to low farmers' participation and low productivity of the irrigation scheme included political unrest in the former Transkei in the late 1980s and the withdrawal of government management and operational support under TRACOR in 1994. After government withdrawal, the Irrigation Management Transfer (IMT) was introduced to give the technically unskilled farmers the autonomy to control, manage and operate the irrigation scheme.

Obviously, much more information is needed to understand the implications of the afore-mentioned challenges by examining a lot of other dimensions including farmers' management capabilities. It is particularly crucial to understand the roles of human capital, social capital, goals and aspirations of farmers and such previously unexamined questions as psychological capital and how these can be harnessed for increased production efficiency and productivity. It is important to measure these issues with respect to the existing and prospective irrigation schemes such as the Qamata irrigation scheme as well as the homestead gardens and food plots and gain understanding on how small farmers can make the transition from small scale to much larger and economic scales. At present, government is busy implementing a comprehensive rural development programme designed to correct past policy errors and this is an opportune time to come up with answers to several crucial questions that have important practical implications for improved decision making on the mix of support measures to kick-start and facilitate entrepreneurship among resource-poor farmers and contribute to the national, regional and global goals of food security and poverty alleviation.

Figure 3.10: A View of the Ncora Irrigation Scheme

3.5.4 Tyefu Irrigation Scheme

Tyefu Irrigation scheme is located 30 km in the western part of Peddie along banks of the lower Great Fish River in the Eastern Cape Province of South Africa. The design was to use water from the Great Fish River to irrigate about 5400 ha of land on the East and West banks of the river but that target has not quite been attained. At present, the Scheme is divided into five sections, namely Ndlambe, Pikoli, Ndwayana, Kaliken and Glenmore sections which comprise 29 commercial farmers who have been allocated 4 ha each while the rest of the area is divided up into 1485 food plots measuring between 0.16 ha to 0.25 ha each. In 1997 the scheme was reported to cover approximately 694 hectares with a future potential of expansion to 1000 hectares of irrigated land. However, according to Belete *et al.* (1999), only about 636 ha was being utilized as at 1999 and the scheme was facing considerable hardships due to financial constraints. The area also features several challenges such as intensive droughts, low soil fertility, irregular rain fall, poor water quality, high rates of evaporation, and extreme temperatures in both winter and summer periods. Evidence generated by researchers (for instance, Sishuta, 2005) suggests that Tyefu area can support profitable commercial crop production as well as extensive and semi-intensive livestock production. But scheme management needs to be improved and farmer participation in the management needs to be encouraged.

3.5.5 Melani Village

Melani village is a rural village located in the Alice area, approximately 12 km North of Alice Town and the University of Fort Hare. Its population is approximately 500 households, housing approximately 3000 people with a clear 70% between the working age of 20 and 50 years and characterized by severe lack of skills. Alice is situated at 32 º 46’ 51”S latitude and 26 º 51’ 43”E longitude, at the altitude of 558m (IDP, 2012). Alice normally receives about 386mm of rain per year, with most rainfall occurring mainly during summer. Alice receives the lowest rainfall (8mm) in July and the highest (59mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Alice range from 19°C in June to 27.6°C in February. The region is coldest during the month of July when the temperature drops to 5°C on average during the nights.

3.5.6 Mbhashe Area

Mbhashe local municipality residents practice livestock farming especially cattle, goats, chicken and sheep (ECDA, 2006). According to the South African Department of Agriculture, Eastern Cape Province has the largest livestock herd in the country with, 21% of South Africa‘s cattle, 28% of its sheep and 46% of its goats. Crop farming is also at subsistence level within the Ngcingwane village, characterised by backyard gardens and medium sized plots where terrain permits. Studies on land use patterns in Mbhashe Local 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.

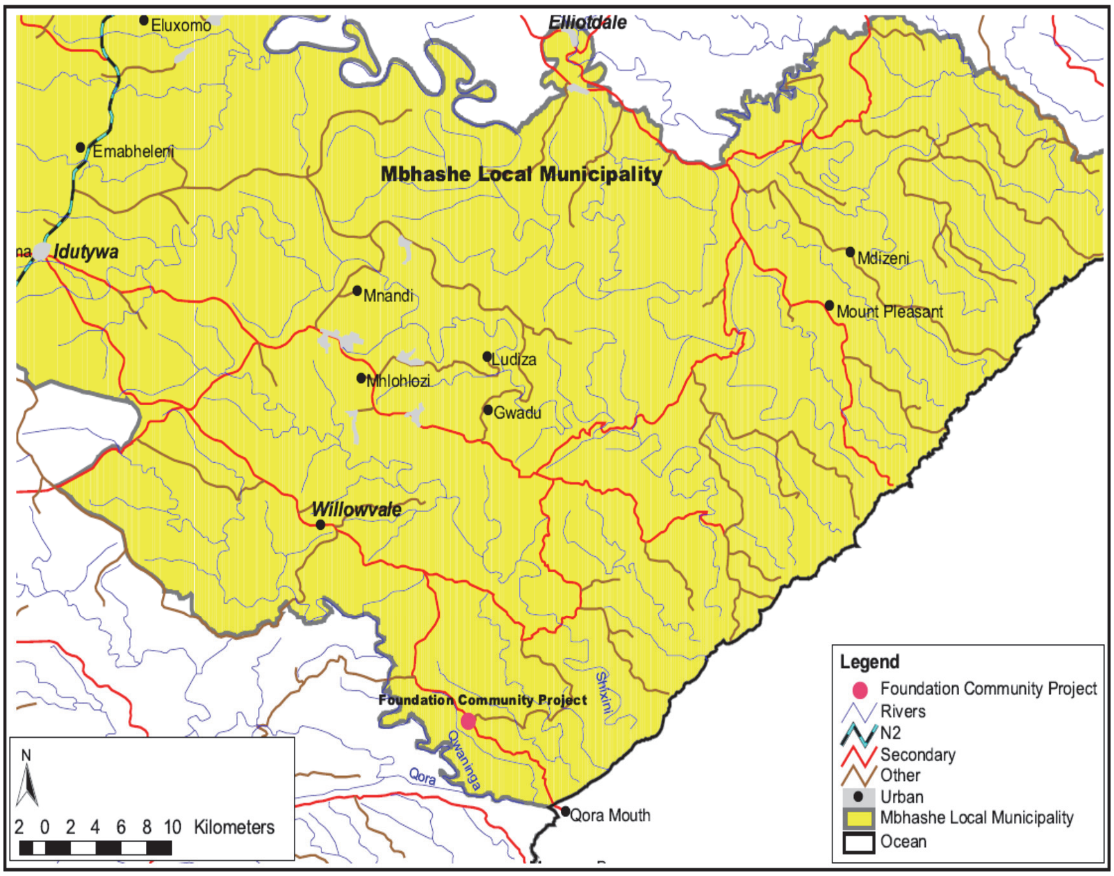

Figure 3.11: Map of Mbhashe local municipality

Mbhashe local municipality stands as one of the local municipalities where the government launched its Green Revolution programme that supported smallholder farmers to increase food production through maximization of land under cultivation. As such several programmes aimed at increasing food production are running in Mbhashe, of which Ngcingwane location is participating in the Siyazondla Food Production Programme. Beneficiaries of the Siyazondla Programme should own less than one hectare piece of land which is not under commercial production. The objective of the programme is to enhance food security through boosting homestead food production (ECDA, 2006)

The nearest commercial farms that do large scale production of livestock and crops are found near East London. However, there are several medium to small scale irrigated plots that produces cabbages, spinach and maize. In Mbhashe Municipality, the Mbhashe River is the most important natural source of water. It provides surrounding villages with water for livestock, as well as crop production on arable lands. Drinking water is obtained either from the river, or a few catchments dams in the village. In the case of Ngcingwane village, Shixini provides the main source of water for irrigation as the village is bounded by this river which is a tributary of Mbhashe River.

3.5.7 Port St Johns Municipality

Port St John's local municipality is located in the OR Tambo District Municipality of the Eastern Cape Province. According to LED (2010), Port St Johns holds a number of nature reserves with indigenous forest and it comprises of 16 wards within a total area of 1239 square kilometres. Port St. Johns municipality has a population of approximately 152 000. Its Gross Domestic Product (GDP) contributes approximately 2.3% to OR Tambo District Municipality's and is the smallest of the seven municipalities under OR Tambo District Municipality (LED, 2010). Port St Johns local municipality comprises of urban area and approximately 130 rural areas. This study area is characterized by mountainous terrain with hills and cliffs, and it is close to the ocean.

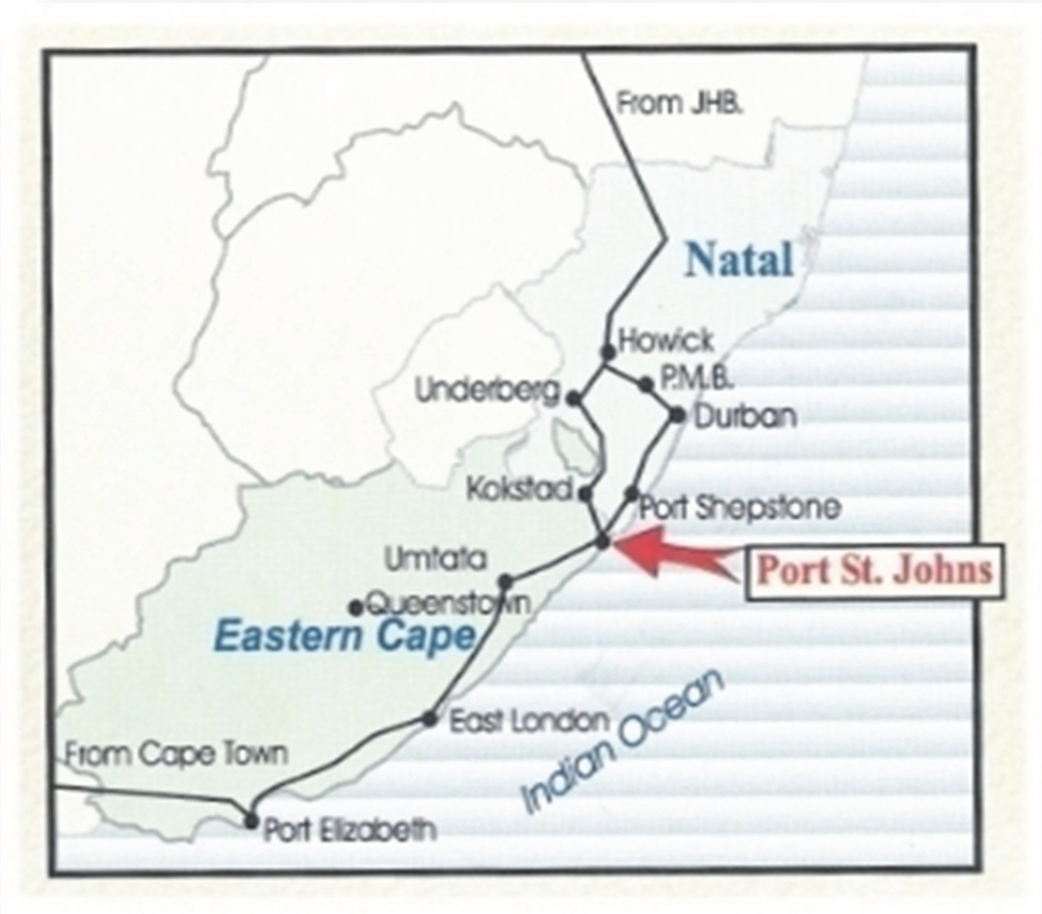

Figure 3.12: Map of Port St. Johns local municipality

Source: LED 2012

In Port St Johns area, agricultural sector plays a vital role in the well-beings of the local community. The population of Port St. Johns is largely illiterate with limited skilled people and the economy is relatively limited. LED (2010), states that the Gross Domestic Product (GDP) contributes approximately 2.3% to O.R. Tambo DM's GDP and is the smallest of the seven municipalities in the district. The most dominant sector is the Community Services sector which contributes 66% to the Port St Johns GDP. This is followed by the trade and manufacturing sectors which contribute 12.3% and 8.6% respectively (SA LED network, 2010).

Thus, the town's topography and natural vegetation play an important role in the development of the tourism and agricultural sectors. Although agriculture is identified as a priority factor in all wards, it only contributes about 5.6% of the GDP, primarily because it is mainly subsistence farming. The available resources of the municipality need to be utilized optimally to ensure that all sectors are develop to contribute meaningfully towards the economy (SA LED network, 2010). The climatic condition here lends itself to the production of a variety of tropical and sub-tropical crops like bananas, pineapple, citrus, mango, pawpaw, avocado to mention but a few.

Port St. Johns area is characterised by a moderate, humid and subtropical coastal climatic conditions. During summer the temperature varies from an average maximum of about 25°C to an average minimum of 20°C, whilst in winter the maximum and minimum is 21°C and 8°C respectively (LED, 2010). The municipality has fairly favourable weather conditions throughout the year, but extreme climatic conditions and local variation are not uncommon in this area.

Natural vegetation plays a vital role in the economic performance of the area as it is one of the main attractions for tourists (IDP, 2012). Unlike most regions in the country, much of the natural vegetation in the Port St. John's has not been touched. It is imperative that communities understand the value of this and be encouraged to conserve it and use it in a sustainable manner. Conservation and sustainable utilization of forest reserves is particularly important.

The annual rainfall varies between 1100 and 1400 ml per annum and occurs mostly during the summer months (October to March). Three main rivers are found in Port St. John's and the largest river is the Umzimvubu River. These rivers flow from the north to the Indian Ocean in the south and they separate the area into 3 catchments. Ward boundaries in some wards are determined by these rivers (LED, 2010). These rivers have an impact on the mobility and safety of the communities, with many communities citing frequent drowning as a result of inadequate infrastructure to cross the rivers in the form of boats and bridges. Drainage in the area is generally poor, depending on the tides, storm conditions and river levels (LED, 2010).

3.6 Chapter Summary

This chapter reviewed the key considerations for the selection of the sites and schemes on which this research was conducted. The main issues examined in relation to research sites were outlined in the Terms of Reference (ToR). It was required that the study sites and schemes be drawn from the two major administrative and political divisions of the Province, namely the former Ciskei and former Transkei Areas, in order to obtain a geographically representative sample. On the basis of information derived from the literature and anecdotal evidence, there was an indication that the two areas differed substantially in terms of the agricultural practices, cropping patterns, occupational structures, as well as the status of the irrigation schemes that have been revitalized and operational under various government programmes. The chapter then identifies the specific sites and schemes enumerated and provides detailed descriptions of them in relation to their socio-economic and physical contexts. On the basis of the criteria outline, the selected irrigation schemes were those at Qamata, and Peddie, while non-scheme sites were drawn from several areas in the former Ciskei and Transkei areas.

CHAPTER 4
ANALYTICAL CONSIDERATIONS

4.1 Introduction

The study was a comprehensive assessment of a wide range of smallholder issues. In that respect, it embraced the cataloguing of the socio-economic characteristics of farmers and rural residents, their goals, aspirations and motivations, and asset ownership and utilization, production in both farm and non-farm contexts within a livelihoods framework. Further, the study involved the important and crucial element of entrepreneurship and how it is measured and developed and the factors that influence it. An important element of the study entailed investigating how small farmers can commercialize through establishing small enterprises that contain elements of value creation as one way to alleviate poverty that continues to challenge the rural dwellers. As might be expected, the issues of entrepreneurship and entrepreneurial spirit are central to the transformation of agriculture from merely delivering expanded output to guaranteeing enhanced livelihoods through income generating activities that contribute to poverty reduction and shared prosperity. To that extent, the study also examined questions of produce utilization, market channel choices and market participation rates. In the light of the foregoing,

In order to achieve the foregoing, it was necessary to consider and apply many of the analytical procedures, including a vast array of statistical and econometric techniques. This chapter affords an opportunity to review these methods and techniques and evaluate their applicability by examining some of their theoretical foundations. A number of these techniques were outlined in the funding proposal submitted to WRC but since then a number of modifications have become necessary in the light of more in-depth literature search and discussions and deliberations during the in-house project meetings, proposal presentation sessions within the Department of Agricultural Economics and Extension, and the Reference Group Meetings chaired by the Water Research Commission over the past 4 years. In the remaining sections of this chapter, the analytical models employed and their theoretical foundations are described in detail.

4.2 The Analytical Models and Theoretical Foundations

A starting point for the discussion on the model around which this research was conducted will be a description of the household model in the context of the farm problem that was identified earlier. As the general objectives of the study clarified, the intention is “to review and evaluate appropriate development paths for expansion from homestead food production to smallholder irrigation farming, increased water use productivity of crop production and improved livelihoods in selected smallholder irrigation schemes in South Africa”. The introduction to the present chapter highlighted the comprehensive nature of the study and the necessity for applying an amalgam of methods and approaches. In this section, the model is specified by first identifying and describing the unit of observation as the household and then proceeding to explain the relationships among the various components of the study and what analytical tools were applied.

4.2.1 The farm household model

The ‘farm problem’ clearly indicates that crop enterprises are resource constrained, therefore, they need to make choices to address the problem of optimal allocation of resources which are available to farm households (Gardner, 1992). The farm household model has received extensive empirical application since its inception (Chayanov, 1923; Lee, 1965; Schmitt, 1988; Dewbre and Mishra, 2002). The model is based on the idea that the household makes decisions as a family on how much income to spend on consumption and how much time to spend on work or leisure in order to maximise their utility (Chayanov, 1923). The model is governed by the following underlying assumptions:-

a) The household cannot spend more money on consumption goods than the money income it receives.
b) The household cannot spend more time in work and leisure than is available.
c) Output and input markets are perfectly competitive hence prices do not vary with quantities produced or purchased by the farmers.
d) When off-farm labour opportunities are present, off-farm wage earned is independent of the amount of time family members spend on off-farm work.

In order to maximise their utility (profit), households are faced with three choices. Firstly, a household can devote all resources solely to farming (Option 1). Secondly, resources may be totally transferred to non-farm activities by terminating farming simultaneously, and this is reflected in the decreasing number of farms over time (Option 2). Finally, resources might be channelled towards both farming and non-farm activities (Option 3). According to Schmitt (1988) the degree of intra-household division of resource use to farm and non-farm activities might differ between various farm households and change over time. Superiority in efficiency of labour allocation in part time farming over full time and non-farm activities depends on the relative size of marginal productivity of farm to non-farm labour input. This explains why part time farming seems to be a rather persistent type of land use due to household's rational decision making (Schmitt, 1988).

The graphical representation in Figure 4.1 of the farm household model draws on the work of Lee (1965), Schmitt (1988) and Dewbre and Mishra (2002). Figure 4.1 represents the optimal allocation of time, the level of income and utility for a household practising farming on a full-time basis. Full time farming is feasible for households who engage in large scale commercial farms who can afford to remunerate all the family members working on the farm (Schmitt, 1988). However, there are situations whereby resource-constrained smallholder farmers may farm on a full time basis due to high adjustment costs into the non-farm labour market (Dewbre and Mishra, 2002). This case prevails in most parts of developing countries.

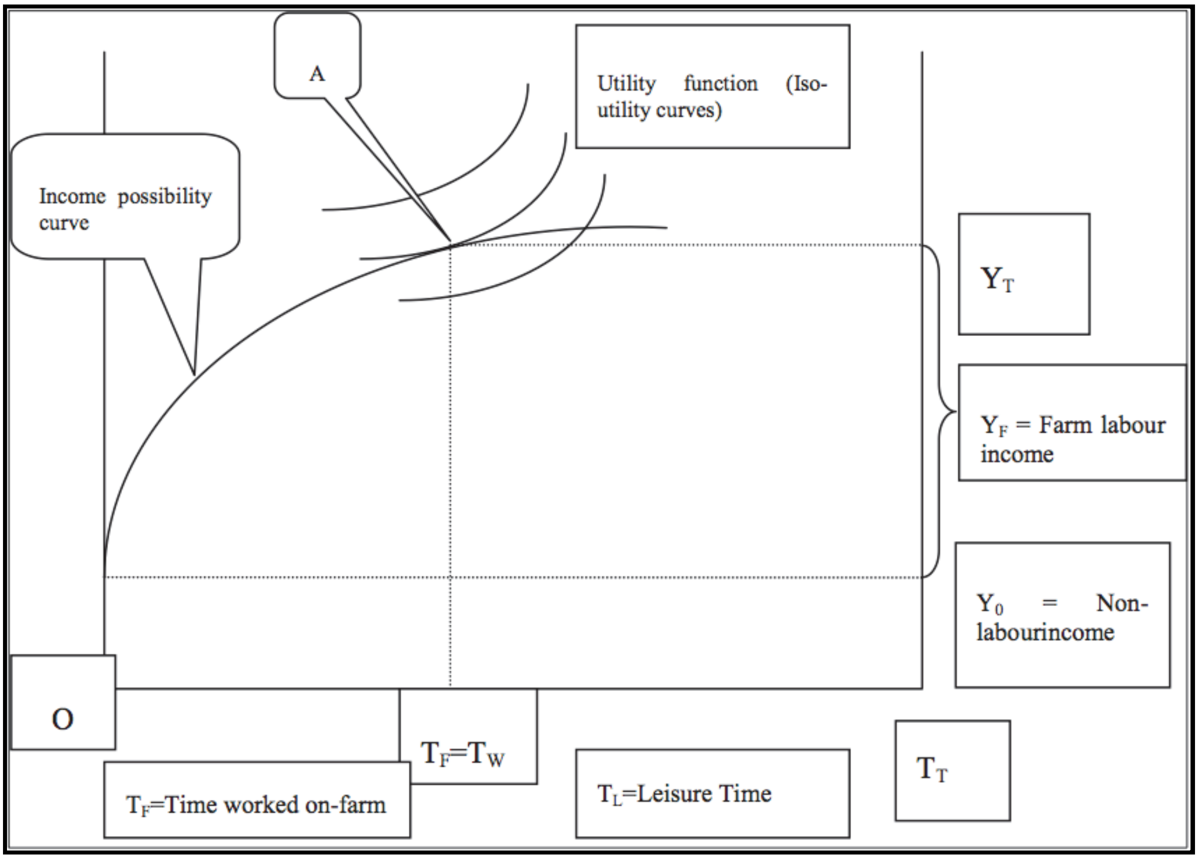

Figure 4.1: Full-time farm household labour allocation

Source: Lee (1965); Schmitt, (1988); Dewbre and Mishra (2002)

The horizontal axis of the graph shows the use of available household time on the farm for either working (T_w) or leisure (T_L). Working time is measured from point O, moving rightwards along the x-axis with T_T being total time. From T_T leftwards represents time spent on leisure and T_TO shows all the time spent on leisure. The vertical axis shows total household income (Y_T). The net earnings from farming are represented by the income possibility curve (IPC) which is a function of relative prices of farm outputs and inputs and technology. The IPC shows the maximum amount of income that corresponds to a certain level of labour and is strongly affected by diminishing marginal factor productivity of farm household labour. Total income is the summation of non-labour income (Y_0) and farm labour income (Y_F), where Y_0 consists of retirement income, dividends, interests, rents, remuneration of assets used in farm activities and remittances. With full-time farming, the only remunerative activity is farming and this is applicable to large scale commercial farms with huge capital endowments that are able to remunerate all active family resources by using their productive time only on the farm. The farm's IPC is often very high and off-farm activities bring in insignificant amounts of income.

When a farm has limited capital endowments, which is normally the case with smallholder farmers, it divides its time between farm and non-farm activities to maximise its utility. This part-time farming is option 3 which was mentioned earlier in the discussion of the farm household labour allocation. The household must decide on how much of total work time (T_W) to devote to on-farm (T_F) and off-farm (T_{NF}) on the basis of the following equality: $T_W = T_F + T_{NF}$. Figure 4.2 shows optimal resource allocation by part-time farmers.

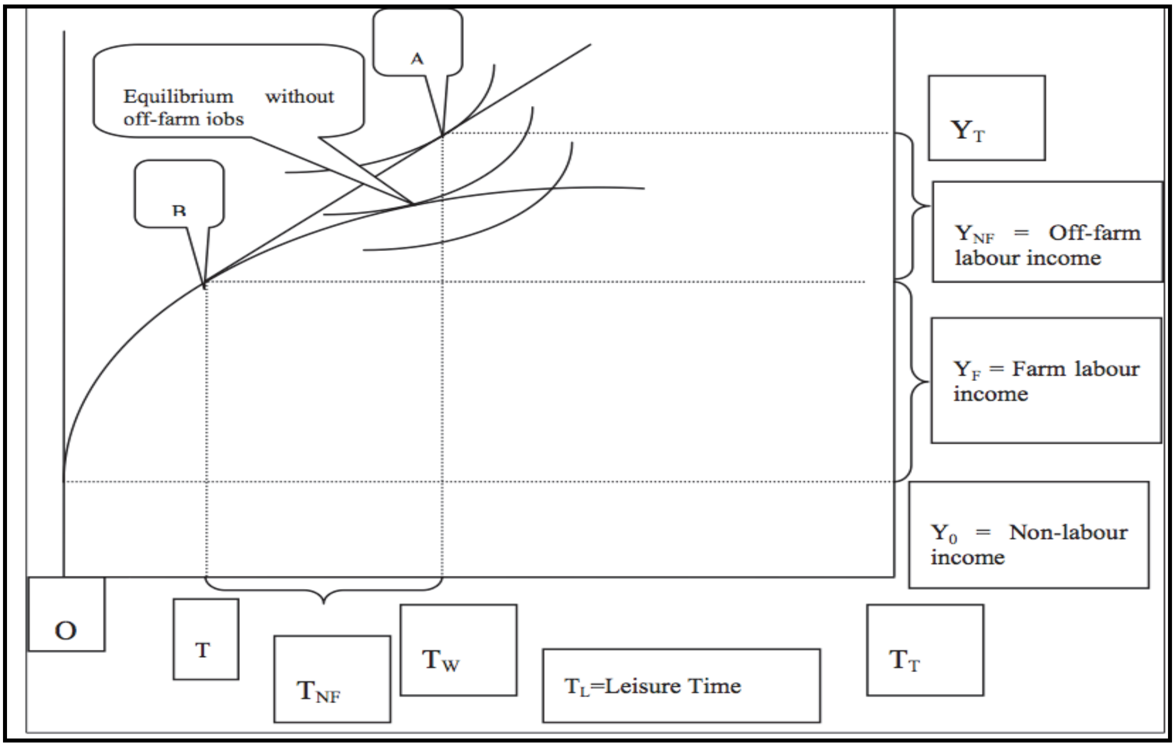

Figure 4.2: Part-time farm household labour allocation

Source: Schmitt (1988); Lee (1965); Dewbre and Mishra (2002)

Participation in non-farm activities increases the household's total income hence the income possibility curve shifts upwards and a new equilibrium is achieved with higher utility levels at point A in Figure 4.2. Farming operations will continue to expand until marginal value productivity of farm labour is equal to the off-farm wage rate at point B. The two indifference curves diverge at this point and labour is more productive or efficient when it is deployed to off-farm activities than on farm work. Therefore, part-time farming is expected to be more efficient than full-time farming provided that marginal productivity of farming at a certain point of the agricultural production function falls short of the non-farm marginal productivity. Total household income is given by the expression: $Y_T = Y_F + Y_{NF} + Y_O$, where Y_T is total income, Y_F is farm income, Y_{NF} is non-farm income and Y_O is non-labour income.

Dewbre and Mishra (2002) came to the conclusion that farm income is lower than non-farm income when farm households have less off-farm opportunities due to geographical locations or lack of non-farm skills. In addition, labour allocation in some cases is biased towards farm labour uses because of non-wage considerations such as the existence of in-kind sources of income and a favourable taxation regime (Gardener, 1992). Schmitt (1988) came to the conclusion that off-farm use of resources is mainly determined by prevailing economic conditions (industrial wage rate and agricultural terms of trade) and farm structure.

Economic conditions are dynamic and they vary across countries and even within countries. Therefore, the degree of structural adjustment of agriculture, its speed and especially its socio-economic configuration (part-time versus full-time farming) vary as well (Dewbre and Mishra, 2002). The slow transition of farmers from homestead gardening to irrigated small scale farming in the Eastern Cape province of South Africa since the inception of land reform may be explained partly by the farm household resource allocation model. Social grants form a huge proportion of household income (Jacobs and Punt, 2009) and this may act as motivation for farmers not to seek off-farm employment. Fakunle and Obi (2015), reported average education as primary at Qamata and Tyhefu irrigation schemes and this poses high adjustment costs to farmers because they lack skills for industry jobs. Geographical location of the study sites also limits access to major markets hence there is no strong incentive to adopt irrigation and produce commercially.

4.2.2 Theoretical Underpinnings

The relationships outlined in the foregoing sections can be explained by a set of theories that have been formulated around choice, technology adoption, production, costs, consumption, market participation, profits and entrepreneurship. Economists and applied economists, including agricultural economists, have a long history of tinkering with these ideas and the practical applications of modelling these functions are extensive (Lin *et al*., 1976; Beattie *et al*., 1985; Schmidt, 1986; Levinsohn and Petrin, 2003). The major objectives for studying these functions include the following:

- If a firm were to expand its operations by increasing its inputs by a certain percent, management would be interested to know the expected outcome of such a decision, that is, by how much output would increase, how much lower its unit costs become and consequently the overall impact on prices and margins.
- If a firm were to mechanise its production operations, then it needs production, cost and profit functions to determine how many fewer manual employees would be needed to produce the same level of output given the level of mechanisation? Management would also be interested in knowing how the substitution from manual labour to machines will impact production in terms of cost and total output produced.
- Management of any firm need to consider the use of certain inputs independently of others.
- In order to measure the output projections of a firm based on the previous year's performance and or industry best practice, it becomes management's concern to know how much more output can be produced for a given level of inputs and how much more output a firm can produce compared to its current output level.

4.2.3 Specification of the Explored Relationships

The specification of the hypothesized relationships can be developed from the basic theory of the firm and the notion of the household as the fundamental decision making unit in respect to production, marketing, enterprise development, among other economic and non-economic activities. Starting from the premise that the basic function of the firm is production, a definition can be proffered that shows that it is a transformation process of a set of inputs $\boldsymbol{X} \in \mathbb{R}_K^+$ into a set of outputs $\boldsymbol{Y} \in \mathbb{R}_M^+$. A production function is a mathematical representation of the technology that transforms inputs into output(s) (Schmidt, 1986). If inputs and outputs are treated as two separate categories, the relationship between inputs and outputs can be expressed as:

$F(x, y) = 0$--(4.1)

Where ***x*** is a **K**dimensional non-negative input vector and ***y*** is a **Z**dimensional non-negative output vector. This formulation is very general and we will consider a much more restricted formulation, which for a single output case can be expressed as:

$y = f(x_1, x_2, \ldots, x_k) \equiv f(\boldsymbol{x})$---(4.2)

Where the function $f(\cdot)$ specifies the technology governing the input-output relationship, and is single valued. In this formulation, $f(\boldsymbol{x})$ is the production function, which gives the maximum possible output, for a given ***x***. Alternatively, given *y* and all other inputs, except *Xk*, this function gives the minimum value of *xk*. A well-defined production function should satisfy the following regularity conditions (Chambers, 1988):

(a) $f(\boldsymbol{x})$ is finite, non-negative, real-valued, and single-valued for all non-negative and finite ***x***;
(b) $f(0) = 0$ meaning that no inputs implies no output;
(c) $f(\boldsymbol{x}) \geq f(\boldsymbol{x}\_)$ for $\boldsymbol{x} \geq \boldsymbol{x}\_$ (monotonicity);
(d) $f(\boldsymbol{x})$ is continuous and twice-differentiable everywhere;
(e) The input requirement set $V(y) = \{\boldsymbol{x} | f(\boldsymbol{x}) \geq y\}$ is a convex set, which implies quasi-concavity of $f(\boldsymbol{x})$;
(f) The set $V(y)$ is closed and nonempty for any $y > 0$.

A production function defines the technological relationship between the level of inputs and the resulting level of outputs. If estimated econometrically from data on observed outputs and input usage, it indicates the average level of outputs that can be produced from a given level of inputs (Schmidt, 1986). Various studies have estimated the relative contributions of the factors of production through estimating production functions at the farm level. These include Cobb-Douglas production functions (Battese and Coelli, 1995; Hyuha *et al.*, 2007), CES production functions and translog production functions (Bergman, 1996; Constantin *et al*., 2009; Hossain *et al*., 2012).

According to Neo-Classical production theory, producer behaviour is entirely based on the assumption that firms make no mistakes in resource allocation and producing output. Thus firms are assumed to be both technical and allocative efficient (Kumbhakar, 2001). The analysis of efficiency becomes imperative for firms do not always operate along a frontier which shows the different combinations of commodities a firm can produce given a set of fixed factors. Stochastic frontier analysis is mainly based on production economics although application has been extended to other fields of research in economics and finance. However, even though the stochastic frontier itself is unobservable, stochastic frontier analysis is applicable to any problem where the observed outcome deviates from the potential outcome in one direction, that is, the observed outcome is either less or more than the potential outcome (Battese and Coelli, 1995; Bergman, 1996; Hyuha *et al*., 2007 Constantin *et al*., 2009; Hossain *et al*., 2012).

4.2.3.1 Allocative Efficiency

According to Farrell (1957), allocative efficiency can be defined as the ability of a firm to choose the optimal combination of inputs given input prices. Inoni (2007) incorporates rational behaviour of a firm and defines an allocative efficient enterprise as one that uses production inputs optimally in the right combination to maximize profits. Thus, the allocative efficient level of production is where the farm operates at the least-cost combination of inputs. Based on current researches there are several new methods that can be used to estimate allocative efficiency. The most employed method of estimating allocative efficiency has been dependent on the input and output prices (Kibirige and Obi, 2013). Due to the significant importance of the input and output prices in the estimation of allocative efficiency, Farrell (1957) called it price efficiency (Badunenko *et al.,* 2006). The output-oriented distance to the frontier in a profit-technical efficiency space is among the new methods that can be used to estimate the allocative efficiency without using the input price.

4.2.3.2 Technical Efficiency

Technical inefficiency refers to the non-optimal use of technology. It is the relationship between observed production and some ideal or potential production (Lovell, 1993). In a single output scenario, we can think in terms of the total factor productivity, which is the ratio of actual output to the optimal value as specified by a production function. The concept of technical efficiency first received empirical application in Farrell (1957) which was an extension of what was initiated by Koopmans (1951) and Debreu (1951). Several other studies have followed: Farell and Lovell (1978); Forsund, Lovell and Schmidt (1980); Zieschang (1983); Esparon and Sturgess (1989). Koopmans (1951) defined technical efficiency as: an input-output vector is technically efficient, if and only if, increasing any output or decreasing any input is possible only by decreasing some other output or increasing some other input. This notion is related to Pareto efficiency; however, the output or input measure depicted in Koopman's model is only relative and remains unknown.

Debreu (1951) proposed the coefficient of resource utilisation which became the first measure of productive efficiency. Debreu's measure has received limited empirical applicability because it is a radial measure which focusses on the maximum feasible equi-proportionate reduction in all variable inputs. Farrell (1957) noted that productive efficiency is a combination of allocative and technical efficiency. Esparon and Sturgess (1989) described technical efficiency as efficiency in relation to factor-product transformation. According to recent literature, technical efficiency is the process of using available resources in the best combination with an objective of maximizing output (Battese and Coelli, 1995). For a farm to be technically efficient, it has to produce at the production frontier level. However, this is not always the case due to random factors such as bad weather, animal destruction and farm specific factors, which lead to producing below the expected output frontier (Battese and Coelli, 1995). Burki and Shah (1998) noted that it is important to quantify the magnitude of technical efficiency and to identify its causes more precisely hence precaution should be taken in estimation.

Technical efficiency can be measured using both, parametric (stochastic frontier estimation) and non-parametric (Data Envelopment Analysis (DEA)) methods. The stochastic frontier model has received extensive empirical application because of its advantage of incorporating factors which are out of the farmers' control. The random error therefore captures the effect of unimportant left out variables and errors of dependent variables as well as the farm specific inefficiencies. It provides the farm efficiency estimates with much lower variability than any other method due to the error term decomposition (Neff *et al.,* 1994).

4.2.3.3 Profit Efficiency

Historically, efficiency had been commonly measured using stochastic frontier production functions (Rahman, 2003; Coelli *et al*., 2005) until it was discovered that such an approach maybe inadequate in estimating efficiency due to heterogeneity of farmers. Yotopoulos et al., in Ali and Flinn (1989) argued that a frontier production function approach may not be appropriate for estimating efficiency when in reality farmers face different prices and have different factor endowments. As a result of this heterogeneity, farmers thus face different best practice production functions and hence different optimal operating points. This led to the application of stochastic profit function models to estimate farm-specific efficiency directly and simultaneously (Kumbhakar, 1987; Kumbhakar et al., 1989; Ali and Flinn, 1989; Kumbhakar et al., 1991; Kumbhakar, 2001; Rahman, 2003). The profit function is an extension of the production function which combines the concepts of technical, scale and allocative efficiency in the profit relationships and any errors in the production decision would result into lower profits for the farm (Rahman 2003).

Profit efficiency is defined as the capability of a farm to achieve the highest possible profit, given the prices and levels of fixed factors of that farm. (Ali and Flinn, 1989) Similarly, the profit frontier is defined in terms of the maximum possible profit and profit efficiency is defined as the ratio of actual to maximum possible profit (assuming that they are both positive and negative). According to Galawat and Yabe (2012) profit inefficiency can be defined as the profit loss from not operating on the profit frontier recognising farm specific prices and resource base. The following discussion implores on the different approaches that have been used in literature to estimate efficiency.

4.3 Profit Maximising Approach

Kumbhakar (1987) proposed the profit maximisation approach which considers output and inputs as endogenous variables. The farmer has control over these variables and can make choices that influence their level. The profit maximising framework assumes that a producer is unable to attain the profit frontier (the maximum profit function) due to the presence of either technical or allocative inefficiencies or both. The presence of inefficiencies affects: input demand function, output supply function, elasticities and returns to scale. The profit maximisation approach corrects the problems that arise from estimating the production function directly. These problems relate to the assumptions that inputs (x) are exogenously given and that inputs are independent of technical inefficiency. The maximisation approach assumes that producers may choose input quantities to maximise profit and that input use maybe affected by the presence of technical efficiency (Mundlak).

The profit maximisation behaviour of a firm is exhibited by the properties of linear homogeneity, symmetry and convexity of the profit function. The property that a profit function is linear homogeneous in prices is imposed by normalising the nominal profit function by any price variable (Bhattacharyya and Glover, 1993). The twice continuous differentiability of the profit function implies symmetry restrictions on the output supply and variable factor demand functions and this guarantees regularity in the process of maximisation. The curvature property of a normalised profit function can be verified by examining whether each principal minor of the Hessian matrix is positive semi-definite. Technical inefficiency can be specified using either using the output oriented approach or the input oriented approach.

4.3.1 Output Oriented Approach

The production function can be estimated as:

$$y = f(x)e^{u}, u \leq 0 \quad \ldots \ldots (4.3)$$

If $u \leq 0$, it shows that actual output (y) is less than the maximum possible output $f(x)$ which is the production frontier, given a vector of inputs (x),μ is the output-oriented technical inefficiency and $e^{\mu} = \frac{y}{f(x)} \leq 1$ is a measure of output technical efficiency.

Given equation 4.3: $e^{\mu} = \frac{y}{f(x)}$, if the ratio of actual output (y) to maximum possible output $f(x)$ is less than or equal to one then it gives us the measure of output technical efficiency. Kumbhakar (2001) points out that when inefficiencies are eliminated, actual output of firms with $u \leq 0$ can be increased by $-100\mu\% \geq 0$, holding inputs (x), fixed.

4.3.2 Input Oriented Approach

With input oriented technical inefficiency, the production relationship is specified as:

$y = f(xe^{\eta})$, $\eta \leq 0$. ……………………………………………………………..(4.4)

Every input is used by $-\eta 100\% \geq 0$ more than what is necessary to produce a given level of output (y) without being inefficient. η is labelled as the input-oriented technical inefficiency and this measure of technical inefficiency is also called radial measure of technical inefficiency. According to Farell (1957), the results from input oriented inefficiency formulation do not differ from output oriented measure and this leads us to the formulation of non-maximum profit function in the presence of technical inefficiency using the output oriented approach which corresponds to the production function in equation 4.3.

4.4 The non-maximum profit function

A non-maximum profit function can be estimated where a firm does not maximise its profits. The non-maximum profit function can be specified as:

$\pi(w, p, u) = \pi(w, pe^{\mu})$……………………………………………………………(4.5)

Where:

$w(w_1, \dots \dots \dots \dots \dots w_j)$ is the input price vector and p is the output price vector.

Taking the first order profit maximisation conditions gives:

$f_j(x) = \frac{w_j}{pe^{\mu}}, j = 1, \dots \dots \dots .., J$ ....(4.6)

where, $f_j(x) = \frac{\partial f(x)}{\partial x_j}$ and the production function in 3 can be re-written as:

$y = f(x)e^{\mu}, \mu \leq 0$ hence $f(x) = ye^{-\mu}$ ....(4.7)

The solutions of input demand and output supply functions adjusted for inefficiency can be expressed as:

$x_j = \psi(w, pe^{\mu}) \;\; j = 1, \dots \dots \dots, J$ ....(4.8)

and

$ye^{-\mu} = \varphi(w, pe^{\mu})$ ....(4.9)

Therefore, the profit function conditional on μ is defined as:

$\pi(w, pe^{\mu}) = \max_{ye^{-\mu},\, x} \{py - w'x | y = f(x)e^{\mu}\} \dots \dots \dots$ ....(4.10)

4.5 Methods for Measuring Efficiency

Fabio (2010) has classified the different methodologies used in estimating efficiency as summarised in Table 4.1 into three criteria viz:

- Frontier vs Non-frontier
- Parametric vs Non-parametric
- Stochastic vs Deterministic

Table 4.1: Summary of methods for measuring efficiency

	DETERMINISTIC		STOCHASTIC		
	Parametric	Non-Parametric	Parametric	Semi-Parametric	Non-Parametric
Frontier	- L/Q Programming & - COLS & MOLS	- DEA FDH	-Stochastic Frontiers	non- parametric	- Stochastic parametric frontiers
Non-Frontier	- Growth Accounting	- Index numbers	-Growth Regressions	- IV and Proxy Variables	

Source: Fabio (2010)

For a detailed summary of all the methods mentioned in Table 4.1, see Del Gatto, Di Liberto and Petraglia (2010) because this study will limit its discussion to two frontier approaches that is, DEA and Stochastic frontier which are the most common and relevant for the study.

4.5.1 Data Envelopment Analysis (DEA)

The deterministic methods for estimating efficiency include the Data Envelopment Analysis, the Free Disposal Hull (FDH) and others as outlined in Table 4.1 (Fabio, 2010). The table shows that the methods can be classified as either frontier or non-frontier and DEA is therefore, a frontier deterministic non-parametric method of estimating efficiency. The DEA is based on the notion that a production unit employing less input than another to produce the same amount of output is more profitable.

The DEA approach applies the linear programming method where a series of equations is used to construct linear production frontiers (Lemba *et al.,* 2012). Hence, production frontier functional assumptions are ignored when using this method. The first DEA models were deterministic but have been modernized by including the stochastic characteristics (Khai *et al.,* 2008). According to Speelman *et al.* (2007), the DEA has some advantages over the parametric approaches. Its major strength is that since it uses linear programing with a constructed series of equations, there are no assumptions underlying the estimation of the production function. Different production frontiers can be compared in terms of a performance index and the efficiency estimate is not affected significantly when using small sample size. In addition, the DEA gives the freedom of determining efficiencies of the sub-vectors, for example specifying a target resource use, unlike the stochastic production frontier (Speelman *et al.,* 2007).

The non-parametric DEA frontier method which has received wide empirical application has a number of limitations that were noted by Coelli *et al.* (1998) as follows:

- Measurement error and other noise may influence the shape and the position of the frontier.
- Outliers may influence the results.
- The exclusion of an important input or output can result in biased results.
- The efficiency scores obtained are only relative to the best firms in the sample.
- The addition of an extra firm in DEA analysis cannot result in an increase in the TE scores of the existing firms.
- The addition of an extra input or output in a DEA model cannot result in a reduction in the TE scores.
- Treating inputs and/or outputs as homogenous commodities when they are heterogeneous may lead to biased results.

For these reasons which have notable implications on the regression outcomes, the stochastic frontier approach was chosen for this study over DEA.

4.5.2 Stochastic Frontier Approach

It was developed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). Econometric techniques have been used recently to estimate efficiency for each production unit based on some specific assumptions on technical and allocative inefficiency (at least in cross-sectional models) and statistical noise components (Kumbhakar, 2000). Measurement errors and any other source of variation in the dependent variable are embedded in the error term.

According to Fabio (2010) stochastic frontiers can be estimated by either parametric or non-parametric methods. Non-parametric techniques work well where there is high technological heterogeneity for example firms coming from different countries characterised by different stages of development, at different stages in their life cycles, from different industries (Olley and Pakes, 1996). Parametric stochastic frontiers work well when productivity differences are constant over time and observations share the same technology. Following Battese and Coelli, (1995) the stochastic frontier approach uses a two-stage analysis. Initially, the farm efficiency levels are estimated and secondly, the efficiency levels are regressed on farmer characteristics to explain the differences in efficiency. (Ali and Flinn, 1989). The stochastic frontier model is governed by the following assumptions:

a. Profit maximization is subject to perfectly competitive input and output markets.
b. Single output technology (quasi-concave in the nx1 vector) of variable inputs X and the mx1 vector of fixed factors Z.
c. Profit function is normalized and assumed to be well-behaved.

The Stochastic Frontier Model was originally developed by Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977). Econometric techniques have been used recently to estimate efficiency for each production unit based on some specific assumptions on technical and allocative inefficiency (in cross-sectional data models) and statistical noise components (Kumbhakar, 2001).The model specification can be written as:

$y = \beta^1 x + v - u$……………………………………………………………(4.11)

Where y is the observed outcome (goal attainment), $\beta^1 x + v$ is the optimal, frontier goal pursued by the individual, $\beta^1 x$ is the deterministic part of the frontier and $v \sim N(0, \sigma_v^2)$ is the stochastic element. $\beta^1 x + v$ forms the 'stochastic frontier'. The amount by which the observed individual fails to attain the optimum level (that is will be operating off the frontier) is u where:

$u = |U|$ and $U \sim N(0, \sigma_U^2)$

In this context u is the inefficiency and this is the normal-half normal model which forms the basis of the Stochastic Frontier Model. The profit maximizing condition of the farmer takes the form:

$\pi(p,z) = Y(X^*,Z) - \sum_i p_i \ X_i^*$..(4.12)

Where X^*= g (p, z), Y (.) is the production function, the normalized price of input (*i*) p_i = W/P, where P is the output price and W is the input price. The prices are exogenous thus there is no market power on the farmer's side. The profit maximizing condition represents gross revenue less total variable cost divided by output price which gives us the profit. The stochastic profit function includes a stochastic term which captures random shocks affecting the farmer. Each farmer faces a different shock but we assume the shocks to be random and they are described by a common distribution. The shocks vary from weather changes to economic adversities. The Cobb Douglas profit function in implicit form can be estimated as:

$\pi_j = f\left(p_{ij}, z_{kj}\right). exp\left(e_j\right)$..(4.13)

π_j is normalized profit of j^{th} farm calculated as gross revenue less total variable cost divided by farm specific output price,p_{ij} is the normalized price of input i for j^{th} farm, i.e. W(input price) divided by farm specific output price P , p_{ij} = W/P, z_{kj} is the level of the k^{th} fixed factor for the j^{th} farm and e_j is the error term where:

$e_j = v_j + u_j$..(4.14)

v_j is a normal or symmetric term with zero mean and a constant variance. v_j is assumed to be independently and identically distributed as N(0, σ^2_v) , u_j is a one-sided or asymmetric error term which has a half normal non-negative distribution N(μ,σ^2_u), u_j represents inefficiency implying the profit shortfall from its maximum possible. u and v are independent of each other. When u_j = 0 ,the farmer is efficient and operating along the profit frontier and when u_j> 0 there is profit inefficiency.

The variance of the model $\sigma^2 = \sigma^2_v + \sigma^2_u$ measures the total variation of profit from the frontier which can be attributed to profit inefficiency, (Battese and Corra, 1977). The inefficiency model can be specified as:

$u_i = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \alpha_3 X_{3i} + \alpha_4 X_{4i} + \ldots\ldots \alpha_k X_{ki}$.............................(4.15)

Where X_i are the explanatory variables of the stochastic profit function for example age, farm size, education and others. The major strength for stochastic frontier estimation is that it takes into consideration stochastic noise. However, there is need for imposing an explicit functional form for the underlying technology and an explicit distributional assumption for the inefficiency term.

4.5.3 Flexible Functional Forms

Estimation of the stochastic production frontier requires a particular functional form of the production function to be imposed. A range of functional forms for the production function frontier are available, with the most frequently used being a translog function, which is a second order (all cross-terms included) log-linear form and Cobb-Douglas function (Kumbhakar, 2001). Many forms of the stochastic frontier model have appeared in literature and a major survey that presents an extensive application of these formulations is Kumbakar and Lovell (2000), also Bauer (1990) and Green (2008). Battesse et al. (1993) noted that most studies on efficiency fail to give a true picture of farmers' efficiency because they use farm-level data on a single crop employing restrictive functional forms. In order to overcome this problem, Burki and Shah (1998) estimated whole farm level data using a flexible functional form (FFF). Diewert (1973) proposed the use of flexible functional forms for profit functions and since then empirical application of FFF's has become increasingly popular. However, Lopez (1985) argued that the choice of FFF for empirical application is purely an arbitrary decision.

According to Lopez (1985), FFF's can be classified into linear FFF and non-linear FFF. The common LFFF used in literature are Generalised Leontief and Normalised Quadratic. These models are associated with undesirable restrictions such as quasi-homotheticity and separability. Quasi-homotheticity or linear expansion paths implies that marginal rate of input substitution is independent of output levels, all input demand elasticities with respect to output tend to one as output increases. However, the Normalised Quadratic form satisfies the global convexity condition. The translog profit function has received a lot of econometric application in literature for estimating profit efficiency (Christensen, Jorgensen and Lau, 1973; Burgman, 1997; Chaudhary et al., 1998; Wadud and White, 2000; Hossain et al., 2012). This form has the capability to model complex technologies involving multi-input-output combinations even though it does not satisfy global convexity. The trend has been clearly to prefer those forms capable of representing more complex technologies even if their global properties are hard to verify.

4.5.4 Translog Stochastic Frontier

This is a relatively flexible functional form, as it does not impose assumptions about constant elasticities of production nor elasticities of substitution between inputs. A transcendental logarithmic form thus allows the data to indicate the actual curvature of the function, rather than imposing *a priori* assumptions. According to Diewert (1974) a translog function satisfies second order flexibility and its logarithmic form has the advantage that inefficiencies are captured by an additive term rather than a multiplicative one which considerably simplifies the econometric estimation (Henningsen and Henning, 2009) In general terms, the translog production function can be expressed as:

$$lnY_{j,t} = \beta_0 + \sum_i \beta_i \, lnX_{j,i,t} + \frac{1}{2}\sum_i \sum_k \beta_{i,k} \, lnX_{j,i,t} lnX_{j,k,t} - \mu_{j,t} + v_{j,t} \dots\dots\dots\dots\dots\dots (4.16)$$

Where $Y_{j,t}$ is the output of the farm *j* in period *t* , $X_{j,i,t}$ are the variable farm inputs (*i,*), of farm *j* in period *t* and $X_{j,k,t}$ are the fixed farm inputs (*k,*) of farm *j* in period *t* to the production process. As noted above, the additive error term is separated into two components, where $v_{j,t}$ is the stochastic error term and $u_{j,t}$ is an estimate of technical inefficiency. The normalised restricted translog profit function for a single output as formulated by Christensen, Jorgenson and Lau (1973) is depicted as follows:

$$\ln \pi^* = \alpha_0 + \sum_{i=1}^{n} \alpha_i \, lnP_i^* + \frac{1}{2}\sum_{i=1}^{n}\sum_{h=1}^{n} \gamma_{ih} \, lnP_i^* lnP_h^* + \sum_{i=1}^{n}\sum_{k=1}^{m} \delta_{ik} \, lnP_i^* lnZ_k + \sum_{k=1}^{m} \beta_k \, lnZ_k$$
$$+ \frac{1}{2}\sum_{k=1}^{m}\sum_{j=1}^{m} \Phi lnZ_k \, lnZ_j + v - u \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.17)$$

Where π^* is the normalised restricted profit calculated as: $\frac{TR-TC}{P_Q}$, with TR and TC being total revenue and total cost, respectively and P_Q is the output price. P_i is price of variable input X_i, which is also normalised by output price, Z_k is the k^{th} fixed input whereas *i=h=1,2,3……..n;* *k=j=1,2,3……m* and $\alpha_0, \alpha_i, \gamma_{ih}, \delta_{ik}, \beta_k \; and \; \Phi$ are parameters to be estimated. Normalised profit functions with fixed inputs are sometimes referred to as normalised restricted profit functions (Lau, 1976).

The generality of the functional form produces a side effect that they become non-monotonic or they do not satisfy global convexity as is the case with Cobb-Douglas model (Greene). This can be corrected by imposing monotonicity either globally or regionally on the production function. However, imposing the appropriate curvature is a generally challenging problem (Salvanes and Tjotta, 1998). To rectify this problem, Henningsen and Henning, 2009 imposed regional monotonicity on translog production frontiers with a simple three-step procedure. Kleit and Terrell (2001), in an analysis of the US electricity industry, have used a Bayesian estimator which directly imposes the necessary curvature requirements on a two output translog cost function. The Bayesian estimator also received recognition by O'Donnell and Coelli (2005).

4.5.5 Cobb-Douglas Stochastic Frontier

The Cobb-Douglas function is a special case of the translog production function which imposes more stringent assumptions on the data than the translog, because the elasticity of substitution has a constant value of 1. This implies that the functional form assumption imposes a fixed degree of substitutability on all inputs. The elasticity of production is constant for all inputs meaning that a 1 percent change in input level will produce the same percentage change in output, irrespective of any other arguments of the function.

The Cobb-Douglas production function is given by:

$$lnY_{j,t} = \beta_0 + \sum_i \beta_i \, lnX_{j,i,t} - \mu_{j,t} + v_{j,t} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.18)$$

Where $Y_{j,t}$ is the output of the farm *j* in period *t* and $X_{j,i,t}$ are the variable farm inputs (*i,*), of farm *j* in period *t* respectively to the production process. As noted above, the error term is separated into two components, where $v_{j,t}$ is the stochastic error term and $u_{j,t}$ is an estimate of technical inefficiency.

Coelli *et al.* (1998), and Thiam (2001), argued that stochastic frontier has the following advantages relative to DEA:

- DEA assumes all deviations from the frontier are due to inefficiency, while the stochastic approach allows for statistical noise.
- Tests of hypotheses regarding the existence of inefficiency and also regarding the structure of the production technology can be performed in a stochastic frontier analysis.

Stochastic frontiers are likely to be more appropriate than the DEA in agricultural applications, especially in developing countries, where data are heavily influenced by measurement error and the effects of weather and disease (Coelli *et al.*, 1998). Mushunje (2005) used this approach for Zimbabwe and his argument was that since the country is developing then data will be marred with noise.

4.6 Data and analytical framework

The data collected for fitting the above-mentioned models were those that helped in profiling the farmers in terms of their socio-economic and demographic characteristics and their performance in respect to the production and marketing activities. For convenience, the data and analytical framework are presented according to the specific analysis carried out within the broader framework of the objectives defined in the original project document. The main issues addressed are the profiles of the households which will focus on their socio-economic characteristics. For these, descriptive statistics such as mean, standard deviation and frequency distributions were used to describe and present the results.

4.6.1 Determination of the extent of rural poverty of household

This section presents the models employed in assessing the extent of rural poverty in the study area. The Foster-Greer-Thorbecke was adopted to understand the dimensions of poverty, but, because an in-depth knowledge is required to develop workable initiative that aims to alleviate poverty among the farmers, the Gini coefficient was computed for the pooled data as well as across sub-samples such as irrigation schemes, land classes, income classes and gender.

4.6.2 FGT assessment of the extent of poverty

The poverty model proposed by Foster-Greer-Thorbecke (FGT)(1984) partly was used to achieve objective 1, that is, to determine the extent of rural poverty status of household in the study area. The model can be presented as follows

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\left(\frac{g}{Z}\right)^{\alpha} I\left(Y_i < Z\right)\right] \text{..............................(4.19)}$$

Where P_α = Poverty parameter, α = Degree of poverty aversion, n = Total number households, q = Number of poor households, $g = Z - Y_i$ = Per capita income deficit (Rand), Z = Poverty line and $I(Y_i < Z) = \begin{cases} 1 \text{ if } \mathrm{Y_i} < \mathrm{Z} \\ 0 \text{ if } \mathrm{Y_i} > \mathrm{Z} \end{cases}$ = Indicator function.

According to Sanusi, Owagbemi, and Suleman (2013), if

α=0, P_α = Poverty incidence (Headcount). It represents the proportion of households below the poverty line.

α=1, P_α = Poverty gap (Poverty depth). It represents the proportion of the poverty line that is required for a poor household to become non-poor.

α=2, P_α = Poverty severity (Squared poverty gap). It represents the extent of severity of a poor household. The closer it is from 1, the harder it is for the household to become none poor.

4.6.3 Gini coefficient assessment of the extent of income inequality

There are a number of income inequality indexes in the literature such as generalized entropy, Atkinson, coefficient of variation, Gini and quintile share ratio of income inequality. However, the Gini coefficient has been widely compared to other, due to its properties and its link to Lorenz curve which is another useful graphical tool for income inequality analysis. The Gini index (Gini, 1912) used in its simplest form can be written as

$$G = -\frac{2}{y}\operatorname{cov}\left[y, \left(1 - F(y)\right)\right] \text{..........................(4.20)}$$

Where $\operatorname{cov}[y,(1-F(y))] = E[y-\bar{y}]*[F(y)]-\overline{F(y)}$, G = Gini index, cov = Covariance between income levels y and the cumulative distribution of the same income $F(y)$ and $\bar{y}$. $0 \leq G \leq 1$

If $G = 0$, there is no inequality.

If $G = 1$, there is perfect inequality.

If $0 < G < 1$, there is inequality.

The closer G is to 1 the higher the inequality and the closer it is to 0 the lower the inequality.

4.7 Determining the Farm Size-Land Productivity Relationship

The inverse relationship (IR) is formally defined as the negative change in average yields as farm size increases (Benjamin, 1995). Technically, this occurred when the coefficient estimate on farm size is statistically less than zero on the regression of yield on farm size. However, some authors have considered alternative methods by regressing average output on farm size, in which case the IR is only acknowledged when the coefficient of farm size is statistically less than one (Benjamin, 1995; Heltberg, 1998). Drawing from the literature, to successfully understand the alleged IR between farm size and productivity among maize and cabbage farmers in Qamata and Tyhefu irrigation schemes, OLS-based models were first fitted. However, because of possible bias due to some unobserved influences, IV-based models were equally fitted and the best model was chosen and interpreted.

4.7.1 Linear Models

Assuming that all the potential explanatory variables are exogenous, the following model which was adapted from the studies of Benjamin (1995); Heltberg (1998); Thapa (2007) and Sial, Iqbal and Sheikh (2012) was fitted as one of the alternative models

$$\ln(Y_i) = \beta_0 + \beta_1 \ln(X_{1i}) + \beta_2 \ln(X_{2i}) + \beta_3 \ln(X_{3i}) + \beta_4 \ln(X_{4i}) + \beta_5 X_{5i}$$
$$+\beta_6 \ln(X_{6i}) + \beta_7 \ln(X_{7i}) + \beta_8 \ln(X_{8i}) + \beta_9 \ln(X_{9i}) + \beta_{10} \ln(X_{10i}) + \beta_{11} X_{11i} + \beta_{12} X_{12i} + U_i \text{.........(4.21)}$$

Where:

$\ln$ = Natural logarithm, Y_i = Value of output, X_{1i} = Farm size, X_{2i} = Age X_{3i} = Age Squared, X_{4i} = Education, X_{5i} = Land inequality, X_{6i} = Irrigated land to cultivated land, X_{7i} = Total labour to cultivated land, X_{8i} = Family labour to total labour, X_{9i} = Family labour to total labour squared, X_{10i} = family labour to total labour squared, X_{11i} = Expenditure on fertilizer/pesticides, X_{12i} = Access to credit, U_i = Stochastic error term, β_0 = Intercept term, and $\beta_1,\ldots,\beta_{12}$ = Partial regression coefficients.

According to Benjamin, 1995; Heltberg (1998), the following can be deduced:

If $\beta_1 = 1$ then, the yield (value of output per hectare of land) is unrelated to farm size, that is, there is no relationship between yield and farm size.

If $\beta_1 < 1$ then, the yield is inversely related to farm size, that is, there is inverse relationship between yield and farm size.

If $\beta_1 > 1$ then, the yield is directly related to farm size, that is, there is a direct relationship between yield and farm size.

Under the assumption that food production increases in arithmetic progression, a variant of equation (4.21) was fitted as follows

$$Y_i = \beta_0 + \beta_1 \ln(X_{1i}) + \beta_2 \ln(X_{2i}) + \beta_3 \ln(X_{3i}) + \beta_4 \ln(X_{4i}) + \beta_5 X_{5i}$$
$$+ \beta_6 \ln(X_{6i}) + \beta_7 \ln(X_{7i}) + \beta_8 \ln(X_{8i}) + \beta_9 \ln(X_{9i}) + \beta_{10} \ln(X_{10i}) + \beta_{11} X_{11i} + \beta_{12} X_{12i} + U_i \ldots\ldots\ldots\ldots\ldots\ldots(4.22)$$

The variables and parameters in the model are defined as previously.

To compare equation (4.21) and (4.22), the following Box-Cox model was estimated using non-linear least squares (NLS) estimator as follows

$$\frac{Y_i^{\theta} - 1}{\theta} = \beta_0 + \beta_1 \ln(X_{1i}) + \beta_2 \ln(X_{2i}) + \beta_3 \ln(X_{3i}) + \beta_4 \ln(X_{4i}) + \beta_5 \ln X_{5i}$$
$$+ \beta_6 \ln(X_{6i}) + \beta_7 \ln(X_{7i}) + \beta_8 \ln(X_{8i}) + \beta_9 \ln(X_{9i}) + \beta_{10} \ln(X_{10i}) + \beta_{11} X_{11i} + U_i$$

Where θ and β_j are the parameters to be estimated under the assumption that U_i follows a normal distribution with zero conditional mean and a constant variance. According to Cameron and Trivedi (2009), under the null hypothesis that the model with log dependent variable is a better representation of the conditional mean function, If θ is close to 0, then model with log dependent variable is a better representation of the conditional mean function. But is theta is close to 1, the model with the dependent variable at its level form is better.

4.7.2 Instrumental Variable-Two-stage Least Square (IV-2SLS) Model

Unobserved land quality heterogeneity and imperfection in credit markets within villages in the study area may contribute to the IR between farm size and productivity either positively or negatively. Moreover, if unobserved land quality is significantly correlated with the farm size cultivated, parameters estimates from equation (4.21) and (4.22) would be bias and inconsistent in which case IV procedures are indispensable (Wooldridge, 2010). Technically, our maintained hypothesis is that farm size and access to credit are endogenously distributed among maize and cabbage farmers in the study area. If farm size and access to credit are truly endogenous, then, apprehending the effects of unobservable on productivity could reveal a better nature of the relationship between farm size and productivity. Thus, IV-2SLS was employed to examine the IR between farm size and productivity.

IV-2SLS as its name indicates is a two-stage estimation procedure. Based on the aforementioned the following first-stage (reduced-form) is a system of equations given the fact that we hypothesize farm size and access to credit to be endogenous

$$\begin{aligned}\ln(X_{1i}) = {} & \beta_{01} + \beta_{11}Z_{1i} + \beta_{21}Z_{2i} + \beta_{31}Z_{3i} + \beta_{41}Z_{4i} + \beta_{51}\ln(X_{2i}) + \beta_{61}\ln(X_{3i}) \\ & + \beta_{71}\ln(X_{4i}) + \beta_{81}X_{5i} + \beta_{91}\ln(X_{6i}) + \beta_{101}\ln(X_{7i}) + \beta_{111}\ln(X_{8i}) \\ & + \beta_{121}\ln(X_{9i}) + \beta_{131}\ln(X_{10i}) + V_{i1} \quad \ldots\ldots(4.23)\end{aligned}$$

$$\begin{aligned}X_{1i} = {} & \beta_{02} + \beta_{12}Z_{1i} + \beta_{22}Z_{2i} + \beta_{32}Z_{3i} + \beta_{42}Z_{4i} + \beta_{52}\ln(X_{2i}) + \beta_{62}\ln(X_{3i}) \\ & + \beta_{72}\ln(X_{4i}) + \beta_{82}X_{5i} + \beta_{92}\ln(X_{6i}) + \beta_{102}\ln(X_{7i}) + \beta_{112}\ln(X_{8i}) \\ & + \beta_{122}\ln(X_{9i}) + \beta_{132}\ln(X_{10i}) + V_{i2} \quad \ldots\ldots(4.24)\end{aligned}$$

Where $Z_{1i},\ldots,Z_{5i} =$ Instrumental variables, Z_{1i} = Restitution, Z_{2i} = Redistribution, Z_{3i} = Ngqushwa, Z_{4i} = Amalahila and Z_{5i} = Family size, $X_{2i},\ldots,X_{4i} =$ Exogenous regressors and are defined as previously, X_{5i} = Access to credit, V_{i1} and V_{i2} = white noise error terms, β_0 , $\beta_1, \ldots, \beta_{11}$ and other variables in the model are defined as previously.

The second-stage (structural) equation is given in equation (4.25) was estimated simultaneously and consistently alongside equations (4.23) and (4.24). The technique has the ability to cut off the part of variation in farm size and access to credit that is related to the error term V_i and therefore causing the part of farm size and access to credit that is exogenous to remain in the system. The model was estimated as follows

$$\ln(Y_i) = \delta_0 + \delta_1 \ln(X_{1i}) + \delta_2 \ln(X_{2i}) + \delta_3 \ln(X_{3i}) + \delta_4 \ln(X_{4i}) + \delta_5 X_{5i}$$
$$+ \delta_6 \ln(X_{6i}) + \delta_7 \ln(X_{7i}) + \delta_8 \ln(X_{8i}) + \delta_9 \ln(X_{9i}) + \delta_{10} \ln(X_{10i}) + \delta_{11} X_{11i} + U_i \ldots\text{.(4.25)}$$

Where Y_i , $X_{2i}, \ldots, X_{4i}$ and V_i are defined as above. δ_j are consistent estimates of partial regression coefficients, and V_i = White noise error term.

4.8 Estimation Tests

The success of the implementation of IV-based regression procedures lies on the reliance and validity of the instruments. The relevance of an instrument implies that the conditional mean of the stochastic error term is unrelated to the error term in the structural model while the validity implies that the instruments are strongly correlated with the endogenous variable and can successfully be excluded from the structural model without causing specification bias (Cameron *et al.,* 2009). This implies that the instruments are only allowed to influence the outcome of interest (productivity) through the instrumented farm size and access to credit variables.

According to Cameron *et al.* (2009), the relevance of an instrument can be obtained through economic theory, persuasive arguments and norms in prior related empirical studies. In this study the relevance of the instruments of farm size were obtained through prior related studies by Chen, Huffman and Rozelle (2006).

4.8.1 Endogeneity Test

There are several test of endogeneity, but pertinent to this study are listed and stated below. All these tests are carried out using STATA 12. The main diagnostic tests carried out are described in the sub-sections below.

4.8.2 Durbin-Wu-Hausman (DWH) Test

If farm size and access to credit are exogenous, then it becomes unnecessary to use IV-based estimators. To assess the endogeneity of farm size and access to credit, the DWH test which is equivalent to the Hausman test was conducted by estimating the following equations as follows

$$\begin{aligned}\ln(Y_i) &= \delta_0 + \delta_1 \ln(X_{1i}) + \delta_2 \ln(X_{2i}) + \delta_3 \ln(X_{3i}) + \delta_4 \ln(X_{4i}) + \delta_5 X_{5i} \\ &+ \delta_6 \ln(X_{6i}) + \delta_7 \ln(X_{7i}) + \delta_8 \ln(X_{8i}) + \delta_9 \ln(X_{9i}) + \delta_{10} \ln(X_{10i}) + \delta_{11} X_{11i} \\ &+ \delta_5 X_{5i} + \theta_1 \hat{V}_{1i} + \theta_2 \hat{V}_{i2} + \varepsilon_i \text{ ....(4.26)}\end{aligned}$$

$\hat{V}_{1i}$ and $\hat{V}_{2i}$ are predicted error terms obtained from equations4.23 and 4.24 respectively. Under the hull hypothesis that farm size is exogenous, if ε_i is independent and homoscedastic, then farm size and access to credit are endogenous if θ_1 and $\theta_2$are $\neq 0$

4.8.3 Bootstrap Hausman Test

If equations (4.23) and (4.24) are misspecified as it is likely to be the case for equation (4.24) – linear probability model (LPM) is fitted in place of logit or probit, the DWH test may not provide robust test for endogeneity (Cameron *et al.,* 2009). In order to overcome this drawback, a bootstrap Hausman test was conducted using a written program within Mata programming component of Stata 12.

4.8.4 Validity/Over-identification/Hansen's Test

If the relevant instruments obtained from prior related studies are not exogenous, the bias of the IV-2SLS estimator could be greater than that of OLS. According to Baum (2008), the Hansen's test should be performed routinely. Using Stata, the post estimation *Ado* command *override* was used after estimating the IV-2SLS model.

4.8.5 Weak instruments' Test

According to Baum (2008), if the potential instruments are weak in terms sufficiently explaining variation in endogenous variables, the bias of IV-2SLS can be aggravated. In order to test for weak instrument, the STATA post estimation command *first stage, forcenon-robust.*

4.9 Relevance of Instruments' Test

Drawing from the study of Chen *et al.* (2005), village dummies can be used as potential instruments of endogenous farm size. According to Chen *et al.* (2005) village dummies capture not only difference in regional soil, weather, irrigation system and multi-cropping index but also imperfection across village markets. Family size was also considered by the authors as a potential instrument because the size of the family can motivates farmers to seek for additional farms which therefore can explain the distribution of land among the farmers in the study area. Finally, the mode of land acquisition was considered as the third potential instrument. The mode of land acquisition is a categorical variable with three categories: farmers who acquired their land through inheritance, restitution and redistribution. However, to avoid the dummy trap, farmers who acquired their land through inheritance were considered as the benchmark category, that is restitution dummy and redistribution dummy were introduced in the model.

It should be noted that local municipality dummies were used in place of village dummies. This is because it is assumed that, due to clustering, there should not be much difference among neighboring villages. Moreover, the village dummies are a set of 13 dummy variables which could potentially be harmful in terms of the identification of the model.

4.10 Measurement and APriori Expectation in Productivity Models

This section presents the variables used in the assessment of the IR between farm size and productivity. The analysis was done based on crop data, irrigation scheme and pooled data. All the following definitions were based on pooled and irrigation scheme data. However, the definitions based on crop data can readily be understood by simply assuming each crop in place of both crops. It should therefore be noted that, the failure to aggregate certain quantities such as quantity of maize and cabbage forced the analysis to use their monetary value which could also affect the IR between farm size and productivity (Ünal, 2006). But this possible challenge was addressed by conducting the analysis based on crop data as mentioned previously.

4.10.1. Value of Output (Y_i)

It was used as the dependent variable in the productivity models presented so far. It includes the value in rand of cabbage and maize harvested during the period of study. It was obtained by multiplying the average price in kg received by farmers during the marketing of their produce and the total quantity of output harvested.

4.10.2. Farm Size(X_{1i})

According to Benjamin, 1995; Heltberg (1998), it is appropriate to use harvested farm size rather than total land holding because it helps reducing error of measurements which could otherwise leads to the phenomenon of nonsense regression. Farm size was then used as the estimated land cultivated for both cabbage and maize and was measured in hectare. Given the plethora of reasons why IR between farm size should hold in developing countries such as poor land quality and high cost of labour supervision to cite only these, farm size was hypothesized to be inversely related to productivity (Ünal, 2006).

4.10.3. Age (X_{2i})

This is the age of the household heads in years. Age tends to be correlated with experience and was therefore hypothesized to be directly related to productivity.

Following the study of Ünal (2006), it was also introduced to control for farmers' heterogeneity in the study area.

4.10.4. Age Squared (X_{3i})

This is the square of household heads' age and was introduced in the model to account for possible non-linearity and diminishing relationship between productivity and farm size. This is due to the fact that ageing farmers may not be able to cope with strenuous labour demanding tasks in traditional agriculture. Moreover, older farmers tend to be conservative in their farming activities and less likely to adopt improved technologies which in turn could affect their productivity. Thus, it was hypothesized to be indirectly related to the dependent variable.

4.10.5. Education (X_{4i})

This is the number of years of schooling of the household heads; it was introduced to account for farmers' heterogeneity in terms of education. Education is expected to increase productivity through higher efficiency as more educated farmers can read and better applied instruction often written on some purchased inputs. Moreover educated farmers can easily acquire loan than their counterparts which in turn could enable them to invest more in productivity enhancing inputs such as fertilizer. Thus, it was hypothesized to be directly related to the dependent variable.

4.10.6. Land Inequality (X_{5i})

This represents the land inequality index across the villages of the study area. It was estimated using the Gini coefficient and was introduced to capture the macro environment in which farmers live in (Ünal, 2006). Although, it could be argued that land inequality across the villages could have both positive and negative influence on productivity, we believe that the most plausible scenario in this study where land is very scarce in the study area and farmers often spend more time working in their farm. Meaning that due to the positive relationship between labour and productivity, the concentration of labour on smaller parcel of land will strengthen the IR through higher increase in productivity among the smaller farmers. Thus land inequality was hypothesized to be positively related to productivity.

4.10.7. **Irrigated Land Intensity**(X_{6i})

It is the ratio of land irrigated to the total land cultivated. This was used in an attempt to control for land quality. However, according to Ünal (2006), there is exogenous irrigation such as canal systems and endogenous irrigation such as tube system. Meaning that, this ratio may not satisfactorily capture the unobserved land quality. Thus, the variable was hypothesized to increase productivity because, farmers with less irrigated land depend more on rain for their production which may not be enough due to varying climatic conditions while irrigated farmers would be less affected.

4.10.8. **Total Labour Intensity**(X_{7i})

It is the proportion of labour per unit of land cultivated. It is a unit less quantity which was estimated as the ratio of total labour to total land cultivated. Based on the labour hypothesis, this ratio was expected to be directly related to productivity.

4.10.9. **Family Labor Intensity**(X_{8i})

It is the ratio of family labor to total labour used during the production period. Given the direct relationship between labour and productivity and the scarcity of labour, farmers with more family labour will be more productive than their counterparts, *Ceteris paribus*. Family labour intensity was therefore hypothesized to be directly related to productivity.

4.10.10. **Family Labor Intensity Squared**(X_{9i})

This is the square root of family labour intensity. It was introduced to capture possible non-linearity and diminishing marginal return of family labour intensity. As farm size gets smaller due to increase family labour, it is believe that there would be a threshold point where increase in family labour would decrease total productivity. Therefore, we expect family labour intensity squared to be negatively related to productivity.

4.10.11. Expenditure on Fertilizer/Chemical(X_{10i})

It is the cost in rand of fertilizer/chemical incurred during the production period. This variable was introduced to control for land augmenting technical progress. Thus, it was hypothesize to be positively related to productivity.

4.10.12. Access to Credit (X_{11i})

It is a dummy variable taking the value of 1 if a farmer had access to credit and 0 otherwise. This variable was used to control from heterogeneity in the credit market in the study area. It is expected that farmers with more access to credit are more likely to adopt improve technology and spend more on land augmenting technical progress which in turn could raise their productivity. Access to credit was therefore hypothesized to be positively related to productivity.

4.10.13. Restitution (Z_{1i}) and Redistribution (Z_{2i})

Restitution and redistribution are dummy variables taking 1 if a farmer accessed land through restitution and redistribution respectively and 0 otherwise. These variables were use as instrument for land quality because we assumed that these variables could be choice variables. Moreover, in the redistribution of land system, farmers with connections could possibly acquire better land that those who did not. In the case of restitution, the land restituted could have been over-utilized before handed over. Farmers who access their land through inheritance were used as the based category. Thus, farmers who access their farms through inheritance were expected to have better land and therefore higher productivity than their counterparts. Consequently, these variables were hypothesized to be inversely related to farm size.

4.10.14. Ngqushwa (Z_{3i}) and Amalahila (Z_{4i})

These are dummy variables for residential location taking 1 if a farmer lived in Ngqushwa and Amalahila local municipality respectively and zero otherwise. These variables were introduced as instrumental variables because as noted by Ünal (2006), just including village dummies as controls for land quality may not be sufficient since the technique only controls for heterogeneity in land quality between villages and not within villages. The direction of influence of these variables on land was considered unambiguous.

4.10.15. Family Size (Z_{5i})

It represents the number of people who lived under the same roof and ate from the same pot during the period under study. Chen *et al.* (2005) used household size as instrument of farm size. They found that a positive and significant impact household size on farm size. Thus, household size was hypothesized to be positively related to farm size.

4.11 Relative Efficiencies of Homestead Gardeners and Irrigation Farmers

Two categories of production functions are commonly used in the literature: average response production functions that assume that deviations from the expected output is entirely due to white noise (independently and identically distributed error term) and those that assume that deviations from the expected output is due to both white noise and inefficiency error terms. If there is inefficiency error term, then efficiency scores to be estimated would comprised of technical, allocative and economic efficiencies. The following gives a detailed path to the evaluation of the efficiency of farmers and how they are related to farm size and other control factors.

4.11.1 Average Response Production (ARP) Functions

According to the literature four ARP functions under the assumption of no inefficiency error term are often fitted to model the relationship between agricultural production inputs and outputs. These are linear, semi-log, exponential, Cobb-Douglas and translog production models. According to Mbanasor and Obioha (2003), Gani and Omonona (2009), Chiedozie (2010) and Mugabo *et al.* (2014) the explicit forms of the models that were considered can be presented as follows

4.11.1.1 Linear Production Function

$$Y_i = \beta_{01} + \beta_{11}X_{1i} + \beta_{21}X_{2i} + \beta_{31}X_{1i} + \beta_{41}X_{4i} + V_i \text{ ....(4.27)}$$

Where Y_i = Production output, X_{ji} = Production inputs, i = Household identifier, V_i = White noise which is assumed to be normally distributed, β_{01} = Intercept term, that is, the average production output when β_{11} through β_{41} = 0. This is, however, a mechanical interpretation which does not make sense in most cases (Gujarati, 2004) β_{j1} = Partial regression coefficient, that is, it measures the mean change in Y_i, $E(Y_i)$, for a unit change in X_{ji}, holding the value of all other regressors in the model constant. J = 1,2,…,n.

4.11.1.2 Semi-log Production Function

$$Y_i = \beta_{02} + \beta_{12}\ln(X_{1i}) + \beta_{23}\ln(X_{2i}) + \beta_{34}\ln(X_{1i}) + \beta_{45}\ln(X_{4i}) + V_i \text{ ....(3.28)}$$

Where Y_i, X_{ji}, V_i, j and i are defined as above. β_{02} = Intercept term, β_{j2} = Absolute change in Y_i for a relative change in X_{ji}, that is, if X_{ji} increases by 1 percent, Y_i will increase by $\frac{\beta_{j2}}{100}$ units.

4.11.1.3 Exponential Production Function

$$\ln(Y_i) = \beta_{03} + \beta_{13}X_{1i} + \beta_{23}X_{2i} + \beta_{33}X_{1i} + \beta_{43}X_{4i} + V_i \text{ ....(4.29)}$$

Where Y_i, X_{ji}, V_i, j and i are defined as above. β_{03} = Intercept term, β_{j3} = Relative change in Y_i, for an absolute change in X_{ji}, that is, if X_{ji} increases by 1 unit, Y_i will increase by $\beta_{j3} * 100$ percent. j

4.11.1.4 Double-log (Cobb-Douglas) Production Function

$$\ln(Y_i) = \beta_{04} + \beta_{14}\ln(X_{1i}) + \beta_{24}\ln(X_{2i}) + \beta_{34}\ln(X_{1i}) + \beta_{44}\ln(X_{4i}) + V_i \text{ ....(4.30)}$$

Where Y_i, X_{ji}, V_i, j and i are defined as above: Ln = Natural logarithm, β_{04} = Intercept term, β_{14} through β_{44} = Partial elasticities of output with respect to inputs, that is, they measures the percentage change in output for, say, a 1 percent change in a given input, holding all other inputs constant (Gujarati, 2004). The sum $(\beta_{14}+\beta_{24}+\beta_{34}+\beta_{44})$ gives information about the return to scale (Scale elasticity), that is, the response of output to a proportionate change in all the inputs. If this sum is 1, then there are constant returns to scale, that is, doubling the inputs will double the output, tripling the inputs will triple the output, and so on. If the sum is less than 1, there are decreasing returns to scale – doubling the inputs will less than double the output. Finally, if the sum is greater than 1, there are increasing returns to scale – doubling the inputs will more than double the output.

4.11.1.5Translog Production Function

$$\ln(Y_i) = \beta_{05} + \beta_{15}\ln(X_{1i}) + \beta_{25}\ln(X_{2i}) + \beta_{35}\ln(X_{3i}) + \beta_{45}\ln(X_{4i})$$
$$+\frac{1}{2}\beta_{55}[\ln(X_{1i})]^2 + \frac{1}{2}\beta_{65}[\ln(X_{2i})]^2 + \frac{1}{2}\beta_{75}[\ln(X_{3i})]^2 + \frac{1}{2}\beta_{85}[\ln(X_{4i})]^2$$
$$+\beta_{85}\ln(X_{1i})*\ln(X_{2i}) + \beta_{95}\ln(X_{1i})*\ln(X_{3i}) + \beta_{105}\ln(X_{1i})*\ln(X_{4i})$$
$$+\beta_{115}\ln(X_{2i})*\ln(X_{3i}) + \beta_{125}\ln(X_{2i})*\ln(X_{4i}) + \beta_{135}\ln(X_{3i})*\ln(X_{4i}) + V_i \text{.............(4.31)}$$

Where Y_i , X_{ji} , V_i , j and i are defined as above. β_{15} through β_{45} = First derivatives, β_{55} through β_{85}= Own second derivatives and β_{95} through β_{135}= Cross second derivatives . It should be noted that parameters in the stochastic frontier model are note directly interpretable and therefore there is need for conduct some post-estimation such as marginal effect in order to interpret the result. In this case production elasticity with respect to each j^{th} input at means was estimated using the following equation

$$\frac{\partial \ln Y_i}{\partial \ln X_{1i}} = \beta_{15} + \beta_{55}\ln(X_{1i}) + \beta_{85}\ln(X_{2i}) + \beta_{95}\ln(X_{3i}) + \beta_{105}\ln(X_{4i}) \text{.....................(4.32)}$$

$$\frac{\partial \ln Y_i}{\partial \ln X_{2i}} = \beta_{25} + \beta_{65}\ln(X_{1i}) + \beta_{85}\ln(X_{2i}) + \beta_{115}\ln(X_{3i}) + \beta_{125}\ln(X_{4i}) \text{.................. (4.33)}$$

$$\frac{\partial \ln Y_i}{\partial \ln X_{3i}} = \beta_{35} + \beta_{95}\ln(X_{1i}) + \beta_{115}\ln(X_{2i}) + \beta_{75}\ln(X_{3i}) + \beta_{135}\ln(X_{4i}) \ldots\ldots\ldots\ldots\ldots\ldots(4.34)$$

$$\frac{\partial \ln Y_i}{\partial \ln X_{4i}} = \beta_{45} + \beta_{105}\ln(X_{1i}) + \beta_{125}\ln(X_{2i}) + \beta_{135}\ln(X_{3i}) + \beta_{85}\ln(X_{4i}) \ldots\ldots\ldots\ldots\ldots\ldots(4.35)$$

4.11.2 Stochastic Frontier Production (SFP) Functions

Based on the models that assume that the deviation from the expected output is due to both the stochastic error and inefficiency terms, two common production functions are often employed: the Cobb-Douglas and translog SFP functions

4.11.2.1 Cobb-Douglas Stochastic Frontier Production Function

$$\ln(Y_i) = \beta_{06} + \beta_{16}\ln(X_{1i}) + \beta_{26}\ln(X_{2i}) + \beta_{36}\ln(X_{1i}) + \beta_{46}\ln(X_{4i}) + V_i - U_i \ldots\ldots\ldots\ldots\ldots(4.36)$$

Where Y_i, X_{ji}, V_i, j and i are defined as above. $\ln$ = Natural logarithm, U_i = Non-negative inefficiency error term which is assumed to be half-normally distributed and β_{16} through β_{46} = Output elasticities with respect of inputs.

4.11.2.2Translog Stochastic Frontier Production Function

$$\ln(Y_i) = \beta_{07} + \beta_{17}\ln(X_{1i}) + \beta_{27}\ln(X_{2i}) + \beta_{37}\ln(X_{1i}) + \beta_{47}\ln(X_{4i})$$
$$+\frac{1}{2}\beta_{57}[\ln(X_{1i})]^2 + \frac{1}{2}\beta_{67}[\ln(X_{2i})]^2 + \frac{1}{2}\beta_{77}[\ln(X_{1i})]^2 + \frac{1}{2}\beta_{87}[\ln(X_{4i})]^2$$
$$+\beta_{97}\ln(X_{1i})*\ln(X_{2i}) + \beta_{107}\ln(X_{1i})*\ln(X_{3i}) + \beta_{117}\ln(X_{1i})*\ln(X_{4i})$$
$$+\beta_{127}\ln(X_{2i})*\ln(X_{3i}) + \beta_{137}\ln(X_{2i})*\ln(X_{4i}) + \beta_{147}\ln(X_{3i})*\ln(X_{4i}) + V_i - U_i \ldots\ldots\ldots\ldots\ldots(4.37)$$

Where Y_i, X_{ji}, V_i, U_i, j and i are defined as above. $\ln$ = Natural logarithm, term, $[\ln(X_i)]^2$ = Log of inputs Squared, $\ln(X_i)*\ln(X_j)$ = Interaction between inputs, β_{07} = Intercept term, β_{17} through β_{47} = First derivatives, β_{57} through β_{87}= Own second derivatives, β_{97} through β_{147} = Cross second derivatives. The output elasticity with respect to each inputs was given by

$$\frac{\partial \ln Y_i}{\partial \ln X_{1i}} = \beta_{17} + \beta_{57} \ln(X_{1i}) + \beta_{87} \ln(X_{2i}) + \beta_{97} \ln(X_{3i}) + \beta_{107} \ln(X_{4i}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.38)$$

$$\frac{\partial \ln Y_i}{\partial \ln X_{2i}} = \beta_{27} + \beta_{67} \ln(X_{1i}) + \beta_{87} \ln(X_{2i}) + \beta_{117} \ln(X_{3i}) + \beta_{127} \ln(X_{4i}) \ldots\ldots\ldots\ldots\ldots\ldots (4.39)$$

$$\frac{\partial \ln Y_i}{\partial \ln X_{3i}} = \beta_{37} + \beta_{97} \ln(X_{1i}) + \beta_{117} \ln(X_{2i}) + \beta_{77} \ln(X_{3i}) + \beta_{137} \ln(X_{4i}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.40)$$

$$\frac{\partial \ln Y_i}{\partial \ln X_{4i}} = \beta_{47} + \beta_{107} \ln(X_{1i}) + \beta_{127} \ln(X_{2i}) + \beta_{137} \ln(X_{3i}) + \beta_{87} \ln(X_{4i}) \ldots\ldots\ldots\ldots\ldots\ldots (4.41)$$

In order to choose the appropriate model to fit the production that, criteria such as specification bias, number of significant regressors, goodness of fit and consistency with a priori expectation were considered.

4.12 Measurement and *A Priori* Expectations in Production Models

This section presents the variables that were used in the analysis both in terms of the pooled dataset (Cabbage and maize) and across irrigation scheme. The definition based on crop can be readily be understood based on those provided for the pooled data.

4.12.1. Production Output (Y_i)

Based on the pooled dataset, production output is defined as the value in Rand of maize and cabbage output harvested by farm households in Tyhefu and Qamata during the farming period under study. Based on individual crop, it represents either the quantity of maize or cabbage harvested and was measured in kilogram (Kg). It is the dependent variable in the assessment of the relationship between production inputs and outputs.

4.12.2. Farm Size (X_{1i})

Based on the pooled data, it represents the total land cultivated in the production of maize and cabbage outputs and was measured in hectare (ha). It is a continuous independent variable and was used to assess its contribution in the production of maize and cabbage. Based on individual crop, it was measured as the area allotted for the production of maize and cabbage respectively and was equally measured in ha. Land is a fundamental input in agricultural production; it is expected that as land increases, the total physical product will also increase either increasingly or decreasingly. It other words, it was expected to be positively associated to the production output, a priori.

4.12.3. Fertilizer (X_{2i})

It is often regarded as land enhancing input and was used in the pooled model as the total quantity of fertilizer applied to both maize and cabbage farms in the pooled model. It was employed as a continuous independent variable in the production model and was measured in kg. Based on the analysis of individual crop production, it was used as the quantity of fertilizer used in cabbage and maize respectively and was equally measured in kg. It was hypothesized to be directly related to the production output, a priori.

4.12.4. Seed (X_{3i})

In the pooled model, it was used as the total value in Rand of maize and cabbage seed planted based on the pooled model. In the production model of maize and cabbage, the quantity of maize and cabbage seed measured in kg was used respectively. It was hypothesized that, the more it is spent on seed or the more it is used, the more it is likely to acquire more outputs. Thus, used as a continuous independent variable, it was expected to be directly related to production output, *a priori*.

4.12.5. Labour (X_{4i})

In the theory of agricultural production, labour is considered as one of the traditional factors of production. Measured in man-day, it was represented as the sum of the quantity of labour used in the both the production of maize and cabbage. Different weights were used to differentiate the workload of an adult from that of a woman or child depending on the type of farming activities. For instance, women and children labor was weighted by 0.75 and 0.4 for land preparation respectively based on prior related empirical studies to obtain an equivalent quantity of labour offered by an adult. Due to the availability of family labour among smallholder of maize and cabbage farms, the value of family labour was hypothesized to be positively related to production output

4.13 Technical Inefficiency Model

This model was used to assess the effect of farm size on the technical efficiency level of the farmers. The socio-economic characteristics of the respondents were included in the model to control for farmers' heterogeneity. Technical efficiency denotes the ratio of the observed output to the maximum feasible output (Ogunbameru and Okeowo, 2013). It can be expressed mathematically as

$$TE_i = \frac{Y_i}{\hat{Y}_i} \quad \text{...(4.42)}$$

Where TE_i = Technical efficiency, Y_i is defined as above, $\hat{Y}$ = Expected output in Rand based on the chosen production frontier. $0 \le TE_i \le 1$

The empirical model was estimated as

$$U_i = \delta_{01} + \delta_{11}Z_{1i} + \delta_{21}Z_{2i} + \delta_{31}Z_{3i} + \delta_{41}Z_{4i} + \delta_{51}Z_{5i} + \delta_{61}Z_{6i} + \delta_{71}Z_{7i}$$
$$+ \delta_{81}Z_{8i} + \delta_{91}Z_{9i} + \delta_{101}Z_{10i} + \delta_{111}Z_{11i} + \delta_{121}Z_{12i} + \theta_i \quad \text{.....................(4.43)}$$

Where

$U_i = 1 - TE_i$ = Technical inefficiency, δ_{01} = Intercept term, $Z_{11i},\ldots,Z_{121i}$ = Socio-economic characteristic and Z_{12i} = Farm size.

4.13.1. Measurement and a priori Expectation in Inefficiency Model

This section provides a succinct insight of the variables used in the determinants of technical inefficiency.

4.13.1.1 Inefficiency error term (U_i)

It is a measure of inefficiency of maize and cabbage farmers in Qamata and Tyhefu. It is a continuously dependent variable and its values were expected to fall between 0 and 1.

4.13.1.2. Gender(Z_{1i})

It represents the gender of the household heads and was measured as a dummy variable taking 1 if a household head is a male and 0 if female. Assuming that male farmers use less productive technology which is observed under organic farming, it can be hypothesized based on the study of Madau (2005) that Gender is negatively related to technical inefficiency.

4.13.1.3. Married(Z_{2i})

It represents the marital status of the household heads and was measured as a dummy variable taking 1 if a household is married and 0 otherwise. This variable is introduced to account for possible heterogeneity in family labour among farmers. It was therefore hypothesized to be negatively related to technical inefficiency since more labour could mean than farmers could have only small land in which case they will tend to maximize their use.

4.13.1.4. Education (Z_{3i})

It is a continuous variable that represents the educational level of the household heads among maize and cabbage farm households and was measured in terms of number of completed years of education. It is an independent variable and was expected, a priori, to be indirectly related to technical inefficiency as more educated farmers are expected to be prompt in adopting improved technology and to apply them better than their counterparts due to their ability to acquire technical knowledge.

4.13.1.5. Household size (Z_{4i})

It represents the number of people who lived under the same roof and ate from the same pot during the period under study. It is an independent variable and was, a priori, expected to be indirectly related to technical inefficiency as household size serves as ready source of farm operations.

4.13.1.6. Association (Z_{5i})

It represents the household heads' association membership status and was measured as a dummy variable taking 1 if a household head belong to any farmers' association and 0 otherwise. Association membership is a significant social capital that can enhance farmers' technical efficiency through sharing of experiences among members. It was, thus, hypothesized to be, a priori, indirectly associated to technical inefficiency, that is, household heads with farmer's association membership was expected to be more technically efficient that their counterparts, *ceteris paribus*.

4.13.1.7. Extension(Z_{6i})

It represents household heads' status in terms of contact with private or public extension agents. It was measured as a dummy variable taking 1 if a household head ever had contact with extension agents and 0 otherwise. The variable was hypothesized to influence technical inefficiency negatively through the acquisition of adapted or modern agricultural practices and technologies through extension agents. Thus, it was, a priori, expected to be indirectly related to technical inefficiency, that is, household heads with contact to extension services were expected to be more technically efficient than their counterparts, *ceteris paribus.*

4.13.1.8. Credit (Z_{7i})

It represents the household heads' status in terms of access to credit service and was measured as an explanatory variable taking one if a household head had access to credit during the farming period and 0 otherwise. Access to credit is a significant input that encourages farmers to invest more on improved technology, use purchased inputs such as hired labour and fertilizer, and adopt soil conservation techniques and so forth which in turn can help them reduce their level of technical inefficiency. It was hypothesized to be indirectly related to technical inefficiency, that is, household heads with access to credit was expected to be more technically efficient that their counterparts, *ceteris paribus*.

4.13.1.9. Main occupation (Z_{8i})

It represents the household heads' main occupation and was measured as a dummy variable taking 1 if a household head is mainly farmer and 0 otherwise. By spending more time on the farm, it is believed that farmers' behavior's error would be reduced over time based on the error-learning theory (Gujarati, 2004). Thus, the variable was hypothesized to the indirectly related to technical inefficiency, that is, households who are mainly farmers were expected to be more technically efficient that their counterparts, *ceteris paribus*.

4.13.1.10.Experience (Z_{9i})

It represents the number of years the household heads have spent as maize and cabbage farmers. It is generally accepted in the literature that experience increases performance. This is probably due to the accumulated knowledge farmers often acquire over time. The variable is a regressors and was hypothesized to be indirectly related to technical inefficiency, that is, a household heads with more number experience was expected to be more technically efficient than those with lower number of years of experience, *ceteris paribus* .

4.13.1.11.Irrigator (Z_{10i})

It is a dummy variable taking 1 if a household head is an irrigator and 0 if he is homestead gardener. Due to the diverse advantages available to irrigators such as access to land and irrigation facilities, irrigator was used as an explanatory variable that influences technical inefficiency indirectly, meaning that, a prior, it was expected that irrigators would be more technically efficient than their counterparts, *ceteris paribus*.

4.13.1.12.Irrigation scheme (Z_{11i})

It represents the household heads' status in terms of whether they participated in the Qamata scheme or in the Tyhefu scheme. It was measured as a dummy variable taking 1 if a household head participated in the Qamata scheme and 0 otherwise. It was used as an explanatory variable and was hypothesized to be indirectly related to technical inefficiency, meaning that farmers in the Qamata irrigation scheme were expected to be more technically more efficient than their counterparts. The hypothesis can be justified by the fact that the location of the Qamata scheme is more favorable than that of Tyhefu based on his closeness to two dams (Lubisi and the Xonxa). Moreover, according to Kibirige (2013), Soil geological formation processes in Tyhefu include several phases of uplifting, erosion and deposition which causes land to be less productive. Nondumiso (2009) pointed out that the erratic rainfalls in this area may contribute to low agricultural productivity forcing many out of farming as their source of livelihood with resultant increase in hunger and poverty.

4.13.1.14.Farm size (Z_{12i})

Farm size was then used as the estimated land cultivated for both cabbage and maize and was measured in hectare. It was expected that large farms tends to be less efficient than their counterparts. Farm size was thus hypothesized to be positively related to technical inefficiency.

4.13.2 Stochastic Frontier Cost (SFC) Functions

This section presents the cost functions for maize and cabbage production that were fitted alongside. Based on the literature two common which are often employed to fit cost functions are the Cobb-Douglas and translog stochastic frontier cost function.

4.13.2.1 Cobb-Douglas Stochastic Frontier Cost Function

$$\ln(C_i) = \beta_{01} + \beta_{11}\ln(P_{1i}) + \beta_{21}\ln(P_{2i}) + \beta_{31}\ln(P_{3i}) + \beta_{41}\ln(P_{4i}) + \beta_{51}\ln(Y_i) + V_i - U_i \text{ ....(4.44)}$$

Where Y_i, P_{ji} = Average cost of input, V_i, i, j and $\ln$ are defined as above, U_i = Non-negative cost inefficiency error term which is assumed to be normally distributed and β_{j1} = Cost output elasticities with respect to input.

4.13.2.2 Translog Stochastic Frontier Production Model

$$\ln(C_i) = \beta_{02} + \beta_{12}\ln(P_{1i}) + \beta_{22}\ln(P_{2i}) + \beta_{32}\ln(P_{1i}) + \beta_{42}\ln(P_{4i})$$
$$+ \frac{1}{2}\beta_{52}[\ln(P_{1i})]^2 + \frac{1}{2}\beta_{62}[\ln(P_{2i})]^2 + \frac{1}{2}\beta_{72}[\ln(P_{1i})]^2 + \frac{1}{2}\beta_{82}[\ln(P_{4i})]^2$$
$$+ \beta_{92}\ln(P_{1i}) * \ln(P_{2i}) + \beta_{102}\ln(P_{1i}) * \ln(P_{3i}) + \beta_{112}\ln(P_{1i}) * \ln(P_{4i})$$
$$+ \beta_{122}\ln(P_{2i}) * \ln(P_{3i}) + \beta_{132}\ln(P_{2i}) * \ln(P_{4i}) + \beta_{142}\ln(P_{3i}) * \ln(P_{4i})$$
$$+ \beta_{152}\ln(Y_i) + V_i - U_i \quad \text{……(4.45)}$$

Where Y_i, P_{ji}, V_i, U_i and $_i$, $\ln$ are defined as above. C_i = Total cost of production (Rand) $[\ln(P_i)]^2$ = Log of average cost of inputs Squared, $\ln(P_i) * \ln(P_j)$ = Interaction between average cost of inputs, β_{02} = Intercept term, β_{12} through β_{42} = First derivatives, β_{52} through β_{82} = Own second derivatives, β_{92} through β_{142} = Cross second derivatives and β_{152}= Return to scale. The total cost elasticity with respect to each input's average cost was estimated using the following equations

$$\frac{\partial \ln C_i}{\partial \ln P_{1i}} = \beta_{12} + \beta_{52}\ln(P_{1i}) + \beta_{82}\ln(P_{2i}) + \beta_{92}\ln(P_{3i}) + \beta_{102}\ln(P_{4i}) \quad \text{……(4.46)}$$

$$\frac{\partial \ln C_i}{\partial \ln P_{2i}} = \beta_{22} + \beta_{62}\ln(P_{1i}) + \beta_{82}\ln(P_{2i}) + \beta_{112}\ln(P_{3i}) + \beta_{122}\ln(P_{4i}) \quad \text{……(4.47)}$$

$$\frac{\partial \ln C_i}{\partial \ln P_{3i}} = \beta_{32} + \beta_{92}\ln(P_{1i}) + \beta_{112}\ln(P_{2i}) + \beta_{72}\ln(P_{3i}) + \beta_{132}\ln(P_{4i}) \quad \text{……(4.48)}$$

$$\frac{\partial \ln C_i}{\partial \ln P_{4i}} = \beta_{42} + \beta_{102}\ln(P_{1i}) + \beta_{122}\ln(P_{2i}) + \beta_{132}\ln(X_{3i}) + \beta_{82}\ln(P_{4i}) \quad \text{……(4.49)}$$

These elasticities represent the percentage change in the total cost of production of maize and cabbage with respect to the cost of each of the inputs.

4.14 Measurement and *A Priori* Expectations in Cost Model

This entailed a breakdown of the different cost items involved in farm production and their analysis by means of non-parametric techniques such as Gross Margin Analysis. The cost items are enumerated below.

4.14.1 Total cost of production (C_i)

It represents the total cost in Rand incurred in the production of maize and cabbage by farm households during the period of study. This was obtained by adding up all the average costs of the various inputs used in the production of both maize and cabbage respectively. It was used as a continuously dependent variable in the cost model.

4.14.2 Cost of farm size (P_{1i})

It represents the total cost in rand of the total land used in the production of both cabbage and maize. It was estimated by adding up the cost of hired land and the opportunity cost of land inherited. It was used as a regressor and hypothesized to be positively related to the total cost of maize and cabbage production.

4.14.3 Cost of fertilizer (P_{2i})

It represents the total cost in Rand of fertilizer used in the production of both cabbage and maize during the period of study. It was estimated by adding the purchased price of fertilizer and the cost of transportation. It was used as a regressor and hypothesized to be positively related to the total cost of maize and cabbage production.

4.14.4 Cost of seed (P_{3i})

It represents the total cost in Rand of seed used in the production of both maize and cabbage during the period of study. It was estimated by adding up the cost of purchased price of the total quantity of seed and the cost of transportation from the market to the house. It was employed as a regressor and was expected to be directly related to the total cost of production of both maize and cabbage.

4.14.5 Cost of labour (P_{4i})

It represents the total cost of labour in Rand used in the production of both maize and cabbage during the period of study. It was estimated by adding up the total cost of hired labour and the opportunity cost of family labour. It was used as an independent variable and was hypothesized to be positively related to the total cost of production.

4.15 Cost Efficiency Model

The model was used to assess the relationship between the socio-economic characteristics of the respondents and their level of cost efficiency. The estimated model can be written as:

$$U_i = \delta_{02} + \delta_{12} Z_{1i} + \delta_{22} Z_{2i} + \delta_{32} Z_{3i} + \delta_{42} Z_{4i} + \delta_{52} Z_{5i} + \delta_{62} Z_{6i}$$
$$+ \delta_{72} Z_{7i} + \delta_{82} Z_{8i} + \delta_{92} Z_{9i} + \delta_{102} Z_{10i} + \delta_{112} Z_{11i} + \theta_i \text{ ....(4.50)}$$

Where $U_i = CE_i = \frac{C}{\hat{C}_i}$, C_i is defined as above, $\hat{C}_i$ = is the expected cost of production based on the cost frontier, Z_{ji} = Socio-economic characteristics, δ_{j2} = Partial regression coefficients, δ_{01} = Intercept term

The allocative efficiency of the i^th farmer can then be deduced as

$$AE_i = \frac{1}{CE_i} \text{ ....(4.51)}$$

Where $0 \le AE_i \le 1$ and Where $CE_i > 1$

Based on equations4.27 and 4.29, the economic efficiency level of the respondents was estimated using the following ratio

$$EE_i = TE_i * AE_i \text{ ....(4.52)}$$

Where $0 \le EE_i \le 1$

4.15.1 Measurement and *A Priori* Expectation in Cost Efficiency Model

In order to fit the cost efficiency model, the variables that relate to the household heads' demographic characteristics and production environment were defined and measured as previously indicated. These are: Gender (Z_{1i}), Married (Z_{2i}), Education (Z_{3i}), Household size (Z_{4i}), Association (Z_{5i}), Extension (Z_{6i}), Credit (Z_{7i}), Main occupation (Z_{8i}), Experience (Z_{9i}), irrigator (Z_{10i}) and Irrigation scheme (Z_{11i}). However, all the variables were hypothesized to be directly related to cost efficiency rather than indirectly as in the case of technical inefficiency.

4.15.2Two-Stage Data Envelopment Analysis (2S-DEA) Models

This section presents the empirical 2S-DEA model that was used for the estimation of production efficiency scores (technical, allocative and economic) under the assumption that there is a non-parametric frontier in the production and cost functions of cabbage and maize in the study area as well as the determination of the effect of farm size on the estimated production efficiency scores.

4.15.2.1 First-Stage DEA

This stage consists of the estimation of the various production efficiency scores. The following provides the details about the linear programming that were used to undertake such exercise.

a) Technical Efficiency Score

Let us assume that agricultural production in developing countries exhibits constant return to scale (CRS) as pointed out by Assunção and Ghatakb (2003). Given that farmers generally have more control over their inputs than their outputs and that they focus more on maximizing their output on the basis of fixed set of inputs, output-oriented CRS DEA model was used to estimate the technical efficiency levels of cabbage and maize farmers in the study area. The empirical linear programming model that was estimated can be presented as

$$\begin{aligned} &\max_{\phi\lambda}\ \theta, \\ &st\ -\phi y_i + Y\lambda \geq 0, \\ &x_i - X\lambda \geq 0, \qquad \text{...(4.53)} \\ &N1'\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned}$$

Where $0 \leq \theta < \infty$), $\theta - 1$ = Proportional increase in output that could be achieved with the ith farmers, with input quantity held constant (Coelli, 1996), , λ = Ix1 vector of

constraints and I = number of farmers, X = Matrix of the input quantities of all the farmers and Y = Matrix of output quantities of all the farmers.
The technical efficiency scored was derived from equation (4.31) as

$$TE_i = \frac{1}{\theta} \quad \text{...(4.54)}$$

Where $0 \le TE_i \le 1$

b) Economic Efficiency Score

Given information on input and output prices, the following cost minimization DEA under CRS was estimated as

$$\begin{aligned} &\min_{\lambda x^*_i} w_i' x_i^*, \\ &st - y_i + Y\lambda \ge 0, \\ &x_i^* - X\lambda \ge 0, \\ &\lambda \ge 0 \end{aligned} \quad \text{..(4.55)}$$

Where w_i = Vector of input prices for the i^th^ decision making unit (DMU) or farmer, w_i' = Transposed of the vector of input prices for the i^th^ decision making unit (DMU) or farmer,
x_i^* is the cost minimizing vector of input quantities of the i^th^ firm, given the input prices w_i and the output levels y_i, x_i = observed input levels, X and Y are defined as previously.

The total cost or economic efficiency of the i^th^ farmer was therefore calculated as

$$EE_i = \frac{w_i' x_i *}{w_i' x_i} \quad \text{..(4.56)}$$

Where w_i', x_i^* and x_i are defined as above. $0 \le EE_i \le 1$

c) Allocative Efficiency Score

From equations (4.54) and (4.56) the allocative efficiency scores were then calculated residually as

$$AE_i = \frac{EE_i}{TE_i} \quad \text{.. (4.57)}$$

Where $0 \leq AE_i \leq 1$

4.15.2.2 Second-Stage DEA

This stage focuses on the presentation of the regression models that were used to determine the effect of farm size of the production efficiency scores of the respondents.

All the three production efficiency scores (technical, allocative and economic) presented so far have a lower and upper limit of 0 and 1 respectively. Assuming that there is censoring in 0 and 1, the two-sided Tobit regression model was estimated as

$$Y_i^* = \begin{cases} Y_i \text{ if } 0 < Yi < 1 \\ 0 \text{ if } Yi \leq 0 \\ 1 \text{ if } Yi \geq 1 \end{cases}$$

……………………………………………………………………..(4.58)

Where

$$Y_i^* = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i} + \delta_5 Z_{5i} + \delta_6 Z_{6i} + \delta_7 Z_{7i} + \delta_8 Z_{8i} + \delta_9 Z_{9i} + \delta_{10} Z_{10i} + \delta_{11} Z_{11i} + \theta_i ,$$

Y_i^*= Observed efficiency score (technical, allocative and economic), Y_i= Unobserved efficiency scores, $\delta_j \theta_i$ and $Z_{1i},...,Z_{11i}$ are defined as previously. The a priori expectations give previously also apply.

4.16 Estimating the Gross Margins of Maize and Cabbage Enterprises

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 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 (Q_{ys}) ($P_y * Q_{ys}$). 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 (P_{xi}) multiplied by quantity of the input used (Q_{xi}) (P_{xi} * Q_{xi}). Thus, $TVC = \sum_{i=1}^{n}(P_{xi} * Q_{xi})$. Gross margin for each enterprise is calculated as:

$$GM = (P_y * Q_{ys}) - \sum_{i=1}^{n}(P_{xi} * Q_{xi}) \ldots\ldots\ldots\ldots\ldots\ldots (4.59)$$

4.17 Estimating the Commercialization Level of Smallholder Farmers

There are several methods of measuring household commercialisation level among smallholder farmers (Jaleta *et al.,* 2009). Some studies like de Janvry *et al.* (1991) and Fafchamps (1992) cited by Jaleta *et al.* (2009) used dichotomy between food and cash crops and examine household decision on resource allocation to these crops as a proxy for smallholder commercialisation . However, this study used the ratio of marketed output to the total value of agricultural production. Estimation of commerciality levels help to establish the farmer's entrepreneurial ability for different enterprises.

Agriculture of Commercialization (Output-Side)

$$= \frac{Value\ of\ agricultural\ sales\ in\ markets}{Agricultural\ product\ value} \ldots\ldots\ldots\ldots\ldots\ldots (4.60)$$

Following Govereh *et al.* (1999); Strasberg *et al.* (1999) as cited by Jaleta *et al.* (2009) the Household Commercialization Index (HCI) can be estimated as follows;

$$HCI_i = \left[\frac{Gross\ value\ of\ crop\ sales_{\ hhi'seasonj}}{Gross\ value\ of\ all\ crop\ production_{\ hhi'seasonj}}\right] * 100 \ldots\ldots\ldots\ldots (4.61)$$

4.18 Estimating the Principal Components for the Farmers' Human Dimensions

Particularly in respect to the specific objectives that entailed evaluation of human and social assets as well as livelihood indices, factor analysis was performed. The purpose of using the factor analysis is to reduce the large number of variables (i.e. human dimensional/attitudinal statements) to a smaller set of new composite factors (WIDCORP, 2008; Kisaka-Lwayo and Obi, 2012). This process also ensures limited loss of information contained in the large number of attitudinal statements. The underlying factors that explain variance among the human dimensional or attitudinal statements were extracted using the factor analysis approach. The extracted factors were then clustered around related attributes such as farmer's entrepreneurial skills, social capital and socio-cultural attitudes towards farming. Another reason for using the Principal Components Analysis (PCA) is its ability to yield convincing results

(Padilla-Fernandez and Nuthall, 2001; Rao, 1964 cited by Kisaka-Lwayo and Obi, 2012).

The variable to be retained in the model had to satisfy the condition that, the coefficients of variables should be equal to eigenvalues that are greater than one. Thus, such factor explains more variance than any of the original set of variables. To ensure greater factoring ability and sampling adequacy, the Kaiser-Meyer-Oklin (KMO) and the Bartlett's Test of Sphericity tests were used (WIDCORP, 2008). According to WIDCORP (2008), the tests are part of the minimum requirements needed before the data set qualifies for PCA. The KMO uses partial correlations to identify the correlations between pairs of variables, and the recommended minimum value of KMO is 0.6. The Bartlett's test of sphericity verifies the suitability of data for PCA by either accepting or rejecting the hypothesis based on the relationship between the correlation matrix and identity matrix.

Following Kisaka-Lwayo and Obi (2012), the principal component (PC) of a given dataset of P numeric variables can be presented mathematically as:

$$PC_n = f\,(a_{ni}X_i, \ldots\ldots\ldots\ldots\ldots\ldots a_{1j}X_j) \qquad (4.62)$$

Where PC is the principal component, n represents a number greater than one. The PC can take different forms of measurement and these include continuous variables, quantity of related products of values that make up a component, and weighted values or generated values from the component loading. a_{1j} is the regression coefficient for the j^{th} variable and it is known as the eigenvector of the covariance matrix between variables. X_j is the value of the j^{th} variable. Explicitly the equation can be written as:

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots a_{1j}X_j \qquad (4.63)$$

Where PC_1 = the first principal component. X_1 and X_2 are the first and second independent variables of PC_1 in the linear additive model needed to derive the principal component, and the a_{11} and $a_{12}$are coefficient (component loadings) associated with the X_1 and X_2 variables. Thus, if the study considers multiple principal components, a series of these additive linear combinations of component loadings and variable values can be presented as:

$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots + a_{1j}X_j$
$PC_2 = a_{21}X_1 + a_{22}X_2 + \ldots\ldots + a_{2j}X_j$
$. \quad . \quad . \quad . \quad$ ……………………………………………………..(4.64)
$. \quad . \quad .$
$PC_n = a_{n1}X_1 + a_{n2}X_2 + \ldots\ldots + a_{nj}X_j$
Where:

$n = 1 \ldots 5$

$j = 1 \ldots 45$

$a_{n1} \ldots a_{nj}$ = the component loading

$X_1 \ldots X_j$ = the human dimensions/farmers attitudes towards farming

4.19 Estimating the impact of irrigation technology.

The study used the propensity score matching (PSM) technique to estimate the impact of irrigation technology on poverty reduction using crop income as proxy. The convenience of the PSM lies in the fact that it is one of the non-parametric estimation techniques that do not depend on functional form and distributional assumptions. In an explorative study such as this, the exact functional form cannot be known with certainty and it is safer to use an approach that is indifferent about that. The method is intuitively attractive as it helps in comparing the observed outcomes of technology adoption on the adopters with the outcomes of counterfactual non-adopters (Heckman *et al*., 1998). Despite its heavy data requirements, the matching method can produce experimental treatment effect results when such data are not feasible and/or available. It also helps to evaluate programmes that require longitudinal datasets using single cross-sectional dataset where the former does not exist. The basic idea of the PSM method is to match observations of adopters and non-adopters according to the predicted propensity of adopting a superior technology (Rosebaum and Rubin 1983; Heckman *et al*., 1998; Smith and Todd, 2005; Wooldridge, 2005). The situations of the homestead gardeners and the participants on irrigation schemes provide strong platform for this type of analysis.

According to Ravallion (2001), Godtland *et al*. (2004) and Bernard *et al.*(2008), the PSM affords a way to obtain robust impact assessments by computing the Average Treatment Effect on the Treated (ATT). Average Treatment Effect in this case refers to the average effect on smallholder farmers who adopted irrigation technology. The empirical problem faced in this case was the typical absence of data concerning the counterfactual, for example, what would have been the situation of the smallholder farmers had they not adopted irrigation. The challenge was to identify a suitable comparison group of non-participants whose outcomes on average provided an unbiased estimate of the outcomes that smallholder farmers would have had in the absence of irrigation and how their crop incomes would have changed by being non irrigators.

Given the non-random selection of smallholder farmers who irrigated and farmers' self-selection into organizations (adoption is a voluntary decision depending on farm resources, knowledge, as well as farmer preference), a simple comparison of outcomes between farmers who practice irrigation was compared with those that are non-irrigators. There are a number of potential sources of bias in naive comparisons. Individual farmers and farmers who are cooperative members are likely to differ from individual farmers in the distribution of observable characteristics such as agro-ecological conditions, public infrastructure and services, market institutions and demands, households characteristics, farm assets and practices. This leads to a bias related to "selection on observables". Such a bias is likely to arise because these observable differences can also be expected to have a direct effect on irrigation adoption. A second source of bias in assessing the impact of an intervention can arise in case of diffusion or spill-over effects between those farmers who have support and the surrounding communities/farmers. For instance, farmers who receive support are more likely to attract extension and input services. In many cases, the benefits from these service providers can spill over to neighbouring farmers that are not adopters of these support services. In such a situation, there is a tendency to under-estimate the contributions of these farmer support services if focus is only on those who have adopted and are consequently direct recipients of the support services. Another source of bias is that farmers with access to technology may differ from non-participants in unobservable characteristics such as personal ability, motivations and preference, which may also affect agricultural output of their farms, resulting in "selection on unobservable" or "self-selection" especially for individual farmers.

To address these potential sources of bias, all individual farmers located in areas in close proximity to the farmers who adopted irrigation technology were excluded from the sample. This procedure reduced further the size of the sample but eliminated any potential sources of diffusion bias. In the absence of a suitable instrument, it was not possible to explicitly control for potential bias related to selection on unobservables. However, the strong incentive provided by irrigation technology was to promote farmer's participation in farming. This provided sufficient reasons to believe that selection on unobservable might also be negligible, especially after the exclusion of individual farmers located in areas close to those have irrigation technology access. What is done is to use the farm household variables presented to control for selection on observables. In the absence of reliable data at the community level, one cannot control for location-specific effects associated with market, agro-ecological and infrastructural conditions on the decision to adopt irrigation technology. Since all these farmers interviewed were located in the Eastern Cape agro-ecological and infrastructural differences across sample sites were assumed to be negligible. It is then justifiable to control for potential bias caused by selection on observables.

The PSM technique involves the estimation of the tendency of farmers to be attached to irrigation adoption on the basis of farm household characteristics (using logit models), and subsequently the matching of individual farmers on the basis of propensity scores and the estimation of Average Treatment Effect (ATE). The Tobit model was used to regress farmers who were irrigation technology adopters and farm household characteristics against those who were not. Propensity Score Matching and Tobit model allow control for selection on observables and providing comparable estimations of participation impact. In both analyses, endogeneity (i.e. simultaneity) problems were avoided by using explanatory variables that include household and fixed farm characteristics (such as the fixed land asset and distance from the market). Moreover, farm-household characteristics were intentionally over parameterized using quadratic terms in order to take into account possible nonlinearities in the impact of these variables and to improve the predictions of both analytical models as suggested by Godtland *et al.* (2004).

A right and left censored Tobit estimator was used as farmers' crop incomes from output market participation contains zero since not all farmers sell produce from farm. Statistical robustness of the PSM analysis was instead promoted by matching farmers using three separate techniques as propensity score matching, Kernel and Nearest Neighbour and by comparing the results obtained. To ensure maximum comparability of the treatment and control groups, the sample used for PSM was restricted to the common support position, defined as the values of propensity scores where both treatment and control observations can be found.

The objective was to estimate the impact of two treatments, participation in irrigation technology (W_1) and those that did not irrigate in these support schemes (W_2) on how the household crop income (Y) are affected. The ultimate goal was to estimate the average treatment effects ATE1 and ATE2 with Y_1 and Y_2 representing the income with treatment, and Y_0 the income without treatment. The Propensity Score Matching (PSM) was thus used to investigate the impact of irrigation technology adoption on crop income (poverty reduction) of smallholder farmers.

ATE1= E for W_1: non irrigation adopters.
ATE2 = E or W_2: irrigation adopters.

The assumption was that there are two treatments, W1 and W2 for households that had either adopted or not adopted irrigation technology.

ATE1 = E for (W_1 =1, W_2=0): non irrigation adopters.
ATE2 = E for (W_1 =0, W_2=1): irrigation adopters.

In the first model (Equation 4.66) referred to as regression on explanatory, control for selection bias was done by including a large set of observable explanatory variables (x) as control functions in the regression on household crop income which are shown by equation [4.64] and [4.65] below.

For (W_1=1,W_2=0):where:

$$\gamma_i = \theta + \alpha_1 + \beta\chi_i + \varepsilon_I \qquad (4.64)$$

For (W_1=0,W_2=1):where:

$$\gamma_i = \theta + \alpha_2 + \beta\chi_i + \varepsilon_i \qquad (4.65)$$

The model to be regressed using OLS is:

$$\gamma_i = \theta + \alpha_1 W_{1i} + \alpha_2 W_{2i} + \beta\chi_i + \varepsilon_i \qquad (4.66)$$

Where χ_i = explanatory variable which includes age, household size, years in farming, farm size, distance to market, market participation and irrigation technology

The ATEs shown by equations [4.64] and [4.65] were then estimated with the propensity score matching method. Matching involves pairing farmers who adopt irrigation with those that have not in terms of their observable characteristics (Abadie and Imbens, 2002). In this study the treated and the controls units were matched according to the estimated propensity score and calculated the ATEs as a weighted average of the outcome difference between treated and matched controls. It is important to note that households that participate or have some form of assistance are matched to those that do not have any assistance. Matching between the treated and control groups is done on the propensity scores estimated as bivariate probabilities from the bivariate logit model.

4.20 Methods of Data Collection

The Terms of Reference for this study indicated that the preferred research method to be followed was participatory learning and action research in conjunction with whole farm budgeting and modelling. In this section, the participatory methods employed will be described. In addition to that, the more conventional methods of data collection that were used will also be described.

4.20.1 The Agricultural Research for Development (ARD)

The University of Fort Hare has partnered with the International Centre for development-oriented Research in Agriculture to promote the Agricultural Research for Development (ARD) which was until recently the most popular participatory learning tool applicable to agriculture. Several studies have employed the Agricultural Research for Development (ARD) concept to generate more participatory, inclusive, and meaningful research outcomes (Hawkins *et al.,* 2009). The ARD aims at innovations for improved agricultural productivity through engagement of multiple actors in contextualizing the problem, identifying strategies, formulating and implementing joint action plans (Hawkins *et al.,* 2009). The ARD innovations evolve where interaction among players, response to feedbacks, analysis and generated solutions from the feedbacks are incorporated in the different processes (Hawkins *et al.,* 2009). According to Hawkins *et al.* (2009), the ARD approach accommodates the technical, social, and institutional constraints, with all their inherent complexities, in an environment that facilitates learning and not mere research products. A brief background on its origin and antecedents is necessary at this juncture.

In a recent review for the Forum for Agricultural Research in Africa (FARA), Obi *et al.* (2013) have observed that a dominant image of the research and farmer support environment of continent is its linear and top-down orientation. Their views are in line with the findings of the International Centre for development-oriented Research in Agriculture (ICRA) which suggest that the research élite and the local levels they are intended to serve are widely separated (ICRA, 2009). This has grown out of a research and support tradition that is long-standing. For instance, according to Eicher (2001), most of the research systems and extension services in the immediate post-colonial era in Africa were immersed within the Ministry of Agriculture. Figure 4.3 illustrates the typical format encountered in almost all the existing research systems on the continent prior to the emergence of the participatory thinking.

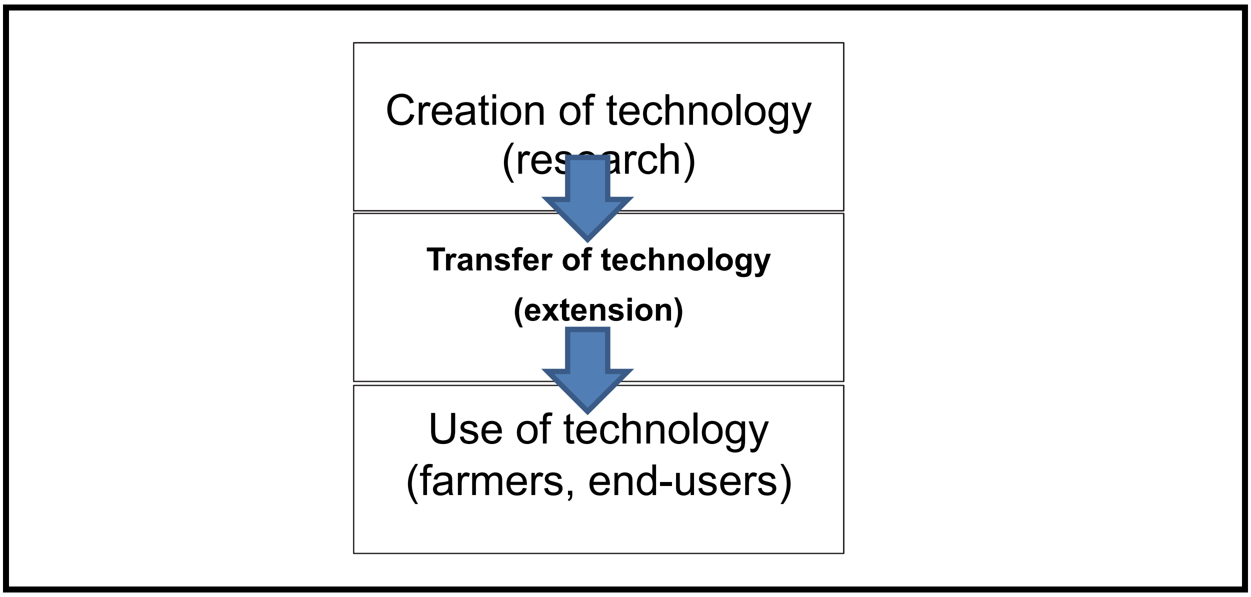

Figure 4.3: Linear format of the conventional research and extension systems

The top-down orientation has been widely seen as removing elements of feedback and ensuring that research priorities incorporate the perspectives of the grassroots (ICRA, 2009). Some of the arguments against the linear model, often referred to as "vertical one-way communication model" (Asiabaka, 1994 and Asiabaka and Mwangi, 2001), include the fact that it limits the role of extension to merely transferring information to farmers and ensures that it tended to be skewed towards research interests instead of reflecting farmers' problems and circumstances. In an earlier international review incorporated in a training manual for people associated with various national agricultural research systems (NARS) in sub-Saharan Africa, the International Livestock Centre for Africa (ILCA), the precursor of the International Livestock Research Institute (ILRI), noted that the format of the agricultural research and extension systems on the continent has led to failures in technology development (ILCA, 1988). According to ILCA (1988), these failures were traceable to a wide range of factors, notably:

i. The weak links between research establishments and entities operating at the level of the traditional farm sector which skews technologies towards the priorities of the research confraternity rather than those who actually use them;
ii. Emphasizing performance criteria developed and applied to high-income, industrialized countries and that are out-of-touch with situations in developing countries;
iii. Insufficient knowledge of small farmer conditions and circumstances.

ILCA was naturally one of the first institutions to call for the application of farming systems research approach to take care of the afore-mentioned deficiencies. In its view (ILCA, 1988), a well-designed and applied FSR should have the following features:

i. Be neutral with respect to the nature of the system by beginning without pre-conditions, that is having an open-mind about the existing situations and the eventual outcome of any programming efforts;
ii. Focus on improvements
iii. Exhaustively examine interactions and relationships and linkages among the various units and entities making up the system under investigation;
iv. Put the farmer at the centre of the entire process, from the conception, description and diagnosis of the system to the development of solutions; and
v. Emphasize the evaluation of the identified solutions in terms of their broader effects on a wide range of indices of welfare, including productivity, equity, stability, and sustainability.

It is apparent that the sector has been the victim of gross mis-diagnosis of the core problem. According to Asiabaka (1994), one attempt to address the top-down orientation of the extension and research system has been the focus on constraints research and interventions to address identified constraints, culminating in the introduction of the farming systems research (FSR) programmes. But this approach has failed to produce the desired changes in adoption behaviour of smallholders and improve livelihoods of African resource-poor farmers, with new insights now showing that this was because the central role of farmers in adoption of improved practices was not recognized by the FSR approach. Maxwell (1986) saw the main problem with FSR as attempting to "hit a moving target" which definitely resulted in failures. According to Maxwell (1986), both the concept of FSR and the way it was implemented did not give sufficient recognition to the fact that the system itself is constantly changing and evolving and not one that can be productively engaged by ones-off methodologies or contacts.

According to Obi *et al.* (2013), the wider development literature presents numerous indications of the erstwhile structure and organization of the agricultural research system on the continent. According to Taylor (1991), the structure of these systems has been influenced largely by the colonial backgrounds of these countries. Especially for the Anglophone countries, the strong influence of colonial thinking is evident (Taylor, 1991), in contrast with the situation in the Francophone countries where there has been some attempt at nationalization of the research systems to better reflect national circumstances and priorities right from the early days., although in many instances this development has been lagged up to 10-15 years after the attainment of political independence. Some of the most comprehensive studies on the origin of agricultural research in Anglophone Africa have demonstrated that there was never an intention to forge a link between the research system and the local farming system (Taylor, 1991; Eicher, 1999).

As has been made clear over the years, the first efforts at conducting research of any type into agricultural systems revolved around the botanical garden concept where the new commodities were "studied, evaluated … (and prepared for)…distribution, dissemination and production…" (Taylor, 1991). Given this focus, it was not necessary to expect that the research system would aim to achieve "balanced and efficient development of the natural resource base or…concern for food or improved nutrition of the peoples" (Taylor, 1991). Attention to food crops only began in the late 1950s, becoming significant only around the 1970s as population pressures became a more serious problem than previously (Taylor, 1991). When all the foregoing are taken into account, the differences between the conventional research tradition and the ARD methodologies become quite glaring as shown in Table 4.2.

Table 4.2: Conventional research and agricultural research for development

Conventional Research	**Agricultural Research Development**
Commodity driven/disciplinary oriented	Systems-oriented, inter-disciplinary
Reductionist	Holistic, constructivist
Aims at increasing yield	Aims at multiple objectives
Simple high input technology	Complex knowledge-intensive technology
Science driven	Responding to clients' needs
Publication oriented	Development oriented
Conducted in isolation	Inter-institutional collaboration
Limited farmer involvement	Participation, empowerment

Source: ICRA, 2009

Against the foregoing background, this study employed the ARD participatory processes as a way of incorporating views of the key players in the rural agricultural sector and ensuring that the findings are policy-relevant to the maximum extent practicable. Three steps of the ARD were considered in data collection and these included organizing the research team, putting the research problem in context and identifying authentic data collection strategies. The key players that constituted the research team included technocrats from the University of Fort Hare, officials from the Department of Rural Development and Agrarian Reforms of the Eastern Cape Province, governmental irrigation scheme managers, and leaders of the farmers' cooperatives, individual farmers and university students.

Team bonding was strengthened during the process of problem contextualization. During the process of problem contextualization, the study area and specifications of the units of analysis in respect to the study objectives were identified. This was achieved through engaging personnel at the Department of Rural Development and Agrarian Reforms, government extension officers, community development officers, irrigation scheme managers, leaders of farmers' cooperatives, managers of private farms and individual farmers. Intensive consultative meetings were carried out to equip the research team with the knowledge regarding farmers' perceptions and attitudes towards farming, societal values and norms, and the best approaches needed to extract the relevant information. In addition to consultative meetings, the research team endeavoured to visit some of the proposed study sites physically and interviewed the technocrats and community leaders to ascertain the feasibility of the study sites.

The most common primary sources of knowledge in social research employ a combination of observable/measurable and unobservable/non-measurable factors needed to answer the research questions and hypothesis (Kodua-Agyekum, 2009). The researcher used proxies and asked questions that addressed the characteristics of the unobservable factors. This was achieved through face to face interviews with individual farmers and technocrats and responses were recorded. Some physical and physiological components of social factors can be observed and measured to qualify the unobservable/non-measurable information. Use of both, measurements and observation is thought to yield better results (Kodua-Agyekum, 2009).

The researcher used observation method to elicit information concerning the biophysical characteristics of the study area such as vegetation, topology, economic activities, social interactions, infrastructure available especially the irrigation system facilities, and farm layout on the irrigation schemes and homestead gardens. Also the method was used to carefully study individual responses towards certain questions that called for understanding farmer's perception and attitudes on farming. Qualitative research uses this method to assess the accuracy of documented and oral information like the status of the irrigation scheme and farming systems present in the research area.

According to Adler and Adler (1994) cited by Kodua-Agyekum (2009), observation research has the ability to extract in-depth information regarding physical/tangible, economic and social behaviours of a given community. However, despite its efficacy, results generated by this method only represent a specific location/environment/social group and can hardly be extrapolated to other locations/environment/social settings.

The data were collected using note books and questionnaires. The majority of the interviews occurred in the communal meeting places. The only exception was in the case of Tyefu smallholder irrigators who were interviewed in their irrigation food plots. A structured questionnaire was used in the interview. The questionnaires were pre-tested on a sample of farmers in the study area. The questionnaires comprise farm management factors like agronomic practices and crop production, and four farmers' human dimensional related questions. A set of questions focused on entrepreneurial spirit and positive psychological capital, farmers' goals, and social capital. Several Likert scales and rankings were developed to address each human dimensions aspect in this study. The data regarding unobservable/non-measuring factors were collected through administering questionnaire in a face to face interview. Though the questionnaire were written in English, interviews were conducted in the Xhosa local language by Xhosa-speaking students.

4.20.2 Conventional Method of Data Collection Employed

The data were collected using structured questionnaires. Information was collected on farmer's socio-economic characteristics such as age, household size, educational status, amount of credit received, numbers of extension contact, years spent on farm, income, livestock ownership, Information on inputs, output and marketing. The questionnaire was pretested on a sample of farmers in Melani village.

4.21 Chapter Summary

The chapter amalgamated the methodology employed in a number of studies spanning almost 4 years within the rural areas of the Eastern Cape. The Terms of Reference specifically required that the study covered the former Ciskei and Transkei areas of the province. This meant that sites selected for the study had to be representative in geographical terms as well as agro-ecological terms in order for the findings to be policy-relevant.

A multistage stratified sampling technique was used to select a predetermined number of respondents using a structured questionnaire. The model and the variables fitted in them with their a priori expectations were clearly stated in the chapter. Descriptive statistics is stated to be used to present the distribution of the respondents in the study area. FGT was stated as the model to get a clear picture of the poverty, and so Gini coefficient to reinforce the understanding of the poverty and inequality dynamics.

Also specified are, ordinary least squares (OLS) and instrumental variable (IV)-based productivity models, OLS-based production functions such as linear, Cobb-Douglas, semi-log and exponential production functions, stochastic and deterministic frontier production and cost functions such as stochastic frontier production and cost functions and data envelopment analysis (DEA). The statistical test statistics included Chi-square test, Student T (T-test), Fisher F (F-test), Likelihood ratio (LR) and Wald tests. The estimation of models and hypotheses testing were carried out using a combination of statistical programs such as Excel, SPSS, STATA, Frontier 4.1 and DEA.

CHAPTER 5

SOCIO-ECONOMIC PROFILE OF HOMESTEAD GARDENERS AND SMALLHOLDER IRRIGATORS

5.1 Introduction

The main goal of this research was specified in the Terms of Reference for the solicited WRC project. The expectation was that the research would yield insights into the factors that would motivate and enable cash-strapped homestead gardeners in the rural areas of the Eastern Cape to transform into smallholder irrigated farming that emphasizes enhanced productivity and leads ultimately to improved livelihoods. Coming to that sort of information required diverse approaches in the true nature of science to seek evidence and test alternative scenarios before an optimal path can be confirmed. As might be expected, it was necessary to first understand the true nature of the problem and establish its theoretical and conceptual foundations. In order to this, a comprehensive literature survey was conducted. This was important for purposes of selecting the appropriate sites, unit of analyses, samples, data, and methods of analyses for each of the specific objectives. The various studies and support activities have been reported in the 14 previous deliverables produced under the project from its inception. In addition to the deliverables, the study has provided inputs to three PhD theses and several MSc and Honours dissertations, information from which have been collated in articulating the following empirical results.

5.2 Demographic and Socioeconomic Characteristics of Sample

The study began with a profiling of the sample households enumerated, focusing largely on their demographic and socioeconomic characteristics. These included Age, Education, Household Size, Experience, Farm Cultivated, Land Inequality, Irrigated land Intensity, Family Labour to Total Labour, Total Labour, Intensity Total Quantity Fertilizer, Total Cost of Fertilizer, Total Cost of Land, Total, Cost of Labour, Total Cost of Seed, Total Cost of Production, Output Value, Total Income, Per Capita Income. The discrete variable among the demographic and socioeconomic characteristics are Gender, Married, Association membership, Access to credit, Extension services, Main occupation, Irrigators, Restitution, Amalahila municipality, Ngqushwa municipality, Redistribution.

To facilitate understanding of the levels of measurement used in calibrating the variables, the continuous and discrete variables among demographic and socioeconomic characteristic were differentiated with *a* and *b* superscripts, respectively. The results are presented in Table 5.1.

Table 5.1: Variables in the models across irrigation schemes (pooled dataset)

Variables	Unit of Measurement	Pooled (267)	Qamata (182)	Tyhefu (86)	Diff. test
Age[a]	Years	61 (12.60)	62 (12.56)	58 (12.26)	-2.65***
Education[a]	Years	5 (4.48)	6 (4.67)	5 (3.98)	-1.94*
Household size[a]	Number	5 (2.43)	4 (2.13)	5 (2.94)	2.15**
Experience[a]	Years	13 (12.38)	17 (12.91)	6 (6.69)	-7.37***
Farm cultivated[a]	Hectares	1.07 (0.97)	1 (1.11)	1 (0.52)	-1.95*
Land inequality[a]	Ratio	0.30 (0.13)	0.34 (0.13)	0.21 (0.07)	-8.97***
Irrigated land intensity [a]	Ratio	0.95 (1.09)	0.83 (1.22)	0.36 (0.28)	-6.56***
Family labour to total labour[a]	Ratio	0.15 (0.08)	0.15 (0.08)	0.19 (0.04)	1.85*
Total lab intensity[a]	Ratio	53.17 (43.52)	52.77 (43.4)	59.08 (46.88)	0.48
Quantity offertilizer[a]	Kilogram	56.08 (94.04)	77.83 (104.2)	10.56 (39.90)	-5.78***
Cost of fertilizer[a]	Rand	871.39 (1645.2)	1207.39 (1873.6)	168.15 (553.8)	-5.04***
Cost of land[a]	Rand	450.94 (409.8)	484.36 (470.4)	380.22 (221.4)	-1.95*
Cost of labour[a]	Rand	778.60 (687.1)	1038.59 (657.9)	228.37 (332.1)	-10.78***
Cost of seed[a]	Rand	602.76 (1252.7)	835.17 (1451.3)	116.05 (319.7)	-4.51***
Cost of production[a]	Rand	2695.05 (3253.1)	3566.2 (3585.4)	870.75 (971.5)	-7.09***
Output Value[a]	Rand	9486.74 (24631.7)	10633.56 (26210.2)	2057.39 (5271.8)	-1.56
Total income[a]	Rand	7794.94 (4733.0)	8487.66 (4362.1)	6328.94 (5162.2)	-3.56***
Per capita income[a]	Rand	2300.36 (2085.6)	2613.13 (2260.4)	1638.47 (1459.4)	-3.65***
Gender[b]	Dummy	176 (66)	134 (76)	42 (24)	-4***
Marital Status	Dummy	195 (73)	132 (68)	63 (32)	0.13
Association[b]	Dummy	163 (61)	147 (90)	16 (10)	-9.73***
Access to credit[b]	Dummy	12 (4)	4 (33)	8 (67)	2.62***
Extension[b]	Dummy	164 (61)	128 (78)	36 (22)	-4.46***
Main occupation[b]	Dummy	245 (91)	160 (65)	85 (35)	2.98***
Irrigators[b]	Dummy	181 (68)	126 (70)	55 (30)	-0.86
Restitution[b]	Dummy	9 (3)	9 (100)	0 (0)	-2.09**
Redistribution[b]	Dummy	75 (28)	4 (5)	71 (95)	13.68***
Ngqushwa[b]	Dummy	75 (28)	0 (0)	75 (100)	14.82***
Amalahila [b]	Dummy	24 (9)	24 (100)	0 (0)	-3.54***

***Note:** Values in brackets are standard deviation and percentage for continuous and discrete variables respectively. T-test and Z-test were used as difference test for continuous and discrete variables, respectively. Where a and b were used to indicate continuous and discrete variables respectively.*

Source: Field Survey, 2015

The data revealed a significant level of heterogeneity in Qamata and Tyhefu. Each of the variables is described in some detail in the next several sections.

5.2.1 Age of Respondents

An important factor in different fields of agriculture is age. According to Agbugba *et al.* (2013), age has an inverse relationship with performance. It therefore becomes crucial to know the age distribution among the respondents in the study area. Table 5.1 shows that the mean age of respondents in Qamata and Tyhefu was 62 years and 58 years with the standard deviation of 12.56 and 12.56, respectively. In the pooled data, the mean age was 61 years with a standard deviation of 12.60. The standard deviation value shows that majority of the age value in this sample are clustering within 12.60 around the mean. This reveal that maize and cabbage farmers were somewhat old in the pooled data but significantly older in Qamata relative respondents in Tyhefu. The finding was contrary to several studies on maize and vegetable production, in general, such as those of Fakayode *et al.* (2004); Onojah *et al.* (2013); Onuk *et al.* (2010) and Tchale and Sauer (2007) who found out that average maize farmers were middle-aged. The reason for the dominance of older respondents may be associated with the migration of the youth to urban areas in search of wage jobs for better security. The youth see farming as a non-profitable enterprise or at least requires enough patience to generate an unattractive return. The likely implication of this result is declined agricultural activity in the study area.

5.2.2 Gender

Gender is important in defining a social arrangement and processes involved in making judgments and understanding the obligation expected of an individual. It shows the level of commitment to take risks and the right to enjoy the opportunities that come with innovative technology introduced within a system (Adeola and Ayoade, 2009). It was, therefore, important to know the gender distribution of respondents. Table 5.1 shows that in Qamata and Tyefu, male representation was 76 percent and 24 percent, respectively. In the pooled data, male representation was 66 percent. This result shows that that maize and cabbage farming in the study area was male dominated. Having more men may have a direct influence on the difference in the total land holding, education, extension services among other production services as it is believed that male farmers get preferential treatment over the female.

5.2.3 Marital Status

Marital status has an important economic role in agribusiness. It then implies that married farming household with large family size would enjoy more supply of labour from family members (Ezihe *et al.,* 2014). Following Ezihe *et al.,* (2014), the distribution of married respondents is presented in Table 5.1. The table revealed that 68 percent and 32 percent of the respondents in Qamata and Tyhefu were. According to the pooled data, 73 percent of the respondents in the study area were married. This result suggests that majority of the respondents are likely to enjoy the use of family labour all things being equal.

5.2.4 Association membership

To be a member of an association is a form of social capital that has important implications for the performance of farmers simply by sharing experience among members. Members communicate with one another and information is exchanged that would otherwise not be available to the general public. Such information may relate to questions of access to resources and inputs or prices of inputs and outputs as well as techniques and practices. Therefore, the distribution of the respondents by membership of associations is very important and this information was obtained and summarized in Table 5.1. The results show that 90 percent of respondents in Qamata and 10 percent of the respondents in Tyhefu are members of one association or the other. In the pooled data it was observed that 61 percent of the respondents belonged to one association or the other.

5.2.5 Access to credit

Access to credit facilities increases the pace at which farmers meet their cash obligations especially in the purchase of inputs needed for farm production and consumption needs (Alvaro *et al.,* 2012). Table 5.1 shows that 33 percent and 67 percent of the respondents in Qamata and Tyhefu had access to credit. The pooled data shows that only 4 percent of the respondents in the study area accessed credit. This result suggests that respondents in the study area had difficulty accessing credit. And this might have a significant adverse impact on improving their level of production.

5.2.6 Main Occupation

The main occupation is a profession that gives the largest share of income, and in which 75 percent of the time is spent (Echebiri, 2001). Table 5.1 shows that 65 percent and 35 percent of the respondents in Qamata and Tyhefu respectively have reported farming as their primary occupation. In the pooled data, 91 percent of the respondents have farming has their main occupation. The study area is a rural area where few non-farm activities are undertaken. Farming is therefore a natural source of employment for residents of such an area.

5.2.7 Educational Status of Respondents

According to Malte and Stephan (2011), education facilitates access to information that strengthens the decision-making skills of farmers to adopt innovative technologies that boost productivity and profit. Any form of knowledge acquisition agricultural production process improves the level of agricultural productivity. In line with the preceding, it is important to know the educational status of the respondents. Table 5.1 shows that the number of years respondents spend in school in Qamata and Tyhefu was 6 years and 5 years with the standard deviation of 4.67 and 3.9, respectively. The pooled data revealed 5 years as the number of years respondents spend in school with a standard deviation of 4.48. The standard deviation value shows that majority of educated respondents in this sample have their educational status clustering within 4.48 year around the mean. Although the dispersion of the level of education of the respondents around their mean value was high, it can be said that farmers had, on average, a primary level of education in both the pooled data and in the irrigation schemes. This implies that an average respondent in the study area had a primary level education which can enable he/her to read, write, interpret instructions relating to the use of machinery, farm inputs and also take advantage of extension services. This statement may be considered valid in line with Koshy in Bembridge (2000) who reported 4 years of education as a standard level of education and that otherwise is unlikely to have acquired any functional literacy.

5.2.8 Household Size of the Respondents

The size of a household has a significant contribution to the amount that could spend and earned from farming enterprise (Enete and Agbugba, 2008). This assertion is plausible because farming requires labour for different on-farm activities which could be sourced at a little or no rate. Family labour gives this opportunity, and this informed the basis for gathering household size data. Table 5.1reveals that the average household size in Qamata and Tyhefu was 4 and 5 members with a deviation of about 2 and 3, respectively. The pooled data showed an average household size of 5 members with a standard deviation of 2. The standard deviation value shows that majority of household size in this sample have their house size clustering within 2 around the mean. This implies that the household size of the farmers going by the pooled data and across the irrigation schemes was small compared to studies of Fakayode *et al.* (2004), Ohajianya *et al.* (2010) and Ahmed *et al.* (2013). The variability of household size was relatively the same in the pooled data and across the irrigation schemes. This implies that an average household in the study area will have to hire labour rather than enjoying the use of family labour on their respective farms.

5.2.9 Years of Experience of Respondents

Farming experience also means the number of years spent in farming. Farming experience has an important bearing on the efficiency of farmers (Fan *et al.,* 2009). Taking its importance into consideration, Table 5.1 reveals that the average farming experience in Qamata and Tyhefu was 17 years and 6 years with a standard deviation of 12.91 and 6.66, respectively. In the pooled data, the average year of experience of respondents was 13 years with a standard deviation of 12.38. The standard deviation value shows that majority of the experienced respondents in this sample have their years of experience clustering with 12.38 years around the mean. This means that the respondents were, on average, quite experienced in farming in the pooled data but significantly less experienced in Tyhefu compared to those in Qamata. Moreover, there was considerable variation in farming experience in the pooled data and across the irrigation schemes. This implies that experienced farmers have sufficient knowledge as a result of the mistake made in the past thus, enable them to make more rational decisions compared to less experienced farmers.

5.2.10 Farm Size Cultivated

Farm size has a significant relationship with agricultural productivity. The relationship between farm size and productivity generated the most contentious issue in agricultural development (Bhatt and Bhat, 2014). While some researchers agreed to the existence of an inverse relationship between farm size and productivity, others have refuted the relationship. Some researchers have also expressed an indifferent view (Bhatt and Bhat, 2014). Since the existence or other of an inverse relationship between farm size and productivity remains contentious, it is important to assess the size of the cultivated land to be able to examine the relationship with productivity and efficiency. Table 5.1shows that the average farm size cultivated in Qamata and Tyhefu is 1 ha with a standard deviation of 1.11 and 0.52, respectively. The average size of farm cultivated going by the pooled data was 1.07 ha with a standard deviation of 0.97. The standard deviation value shows that majority of the cultivated farm size in the sample have their size clustering within 0.97 hectare around the mean. This means that the respondents across the irrigation scheme and the pooled data were smallholder farmer. The implication of this result is that respondents cannot scale up their production and therefore can only grow in little quantity.

5.2.11 Land Inequality

Land inequality could be described in terms of the land inequality index. It was estimated using the Gini coefficient to ascertain the degree of equity in land distribution. Like the Gini Coefficient measure of income inequality, the land inequality index ranges from 0 to 1. The lower the value the more equal the distribution and vice versa. Table 5.1shows that the land inequality index in Qamata is 0.34, and 0.21 in Tyhefu. The pooled data revealed that land inequality index was 0.30, on average, in the study area. This finding suggests that land holding is fairly uniformly distributed among the respondents in the study area. It is common knowledge that during the Apartheid Era, the regime allocated each family in the communal areas a plot measuring 1.5 ha to set up a homestead comprising the family's residence and garden.

5.2.12 Irrigated Land Intensity

According to Saunder and Saunder (2012), farmers that irrigate their farmland create more job opportunities, add more value and earn more household income per hectare compared to farmers with rain-fed farms. The average ratio of irrigated land to the total area cultivated was computed and presented in Table 5.1. The table reveals that the irrigated land intensity in Qamata and Tyhefu was 0.83 and 1.22, respectively. These irrigated land intensities had standard deviations of 0.36 and 0.28, respectively. In the pooled data, irrigated land intensity was 0.95 with a standard deviation of 1.09. The standard deviation value shows that the majority of irrigated land intensity values are clustering within a distance of 1.09 around the mean. This could mean that respondents in Qamata and Tyhefu irrigated 83 percent and 36 percent of their cultivated land, respectively. The pooled data revealed that respondents could possibly have irrigated up to 95 percent of the cultivated land. In other words, the respondents in the study area did not rely on rainfall to cultivate their farm land. Similarly, the number of respondents who relied on irrigation to cultivate their farmlands was higher in Qamata than in Tyhefu. The implication of this result is that respondents have the opportunity of increasing their productivity since irrigation enables the households to work a given plot of land for more than one growing season. This multi-cropping possibility remains one of the most important performance criteria for irrigation technology in semi-arid environments where the growing season is limited by water scarcity.

5.2.13 Family Labour

According to Picazo-Tedo and Reig-Martínez (2005), family labour is a crucial cost item for smallholder farmers. If emphases on transaction costs are relaxed, a farmer will use labour to an optimum point where the marginal product of labour equals the wage rate that gives the opportunity cost of farm labour (Picazo-Tedo and Reig-Martínez, 2005). Considering the importance of family labour in smallholder's farming activities, information on family labour was collected and presented in Table 5.1. The table reveals that the ratio of family labour per hectare of cultivated land in Qamata and Tyhefu was 0.15 and 0.19 with a standard deviation of 0.08 and 0.04, respectively. In the pooled data, the ratio of family labour per hectare of cultivated land was 0.15 with a standard deviation of 0.08. The standard deviation value suggests that the majority of the respondents that used family labour in the sample clustered around the mean, and implied a high degree of uniformity among households in terms of both household sizes and labour use patterns. Overall, the results suggested a very modest family labour use since only about 15 percent of the total labour used in the pooled data emanated from family labour. Given the considerably small land sizes cultivated, this is not surprising.

5.2.14 Total Labour Intensity

The majority of the labour force in the rural area are engaged in farm labour since there are few alternative economic activities available. According to Agwu *et al.* (2012), poor supply of farm labour contributes to low farm output among rural farming households. The average ratio of total labour used to total land was computed and presented in Table 5.1. The results show that the total labour intensity in Qamata and Tyhefu averaged 52.77 work-days and 59.08 work-days, respectively. In the pooled data, the average ratio of total labour used to total land cultivated was 53.17 work-days. Based on the result of the difference test it can be said that farmers in Qamata and Tyhefu virtually used the same quantity of labour per hectare of land.

5.2.15 Cost of Production

The cost of production is an important factor in farming and determines the extent to which a practice or technology is adopted and the scale at which the farmer operates. Among resource-poor farmers such as the ones that dominate the project area, this variable assumes even greater significance. It represents the total sum of money incurred by the farmer in the production process. The data collection was structured to allow for participants to be enumerated with respect to the different items of cost which they employed in their farming and the money spent to acquire and use them. This information was recorded and expressed in South African Rands (ZAR) and aggregated for all the survey households and averaged as shown in Table 5.1.

According to the results, the cost of production of maize and cabbage in Qamata and Tyhefu was ZAR 3,566.2 and ZAR 870.75, respectively. For the pooled data, the cost of production was ZAR 2,695.05 with a very large dispersal around the mean. The expenditures were on such items as fertilizer, labour, land and seeds. In the next several section, the household expenditures on each of these items are examined more closely.

5.2.16 Quantity of Fertilizer Used

Fertilizer is a key farm input for increasing crop yield (Mwangi, 1996). To have an understanding of quantity of fertilizer farmers applied on their cultivated crop, the data on the quantity of fertilizer that respondents used were collected and analyzed and the results are presented in Table 5.1. The results revealed that the average quantity of fertilizer (kg/ha) applied in Qamata and Tyhefu was 77.83 kg/ha and 10.56 kg/ha, respectively. It was clear that farmers in Qamata used more fertilizer than those in Tyhefu, but there was considerable variation in fertilizer consumption among the farmers in Qamata as revealed by the fairly high standard deviation of 104.2 (Table 5.1).

5.2.17 Cost of Fertilizer Used

The cost of fertilizer is the total monetary outlay on fertilizer consumption. The amount of money declared by the respondent for the purchase of fertilizer was summed up and presented in Table 5.1. It was revealed that respondents in Qamata and Tyhefu incurred a total cost of ZAR 1207.39 and ZAR 168.15 on fertilizer, respectively, suggesting a considerably higher outlay in Qamata than in Tyhefu. But the results showed an equally large variability in the Qamata data, with a standard deviation of 1873.6. In the pooled data, the total expenditure on fertilizer was 871.39 with a standard deviation of 1645.2.

5.2.18 Cost of Land

The cost of land is total amount of money reported for purchasing land. The reported expenditure on land purchase was averaged across the relevant sample and the result is presented in Table 5.1. The table shows that the average cost of land cultivated in Qamata and Tyhefu was 484.36 rand and 380.22 rand, respectively. The average cost of land cultivated in the pooled data was 450.94 rand with a standard deviation of 409.8. the apparent wide variation households in the average cost of land may be a reflection of the differences in tenure arrangements and means of land acquisition wherein a majority of the farmers inherited their farm lands and therefore paid less for farmland while others transacted in the land market with all the imperfections that can be expected in the communal areas.

5.2.19 Cost of Labor

Labour cost is an essential part of production. Wage, salaries and other incentives of employee remuneration make up a significant element of operation cost. Rewarding employees for the work done is an important factor that both affect production cost and the relationship in the industrial setting (Association of Accountancy Bodies in West Africa, 2009). South Africa is reputed to have higher average labour costs than most countries in the emerging markets category such as Brazil, Chile and Argentina (World Bank, 2010). As this situation is seen as contributing to the high unemployment rates in the country and a serious drag on national development, this variable is considered a very important one (Kanbur, 2015).The cost of labour was averaged for the sample and the result is presented in Table 4.1which shows that the cost of labour in Qamata and Tyhefu was ZAR 1038.59 and ZAR 228.37, respectively. The result from the pooled data shows that cost of labour in the study area was ZAR 778.60. This result shows that respondents in Qamata spent more on labour compared to respondents in the Tyhefu. While the higher labour costs in Qamata than in Tyhefu may reflect the larger farms in Qamata than in Tyhefu or more intensive cropping, it is also possible that price distortions may be responsible for the higher nominal values reported.

5.2.20 Expenditure on Seeds

The expenditure on seeds is the total monetary outlay on seed. The amount of money dedicated to the purchase of seed or actually spent by the household to purchase seeds was obtained from the respondents and analyzed and the results are presented in Table 5.1. The results show that the average cost of seeds in Qamata and Tyhefu was ZAR 835.17 and ZAR 116.05, with the expenditure in Qamata being subject to much greater variability than for Tyhefu. There was also some suggestion of poor market integration of maize and cabbage seed in the study area. This result implies that respondents in the study area will spend more to obtain seed they grow on their farm.

5.2.21 Value of Output

The value of output is the market value of the entire agricultural product produced by a farmer in a production season. The figure was computed using the gross margin and the result is presented in Table 5.1. The table shows that the value of output estimated by gross margin in Qamata and Tyhefu was ZAR 10,633.56 and ZAR 2,057.39 with a standard deviation of 26,210.2 and 5,271.8, respectively. In the pooled data, the value of output estimate using gross margin was ZAR 9,486.74 with a standard deviation of 24, 631. The large standard deviation confirms the intuitive indication that considerable variations exist between the revenues of the households, highlighting the income inequalities that characterize the rural sector.

5.2.22 Total income

The total income was computed as the monetary value of the gross output and presented in Table 5.1. The table reveals that the total income in Qamata was ZAR 8487.66 and ZAR 6328.94 in Tyhefu, on average. When the entire project area is taken as a unit, the average gross income was ZAR 7794.94. It is clear that income realised by respondents in Qamata was higher compared to farmers in Tyhefu.

5.2.23 Irrigation Status

The irrigation status separates farmers into those that cultivate crop under the irrigation scheme and farmers that grow crops in the homestead garden. Table 5.1shows that 70 percent and 30 percent of the farmers grow their crops under the irrigation scheme in Qamata and Tyhefu, respectively. Also, 68 percent of the farmers in the pooled data practised more of an irrigated system of farming. The implication of this result is that majority of the respondents in the study area have access to plots under the irrigation scheme programme. This result shows that respondents have the opportunity to cultivate crops all year round as a result of water supply which is known to hinder farmers from crop production.

5.2.24 Pattern of Land Acquisition

Land reform in South Africa aims to redress land ownership bias introduced by the apartheid regime. This is being done through a comprehensive land reform programme that has three key pillars, namely land redistribution, restitution and land tenure (Antwi & Nxumalo, 2014). It is important to know the distribution of respondents in the study area in relation to land ownership and patterns of land acquisition. Table 5.1shows that all the nine respondents that accessed land through restitution were from Qamata. None of the respondents in Tyhefu accessed land through restitution. Going by the pooled data, only 3 percent of the percent accessed land through restitution and they are all in Qamata. In terms of access to land by redistribution, 5 percent of the respondents in Qamata and 95 percent of the respondents Tyhefu were observed to have accessed their lands through redistribution. This suggests that much of the benefits of land reform that seeks to redistribute land were not enjoyed by the many respondents especially those in the Tyhefu study area.

5.3 Extent of Rural Poverty in the Study Area

Poverty and inequality analysis assessed the poverty status of the smallholder farmers in the study area. The analysis was conducted using data from farmers who cultivated maize and cabbage in the study area. The study focused on gender, irrigators and homestead gardeners and across land classes

5.3.1 Poverty Analysis among Maize and Cabbage Farmers

Pushing back the frontiers of poverty are among the most important global challenges as poverty is seen as one of the three affronts to human lives in South Africa, the other two being inequality and unemployment (Nicolson, 2015). According to Townsend (2006), poverty is any condition that exposes an individual or household to social discrimination, lower personal self-esteem and deprives them access to essential commodities of life. Going by the foregoing, it is important to assess the poverty status of respondents in the study. A poverty line was defined. Any household head with a mean income lower than the poverty line is considered poor. Using Foster Greer Thorbecke (FGT), the poverty status of irrigators and homestead gardeners was determined and the result is present in Table 5.2.

Table 5.2: Poverty profile analysis of maize and cabbage

Variables	**Headcount (P_0)**	**Poverty gap (P_1)**	**Poverty Severity (P_2)**
Pooled	0.49 (0.03)	0.25 (0.02)	0.15 (0.02)
T-value	15.81***	12.67***	10.12***
Gender			
Male	0.45 (0.04)	0.2 (0.02)	0.11 (0.02)
Female	0.56 (0.05)	0.34 (0.04)	0.24 (0.03)
Difference	-0.12 (0.06)	-0.14 (0.04)	-0.13 (0.03)
T-value	-1.82*	-3.20***	-3.83***
Irrigation Scheme			
Qamata	0.39 (0.04)	0.16 (0.02)	0.08 (0.01)
Tyhefu	0.65 (0.05)	0.4 (0.04)	0.28 (0.03)
Difference	-0.26 (0.06)	-0.24 (0.04)	-0.2 (0.04)
T-value	-4.11***	-5.61***	-5.53***
Irrigator and Homestead gardener			
Irrigators	0.45 (0.04)	0.22 (0.02)	0.14 (0.02)
Homestead	0.56 (0.05)	0.3 (0.03)	0.18 (0.03)
Difference	-0.12 (0.07)	-0.08 (0.04)	-0.04 (0.03)
T-value	-1.76*	-1.86*	-1.26
Land classes			
<2 ha	0.55 (0.04)	0.3 (0.03)	0.2 (0.02)
>=2 ha	0.38 (0.05)	0.15 (0.02)	0.07 (0.02)
Difference	-0.17 (0.06)	0.16 (0.04)	-0.13 (0.03)
T-value	-0.04	4.35***	-4.93***

****P<0.01,*P<0.1. Values in brackets are standard errors. Poverty line = 2/3* (Per capita income) =1537.41*

Source: Field Survey, 2015

Table 5.2shows the poverty profile analysis of respondents in the study area using an annual poverty line of ZAR1537.41.Table 5.2 reveals that the headcount index of male and female respondents in the study area stood at 0.45 and 0.56, respectively. Moreover, the headcount differential of -0.12 was significant at 10 percent level of probability between male and female respondents. This shows that poverty was more prevalent among the female farmers in the study area. The poverty gap among the male and female farmers was 0.2 and 0.34 with a poverty gap differential of -0.14. The implication of the finding is that the average poor female respondent was poorer than the average poor male farmer in the study area. In other words, female and male respondents would need on the average, ZAR 522.72 and ZAR 307.48 respectively to be out of poverty. The poverty severity among the male and female respondents was 0.11 and 0.24; this implies that, the depth of poverty was higher among the female farmers than their male counterparts even after accounting for the inequality among the poor.

Table 5.2 revealed the headcount index in Qamata and Tyhefu as 0.39 and 0.16, respectively. The headcount differential of 0.26 was significant at 1 percent level of probability. This result indicates that poverty was more prevalent in Tyhefu than in Qamata. The poverty gap in Qamata and Tyhefu was 0.16 and 0.4 respectively; this implies that the depth of poverty was higher in Tyhefu than in Qamata. In other words, respondents in Qamata and Tyhefu would need an average of R246 and R614.96 respectively to emerge out of poverty. The poverty severity index in Qamata and Tyhefu was 0.08 and 0.28, respectively. This index shows that the depth of poverty was higher in Tyhefu than in Qamata after accounting for inequality among the poor.

Table 5.2 shows that the poverty incidence among the irrigators and homestead farmers was 0.45 and 0.56, respectively. This outcome reveals that poverty was prevalent among the homestead gardeners based on the fact that there is a significant difference in their headcount indices. The poverty gap among the irrigators and homestead gardeners was 0.22 and 0.3, respectively. This is an indication that the depth of poverty among homestead gardeners was higher than the irrigators. In other words, homestead gardeners need ZAR 461.22 to mitigate poverty while the irrigators need just about ZAR 338 escape poverty. The possible reason why homestead gardeners are poorer might be as a result of their small scale of production which is barely enough to feed the household. The possible reason why irrigators require less to alleviate poverty might be associated with a larger scale (farm size) of production and access to better production resource such as irrigation. The poverty severity was 0.14 and 0.18 among the irrigators and the homestead gardeners; this implies that the depth of poverty was still higher among the homestead gardeners than the irrigators even after accounting for inequality.

Table 5.2 shows that the headcount among respondents with less than 2 ha and more than 2 ha was 0.55 and 0.38, respectively. These values suggest that farmers with less than 2 ha of land were poorer than those with more than 2 ha of land. The poverty gap was 0.3 and 0.15, and this means that the depth of poverty was higher among the farmers with less than 2 ha than respondents with more than 2 ha of land. Precisely, farmers with less than 2 ha of land would need an average of ZAR 461.22 to reduce the effect of poverty while those with more than 2 ha of land would need ZAR 230.612 to do the same.

Table 5.2 shows that the headcount (poverty incidence) index of the pooled data was 0.49. This result shows that 49 percent of the respondents in the study area were poor. The poverty gap index was 0.25, which implies that an average poor maize and cabbage farmer in the study area would need about ZAR 614.96 to escape from poverty. Poverty severity index was 0.15 which could be interpreted as the depth of poverty after accounting for inequality among the poor. The finding is close to the study of Baiyegunhi and Fraser (2014) who found that 44 percent of smallholder farmers were poor in the Eastern Cape Province.

5.3.2 Income Inequality Analysis among Maize and Cabbage Farmers

Growing evidence of inequality across the globe has encouraged much discourse in recent times (Netshitenzhe, 2013). Inequality, according to King (2014), imposes a huge burden on economic growth, suppresses the movement of people from one social class to another, promotes crime and erodes the foundation of society. Many have blamed Apartheid for South Africa's egregious history of inequality and overbearing racial discrimination (Leibbrandt *et al.,* 2007). Whatever their causes, it is important to measure them and ascertain their extent and severity as one route towards doing something about them.

The Lorenz curve measure the extent of inequality in income distribution (Lorenzo and Paolo, 2005) and this study plotted a few to highlight the situation in the study area. As already highlighted in the methodology chapter, the equidistribution (45^0) line represents an ideal situation where there is no income inequality while the Lorenz curve gives the actual indication of the extent of income inequality in the sample. The convexity of the Lorenz curve tells the extent of income inequality in a sample (Lorenzo and Paolo, 2005). The results obtained from the computation of the Gini coefficient are presented in Table 5.3. Similarly, the two-dimensional graphs with the cumulative proportional income scale on the x-axis and the cumulative proportion of population on the y-axis are presented in Figure 5.1 and Figure 5.2.

Table 5.3: Gini-inequality indices by respondents' income source

		Income source				
Group	**Freq**	**Farm**	**Livestock**	**Non-farm**	**Remittances**	**Total**
Gender						
Male	92	0.022	0.679	0.771	0.437	0.317
Female	175	0.538	0.706	0.697	0.426	0.337
Irrigation Scheme						
Qamata	181	0.517	0.644	0.753	0.301	0.284
Tyhefu	86	0.668	0.833	0.764	0.529	0.416
Irrigation Status						
Irrigators	180	0.569	0.765	0.816	0.459	0.343
Homestead	87	0.592	0.591	0.665	0.394	0.309
Land classes						
Bottom tercile	104	0.638	0.784	0.699	0.51	0.385
Middle tercile	91	0.412	0.627	0.701	0.286	0.233
Top tercile	72	0.489	0.636	0.808	0.363	0.25
Income classes						
Bottom quintile	57	0.418	0.829	0.729	0.483	0.329
Second quintile	50	0.398	0.653	0.65	0.212	0.156
Third quintile	54	0.589	0.552	0.831	0.458	0.231
Fourth quintile	55	0.46	0.497	0.689	0.202	0.203
Top quintile	51	0.544	0.772	0.777	0.566	0.233
Pooled	267	0.61	0.717	0.772	0.439	0.337

Note: Bottom tercile= [0.5; 0.6], Middle tercile= [0.6; 3.4], Top tercile= [3.4; 12]. Quintile= [83.33; 802], Second quintile= [802; 1625], Third quintile= [1625; 2256], Fourth quintile= [2256; 3203.14], Top quintile= [3203.14; 10000].

Source: Field Survey, 2015

Table 5.3 shows that the Gini coefficient in Qamata and Tyhefu was 0.284 and 0.416, respectively. It is clear that income inequality is higher in Tyhefu than in Qamata. Non-farm income accounted for the highest Gini coefficient while remittance had the lowest Gini coefficient in Qamata. This signifies that non-farm income is an income source with the highest income inequality while the remittance has the lowest. In Tyhefu, livestock and remittances had the highest and lowest Gini index, respectively.

Table 5.3 shows land classes of respondents in the bottom and middle tercile with the highest and lowest Gini coefficient of 0.385 and 0.233, respectively. It was also observed that livestock was a source of income with the highest Gini coefficient of 0.784 among respondents in the bottom tercile. Further, non-farm income was a source of income with the highest Gini coefficient of 0.701 among farmers in the middle tercile. The possible reason why respondents in the bottom tercile have the highest inequality index may be associated with their relatively small farm sizes.

Table 5.3 shows income classes of respondents in the bottom quintile with the highest and lowest Gini coefficients of 0.329 and 0.156, respectively. This result shows that respondents in the bottom quintile experience the highest income equality while the respondents in the second quintile experienced the least income inequality. Going by the fact that non-farm income had the highest Gini coefficient in the bottom quintile suggests that respondents had other income generating activities. This suggests that respondents allot time between farming and other income-generating activities. Though there was an indication in the preceding paragraph that production scale (small farm size) could be the reason for the high Gini coefficient among respondents in the bottom, allotting time between farming and other income-generating, activities could result in the suboptimal use of farmland.

Table 5.3 shows that the overall Gini coefficient of total income was 0.337which is clearly an indication of moderate to low income inequality in the study area. This finding provides some justification for the position that rural households are uniformly poor since they operate from more or less similar resource profiles such as land holding, asset ownership, and skills base.

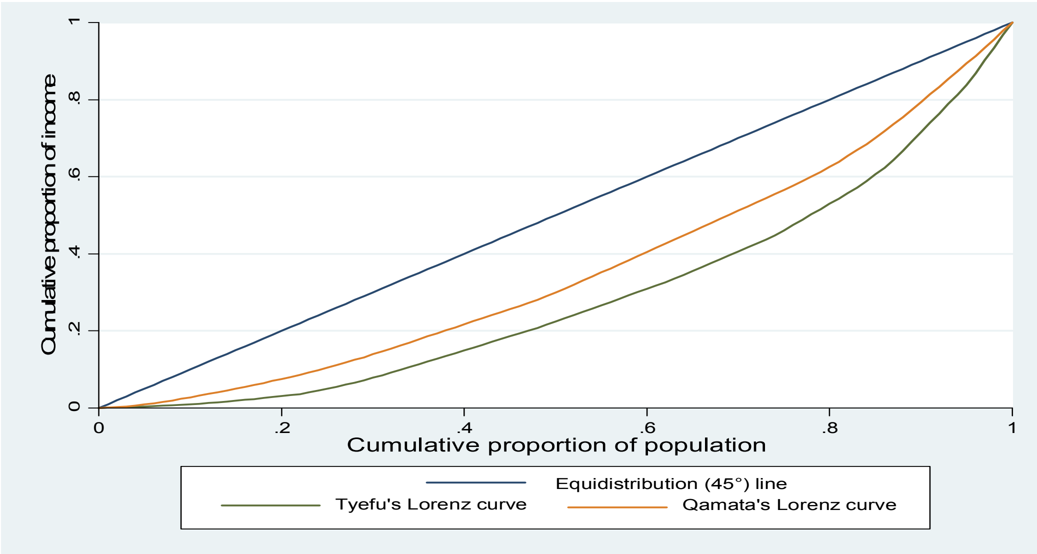

Figure 5.1: Income inequality in Qamata and Tyhefu irrigation schemes
Source: Field survey, 2015

Figure 5.1 shows the graphical comparison of income inequality between Qamata and Tyhefu. The graph shows that the Lorenz curve of Qamata was closer to the equidistribution line than that of Tyhefu; this implies that income inequality was lower in Qamata than in Tyhefu. The implication of this result in Qamata is that there is an equal distribution of income because the Lorenz curve is close the situation of perfect equality.

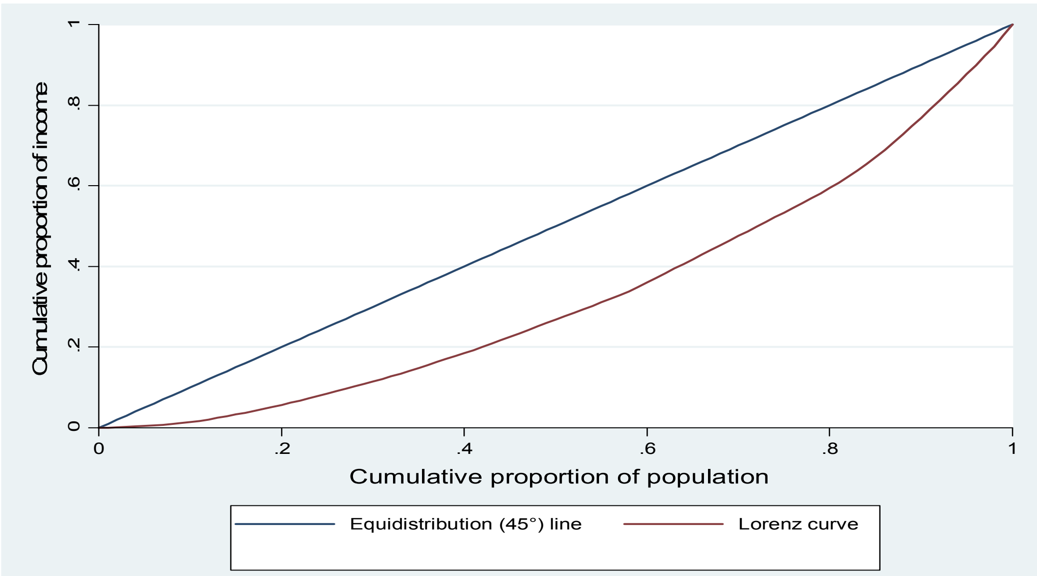

Figure 5.2: Income inequality in the pooled data
Source: Field survey, 2015

Figure 5.2 shows that there was an unequal distribution of income among the maize and cabbage farmers in the study during the period of study. The degree of inequality was important as the Lorenz curved drifted significantly away from the equidistribution line.

5.4 Chapter Summary

This chapter presented the socio-economic and demographic profile of the smallholder irrigators and homestead gardeners who were enumerated as part of this study. The profile began by examining the personal characteristics of the farmers in respect to their gender, age, educational status, marital status, occupational structure and income earning patterns. The production environment of the farmers were then described by presenting details of land ownership and utilization, input use patterns and associated cost relationships, and their output and revenue situations. The final part of the chapter focused attention on the poverty profile of the sample farmers, presenting details on the measurement of poverty and establishment of a poverty line on the basis of which the depth and severity of poverty were measured. Lastly, information on income inequality was presented on the basis of the results of the computation of Gini Coefficients and plotting of Lorenz curves for the study area.

CHAPTER 6

NATURAL, PHYSICAL AND FINANCIAL ASSETS AND IRRIGATION

6.1 Introduction

According to ICID (2007), natural capital refers to the naturally-occurring, as opposed to man-made, phenomena, resources, or products. They are goods and services that relate to the natural environment rather than the products of the manufacturing process. For this reason, ICID (2007) identifies in these categories such things as harvesting of food and fibre, utilizing available soils, water supply, occurrence of drought and floods. To some analysts, natural capital comprises the natural resource stocks, such as land, water, and vegetation. Irrigation investment contributes to the improved availability and reliability of water during the main growing seasons. There is a perception among farmers, though, that intensification of agriculture due to irrigation can be detrimental to soil fertility (Brabben *et al.,* 2004). On the other hand, it is also possible that irrigation reduces pressure on the surrounding forest resources and marginal lands. Some studies suggest that irrigation can increase soil erosion and cause some loss of soil fertility through intensive cultivation practices. Investment in irrigation helps to reduce the risks of crop damage by allowing cultivation at times of the year when climatic conditions are less unfavourable (Angood *et al.,* 2002, 2003).

It has been said that natural resources are the primary factors of production and many villagers across the world rely on such natural resource-based livelihoods gathering, fishing and hunting in forests to get food as regular sources of protein and fat. In many parts of the world, local people depend on forest products for food. It is often the case that Non-Timber Forest Products (NTFP) are a food reserve during years of poor agricultural harvest and for others, forest foods are the most important sources of food besides the dietary staples. This category of items includes wildfish from rivers and other aquatic animals (frogs, etc.), wild fruit, vegetables and mushrooms, insects, animal wildlife (big and small) for meat. Therefore, the collection of NTFPs is both a source of food as well as income. According to that source, it also includes such things as existing levels of pests and diseases, the climatic conditions and extent of climatic variation, the stock of wildlife, wetlands and biodiversity. Many authors see “land” as one example of natural capital (Prugh *et al*., 1999; Hawken, 1999). Their significance rests on the fact that without them production may not take place in the first place. For this reason, the World Bank and other international development agencies now take them into account in their programming for assistance to member countries.

6.2 Land Availability and Ownership

Land is easily the most important resource/asset in agriculture. It is particularly crucial in resource-poor contexts where the households have little else by way of assets. The on-going land reform programme in South Africa is designed around the question of accessibility of the black population to the available land resources so as to be in a position to expand their scale of operations. This expansion is expectedto make agriculture more productive and able to generate high enough revenue to contribute to poverty alleviation. The surveys assessed the extent of land availability within the study areas to test the dominant view about the slow pace of the on-going reform to transfer land to the black population. The contention is that enhanced access to land will enable black plot holders to produce at a much larger scale than has been the case to date. Table 6.1 presents the distribution of respondents by the plot types owned.

Table 6.1: Distribution of respondents by plot types operated in Qamata area

Plot Type	Number of Households	% of total	Cumulative %
Homestead	40	80.0	80.0
Irrigated Land	8	16.0	96.0
Dry Land	2	4.0	100.0
Total	50	100.0	

Source: Field Survey, 2012

According to the results (Table 6.1), three plot types were available to respondents in the Qamata area, namely homestead land, irrigated land and dry land. As Table 6.1 suggests, most respondents operated land that is located around their residential areas. These are plots on which rural people can carry out some agricultural activities within enclosures that also contain their residences. Under the betterment planning programme during the Apartheid era, each family was allocated a plot which includes a residential area and a small plot for gardening. Each household was also allocated a plot in a farming area outside the residential areas where field crops can be cultivated. However, it is understood that not all the households are in a position to operate the field plots due to the costs that may be prohibitive for resource-poor households that constitute the bulk of the rural dwellers in Qamata, as in the other communities within the communal areas of the province. The results show that a small number of the respondents are able to manage plots in the irrigation schemes and in the field plots (Table 6.1).

The size of the plots also varies among the rural households. As Table 6.2 shows, up to 16% of the small sample enumerated did not have land to farm on. For those that managed farms, the majority (about 52%) held plots that measured under 0.25 ha, followed by about 26% that managed plots of up to 0.5 ha. A very small number of households (probably about 6%) within the sample had farms that measured up to 4 ha. This is consistent with indications from studies elsewhere in the communal areas where land holdings are very small and the expectation of the land reform programme for land holdings of the average rural black household to increase has not yet been realized.

Table 6.2: Distribution of respondents in Qamata by land size holdings (Ha)

Land size (Ha)	Number of Households	% of Total	Cumulative %
No Land	8	16.0	16.0
0-0.25	26	52.0	68.0
0.25-0.5	13	26.0	94.0
<4	3	6.0	100.0
Total	50	100.0	

Source: Field Survey, 2012

6.3 Water Availability

The other crucial natural resource from the point of view of smallholder farming in the Eastern Cape Province is water. South Africa suffers gross deficiency of this vital resource. A ta glance, this is a function of the meager amounts of rainfall over much of the sub-continent which also features land forms that are oriented in a manner that limits access for rain-bearing winds. For instance, while annual rainfall ranges from as little as 100 mm/year in the West Coast of the country, to as much as 2,000 mm/year in the East Coast, the mean annual rainfall nationally is given as 497 mm which falls far below the global mean of 860 mm, making it a semi-arid country. It is estimated that as much as 65% of the country receives less than 500 mm of rain per year, with about 20% receiving less than 200 mm of rainfall per year. It is therefore not surprising that water is a scarce resource in the country and that frequently severe water shortages occasioned by droughts occur. Ironically, flooding usually comes at the end of some of the drought conditions, bringing more devastation and misery to many.

Water for agricultural use has featured as an important element of the demand for water in the country. According to several studies, this fact governed the pattern of early development of water resources in the country which emphasized the provision of irrigation structures, including dams and associated systems of water distribution in cropped areas. The period up to the middle years of the 20^{th} century featured the proliferation of such developments across the country. The second half of that century was marked by changing emphasis to the development of water systems to serve industrial activities as the trend shifted towards increasing urbanization which created a huge demand for the products of modern industry. Table 6.3 presents preliminary information on the extent of water availability to average rural people, showing that as much as 54% of the sample may often find it difficult to obtain the water they need for productive use.

Table 6.3: Distribution of households by water availability

Access category	Number of Households	% of Total	Cumulative %
Always Available	23	46	46
Sometimes	27	54	100
Total	50	100	

Source: Field Survey, 2012

Table 6.4 shows how the local people enumerated access water for purposes of irrigation. It would appear that the dams and boreholes are the major sources of irrigation water, with rivers and harvested water being of minimal importance. This highlights the precarious situation of the rural dwellers as they cannot count on natural sources of water supply and must depend on sources that involve high expenditures to establish, operate and maintain. When these sources breakdown, the rural dwellers are unable to access the desired quantity and quality of water.

Table 6.4: Distribution of households by source of irrigation water

Variables	Number of Households	% of Total	Cumulative %
Dam	35	70.0	70.0
River	1	2.0	72.0
Borehole	12	24.0	96.0
Harvested Water	1	2.0	98.0
Individual tanks	1	2.0	100.0
Total	50	100.0	

Source: Field Survey, 2012

6.4 Availability of Physical Capital

Physical capital looks at the more hardware aspects of productive capital/resources that serve agriculture. They are viewed generally as the tangible assets as opposed to the intangible ones such as social capital which are discussed in a separate chapter of this report. Physical capital is usually in the form of physical goods or assets. The present research considers physical capital in the form of assets ownership, and availability of basic infrastructure. In the theory of the firm, asset ownership defines firms and determines the extent to which the objectives of production are met. In the presence of incomplete contracts, asset ownership confers control rights, allowing the firm to use fiat to govern the use of owned assets (Williamson 2000, Grossman and Hart 1986).

Physical capital cannot be defined objectively; the definition has to be subjective. However, within the context of this study one can explain what physical capital means to an average smallholder farmer. Physical capital comprises those physical assets and infrastructures possessed or needed by a producer for the enhancement of productive activities. Physical capital often comes in the form of support needed to augment the living standard of the people or to enhance sustainable livelihoods.

Assessment of physical capital availability is usually conducted in order to justify an intervention or an initiative. Often, the extent to which a development programme has succeeded is reflected in the amount of physical assets accumulated during its operation and how much of this remains at the end of the programme. This becomes necessary for the purpose of measuring the impact of such initiative on the people. Studies have shown that the ex-post evaluation of rural projects in sub-Saharan Africa indicates a strong positive correlation between feeder roads and agricultural productivity (Njenga, 2003). Gavira (1990) noted that an inadequate public infrastructure could result in massive losses to producers. In 1988, three regions in Tanzania lost 50% of their cotton, one region 80% of its rice due to heavy rain that rendered the already bad roads completely inaccessible (Gavira, 1990). Investment in physical capital to support agricultural production is very essential, especially among the poor rural farmers.

6.5 Physical Asset Ownership

How much physical assets like ploughs the local people own has implications for their production and productivity and their ability to command other resources for priming their agricultural enterprises should the need arise. Table 6.5 presents information on the distribution of the households according to their access to ploughing services and ownership of ploughing assets.

Table 6.5: Distribution of respondents by ploughing method and equipment accessed

Assets Owned/Accessed	Number of Households	% of Total	Cumulative %
Not Ploughing	9	18.0	18.0
Hire Tractor	32	64.0	82.0
Hand Tools	8	16.0	98.0
Employ labour	1	2.0	100.0
Total	50	100.0	

Source: Field Survey, 2012

According to the results shown in Table 6.5, out of 50 farmers rapidly enumerated, it was found that 9 do not have the capability to plough their plots, probably due to the costs, while as many as 32 have to hire tractors in order to be able to plough their fields. The existence of hiring services is helpful for farmers to access improved mechanical technology without having to own the equipment, but it can also mean that farmers must put up with some inevitable delay when bottlenecks arise in farm operations and the local demand outstrips available equipment in the hiring market. Some eight respondents reported using only hand tools to plough as they are not able to afford equipment hire. Table 5.6 shows what implements the farmers are actually accessing.

Table 6.6: Distribution of respondents by implements used for ploughing

Ploughing Implements owned/accessed	Number of Households	% of Total	Cumulative %
No cultivating	10	20.0	20.0
Tractor drawn Plough	3	6.0	26.0
Cultivator	4	8.0	34.0
Disc Plough	2	4.0	38.0
Tractor	13	26.0	64.0
Garden tools	18	36.0	100.0
Total	50	100.0	

Source: Field Survey, 2012

Table 6.7 shows that in respect to the irrigation systems in use, the respondents differ in ways that mirror their ownership of other farming assets and means. For instance, it was observed that only a very small proportion of the farmers use the relatively more sophisticated sprinkler irrigation system while the majority uses the gravity-flow method that obtains water from furrows dug around the fields. A few farmers are able to access pipes for delivering irrigation water to their fields.

Table 6.7: Distribution of respondents by Irrigation System

Irrigation System	Number of Households	% of Total	Cumulative %
Sprinkler	9	18.0	18.0
Furrowing	25	50.0	68.0
Pipes	16	32.0	100.0
Total	50	100.0	

Source: Field Survey, 2012

6.6 Availability of financial capital

The conference information material for the Second African Regional Conference of the International Commission on Irrigation and Drainage (ICID) defines financial capital as the form of capital "requiring international, national and local investments, mobilization of savings and credit, urban-rural linkages with accompanying migration of labour, remittances, welfare and pensions, government grants and subsidies" (ICID, 2007). There is a view that it can refer to money that entrepreneurs and businesses use for procurement of raw material and other inputs (Boldizzoni, 2008). There is therefore a wide array of meanings of financial capital depending on the context. For instance, in settings where in-kind transactions are common, the medium of exchange can fall under this definition. But for purposes of evaluating the availability of financial capital in line with the ToR for this research, the respondents were asked to indicate their sources of money income for the household in the immediate past season. A much larger sample was enumerated and information was obtained that allowed for the sources to be compared with one another to determine which sources were more important for the household. The results are presented in Table 6.8.

Table 6.8: Sources of farmers' income per cropping season

Source	Smallholders Irrigators (n=108)		Homestead Food Gardeners (n =50)		Overall Sample (n=158)		
	Mean	**S. D.**	**Mean**	**S. D.**	**Mean**	**S. D.**	**T-value**
Crop incomes (R)	3087.85	3866.88	1530.53	2001.94	2309.19	2934.41	3.331***
Livestock incomes (R)	828.37	1902.09	993.07	1284.07	910.72	1593.08	-0.556
Off-farm incomes (R)	294.94	630.27	987.47	1678.79	641.205	1154.53	-3.749***
Remittances, social grants & pension (R)	3516.9	3746.81	3710.40	2742.88	3613.65	3244.85	-0.365

Where *** denotes significant at 1% level, and S.D = Standard Deviation and R = Rand

Source: Field Survey, 2012.

According to Table 6.8, social grants, remittances and pensions were a major source of financial resources for the farmers enumerated. This was true for both smallholder irrigators and homestead food gardeners. Income from crops came next, followed by livestock incomes, with assorted off-farm activities being the least.

It is important to note that social grant as source of financial asset was not statistically significantly different among the farmer-groups probably because the grants are set at the same level for all recipients, total household receipts varying only on the basis of number of recipients. On the other hand, financial asset from both crops and off-farm sources were statistically significantly different between smallholder and homestead farmers. In general, smallholder irrigators received more income from crops than homestead garden owners while the homestead gardeners made more income from off-farm activities than smallholder irrigators which makes economic sense in terms of time usage.

6.7 Chapter Summary

This chapter examined the concept of assets and their relevance in agriculture and irrigation systems and how their availability influenced agricultural production and livelihoods. The definition of assets provided by the ICID was employed to guide the systematic enquiry into the availability and ownership patterns of natural, physical and financial assets which were found to vary quite significantly between homestead plot holders and the smallholders operating on irrigation schemes. It was undeniable that the smallholder irrigators were better capitalized and had much larger land holdings which allowed them to generate much larger outputs. The differences in opinions about the definitions of some assets were presented and discussed, especially in the case of financial assets which seemed to be the subject of quite divergent views.

CHAPTER 7

HUMAN AND SOCIAL ASSETS, ENTREPRENEURIAL SPIRIT AND MANAGEMENT CAPABILITIES

7.1 Introduction

Apart from the tangible assets discussed in the previous chapter, it is now accepted that a host of intangible assets play a crucial role in the production process and can make a huge difference in the extent to which individuals and groups are affected by a development intervention. Essentially, these assets deal with the human dimensions which provide the environments within which the more tangible assets are utilized. For this reason, the present study specifically addressed these issues and undertook to explicitly obtain information regarding their availability and impact on other measures of performance of the agricultural system. There were 108 smallholder farmers' questionnaires that qualified for this analysis to identify the most relevant human dimensions and their determinants for increased production, production efficiency and household commercialization level. A comparison between smallholder irrigators and homestead food gardeners was also carried out. The crucial issue of entrepreneurial spirit and how it influences adoption of improved technologies and contributes to the performance of the farm business was also assessed. The chapter ends by establishing the impact of human dimensions on production, technical efficiency and household commercialization level of the smallholders' maize and cabbage enterprises.

7.2 Human Dimensions of Smallholder Development

The human dimensions assessed and explained in this Chapter include the entrepreneurial spirit or positive psychological capital. As indicated in the literature, positive psychological capital plays a great role in building the entrepreneurial spirit. Therefore, this section uses entrepreneurial spirit and positive psychological capital interchangeably. Farmers with higher entrepreneurial spirit or positive psychological capital are assumed to be more productive and have the ability to produce more marketable surplus. For a better understanding of the entrepreneurial spirit or positive psychological capital among smallholder farmers in Qamata and Tyefu irrigation schemes, the research incorporated a set of entrepreneurial attitudinal statements (positive psychological capital statements) into the questionnaire. The statements were designed to measure the farmers' perceived risk taking ability (hope), innovativeness (confidence) and the ability to respond to available farm business opportunities (optimism), all aimed at maximizing profits. Using a 4-point Likert scale, respondents were asked to indicate their level of agreement in response to the 15 entrepreneurial (positive psychological capital) attitudinal statements, where "1" represents strong disagreement and "4" represents strong agreement. Some of the attitudinal statements used in this study were adapted from literature linked to industrial organizational theory and non-farm situations (WIDCORP, 2008) and had to be redesigned to suit the present research.

7.2.1 Entrepreneurial Attitudinal Characteristics of Respondents

The data on respondents' entrepreneurial attitudinal characteristics were analyzed by means of counts and frequencies to obtain mean scores which are presented in Table 7.1. The results were compared the average mean scores for smallholder irrigators and homestead gardeners for each of the 15 attitudinal features enumerated. The indication from the results was that both smallholder irrigators and homestead gardeners enumerated had a favourable disposition towards adoption of new technologies, expressed a willingness and keenness to organize available resources to achieve a goal, seize opportunities perceived to be profitable and can easily supply their produce on credit. This indicates that smallholder farmers in general are innovative and are demand driven. In addition to adoption of new technologies, organizing resources to achieve production goals, seizing business opportunities and supply of produce on credit, the homestead food gardeners were revealed to be different from the smallholder irrigators in relation to risk taking when it comes to adoption of new technologies. Although the nominal values of the scores would suggest that the homestead gardeners are more entrepreneurial attitudes than smallholder irrigators, it is important to take into account the signs of the t-values especially for the significant results. On the basis of these results, Table 7.1 suggests that the homestead food gardeners scored slightly higher than the smallholder irrigators in terms of the aggregate entrepreneurial attitudinal score but the negative sign of the t-value could suggest that the smallholder irrigators are in fact more entrepreneurial in terms of the criteria outlined in the statements.

There is significant difference between the smallholders irrigators' and homestead food gardeners' scores on statements related to: not being afraid to be different from others when adopting a new and can supply produce on credit at 1% level, respectively. The ability to supply produce on credit however needs to be strengthened by formal contracts to avert opportunistic behaviours between the buyer and the seller whereby buyers may take advantage of information asymmetry to cheat the uninformed farmers.

Further interpretation of the results displayed in Table 7.1 is necessary to highlight the important, even if non-significant differences, between homestead gardeners and smallholder irrigators. The signs of the t-values may hold more information about the differences between these two categories of farmers and these obviously have important practical implications. The positive t-values are associated with attitudes that relate to whether or not the farmer is afraid to try new techniques, readiness to act in the absence of governmental response, profit motivation, willingness to invest in new technology and preference for group marketing. In all the foregoing aspects, the smallholder irrigators scored higher than the homestead gardeners. These results clearly fit the stylized profile of commercialized farmers who are motivated by profit, are willing to try new methods and invest money because they are not risk averse to the same extent as the typical resource-poor farmer. With respect to the negative t-value results, the homestead gardeners were shown to score higher than the smallholder irrigators and these were in relation to such attributes as perseverance, ability to mobilize resources, independence of subsidies and opinions of others, time allocation pattern, readiness to sell on credit, pay for training and source information. These outcomes may actually provide a basis for evaluating the phrasing of the attitudinal statements since the negative t-values, regardless of level of significance, suggest an outcome that contradicts the question, so that a high score may relate to an affirmation of the statement than otherwise.

Table 7.1: Average Item Scores of Entrepreneurial Spirit for Smallholder Farmers

Entrepreneurship spirit/drive	Smallholder irrigators (n=75)		Homestead Food Gardener (n=33)		Overall Sample (n=108)		T-Test
	Mean	S. D	Mean	SD	Mean	S. D	
Not Afraid to try a new technique	3.09	0.89	2.85	0.97	2.97	0.93	1.28
Irrespective of any challenges I continue trying till the solution is got	2.35	0.89	2.46	1.06	2.41	0.98	-0.55
You have the ability to organize available resources to achieve a goal	2.60	0.92	2.76	0.90	2.68	0.91	-0.83
If there is a change in supply and demand, you take action faster before any government response	2.40	0.99	2.12	0.93	2.26	0.96	1.41
Take action always on the basis of what you perceive profitable	3.00	0.79	2.76	0.83	2.88	0.81	1.45
Do not wait for subsidies before applying new technology	2.21	1.04	2.24	1.03	2.23	1.04	-0.13
You take your own judgment about the new technology before consulting friends	2.15	0.98	2.46	1.20	2.31	1.09	-0.40
Not afraid to be different when adopting new technologies on your farm	2.27	1.01	2.88	1.02	2.58	1.02	-2.90***
Spend more time on new technologies where you anticipate profits	2.47	0.95	2.70	0.68	2.59	0.82	-1.42
You are not afraid of investing more money in new technologies	2.29	0.98	2.24	0.97	2.27	0.98	0.25
Risks of new technologies isn't your first priority to take a decision	2.04	0.86	2.15	0.87	2.10	0.87	-0.62
I prefer group marketing	2.77	1.07	2.64	0.99	2.70	1.03	0.63
Can supply produce on credit	2.21	1.03	3.21	1.02	2.71	1.03	-4.65***
Willing to pay for any farm related trainings	2.15	1.11	2.42	1.09	2.29	1.10	-1.21
Willing to source for information wherever possible at a cost	2.09	1.00	2.42	1.03	2.26	1.02	-1.57
Total Average Score	2.41	0.95	2.55	0.99	2.48	0.97	

*Where *** represents significance at 1% level: SD = Standard Deviation: Data were elicited using* a *4-point Likert scale* (*1 = Strongly Disagree to 4 = Strongly Agree).*
Source: Results from Field Survey, 2012.

Overall, farmers lacked confidence especially on statements regarding individual decision making and investing in new innovations and this explains the low total average entrepreneurial spirit scores. The apparent low entrepreneurial spirit among smallholder farmers may not differ from the general low rates of entrepreneurial activities reported in South Africa (Modiba, 2009; First National Bank (FNB) and Endeavor SA, 2010; GEM, 2011; Herrington, 2011). Farmers were not willing to invest more money in new technologies, and lacked the patience and discipline for searching for information by any means available. Fear of risks to invest in new technologies and information search may result in low productivity and low farm incomes among smallholder farmers. Therefore, training on risk management and establishment of forward contracts for assured markets for produce, and improved business environment that aid farmers' entrepreneurial skills may be an option (Kisaka-Lwayo and Obi, 2012). Using the positive psychological capital interpretation, it can be concluded that smallholder irrigators are confident and optimistic in farm business, while homestead food gardeners are confident, optimistic and endowed with a hopeful attitudinal mindset. Thus, homestead food gardeners have relatively more accumulated positive psychological capital compared to smallholder irrigators. However, the accumulated scores for both categories of farmers indicate that they all have low positive psychological capital.

The seemingly low entrepreneurial spirit among smallholder irrigators is difficult to explain. In the past, farmers received diverse support from Government but this has been discontinued, particularly in respect to providing farmers with input subsidies, including the provision of free tractor services, and technical staff managing and operating the small irrigation schemes (Kodua-Agyekum, 2009). This has made farming on small irrigation schemes difficult to sustain in the absence of Government support. During the interviews, farmers declared that they can hardly meet input costs and tractor hire costs, and lack technical skills to efficiently utilize these schemes. Due to unfavourable entrepreneurial environment, most smallholder irrigators have resorted to intensifying cultivation of homestead food gardens that require less purchased inputs, less labour, and less technical skills. For example, farmers use manure and compost to improve soil fertility, hose pipes or buckets to irrigate their gardens, and family labour to plough the land (Fay, 2011). It may well be that farmers are responding to the support environment which has affected the profitability of farming with a possible disincentive element. In such an atmosphere, the smallholder irrigators may appear to be less entrepreneurial than homestead gardeners. A more in-depth analysis of these human dimensions is, however, needed to more precisely identify the factors that explain the response of the farmers.

7.2.2 Principal Components for Perceived Entrepreneurial Spirit and Positive Psychological Capital

Factor analysis was performed on the data incorporating the 15 entrepreneurial spirit (positive psychological capital) attitudinal statements. This analysis was used because of its power to yield insights into the underlying factors explaining the variance within the entrepreneurial (positive psychological capital) attitudinal statements. Factor loadings method was employed to elicit factors that explain statistically the variances within the statements, and the principal components were generated. Under the entrepreneurial spirit (positive psychological capital), three factors or principal components were extracted that explained 61.48% variance in the responses. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (0.615) was above the recommended minimum value of 0.60 (Table 7.2). Also, the Bartlett's test of sphericity test indicated the feasibility of proceeding to the factor loading stage.

Based on the factor correlation with entrepreneurial (positive psychological capital) attitudinal statements, the extracted three principal components are labelled "risk taking" (hope), "innovativeness" (confidence), and "ability to seize opportunities" (optimism). The most correlated entrepreneurial spirit statements that best described the first principal component were mainly related to "risk taking" (hope). This principal component was explained by 30.55% of the variances in the explanatory variables with six estimated coefficients above 0.3 being positive. Risk taking related variables included the ability to organize available resources to achieve a goal, spend more time on new technologies where profits are anticipated, not being afraid of investing more money in new technologies, not considering risks as a first priority in adopting new technologies, willingness to pay for any farm related trainings, and willingness to seek information wherever possible at a cost. Taking into account the signs of the t-values displayed in Table 7.1 in previous section, it is clear that the attitudinal statements that constitute this principal component apply more to smallholder irrigators than to homestead food gardeners. This implies that the farmers may be less able to organize available resources to achieve a goal, less likely to spend sufficient time on new technologies, could be afraid to channel scarce funds into testing whether or not a new technology works, just as they are less likely to make expenses to acquire new training and information. Given that these attitudinal trends are reflective of "hope", it is safe to infer that the farmers have grown more despondent and discouraged over time, probably in response to declining profitability which would normally result from low investment in inputs, training, and information.

The second extracted principal component was explained by 17.64% of the explanatory variables with five estimated coefficients above 0.3. Of the five coefficients, one statement is negatively associated with innovativeness (confidence) and four are positively associated with innovativeness. Farmers had a more positive attitude towards adopting new techniques, taking action before any government response, taking action always on what is perceived to be profitable and willing to invest more money in new technologies. However, farmers seemed to have a negative attitude towards organizing resources to achieve goals and did not consider spending more time on new technologies anticipated to be profitable as an important aspect in innovativeness. Thus, farmers were willing to spend less time on any risky venture and this calls for time saving technologies involving fewer risks. Again, taking the signs of the t-values into account as in the case of the first PC, it is safe to infer that the second principal component applies more to smallholder irrigators than homestead food gardeners based on the entrepreneurial (positive psychological capital) statements scores in Table 7.1. Smallholder irrigators are relatively more enlightened and better exposed and open to communication on new technologies that they are more likely to try on their farms with or without government intervention, although absence of government support may tend to impose higher costs on the farmers and lower the profitability, and hence attractiveness, of the new approach. But whatever their response, smallholder irrigators are more likely to be more responsive than homestead gardeners. It is also understandable that farmers who are motivated by profit will be less willing to waste their time on an approach that holds little promise of profitability.

Table 7.2: Estimated principal components for the perceived entrepreneurial spirit/positive psychological capital

	Risk Taking (Hope)	**Innovative (Confidence)**	**Recognize Opportunities (Optimism)**
Proportion of Variation (%)	*30.55*	*17.64*	*13.29*
Eigen Values	*2.444*	*1.411*	*1.063*
	Factor Loadings		
Entrepreneurial Spirit/drive	PC1	PC2	PC3
Not Afraid to try a new technique	-0.005	**0.714**	-0.106
You have the ability to organize available resources to achieve a goal	**0.393**	**0.395**	**-0.638**
Take action always on the basis of what you perceive profitable	-0.103	**0.608**	**0.597**
Spend more time on new technologies where you anticipate profits	**0.324**	**-0.527**	-0.085
You are not afraid of investing more money in new technologies	**0.505**	**0.309**	-0.178
Risks of new technologies isn't your first priority to take a decision	**0.742**	-0.012	-0.164
Willing to pay for any farm related trainings	**0.828**	-0.044	**0.338**
Willing to source for information wherever possible at a cost	**0.825**	-0.035	**0.329**
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy = 0.607 Bartlett's Test of Sphericity: Approx. Chi-Square = 172.894 df = 28 Model significance level = 1%			

Where: df = degree of freedoms; Note: The bold and underlined factors > (0.3) qualify to constitute a given component: Extraction method; Rotation Method: Varimax with Kaiser Normalization (n=108)

Source: Results from Field Survey, 2012.

The third principal component (PC3) describing farmers' entrepreneurial (positive psychological capital) accounted for 13.29% of the variation and showed that farmers had a strong attitude towards seizing farm business opportunities available and sourcing for more opportunities through trainings and information access (optimists). With exception of organizing available resources to achieve a goal, farmers viewed taking action always on the basis of what is perceived to be profitable, access to training, and sourcing for information as vital tools for improved farm business. When compared to average scores displayed in Table 7.1, both smallholder irrigators and homestead food gardeners seemed to consider the third principal component important for maximizing farm profits. But on the basis of the signs of the t-values, it would again seem that smallholder irrigators were more optimistic about the future than the homestead gardeners in their proactive procurement of know-how through self-sponsored training and aggressively seeking information at cost in order to tackle the problems they confront.

7.2.3 Entrepreneurial Spirit/Positive Psychological Capital and Farmer Characteristics

If a set of entrepreneurial attitudinal characteristics are found to be important, it will be helpful from a policy point of view to determine what factors predispose farmers to such characteristics. Many farmers' characteristics can be manipulated by policy to obtain outcomes of choice. For this reason, they should be the first candidates for an enquiry into the determinants of entrepreneurship and positive psychological capital. This was done in this study by using multiple regression models to estimate the possible relationships. A set of multiple regression models were fitted. Table 7.3 presents results from the estimated multiple regression models. The coefficients (β) and the *p*-values to establish the relationship between the dependent and the independent variables are presented in the Table 7.3.

Results in Table 7.3 indicate that the regression models for the principal components one and three are statistically significant at 1% level, respectively. Socioeconomic factors that are responsible for a positive and significant impact on the first principal component (risk taking) at 1% level, respectively, include major occupation of the household head and livestock incomes while age and education level (year spent in school) of the household head have a positive and significant impact on the same at 10% level, respectively. Farming experience and source of water for crop production have a negative and significant influence on farmers' risk taking ability (hope) at 10%, respectively. Based on these results, it can be concluded that an increase in farmers' age, education, farming as a major occupation and livestock incomes boost farmers' hope to take up calculated farming risks while farming experience and irrigation water from the dam results in less and less farmer's interest in taking up risky farm business activities. That is to say, older farmers who have some education and are full-time farmers who combine crop and livestock farming will be more upbeat about the future and better able to invest in seemingly risky activities because they would have accumulated sufficient experience to deal with any eventuality.

Roslan *et al.* (2012) argue that older farmers are more likely to be wealthier with more accumulated social capital as compared to youthful farmers. Accumulated wealth and social capital provides a stronger basis for older farmers to venture in more farm production risks than younger farmers. Results generated in this study are consistent with Roslan *et al.* (2012) who reported a positive and significant relationship between farmers' attitudes towards risk taking and age, education level, and rice farming as main occupation in Malaysia. In contrast, Dadzie and Acquah (2012) reported a negative and significant relationship between farmers risk taking attitudes and age, and education level at Agona Duakwa in Agona East District of Ghana. Brauw and Eozenou (2014) reached similar conclusions for Mozambican farmers, while Trujillo *et al.* (2016) observed similar tendencies among Dutch livestock producers.

The negative impact of sources of water for crop irrigation (mainly dams) on the PC1 may be due to less or lack of control/power over the use of dam water which may have the effect of impeding individual's initiative to experiment with alternative water use regimes. Naturally, any factor that negatively influences "hope" will be expected to have identical effect on "optimism" since both represent the extent to which the farmer expects future conditions to be better than the present. Some of the set regulations regarding irrigation water use include the number of times a farmer is allowed to irrigate, amounts of water used and the type of crops grown on the irrigation scheme. Such rules and regulations on irrigation schemes suppress farmer's entrepreneurial spirit and expectation that future rewards would justify current efforts and sacrifice.

Table 7.3: Estimating the relationship between entrepreneurial spirit/positive psychological capital and farm/farmer's characteristics

	Dependent Variables (Extracted from Factor Analysis -PCA)					
	Risk Taking (Hope)		**Innovative (Confidence)**		**Recognizing Opportunities (Optimism)**	
Independent Variables	β	p-value	β	p-value	β	p-value
Household size	0.000	0.978	-0.014	0.726	0.011	0.765
Age	0.018	0.074*	-0.003	0.816	-0.023	0.049*
Education level (years)	0.047	0.066*	0.042	0.172	-0.036	0.203
Major type of occupation	0.203	0.004***	0.143	0.088*	0.072	0.357
Farming experience	-0.015	0.091*	-0.018	0.085*	0.011	0.268
Amount of land owned	0.064	0.530	-0.021	0.861	-0.043	0.707
Crop Incomes	0.000	0.143	-0.000	0.330	0.000	0.010***
Livestock incomes	0.000	0.000***	0.000	0.256	0.000	0.339
Remittances, social grants & pension	0.000	0.270	0.000	0.955	0.000	0.030**
Source of water for crop production	-0.148	0.060*	0.034	0.717	-0.128	0.145
Location of irrigation scheme	0.074	0.799	-0.326	0.350	0.894	0.007***
Constant	-1.529	0.102*	0.364	0.744	0.098	0.925
R^2 adjusted p-value	0.320 0.006***		0.019 0.307		0.143 0.006*** 1.465	

*Where: ****, **, * = significant at 1%, 5% and 10% level, respectively: β = coefficients and p-value = probability value.*
Source: Results from Field Survey, 2012

Only two socioeconomic factors have a significant impact on farmers' innovativeness (confidence) namely, major occupation and farming experience. Farming as a major occupation has a positive and significant impact on farmers' innovativeness while farming experience has a negative and significant impact on the same at 10%, respectively. This is an indication that considering farming as farmers' major occupation improves on farmers' confidence to innovate new ways of maximizing farm profits given that he/she spends more time on the farming activities. The negative impact of farming experience on farmers' innovativeness or confidence may be attributed to the tendency for experienced farmers to become routinized in their behavior towards new technologies and innovations; they tend to continue doing what has always worked for them rather than try new things. It might seem that the more experienced, the older, and possibly wealthier a farmer is the less he or she is likely to consider a different way of doing the same thing. Interestingly, the age of the household head was also found to be negatively related to all three principal components, being significant in the case of "hope" and "optimism".

Crop incomes remittances, social grants and pension, and location of the irrigation scheme have a positive and significant influence on farmers' ability to recognize business opportunities at 1%, 5% and 1%, respectively. As has been noted, most smallholder irrigators are old and they tend to be less optimistic about future farm business. A study carried out by Giacomin *et al.* (2011), reported a negative relationship between necessity to recognize business opportunity and age of responding. They argue that often older individuals have already accumulated wealth and social capital and thus, their actions are not mainly driven by available opportunities. The old age demotivates them to undertake new technologies perceived to be profitable and they are not willing to pay for trainings and information important for profit maximization. This may result into the older farmers' tendency to adhere to the old farming styles which are less productive. Crop incomes and remittance, grants and pensions may be a source of capital needed to undertake business opportunities. Results presented in Table 7.3 further suggest that smallholder farmers at the Qamata irrigation scheme take faster action to benefit from available farm business opportunities (optimists) than Tyefu smallholder farmers. This is so because most respondents interviewed are located around the Qamata irrigation scheme area. In the positive psychological capital perspective, optimism among smallholder farmers can be promoted by including the youths in farming, increase farm incomes, and remittances, social grants, and pensions.

7.3 Social Capital and Farming

Due to its complexity, the concept of social capital has been defined, measured and applied differently by different authors (McHugh and Prasetyo, 2002). Most conceptual frameworks have acknowledged the role of individuals and groups (Bonding social capital) and societal interrelations (Exclusive Social Capital) in defining social capital. Also, identified structures (state institutions, rules and laws) and cognitive factors like trust, norms and values (Paxton, 1999; Grootaert and Van Bastelaer, 2002) have been important in defining social capital. The group cohesion and societal interactions coupled with rules, norms, and laws are critical in enhancing proper management and utilization of natural resources for both social and economic gains. Several socioeconomic studies have been carried out and attest to the importance of social capital in increasing agricultural productivity (Tshikolomo, 1996; Wolz *et al.*, 2005; Yamaoka, 2007; McAllister, 2010; Hongmei and Mangxian, 2011).

In this context, this study constructed 15 attitudinal statements to assess farmers' perception on the importance of social capital in agricultural production and marketing using a 4-point Likert scale where "1" represents "extremely not important" and "4" represents "extremely important". The attitudinal statements included farmers' perceptions towards exclusive/external social networks like government, NGOs and private companies' for improved agricultural productivity. Also the statements were aimed at establishing farmers' attitudes towards bonding social capital (farmer groups) and its role in aiding productivity and marketing. Generated average mean scores for both smallholder irrigators and homestead food gardeners are presented in Table 7.4.

Considering factors with an average mean score of greater than 3, smallholder irrigators acknowledged the importance of working with government departments, supporting fellow farmers in times of hardship, accessing farm information through fellow famers, subscribing to cultural rules and norms to regulate conduct and practices, and participation in voting, as crucial social factors needed for increased productivity and access to agricultural markets. On their part, homestead food gardeners considered the following as important: working as farmer groups/cooperatives, group membership for labour access and farm implements, supporting fellow farmers in times of hardships, adhering to cultural rules and norms, and participation in voting of village leaders as important social capital factors that can enhance productivity and market access. Table 7.4presents the statements that were included in the questionnaires administered on the smallholder irrigators and homestead food gardeners in order to determine the factors needed for improved agricultural production and marketing. These statements cover issues that range from access to farm inputs through farmer groups, trust, and whether or not the farmer had confidence in the existence of formal arrangement such as a constitution and rules among farmer groups/cooperatives.

The smallholder irrigators and homestead food gardeners differed in four statements on the importance of social capital in agricultural production and marketing. Smallholder irrigators scored higher than homestead food gardeners on statements related to the importance of information access from fellow farmers and trust among community members at 1% and 5% significant levels, respectively. Homestead food gardeners, on the other hand, believed in farmer groups as an easy channel for accessing farm implements and acknowledged the importance of cultural rules and norm more than smallholder irrigators at 1% and 5% significant level, respectively.

Table 7.4: Average item scores of farmers' perception about the importance of social capital on farming

	Smallholder Irrigators (n=75)		**Homestead Food Gardeners (n=33)**		**Overall Sample (108)**		**T-Test**
	Mean	S D	Mean	SD	Mean	SD	
Working with government improves production & market access	3.04	0.95	2.79	1.11	2.915	1.03	1.205
Working with private companies/NGOs improves production & access to markets	2.76	1.14	2.70	1.13	2.73	1.14	0.266
Working as farmer groups/cooperatives improves production & access to market	2.79	0.87	3.00	1.09	2.895	0.98	-1.081
Attending group meetings regularly improve production & access to market	2.88	0.92	2.88	0.74	2.88	0.83	0.007
Group membership ease access to farm labour,& improves production & marketing	2.80	0.75	3.00	1.03	2.90	0.89	-1.131
Can easily access farm inputs like fertilizer when connected to group membership	2.51	0.92	2.67	0.96	2.59	0.94	-0.822
Can easily access farm implements when belonging to farmer group	2.51	0.96	3.12	1.08	2.82	1.02	-2.938***
Access to information from fellow famers is vital in production, and output marketing	3.09	0.52	2.76	0.66	2.93	0.59	2.821***
I support others (fellow farmers) and they support me in times of hardships	3.20	0.77	3.12	0.96	3.16	0.87	0.453
Group membership ease access and adoption of new technologies	2.68	0.90	2.70	0.95	2.69	0.93	-0.089
Can contribute money towards a common goal in my community	2.69	0.97	2.73	1.21	2.71	1.09	-0.155
Farmer groups/cooperatives with constitution/rules perform better than others	2.55	0.92	2.76	1.09	2.66	1.01	-1.036
Culture rules and norms are vital in group formation, farm production and marketing	3.08	0.96	3.49	0.71	3.29	0.84	-2.439**
Trust among community members is a key factor for successful farmer	2.88	0.97	2.42	0.94	2.65	0.96	2.303**
Participation in voting village committees is crucial for equitable access to resources	3.12	1.00	3.27	0.88	3.195	0.94	-0.799

*Where *** and ** represents significance at 1% and 5% respectively: SD = Standard Deviation*

Survey: Results from Field Survey, 2012.

7.4 The Principal Components for the Perceived Farmers' Social Capital

As already noted, social capital is a composite element which cannot be measured directly except through a number of interrelated aspects, hence the 15 attitudinal statements which may generate conflicting responses. In such a situation, it is necessary to streamline these statements in a way that identifies a smaller number of crucial ones around which policy can be easily engaged. This was done in this case by means of principal component analysis. Three principal components were obtained out of nine farmers' social capital attitudinal statement using the Kaiser-Guttmann rule where the entire three principal components scored Eigen values greater than 1. To satisfy the KMO minimum value and Bartlett's Test of Sphericity, the fifteen farmers' social capital related statements were reduced to nine statements that best described the three principal components as indicated in Table 7.5. The Kaiser-Meyer-Olkin measure (KMO) of sampling adequacy was 0.603 and all the three principal components that explained 64.16% of the variance in the 9 statement were extracted from the covariance matrix. Based on the factor loading results presented in Table 7.5, principal components 1 to 3 are labelled "bonding social capital" "exclusive social capital" and "social values" respectively.

The first principal component explained 31.30% of the variance in the explanatory variables. Smallholder farmers indicated that belonging to farmer groups can ease access to inputs and implements. Voluntarily, smallholder farmers were willing to contribute some money towards a common goal of the community. Voluntary participation or collective action is thought to strengthen social relations and bonds, and participating individuals are regarded as responsible members of the community. Collective action is one of the major instruments advocated for by most cooperatives especially in managing and use of resources in a more efficient and sustainable way for increased productivity and bulk marketing. Created social bonds sometimes serve as strategies to get rid of future risks and societal shocks. Smallholder irrigators who belong to groups believe in constitution/rules as vital instruments for better performance of groups/cooperatives.

Involving community members in farm work results in reciprocation within the farm community members that culminates in the creation of a psychological bond among community members. The constructed psychological bonds can then result into increased sustainability and achievement of the farm goals (Dillon, 1990). In their farming operations, Bantu groups shared group farming responsibilities among communities and in some cultures they exchange gifts in the form of crop harvests and livestock. The socialization creates a sense of belonging to the farming community and farmer groups. These activities afford a chance of interacting socially and also to transfer a range of farm and community related information. Development programmes can aim to use these social bonds to strengthen farmer groups in different farm business related activities like collective marketing, labour supply, bulk farm inputs and implement acquisition, and group/cooperative credit unions.

Table 7.5: Estimated principal components for the perceived farmers' social capital

	Bonding Social Capital	**External Social Capital**	**Social Values**
Proportion of variance (%)	*31.30*	*17.61*	*15.25*
Eigen values	*2.817*	*1.585*	*1.372*
	Factor Loading		
Social Capital Aspects	PC1	PC2	PC3
Working with government departments improves production & market access	0.167	**<u>0.855</u>**	-0.075
Working with Private companies improves production & access to markets	**<u>0.377</u>**	**<u>0.734</u>**	0.140
Working as farmer groups/cooperatives improves production & access to market	**<u>0.763</u>**	-0.018	-0.186
Can easily access farm inputs like fertilizer when connected to farmer groups	**<u>0.873</u>**	-0.122	-0.245
Can easily access farm implements when belonging to farmer group	**<u>0.813</u>**	0.012	**<u>-0.359</u>**
Can contribute money towards a common goal in my community	**<u>0.337</u>**	-0.071	**<u>0.673</u>**
Farmer groups/cooperatives with constitution/rules perform better than others	**<u>0.673</u>**	**<u>-.378</u>**	**<u>0.318</u>**
Trust among community members is a key factor for successful farmer	0.055	**<u>-.388</u>**	**<u>-0.312</u>**
Culture rules and norms are vital in group formation, farm production and marketing	0.269	-0.031	**<u>0.687</u>**
Kaiser-Meyer-Olkin Measure (KMO) of Sampling Adequacy = 0.603 Bartlett's Test of Sphericity: Approx. Chi-Square = 299.053 df. = 36 Model Significance level = 1%.			

Note: The bold and underlined factors > (0.3) qualify to constitute a given component. (n = 108)

Source: Results from Field Survey, 2012.

The second principal component (external social capital) accounted for 17.60% variation in the explanatory variables with two positive estimated coefficients above 0.30. The index suggests that smallholder farmers believe that exclusion/external social network is crucial for improved farm production and market accessibility. Rural smallholder farmers view connections with government departments, private companies and NGOs and belonging to farmer groups/co-operatives as means to improve access to farm inputs, implements and agricultural markets.

The third principal component was mainly defined by social values and accounted for 15.25% of variance in the explanatory variables. Farmers valued cultural rules and norms, and group/cooperative constitutional rules and regulations as vital factors in farming with less importance attached to trust among community members. Availability of cultural rules and norms, and group/cooperatives constitutional rules and regulations ensure order in the management and operations of the farm business. Thus, policy makers may need to consider farmers' social values to strengthen farmer groups and cooperatives for improved access to input/output markets. Strong social values can also aid the flow of information regarding efficient and sustainable use of resources, diffusion of new technologies and good agronomic practices, and quality assurance along the agricultural produce value chain.

7.5 Social Capital and Farmers' Characteristics

As was done in the case of entrepreneurial spirit, it was necessary to explore the farmer characteristics that predispose them to the identified perceptions about social capital. Accordingly, multiple linear regressions were run to establish the relationship between the farmer/farm characteristics and farmers' attitude towards the role of social capital in agricultural production and marketing among smallholder farmers.

According to the results presented in Table 7.6, bonding social capital was significantly influenced by such variables as age of household head, education level, gender of household head, land size, whether or not the family was receiving cash transfers, sources of water for crop production and location of the irrigation scheme. Of these variables, the strongest associations were with education level (at 1%), and water source and location of irrigation scheme (at 5%). The other variables were only significant at 10%.The results further show that the relationship between bonding social capital and cash transfers (remittances, grants and pensions) and source of agricultural water was a negative one, while all the variables have a positive relationship with bonding social capital. In the case of cash transfers, it is probably suggestive of weaker commitment to fostering networks that support farm enterprise if a household enjoys some financial security through direct cash receipts either from non-resident family members or through pensions and grants. People would normally seek to bond with others if there is something to gain from such a relationship. This finding provides strong support to the notion that social capital is a vital element in rural entrepreneurial development as it could be a source of much-needed priming of the business. The case of water source for crop production is probably a reflection of conflicts that are known to exist over the allocation of water resources within communities (Van Averbeke *et al.,* 2011).During interviews, farmers reported some conflicts within smallholder irrigators' groups especially during the distribution of farm inputs, access to tractor and access to irrigation water.

Smallholder farmers who are highly experienced and use irrigation water from the dam and river are more likely to have loose ties with external social networks this is because farm experience and source of water have a negative and significant impact on external social capital at 5% and 10% level, respectively. However, farmers located at Qamata irrigation area and those who earn more crop incomes are more likely to recognize the importance of external social networks especially with the government departments. This is so because crop incomes and location of irrigation scheme have a positive and significant impact on the farmers' external social capital at 10% level, respectively. The negative attitude of more experienced farmers towards external social networks may be attributed to the disappointments caused by government's withdrawal from providing subsidized inputs as was the case when the small-scale irrigation schemes were first established. Also, smallholder farmers who have stayed long together in farming tend to resist external influence which is viewed as a threat to established internal group cohesion/bonding (Yamaoka, 2007 and Ostrom, 1998).

Social values were positively and significantly influenced by farming experience at 10% level while source of water for crop production negatively and significantly influenced farmers' perception about the importance of social values in agricultural production and marketing at 1% level. As farmers grow older they tend to respect the cultural rules and norms, and group constitutional rules and regulations. The negative relationship between sources of water for crop production and social values may be due to social conflicts that undermine the cultural rules and norms, and group/cooperative constitutional rules. Most conflicts are related to skewed land distribution on the irrigation scheme and inequitable distribution of input subsidies and farm support rendered by the government, private companies and NGOs.

Table 7.6: The Relationship between farmers' social capital, and farmer/farm characteristics

	Dependent Variables (Extracted from Factor Analysis -PCA)					
	Bonding Social Capital		**External Social Capital**		**Social Values**	
Independent Variables	β	p-value	β	p-value	β	p-value
Age of the household head	0.017	0.094*	0.010	0.385	0.008	0.497
Sex of the household head	0.343	0.092*	0.172	0.434	0.258	0.247
Education level	0.113	0.000***	-0.007	0.813	0.047	0.115
Farming experience	0.011	0.215	-0.019	0.050**	0.016	0.086*
Land size	0.189	0.076*	0.175	0.129	-0.084	0.471
Household size	-0.055	0.120	0.043	0.265	0.002	0.964
Crop incomes	-0.000	0.234	0.000	0.062*	0.000	0.202
Remittances, grants & pension	-0.000	0.085*	0.000	0.313	0.000	0.316
Source of water for crop production	-0.177	0.033**	-0.148	0.099*	-0.235	0.011***
Location of irrigation scheme	0.568	0.056**	0.542	0.093*	0.371	0.254
(Constant)	-2.132	0.023**	-1.427	0.158	-1.033	0.311
R^2 adjusted p-value	0.257 0.000***		0.123 0.010***		0.103 0.022**	

*Where ***, **, * represents significance level at 1%, 5% & 10%, respectively; β = coefficient*

Source: Results from Field Survey, 2012.

The difference between the smallholder irrigators' and homestead food gardeners in their attitudes regarding the importance of social capital in agricultural production and marketing was also assessed. Smallholder irrigators acknowledged the importance of working with government departments, supporting fellow farmers in times of hardship, accessing farm information through fellow farmers, adhering to cultural rules and norms, and in voting, for increased agricultural productivity and marketing. Homestead food gardeners placed a high premium on working as farmer groups, group membership for labour access, enhanced access to farm implements, support of fellow farmers in times of hardships, adhering to cultural rules and norms, and participation in voting. Evidently, both smallholder irrigators and homestead food gardeners affirmed the importance of social networks in accessing farm inputs and individual trust in the community for improved agricultural productivity and market access. It would seem that homestead food gardeners would prioritize bonding social capital while smallholder irrigators tended to prioritize external social capital while both would consider social values to varying degrees.

7.6 Aggregate Human Dimensions and Maize Productivity

A robust OLS Cobb-Douglas log-linear regression model was fitted to determine the impact of human dimensions on maize production. The model included other agro-inputs used by smallholder farmers since neither human dimensions nor physical resources can be used in isolation to yield agricultural outputs. The results are presented in Table 7.7.

Table 7.7: Estimating the role of human dimensions on maize productivity among smallholders

	Maize Output (Y) = Dependent Variable			
Independent Variables (in natural logarithm)	**Coefficient**	**Robust S.E**	**T-value**	**P-value**
Land (ha)	2.411	0.367	6.58	0.000***
Seed (Kg/ha)	0.284	0.149	1.90	0.061*
Fertilizer (Kg/ha)	0.005	0.070	0.08	0.939
Pesticide (L/ha)	0.239	0.175	1.37	0.175
Herbicide (L/ha)	0.140	0.234	0.60	0.553
Number of irrigations/ha/season	1.241	0.236	5.26	0.000***
Total input costs (R)	0.132	0.170	0.78	0.439
Cost for tractor hire (R)	0 .018	0.049	0.37	0.712
Education level (years)	0.110	0.079	1.39	0.167
Farming experience (years)	0.148	0.094	1.58	0.118
Risk taking (hope) (score)	-0.747	0.530	-1.41	0.162
Innovativeness (confidence) (score)	-0.564	0.491	-1.15	0.254
Recognizing opportunities (optimism)	0.608	0.672	0.91	0.368
Farm status oriented goal (score)	1.806	0.595	1.13	0.261
Business oriented goal (score)	-3.423	2.287	-1.50	0.138
Social oriented goal (score)	-1.684	0.962	-1.75	0.084*
Independence oriented goal (score)	3.489	1.469	2.38	0.020**
Bonding social capital (score)	-0.765	0.483	-1.58	0.117
External social capital (score)	2.292	0.854	2.68	0.009***
Social values (score)	-0.819	0.645	-1.27	0.208
(Constant)	-0.196	0.934	0.21	0.834
R-squared = 0.8671 Prob > F = 0.000*** Number of Observations (n = 108)				

*Where ***, **, * represents significance at 1%, 5% and 10% level, respectively. Kg = Kilograms, ha = hectares, L = litres, and scores = average item scores of the human dimensional Principal Components.*

Source: Results from Field Survey, 2012.

According to the results presented in Table 7.7, the tangible (physical) agro-inputs that have a positive and significant impact on maize production include land size under maize production, amount of seeds planted and the number of irrigations/ha/season at a 1%, 5% and 10%, level, respectively. Therefore, for increased maize output, farmers need to increase land size under maize production, amount of improved seeds and the amount of irrigation implemented. The human capital related farmer characteristics have a positive relationship with maize output though this was not found to be statistically significant. Farmers' education level is linked to adoption and efficient use of new technologies and higher education level attainment is expected to increase production.

Among the intangible resources expected to positively influence maize production are entrepreneurial spirit or positive psychological capital. The principal components for farmers' entrepreneurial spirit (positive psychological capital) were found not to have a statistically significant impact on maize production. Despite their not showing significant impact, it is necessary to remark on the relationships between the indicators of entrepreneurial spirit and the farmer's crop production based on the indications from the analysis. As the results (Table 7.7) suggest, farmers' risk taking (hope) and innovativeness (confidence) have a negative influence on maize production while response to available opportunities (optimism) had a positive impact on maize production. This means that, the smallholders' maize enterprise has less risks and calls for less innovativeness to achieve increased maize output while a sense of farmers' responsiveness to available opportunities (optimism) may be crucial for increased production. Therefore, farmers may need to have the ability to organize resources, take on the available opportunities, have the zeal to pay for trainings on good agronomic practices and business skills, and engage in information search in order to maximize maize output.

Farmers' social capital indices, on the other hand, have much stronger relationship with maize production, as the results (Table 7.7) show. The farmers' social-oriented goal as a composite index was shown to be negatively statistically significant which could mean that a social goal-oriented view of agriculture, rather than a profit maximizing view, will likely lead to lower maize productivity. Also, the negative impact of the social oriented goals on maize output may be explained by farmers' tendency to cultivate land for tenure security purposes. In most African traditional societies, land has more sentimental than economic significance and is an important factor in defining the individuals' social status (Obi, 2006). Such a perspective is not consistent with improved agricultural productivity, hence the call for agricultural to be viewed as a business rather than as a way of life.

One important variable included in the model was "Farmers' independence oriented goal". Such a goal encapsulates a view of farming as a source of self-employment, leisure time, participate in social gathering and maximize farm incomes. Thus, promoting this farmers' goal may enhance job creation and increased household incomes of the smallholder farmers both at Tyefu and Qamata irrigation schemes. The result shows a positive statistically significant (5% level of significance) relationship between this farmers' goal the farmers' maize productivity. This is the sort of environment in which the farm family and the farm business are intimately related and non-distinguishable. This can easily be the more commonly occurring set-up in the communal areas as a transitional phase before full commercialization.

Further, results presented in Table 7.7 indicate that external social networks are important for increased maize production since this type of capital is positively and significantly related to maize output at 1% level. At least some smallholder farmers at the irrigation scheme receive support from government extension service and under the various schemes being implemented as part of the on-going agrarian reforms in the country. Also, farmers receive some input subsidies, tractor services to plough their fields and financial assistance to cover the irrigation scheme facility rehabilitation costs. Other external social networks include private companies/business that constitute markets for farmer produce. For social values, some cultural rules and norms may have a negative impact on agricultural production like denying women access to land which results in their having little or no voice and power participate in decision making concerning farming. Ironically, these women are known to contribute as much as 70% of farm labour in the area (Kodua-Agyekum, 2009).

7.7 Human Dimension and Cabbage Production

In order to estimate the impact of human dimensions on cabbage production (number of heads produced), a log-linear Cobb-Douglas production function was run and results are presented in Table 7.8. According to the results, the land under cabbage production, amount of fertilizer applied and the number of times a farmer irrigates his/her field per hectare per season are all important. It was shown that the land area, quantity of fertilizer and frequency of irrigation each had a positive and significant impact on cabbage output at 1% level, respectively. This could suggest that for farmers to realize increased cabbage output, they need to allocate more land to cabbage production, apply more fertilizer and increase the number of irrigations per hectare per season. But apparently the smallholder farmers' increased use of pesticides, total input costs and tractor hiring costs could result into decreasing cabbage production since the model hinted at a negative impact on the number of heads of cabbage produced.

Farming experience has a positive and significant impact on cabbage produce at 10% level. Thus, increased cabbage production among smallholder farmers calls for more farming experience and this may be due to the agronomic practices which need skills developed overtime. Such skills that call for more experience may include estimating the right measure of seeds and pesticides applied, and reduction in crop failure risks. In this regard, there is a need of improving the human capital for a vibrant vegetable production among Amati and Tieu smallholder farmers. The level of education has a negative impact on cabbage production. Sometimes higher education level has a negative impact on agricultural production because individual with higher qualification tend to migrate from the less paying farming activities to formal employment thought to be more paying in terms of incomes (Barambah, 2007).

Turning to the human dimensions and their possible impacts, it was shown that entrepreneurial spirit or positive psychological capital related factors have no significant influence on cabbage production. Risk taking (hope) has a negative relationship with the number of heads of cabbages produced while innovativeness (confidence) and response to opportunity (optimism) positively affect cabbage production. This may call for more innovativeness (confidence) and use of available opportunities (optimism) with calculated risks for increased cabbage production. The negative impact of risk taking entrepreneurial spirit on cabbage production may be due to lack of storage facilities and geographical location of the area which is far away from the major urban markets yet cabbage is perishable produce. Thus, farmers tend to produce less to minimize marketing and postharvest loss risks. These findings are consistent with Kisaka-Lwayo and Obi (2012) who indicated that farmers are risk averse and are reluctant to invest in unclear and high risk farming activities.

Table 7.8: Estimating the role of human dimensions on cabbage production

Independent Variables (in natural logarithm)	Cabbage Output (Y) = Dependent Variable			
	Coefficient	Robust S.E	T-value	P-value
land under cabbage (ha)	4.071	0.703	5.79	0.000 ***
cabbage seeds (Kg/ha)	0.276	0.470	0.59	0.559
Fertilizer (Kg/ha)	0.619	0.159	3.89	0.000***
Pesticide (L/ha)	-0.047	0.211	0.22	0.826
Number of irrigations/ha/season	2.192	0.310	7.07	0.000***
Total input costs (R)	-0.244	0.166	1.47	0.146
Cost for tractor hire (R)	-0.09	0.065	-1.42	0.160
Education level (years)	-0.019	0.117	-0.16	0.871
Farming experience (years)	0.207	0.116	1.79	0.077*
Risk taking (hope) (scores)	-0.512	0.510	1.00	0.318
Innovativeness (confidence) (scores)	0.503	0.621	0.81	0.420
Recognizing opportunities (optimism)	0.724	0.586	1.24	0.220
Farm status oriented goal (scores)	4.477	1.451	3.08	0.003***
Business oriented goal (scores)	-6.648	2.314	-2.87	0.005***
Social oriented goal (scores)	-0.785	0.748	-1.05	0.298
Independence oriented goal (scores)	3.434	1.292	2.66	0.009***
Bonding social capital (scores)	0.917	0.612	1.50	0.137
External social capital (scores)	-0.098	0.745	-0.13	0.896
Social values (scores)	-0.492	0.681	-0.72	0.472
(Constant)	-1.155	1.047	-1.10	0.273
R-squared = 0.9136 Prob > F = 0.0000*** Number of Observations (n = 107)				

*Where: *** and * represents significance at 1%, and 10% level, respectively. Kg = Kilograms, ha = hectares, L = litres, and scores = average item scores of the human dimensional Principal Components.*

Source: Results from Field Survey, 2012.

Based on the results displayed in Table 7.8, farmers' goals have an important role in defining the number of heads of cabbages produced among smallholder farmers. The farm status/self-esteem and independence (self-employed) have a positive and significant impact on cabbage production at 1% level, respectively, while the business oriented goal has negative and significant impact on cabbage production at 1% level. Therefore, policies and development programmes that are geared towards promoting the farmers' farm status oriented goal, and independence oriented goal (farming for self-employment) may lead to increased cabbage production. All social capital related human dimensional factors have no significant influence on cabbage production. The external social capital and social values were regarded less important in the smallholder cabbage production since they exhibited a negative relationship with cabbage output. Cabbage is a dietary staple in the study area and farmers would grow it with or without support, as long as the basic physical requirements are met.

7.8 Chapter Summary

This chapter presented quantitative information on the extent of entrepreneurship and psychological capital possessed by the smallholder farmers (both irrigators on the schemes and homestead gardeners) in the study area. The results suggest that these farmers exhibited some entrepreneurial spirit or positive psychological capital although it is low and need to be strengthened. Entrepreneurial spirit (positive psychological capital) statements that scored highly included farmers' ability to adopt new, ability to organize available resources to achieve a goal, take action always on the basis of what is perceive to be profitable, and supply of produce on credit. Attitudinal statements that referred to some form of individual decision making and sourcing for knowledge at a given cost, received the least scores. Three principal components were extracted using factor and principal component analysis through factor loading statistical method. The three components included risk taking (hope), innovativeness (confidence), and taking on available opportunities (optimism). Comparing the mean scores for entrepreneurial spirit principal component, smallholder irrigators are endowed with innovative spirit (or confidence) while homestead food gardeners seemed less so. Both smallholder irrigators and homestead food gardeners seemed to equally exhibit the potential for taking advantage of farm business opportunities (optimists).

The socioeconomic factors that significantly influenced farmer's entrepreneurial spirit or positive psychological capital in the study area were identified. These included age, education level and major occupation of household head, and livestock incomes that have a positive and significant influence on farmers' risk taking (hope) while farming experience and source of water for crop production had a negative impact on risk taking. The determinants of the second principal component included farming as the major occupation which had a positive and significant influence on innovativeness (confidence) while farming experience had a negative and significant influence on same.

Farmers' recognition of business opportunities (optimism) was positively and significantly related to crop incomes, remittances, grants and pension, and location of the irrigation scheme while age had a negative and significant influence on farmers' ability to take on the available farm business opportunities. Therefore, interventions to improve on the socioeconomic factors which are positively and significantly related to entrepreneurial spirit or positive psychological capital may catalyze the shift from subsistence to more business oriented commercial farming. This is thought to enhance productivity, household incomes, food security and poverty alleviation in rural communities. This may not necessarily apply to the socioeconomic factors that negatively and significantly impact farmers' entrepreneurial spirit/positive psychological capital.

Social capital was also measured in this chapter and reported in much the same way as entrepreneurship. Using factor analysis statistical method, three principal components were extracted from the covariance matrix. The three principal components extracted can be best described as bonding social capital index, external social capital index and social values index, respectively. Age, sex and education level of the household head, and land size had a positive and significant influence on bonding social capital while household incomes earned from remittances, social grants and pension, and source of water for crop production had a negative and significant influence on bonding social capital. Crop incomes and location of the irrigation scheme had a positive and significant influence on external social capital while farming experience and source of water for crop production had a negative and significant influence on external social capital. Social values had positive and significant relationship with age of the farmer while source of water for crop production had a negative and significant influence on social values. Therefore, for improved external social capital and adherence to social values, conflicts on the former state-run small-scale irrigation schemes need to be addressed.

CHAPTER 8

LIVELIHOODS AND OPPORTUNITIES TO IMPROVE FARMING CONTRIBUTION

8.1 Introduction

The results of this study relate directly to the research aims specified at the outset and elaborated in the previous chapter. The purpose of the study was to determine the sources of livelihoods and opportunities to improve contribution by farming within available food value chains. The deepening poverty in the communal areas of the country continues to be a source of concern and the on-going agrarian reforms in the country have been designed specifically to address this problem. The chapter drew insights from an exercise that was jointly undertaken with the project supervised by the International Centre for development-oriented Research in Agriculture (ICRA) to introduce the Agricultural Research for Development (ARD) methodology. To that extent, it employed a participatory methodology to engage with the respondents to obtain the information on livelihoods and opportunities to improve the contribution of farming. The chapter begins by looking at the current state of the livelihoods in the study area and the livelihood strategies they employ to cope with the circumstances in which they find themselves. The chapter then turns to the livelihoods outcomes and the factors that influence livelihoods, including an examination of the role of enhanced market access and the factors that influence market participation decisions. The opportunities to improve the contribution of farming within available food value chains are then considered.

8.2 Current State of the Livelihoods and Livelihoods Strategies

Clarifying the current state of the livelihoods in the study areas is a key aim of this study and relates to the case that was made in the first instance for the study. On the basis of comprehensive literature reviews and document analysis, it has been shown that the livelihoods situation in the Eastern Cape Province, especially within the rural areas, is very precarious. The deterioration in welfare has been unrelenting and many more people have fallen into poverty in recent years than was previously the case. The concern of the government and development community about this state of affairs comes from the realization that the province, in line with national priorities, has been investing massively in rural transformation and through agricultural and rural development which would have produced a completely different outcome than what is being observed. The national focus on revitalization of small scale irrigation schemes is also in evidence in the Eastern Cape. It was necessary to establish through this systematic assessment the current state of livelihoods and provide a basis for identifying areas of flexibility in the system that can allow for policy-relevant interventions to be introduced in order to improve livelihoods.

In the light of the foregoing, the study analyzed diverse qualitative information in three different locations. In the context of the research question as to the current state of livelihoods, the relevant sub-questions that were addressed are as follows:

i. What are the available resources within the area?
ii. How are the resources distributed spatially?
iii. What is the occupational structure of the area?

These sub-questions are addressed in the next three sub-sections.

8.2.1 Resource Profile of the Project Areas

The resource profiles of the study areas were assessed by means of the diverse qualitative data collection and analytical procedures employed. In the first instance, the broad focus group meetings and key informant interviews were helpful in gaining general understanding of the resource profile of the area. This information was then used as key input into the assessments made during the Transect Walk and the participatory resource mapping exercises. The results reveal that the villages are endowed with the five categories of assets, namely natural, physical, social, financial and entrepreneurial assets. According to the FAO (2009), assets are the resource base of people and remain the chief contributor to the realization of livelihoods outcomes. For this reason, the qualitative asset analysis that draws from the in-depth experience of the local people, lies at the core of the livelihoods framework. It is virtually impossible to define the vulnerability context of the community without reference to the assets they own and manage. Features that are worth noting and that have implications for livelihoods are how the community and individual resources and assets are located in relation to where humans reside and what scope exists for individuals to access the resources they need to enhance their livelihoods. The current orientation of the resources relative to human settlements can also provide valuable insights into the historical trends and current tendencies.

The three resource maps prepared for the three main irrigation schemes examined are presented as Figures 8.1, 8.2 and 8.3, representing the situations observed in respect of the relevant study locations in the Intsika Yethu, Ngqushwa and Nkonkobe Local Municipalities, respectively. According to Figure 8.1, the community of Maya Section 3 of Cofimvaba is fringed by mountain ranges at the foot of which is a gravel road that provides access to the community's forest resources and farming areas, including the Qamata irrigation scheme. The distinctive feature for this community is that the homesteads in which the community members reside intermingle with the business and service entities comprising shopping centres, schools, a tavern and one tuck shop. Right in the middle of the village are two graveyards which might suggest high mortality in the past and on-going health challenges. All the natural assets of the community in the form of forest and farming lands are located right outside this residential area and it is virtually enclosed by its resources in a sort of circle.

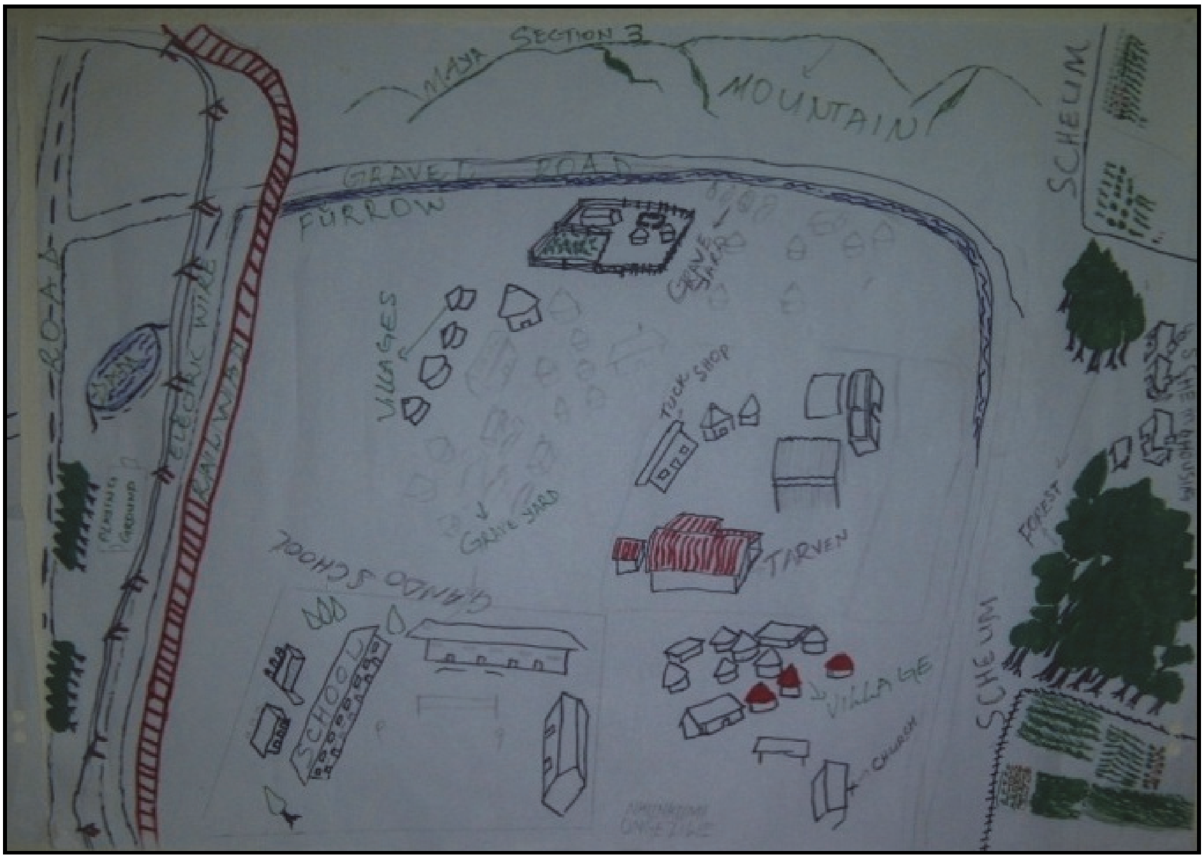

Figure 8.1: Resource Map of the Maya Section 3 of Cofimvaba in Intsika Yethu Municipality

In the case of Figure 8.2 showing the location and distribution of the assets, people and business and service centres for the Peddie area, people are more sharply separated from their means of livelihoods. The business and service areas are completely outside the human settlements on one side of the village while the farming areas are on the other side of the village, again completely removed from where the villagers reside. All the farms, including the small food plots of the resource poor households, the pomegranate farms run on commercial scales on contract basis for entrepreneurs based outside the village, and the irrigated farms under the Tyhefu Scheme, are located in the South East corner of the village and are separated from human residential areas by extensive grasslands some of which serve as communal grazing lands for the small stock such as sheep and goats. The community has a large water reservoir to the North West which is fed from the Tyhefu River and is surrounded by grazing lands that are devoted to much larger stock such as cattle and donkeys. There is one Cemetery just outside the village precincts and some distance away from the school and the business area (featuring a Café). Another school is located on the North East of the village, again outside the living area. Looking at the resource map, it is apparent that grazing of livestock, both large and small, is a major economic activity and a large share of the natural resources is devoted to this activity.

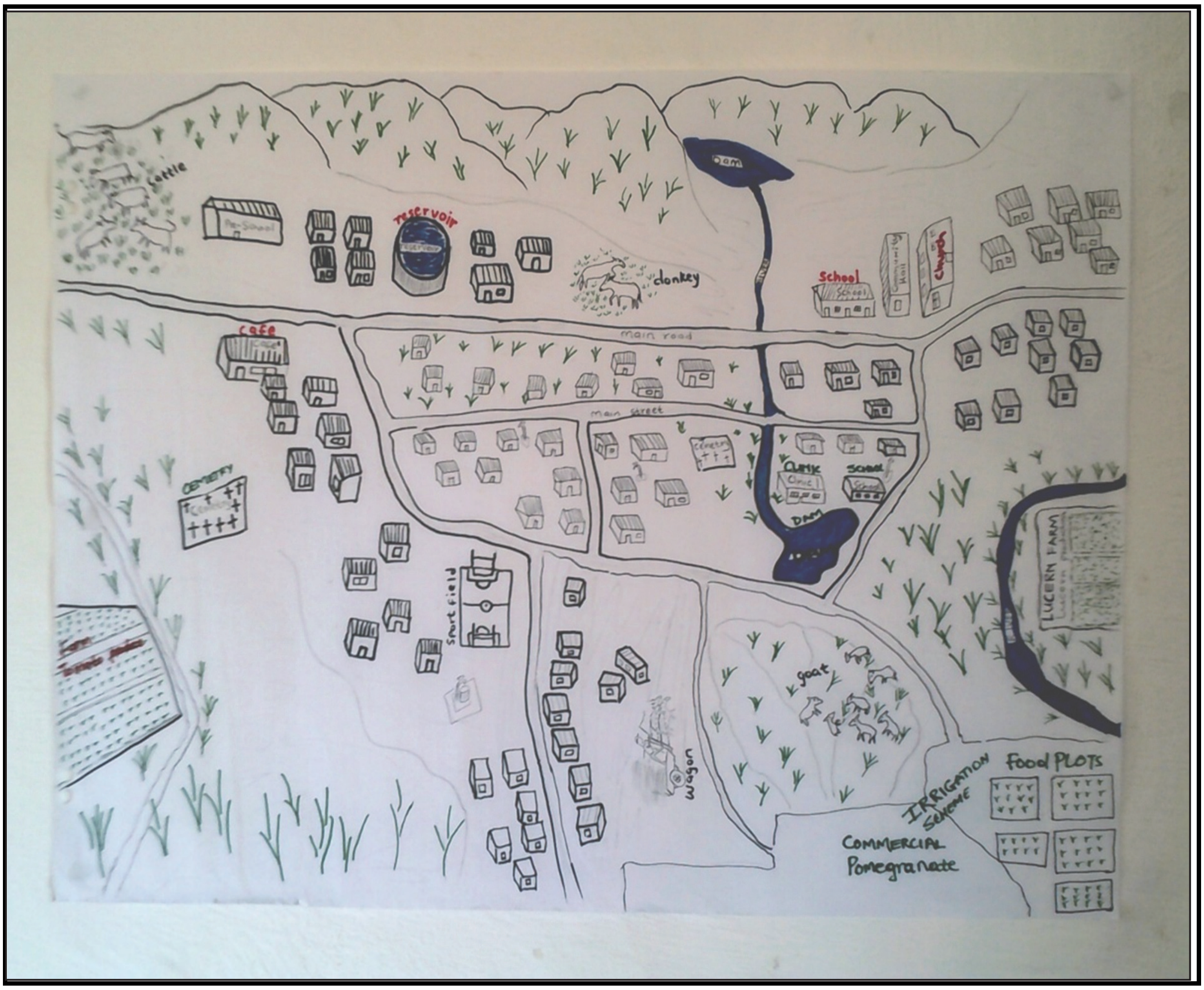

Figure 8.2: Resource Map of the Tyhefu Irrigation Scheme Catchment Area of Peddie Area of the Ngqushwa Local Municipality

Figure 8.3 presents the resource map for the Melani Village in the Nkonkobe Local Municipality. There are similarities between the Melani village and the Peddie village where the residences are completely separate from the areas of economic activity. Community forests that seem to have spawned a major rural industry for charcoal production are located on one part of the village area, while food plots are located in the uninhabited area between the settlement and the road leading to Hogsback. The schools also lie outside the village and area clearly distinguishable from human settlements. The river is a significant landmark that runs the entire length of the village from one end to the other and passes through the food plots and the irrigated farms.

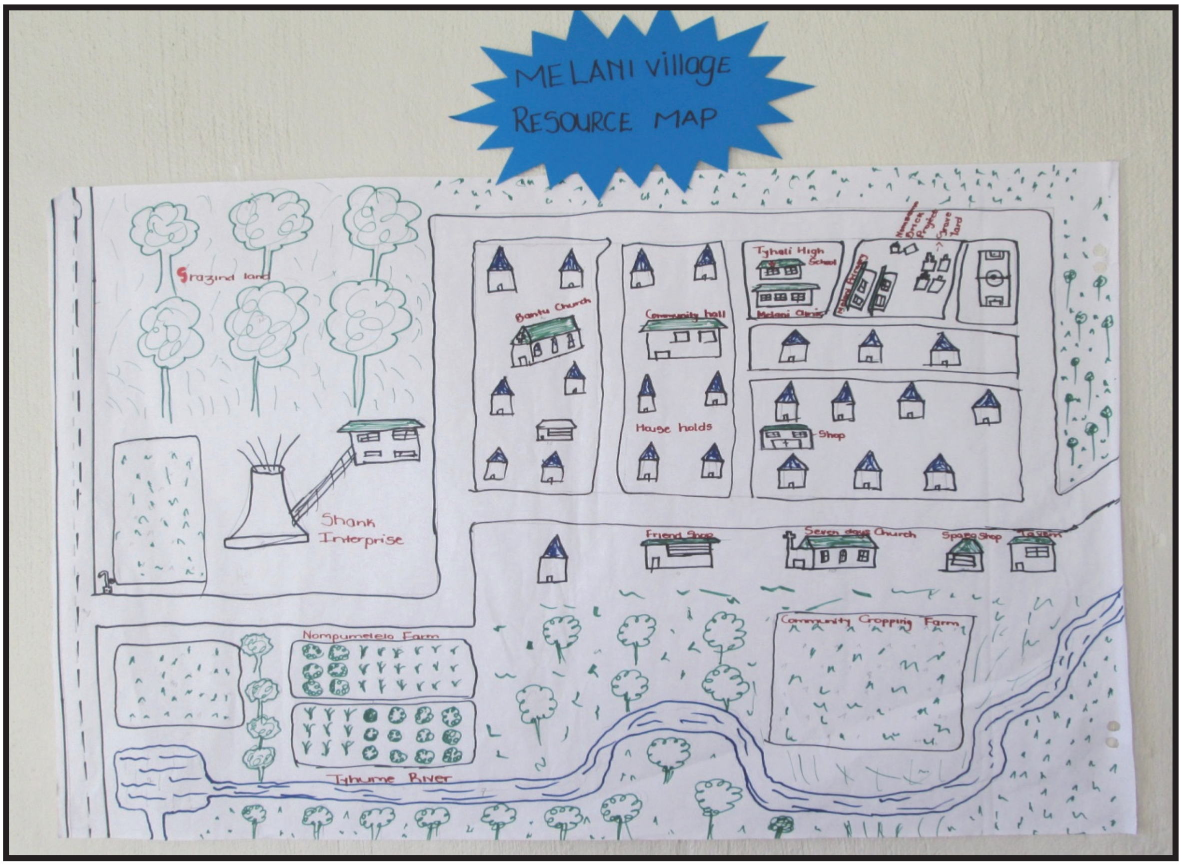

Figure 8.3: Resource Map of the Melani Village of the Nkonkobe Local Municipality

8.2.2 The Resource Ownership Patterns

The pattern of ownership of resources was an issue that was quite explicitly investigated in the group meetings held at the inception of the study. Key sources of information in this respect were the community leadership, the key informants and the officials from the DRDAR who provided extension services to the communities. Much of these issues were further investigated in the focus group discussions. It was revealed that clearly defined property rights exist in all the villages; people knew with clarity who owned what and clear frameworks existed for reconciling conflicting perceptions. Communal areas were equally clearly defined and the extent to which people operated on the basis of guidelines and rules and regulations was quite high.

What stood out in the meetings held with the communities was that the vital resource of land, while being accessible to all community members by virtue of new legislation, could not be transferred from one individual to another on permanent basis. The issue of title deeds was always cropping up and the people were concerned that they could not use their land to raise working capital since untitled land cannot be used as collateral. This issue remains a crucial one from the standpoint of livelihoods enhancement. The indication is that the people are aware that some change is likely in the future. For now, the dominant arrangement is leasing of land to avoid bush-encroachment, especially in the Qamata area where the bulk of the available land is uncultivated and quickly reverts to bush.

Water rights are being allocated to community members for access to irrigation water. This is the case in the Melani village. A Water Users Association also operates in the area and helps to control the use of water and avoid wastage of this vital resource. In a place like Qamata, this arrangement was not in existence and no Water Users Association was in evidence, leading to more indiscriminate use of water and wastage. Exploitation of forest resources in the Qamata area seems to be in a similar situation in which access is open to the wider community. Forests and gumtree plantations dominate and are clearly beneficial as sources of feed to animals, firewood and fencing material. Gumtree plantations were identified in one section and from its people benefit from the poles harvested which they use for construction purposes.

8.2.3 Employment and Occupational Structure of the Population

The occupational structure in the project areas was assessed in a similar manner as in the case of resources by obtaining insights from the community members about what they do for a living. This particular sub-question has many ramifications, including helping the researcher to also answer questions about how the human capital is distributed and utilized in the community. Defined as “manpower with different skills”, human capital determines the extent to which the community members utilize the resources and assets (i.e. natural and physical capital) in their environment for purposes of making a living. Another element of this sub-question is that it depends also on the entrepreneurial spirit possessed and manifested by the community members who may or may not utilize the resources in their environment according to the attitude they have to risk-taking and trying out new things. The literature has shown that this has everything to do with the psychological capital stock of the people which may make them perceive different situations as either motivating and inspiring or demotivating and challenging and determine the extent to which they exhibit enterprise in trying to solve perceived problems. The results of the initial enquiries as to what people do for a living are presented in the next three pie-charts as Figure 8.4, Figure 8.5, and Figure 8.6.

The various sources of income as well as factors that have a bearing on the crop producers' household livelihoods in the Melani village were assessed and the contribution of each strategy is depicted in Table 8.1 and in the Pie Chart or Chapatti Diagram presented as Figure 8.4.

Table 8.1: Sources of Livelihoods in Melani Village, Nkonkobe Local Municipality

Sources of household income	% of total
Social Grants	52
Crop Farming	22
Livestock Farming	4
Casual Employment	22
Total	100

Source: Field Survey, 2012

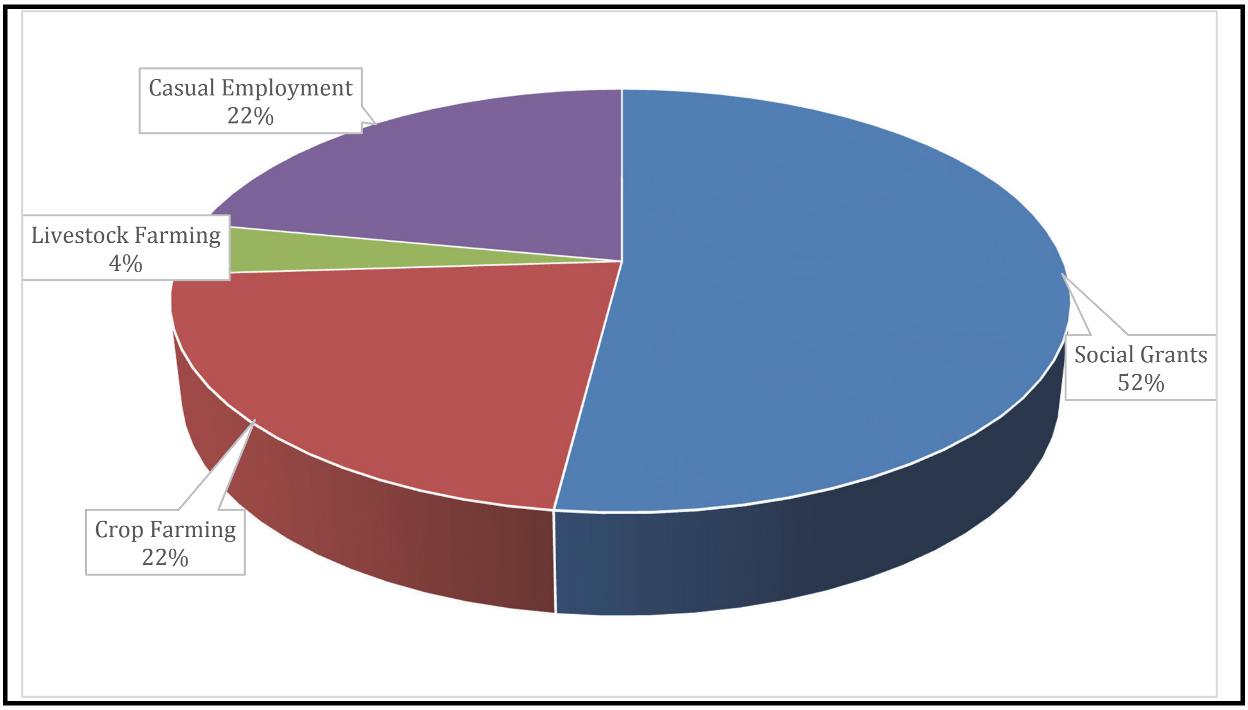

Figure 8.4: Sources of livelihoods in Melani Village
Source: Field Survey, 2012

As Figure 8.4 shows, sources of livelihood in Melani village include both agricultural and non-agricultural activities as depicted in Figure 8.4. The interview results indicated that most farmers (74%) in both irrigation and homestead farming depend on non-farming activities such as social grants and casual/piece work performed for others for a piece-rated wage (52% and 22% respectively); some use the money from these activities for agricultural purposes. Therefore, some of the people who reported social grants as source of income also engage in agriculture, either as crop farming or livestock keeping.

Table 8.2 and Figure 8.5 present the situation in the catchment area of the Qamata Irrigation Scheme. The typical household labour allocation pattern was determined and the members broadly divided their activities into two categories according to whether they are farm or non-farm, and according to whether they are performed by male or female members of the household.

Table 8.2: Typical household labour allocation pattern in Qamata, 2013

Household labour allocation	% of total
On-farm activities (Males)	38
Off-farm activities (Males)	12
On-farm activities (Females)	20
Off-farm activities (Females)	30
Total	100

Source: Field Survey, 2012

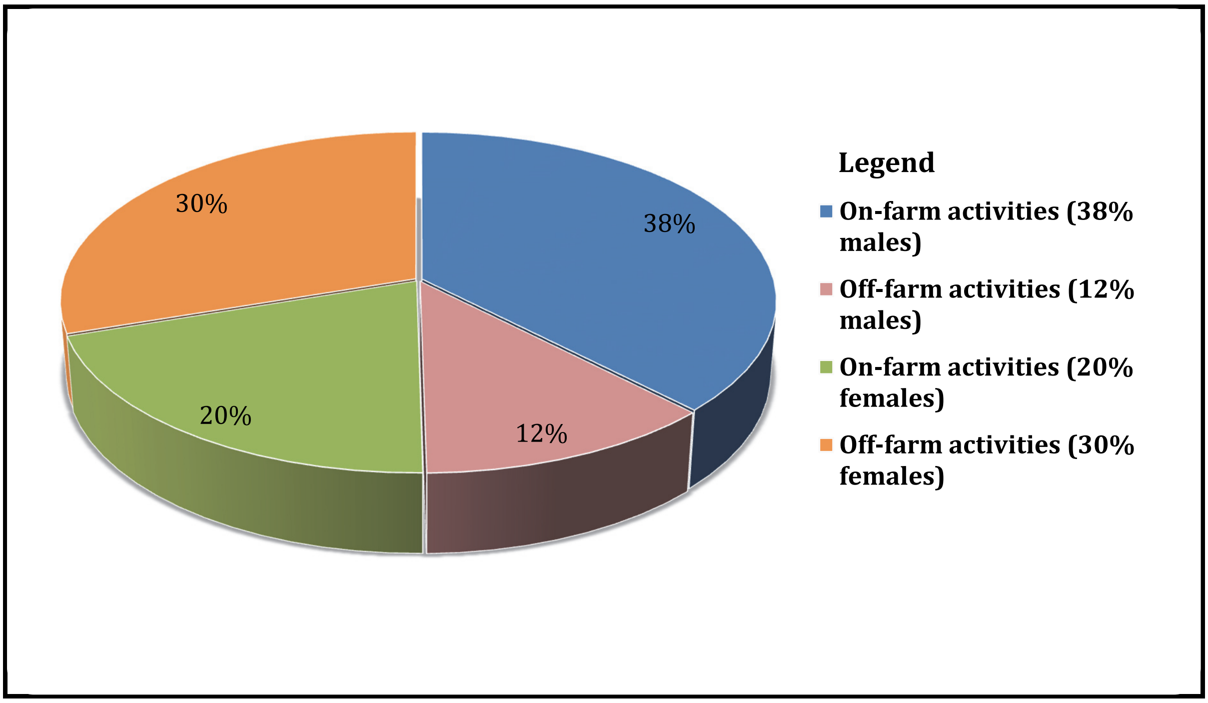

Figure 8.5: Distribution of economic activities in Qamata Area
Source: Field Survey, 2012

As Figure 8.5 shows, 58% of the household members were engaged in active farming while the rest (42%) performed diverse tasks categorized as off-farm activities. In Figure 8.6, the way the household distributed its income according to how it was made, was investigated. The household head was asked to say how much the family received in one month and from what sources they came. Their responses are presented in Table 8.3 and charted in Figure 8.6. According to the results (Table 8.2), the typical household derived its income from as many as eight sources.

Table 8.3: Source of household income in a typical Qamata household, 2013

Sources of household income	% of total
Social Grant	50
Crop Farm Production	12
Livestock Production	8
Casual Work	8
Self-employment	10
Projects	8
Remittances	2
Paid Employment off-farm	2
Total	100

Source: Field Survey, 2012

As Table 8.3 shows, social grants contributed the bulk of the income received by the household in the month. These grants include the child support grants, the old age pensions and assorted social security payments. In some households, multiple payments are received by eligible household members and these add up to some sizeable receipts that make many households live comfortably in the month. A separate analysis of the extent and impact of the social security grants will be implemented soon. But in general, they have made significant impact on the socioeconomic life of households in the country, and the study areas are no exception. The next category of sources in order of importance is crop farming which accounted for 12% of the household's gross monthly earning. Many household members undertake some menial jobs and petty trading which bring in some cash income, with a few making some reasonable contribution. Many households still receive significant support from their members who reside outside the village or even province. Historically, remittances have played a very important role in livelihoods in Southern Africa but seem in recent months to have been replaced to some extent by social grants. Livestock production, casual work, some paid employment or wage labour, etc. were also mentioned as shown in Table 8.3. These proportions have been used to draw a pie-chart (Chapatti Diagram) which is presented as Figure 8.6 to pictorially display the situation in Qamata with respect to income sources.

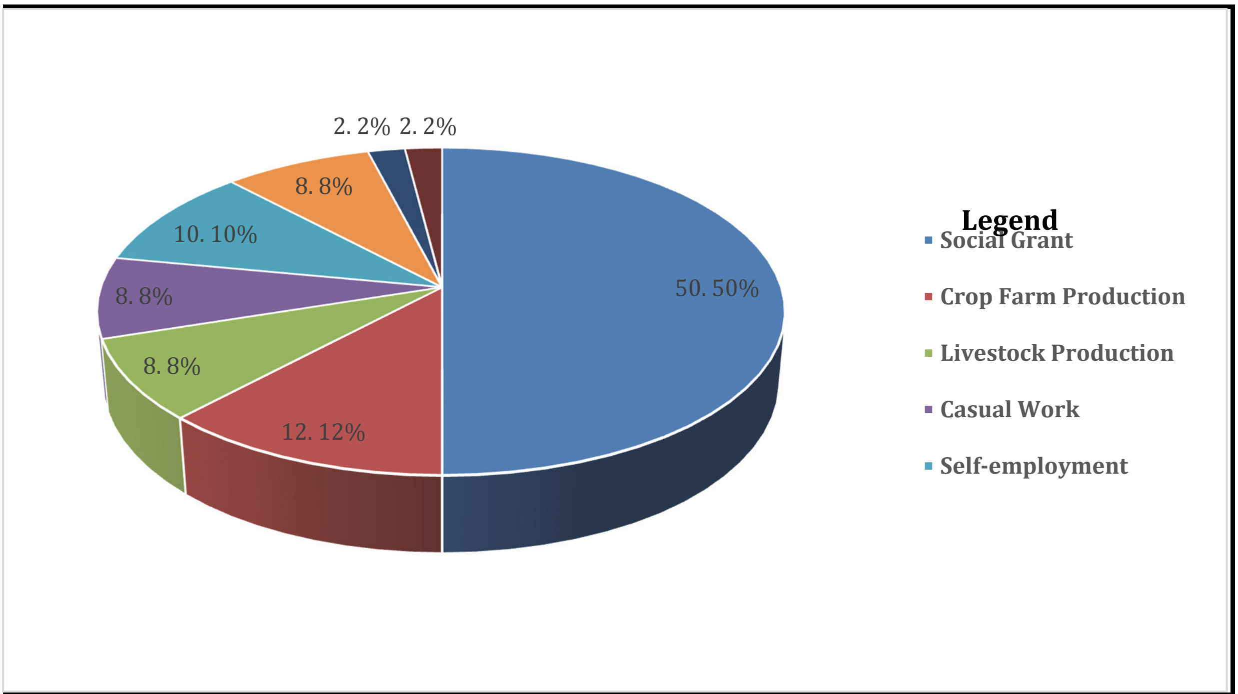

Figure 8.6: Sources of household income in a typical Qamata household, Intsika Yethu Local Municipality
Source: Field Survey, 2012

While there are similarities between the two study areas based on the qualitative assessments, particularly with respect to the importance of social grants, a few differences are worth noting and need to be explained. The most important difference is with respect to the crop income which was clearly more important in the Nkonkobe area (Melani Village) than in the Intsika Yethu area (Qamata). One possible reason for this difference is that the former Transkei area now suffers serious shortage of high potential arable land. The Qamata area also experiences very extreme weather conditions that do not favour crop production except under irrigation. On the other hand, the former Ciskei area, especially in the Nkonkobe Local Municipality, crop production remains the major agricultural activity. The other important difference is with respect to the size of the casual work force in the Melani sample relative to the Qamata sample. The fact that Melani Village is close to the more metropolitan cities of King Williams Town, East London and Port Elizabeth and the University Town of Alice can explain the importance of casual work for residents of that village. But it may also be as a result of the methodological differences and the fact that while the Qamata data broke down the income sources to finer activities, the Melani data were more highly aggregated. The groups were different but worked in the two locations simultaneously and by the time the differences in the question formats were detected, it was too late to harmonize them. It is possible that when the responses to the more detailed categories are aggregated, the two study sites may have casual work proportions that are not too different from each other.

8.3 Livelihoods Outcomes

In the original Sustainable Livelihoods Framework (SLF) developed by DFID as already described and its numerous modifications and adaptations, the livelihoods outcomes that are targeted by development actions include improved crop outputs, improved cash income, reduction of poverty, acquiring more assets, reduced vulnerability, increased well-being, improved food security, and more sustainable use of the natural resource base. Without question, the list can be longer or shorter depending on the local standards of achievement and what constitutes success for the people as defined by the culture and available frames of reference. Economic Naturalists are increasingly redefining progress in terms of the dominant signals in the zone of influence of economic actors rather than some immutable standards generally based on income (Frank, 2009). This seems to be the stance of the sustainable livelihoods framework (SLF) which incorporates a wide range of possibilities.

For the most part, in the different study sites enumerated for purposes of this deliverable, the basis for measuring performance was farm production (both crops and livestock). In Qamata irrigation scheme it was found that the major crop produced is maize followed by Lucerne and cabbage with beans, potatoes and butternut entering the system in that order. The soil conditions favour the production of maize and the local people reported the crop as their staple and most popular crop. Lucerne was next in popularity after maize because of the high market demand for the crop which is a fodder crop for feeding livestock.

In a multiple cropping programme it is useful to have a basis for determining the contribution of each enterprise to the total livelihood outcome. In this respect, the method of matrix scoring has become very important. In general, the method affords a basis to make comparisons between/among alternative options of an issue. By this process, it becomes possible to assign scores to the items being compared to indicate their relative importance. The comparison can be taken further to undertake detailed analysis which will yield information on the reasons one option is preferred to others. It is often employed for purposes of establishing the baseline in an M&E programme (Guijt and Woodhill, 2002).

In this case, the frequency of mention by households constitutes a basis for scoring the production and consumption of crops and assigning a score to each crop or enterprise. A global score is adopted as the maximum achievable and the individual scores are expressed as proportions of the global score to establish their relative importance.

Table 8.4: Matrix scoring of principal crops to determine relative contribution to livelihoods

Criteria	**Scoring (scale 1-30)**						
	Maize	**Lucerne**	**Cabbage**	**Beans**	**Potatoes**	**Butternut**	**Global Score**
Importance in livelihood improvement	10	7	6	4	2	1	**30**

Source: Field Survey, 2012

Table 8.4 shows that maize is the most important from point of view of contribution to livelihood improvement in the study area. Maize is the key staple and has high cultural significance within the region. But its commercial value does not match its high cultural value and consumer appeal because of sub-optimal input utilization and the fact that almost everybody is producing a similar and non-differentiable product, limiting the scope for any individual producer to charge a price premium. This probably explains the high and deepening poverty rates in the communities.

Making use of more conventional data collection methods, a parallel study in the Nkonkobe and Ngqushwa Local Municipalities produced almost identical results in terms of the relative importance of the crops in a multi-crop system. The figure provides evidence that maize is a widely grown crop. Figure 8.7 presents the results and shows that 80% of the sampled households grew maize in their home gardens or food plots. The main reason was that it is easy to sell locally than other crops and does not spoil easily. The second most frequently grown crop was potatoes (57%). Other crops grown included: spinach (28%), cabbage (28%), butternut (16%), melon (10%), onion (10%), carrot (3%) and Lucerne (3%).

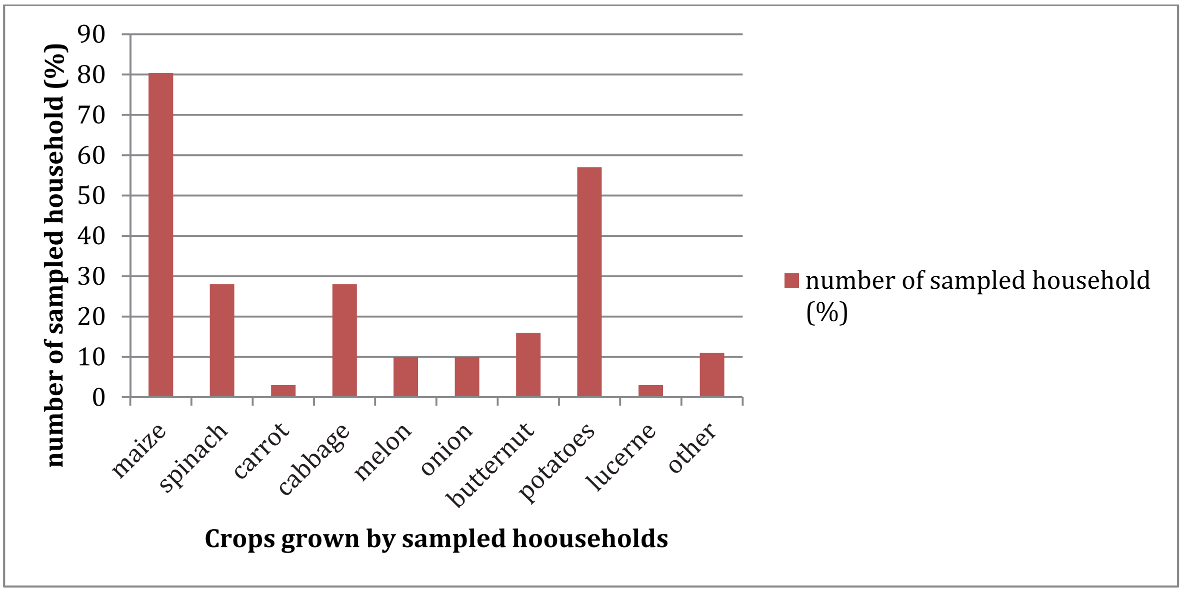

Figure 8.7: Relative importance of crops grown by small farmers in Nkonkobe and Ngqushwa Local Municipalities.
Source: Field Survey, 2012

8.4 Factors Influencing Livelihoods – an Empirical Analysis

How livelihoods are derived and from where have been the focus up to this point. As a logical next step, it should be interesting to determine what factors influence livelihoods because it will be helpful in understanding what factors can be manipulated in order to improve livelihoods whenever the need arises. Two sets of data were collected to achieve this aim: one set to use logistic regression to determine the factors influencing market choice, while the other assessed the factors that influenced quantity decisions.

8.4.1 Enhanced Market Participation

Within the accepted definition of livelihood outcome that includes increased income, food security and reduction of vulnerability, the market participation of smallholder farmers on irrigation schemes and homestead gardeners were assessed. Farmers who access markets and are able to sell the bulk of their produce are more likely to end up with enhanced incomes and experience improved livelihoods. But being involved in the marketing process has not always been easy or a foregone conclusion so to speak because there are always obstacles of one type or the other. On top of that, goals and preferences may differ and condition attitudes to scale enlargement and commercialization.

The study was conducted in Nkonkobe and Ngqushwa Local Municipalities of the Amathole District Municipality in central Eastern Cape Province, focusing on the Ndlambe village which is part of Tyefu irrigation scheme and a Women's Project in Melani village of Alice. This was achieved through personal interviews in these two areas. Primary data were obtained by means of a structured questionnaire in both areas. These two villages were chosen because the study intended to compare the market participation between farmers who have access to irrigation and those that depend on rain-fed production. In order to test the factors that have a probability of influencing market participation choices among the sampled households, a binomial logistic regression model was used and a truncated regression model was used to test factors that influences quantity decisions of the households who are already participating in markets and actually sell some or the intended marketable surplus.

The summary statistics on the households surveyed for this component of the study are presented in Table 8.5. The indication is that market participation is not as high as would have been desired although a fair amount of sales do go on in the small farm sector. The bulk of sales by the small farmers is conducted on their farms directly to buyers who might be local residents buying for own consumption or merchants who are able to access the remote farm locations to buy produce in small lots from producers at their farm gates. This arrangement has been well described in the literature and is known to be associated with unfavourable pricing of produce which means that these producers experience severely low margins for their produce. But this is also the only means by which these farmers can make any sales since the road conditions and their limited means combine to curtail their easy access to market outlets in the city or towns where prices might be better.

From Table 8.5, it is also revealed that, despite alternative market outlets for farm produce, small farmers in the sample sold mostly in the local area where they reside. Apart from what has been said earlier about the exploitation of the handicap of the small farmer by the buyers from the urban area, the fact that the small farmer can only sell in the village to fellow resource-poor households means that only small volumes can be sold and at the lowest prices possible given the extreme poverty of the buyers whose purchasing power is questionable at best.

Table 8.5: Summary statistics of smallholder production and marketing activities in Melani and Ndlambe villages

Variable	Frequency	Valid percent	Cumulative percent
Farm implements owned			
None	62	48.4	48.4
Only basic implements	21	16.4	64.8
Less expensive implements	43	33.6	98.4
More expensive implements	2	1.6	100
TOTAL N (128)			
Condition of the farm implements			
None	62	48.4	48.4
Bad	7	5.5	53.9
Fair	19	14.8	68.8
Good	40	31.3	100
TOTAL N (128)			
Primary occupation			
Farming	124	96.9	96.9
Civil servant	1	0.8	97.7
Off- farm business	2	1.6	99.2
Other	1	0.8	100
TOTAL N (128)			
Land not cultivated			
Yes	26	20.3	20.3
No	102	79.7	100
TOTAL N (128)			
Reason of uncultivated land			
None	104	81.3	81.3
Lack of capital	18	14.1	95.3
Lack of skills	2	1.6	96.9
Not interested	1	0.8	97.7
Lack of inputs	2	1.6	99.2
Not fenced land	1	0.8	100
TOTAL N (128)			
Directly selling from the farm			
None	41	32.0	32.0
Yes	58	45.3	45.3
No	29	22.7	100
TOTAL N (128)			
Market outlet			
None	56	43.8	43.8
Local	26	20.3	64.1
Supermarkets	2	1.6	65.6
Neighbours	1	0.8	66.4
Hawkers	1	0.8	67.2
Farm gate	42	32.8	100.0

Source: Field Survey, 2012

To determine the factors influencing market participation of the small farmers in the study area, detailed information was collected on quantities produced and utilized and market orientation, among other variables that relate to the environment of production and marketing, including pricing of inputs and outputs. The distinction was made between farmers who are affiliated with irrigation schemes and those who cultivate homestead gardens and may be producing chiefly for subsistence.

The farmers' objective of market participation is evaluated against variables like farm implements, farm experience, access to markets, reasons for production, membership of the household in any farmers association, membership of the household in one of the irrigation projects or plots in the area as well as total land cultivated. A non-parametric correlation model was used to establish whether there exist some relationships between sets of selected marketing and production variables extracted from the complete dataset. Specifically, the two-tailed Pearson‘s correlation analysis was computed to indicate the strength and direction of the linear relationships (Tables 8.5) rather than to assess causality. Correlation quantifies the extent to which two quantitative variables, X and Y, go together. When high values of X are associated with high values of Y, a positive correlation exists. When high values of X are associated with low values of Y, a negative correlation exists. The sign of the correlation coefficient determines whether the correlation is positive or negative. The magnitude of the correlation coefficient determines the strength of the correlation.

As has been highlighted in the foregoing chapters, the study aimed to explore the role of water use patterns in transition from subsistence farming to market oriented production. Major contributors to the market participation were assumed and correlation tests were done for all the targeted variables. The variables include: farm experience, source of capital, land cultivated, membership on farmers' association, membership on irrigation scheme or food plots, access to markets and type of irrigation. The results are presented in Table 8.6.

Looking at the results more directly relevant to the question of market participation, the estimates took off from a few basic assumptions. First, the assumption was that the more experience the farmer has in farming, the more he/she is likely to adapt to different farming enterprises which result in enhanced participation in the market. However, survey data indicated that 52% of sampled famers did not have much experience on farming. As such, Pearson's correlation coefficient was negative in relation to households' choice of market participation (r= -0.057) as well as level of market participation (r= -0.144). However the correlation was statistically insignificant (p= 0.525 and p=0.112 respectively). The relationship between farming experience and market participation decision is very weak (r=0.057), implying that the variables are independent and can be modelled together.

Membership of farmers' association was also considered to have an influence on market participation decision. Collective action as measured by belonging to farmers' association was expected to have a positive linear relationship with market participation. Cooperation with experienced commercial farmers lowers transaction costs as it enhances opportunities for information sharing. However, survey data indicated that 79% of the farmers do not belong to any association. Some farmers indicated that they are still initiating membership of an association or establishing a new group. As such, Pearson's correlation coefficients were negative (r=-0.217) in relation to market participation at 5% significance level (Table 8.6).

Table 8.6: Correlation matrix of explanatory variables used in models

Variables	GENDER	AGE	MARITAL	EDUC	EMPLO	FARMEXP	LANDCULT	MEMBERT	TYPIRIG	PARTIC	PARTLEVE	MAKTOUT1
GENDER	1											
AGE	.109	1										
MARITAL	.079	.218**	1									
EDUC	-.116	-.439***	-.166*	1								
EMPLO	-.135	-.164*	-.119	.149*	1							
FARMEXP	.095	.210**	.153*	-.043	-.062	1						
LANDCULT	.180**	.003	-.046	.037	-.034	.061	1					
MEMBERT	.179**	.046	-.023*	-.033	-.069	-.236***	.184**	1				
TYPIRIG	.016	-.120	.024	-.035	-.078	-.422***	-.056	.430***	1			
PARTIC	.156*	-.090	.125	-.050	.031	-.120	.132	.192**	.363***	1		
PARTLEVE	.089	-.007	.137	-.051	-.003	-.124	.185**	.140	.263***	.646***	1	
MAKTOUT1	.124	-.045	.174**	-.014	-.022	-.151*	.138	.235***	.426***	.649***	.848***	1

Where: *** significant at 0.01 level (2-tailed); ** stands for significant at the 0.05 alpha level; . *stands for significant at the 0.10level (2-tailed).
Source: Field Survey (2012)

Based on the feedback from the correlational analysis (Table 8.6), the initial assumptions of the determinants of the market participation within the smallholder sector. The dichotomous dependent variable of market participation (1=Yes, 0 otherwise) was defined and the starting explanatory variables consisted of a range of demographic, production and marketing data obtained from the farm-level interviews. The results are presented in Table 8.7.

Table 8.7: Binary logistic regression results on market participation choice

Variables	**Coefficient**	**Standard error**	**Wald**	**Significance (P-Value)**	**Odds Ratio**	**95.0% C.I. for odds ratio**	
						Lower	Upper
Level of education (EDUC)	-.672	.653	1.059	.303	.511	.142	1.836
Membership on farmers association (WAYFARM)	-.672	.750	.804	.370	.510	.117	2.219
Membership on irrigation scheme(MEMBERT)	-.351	.872	.162	.687	.704	.127	3.885
Access to Markets (MAKTOUT1)	4.046	.869	21.667	.000***	57.179	10.407	314.153
Type of irrigation used (TYPIRIG)	1.398	.766	3.332	.068*	4.046	.902	18.150
Crops grown (CROP1)	-1.116	.747	2.229	.135	.328	.076	1.418
Ability to sustain production (SUSTPRD)	3.601	.918	15.392	.000***	36.652	6.063	221.558
Constant	-3.664	1.117	10.760	.001	.026		
Overall prediction		57.03					
Participants		57.03%					
Non participants		42.9%					
-2Log likelihood		83.188					
Cox & Snell R Square		.512					
Nagelkerke R Square		.687					
Hosmer and Lemeshow Test (8)		8.228	(P=0.313)				

*Where: ***1% significant; **5% significant; and *10% significant*

Source: Field Survey, 2012

Generally, the coefficient values measure the expected change in the logit for a unit change in each independent variable, holding all other independent variables constant. The sign of the coefficient indicates the direction of influence. A positive value indicates an increase in the likelihood that a farmer would change to the alternative option, that is, market participation. On the other hand, a negative value shows that it is less likely that a farmer would consider the market participation. Therefore, in this study, a positive value implies an increase in the likelihood of market participation. Coefficients close to zero indicate that an association between the predictor and binary response may not be important. Odds ratio is used to interpret the effect of predictor variables on the binary response. Odds ratio corresponds to the likelihood of realizing a certain outcome by the one unit change in the explanatory variable. The initial binary regression model is as follows:

Logit (P_i) = (P_i/P_i) = β_0+ β_1 EDUC + β_2WAYFARM + β_3MEMBERT + β_4MARKTOUT1 + β_5 TYPIRIG + β_6CROP1 +β_7SUSTPROD +E_t

After removing insignificant variables access to market (MARKTOUT1), type of irrigation used (TYPIRIG) and ability to sustain production (SUSTPROD) remain as the main factors that have an impact on the binary response, therefore the final binary logistic regression model is as follows:

Logit (market participation) = -3.664 + 4.046MARKTOUT1 + 1.398TYPIRIG + 3.601SUSTPROD+ 1.117

The logistic regression of the market participation on a set of explanatory variables correctly predicted more than 57% of the observed variation in comparing participants and non-participants.

8.4.2 Factors Affecting Quantity Sold

For those who are already accessing markets, there can be important differences in the quantity they sell out of marketable surplus. More will be sold if (a) the farmer produces more, (b) marketing facilities are adequate, (c) the requirement for home use/consumption is not too high (d) more cash is desired, among other reasons. Such differences are important and have implications for livelihoods for the small farmer.

Policy to improve the contribution from farming towards household livelihood will be enhanced by knowledge about what factors play a role in these quantity decisions.

For that reason, the truncated regression model was fitted to the whole data to identify the factors that influence the decisions taken by those farmers who are actually selling. This procedure allows the policy maker to gain knowledge as to the extent to which participation in the relevant process falls within the desired level. For instance, it is not enough to have market access or participate in markets if the farmer is only able to sell a small quantity that hardly meets poverty reduction needs. For poverty alleviation to be realized, there has to be effective market participation and it has to be sustained. That level of analysis, while necessary, was however not done in respect to the present study and might be considered at a later stage possibly by tracking the same farmers over time to assess the quantities of output they are able to send to the market and successfully sell at a profit.

The results suggest that market access and membership of irrigation scheme are important determinants of selling at optimal levels. An improved market access would result to market participation as well as increased level of market participation. This is most probably through positive improvements in market infrastructure such as road networks, information systems, market facilities for storage and preservation and security, among others. This implies that there will be an upward trend in commercialization of communal agriculture in rural areas if those facilities are provided alongside efforts to enhance their use of improved technology and expand output. The results suggest that type of irrigation used has some modest impact on commercialisation of communal agriculture since it was found to be statistically significant at 10%. The study concludes that improved market access will significantly lead to high level of commercialisation.

Table 8.8: Results of truncated regression analysis of determinants of quantity marketed

Variables	Coefficient	Standard error	Z-Value	P-value	95 % confidence interval	
Farming experience	.0593428	.0578304	1.03	0.305	-.0540027	.1726882
Source of capital	-.0850788	.0854976	-1.00	0.320	-.252651	.0824934
Membership on irrigation scheme	-.2158865	.1141262	-1.89	0.059**	-.4395698	.0077968
Crops grown	.1078589	.1038239	1.04	0.299	-.0956321	.31135
Access to Market	.7274231	.0793906	9.16	0.000***	.5718205	8830257
Ability to sustain production	.0493991	.0654855	0.75	0.451	-.0789502	.1777483
Training obtain	.0772713	.0600212	1.29	0.198	-.0403681	.1949107
_cons	.0538074	.1179072	0.46	0.648	-.1772865	.284913
Number of observation		70				
Wald chi2(7)		102.06				
Log likelihood		23.500113				
Prob>chi2		0.0000				
Number of truncated observations		58				
***significant at 1% level						
** significant at 5% level						
*significant at 10% level						

*Where: *** = significance at 1%; ** = significant at 5%*

Source: Field Survey, 2012

8.5 Contribution of Farming within Available Food Value Chains

The food value chain denotes a process and a transition. An agricultural commodity is transformed from the inputs that generate it in the first instance and, through the actions of several actors working in concert, turns into something that is desired and utilized to satisfy a need. The definition attributed to Muchara (2011) which sees the food value chain as a concept that describes the links and interactions among stages and activities involved in the transition from food production to consumption is an apt one and carries all the connotations of value creation and value enhancement and how those are manifested and can be determined and measured. From this standpoint, a food value chain can be said to incorporate the commodity, the activities involved in its transformation, the actors and their diverse roles and responsibilities, and the final outcome or end-point of the link or chain. The process of describing the food value chain in order to properly situate the commodity within its unique network of activities, actors and value structure is referred to as "value chain mapping" (M4P, 2008; Wardley, 2015). In order to determine the contribution of the selected commodities to livelihoods, it is necessary to map the value chain that relates to that commodity and understand who does what and how their contributions can be enhanced for the benefit of the end users or beneficiaries. For the smallholder system where little or no differentiation exists between the farm and the family and the system is characterized by multiple products that result from the involvement of multiple actors playing multiple roles, value chain analysis is best approached through stakeholder analysis.

8.5.1 Stakeholder Analysis

In the context of the participatory learning approach required for this deliverable, a qualitative assessment was conducted to map the stakeholder structure for the farming system and identify and map their roles and responsibilities. This is called "Stakeholder Analysis". Relevant stakeholders were identified through semi structured interviews in order to gain insight into stakeholder role and interests. Given its cultural significance and role in the dietary system of the project areas, maize is the principal commodity for which the value chain mapping is conducted. However, due to the multi-product structure of the economic life in the area, the value chain is described for the entire agricultural system and the stakeholder analyses is treated similarly. The stakeholder analysis also revealed the relationship, as well as the influence that they have on the irrigation scheme. This exercise resulted in a large amount of qualitative information that was subjected to a comprehensive content analysis to construct two kinds of matrices that are vital to understanding stakeholder dynamics, namely the stakeholder role matrix and the stakeholder perception matrix. The specific functions of these tools in the context of value chain analysis and assessing the contribution to livelihoods will be explained.

8.5.2 The Stakeholder Role Matrix

The analysis resulted in a stakeholder role matrix which is presented in Table 8.9 for Melani Village and Table 8.10 for Qamata. The stakeholder role matrix identifies the stakeholders and their relative importance and defines their respective roles within the chain.

Table 8.9: Stakeholder role matrix for Melani

Stakeholder	Key stakeholder	Role/s
Nompumelelo and Melani Farmers	Yes	Production activities at farm level
DRDAR	Yes	Provide extension services to the farmers
DWAF	Yes	Authorization of irrigation water to the schemes
Amathole municipality	No	Provide water for consumption

Source: Field Survey, 2012

Key stakeholders are those individuals that are directly influential or will be directly impacted by the changes that occur within the system (NARDTT, 2009). Machete *et al*. (2004) linked low crop yields to limited knowledge and lack of skills in crop production among farmers. Hence it is important that farmers receive regular training such as weed control, water management, fertilizer application and plant population management, late planting and choice of cultivar, etc. It is encouraging that DRDAR provides this training as is depicted in the table above. The table further recognizes the role of the Department of Water Affairs (DWAF) to provide water for irrigation purposes; however, it is the responsibility of all stakeholders involved to ensure that water is used and managed efficiently and effectively.

The complexity of the value chain is also reflected in the number and diversity of the stakeholders and the nature of the roles they play. It is obvious from Tables 8.9 and 8.10 that spatial differences exist in stakeholder diversity and roles; while Melani Village has few stakeholders involved in the agricultural value chain, the situation is different in Qamata where a wide range of groups and individuals were identified.

Table 8.10: Stakeholder roles matrix for Qamata

Stakeholder	Key Stakeholder	Roles
Farmers	Yes	-Involved in crop farming activities
Producers Assembly (PA)	Yes	-Controls ploughing of the land -Distributes inputs (seed, weedicide, etc.) -Organises stakeholder meetings -Source funds. -Develops business plans for the scheme.
Department of Rural Development and Agrarian Reform (DRDAR)	Yes	Provides funding for: - Inputs (fertiliser, seeds) - Equipment/Implements (tractors, etc.) - Training and Technical advice - Infrastructure (fencing dams and fields) - De-bushing
Land Affairs	Yes	Provides funding for : -Infrastructure (fencing) -De-bushing -Input supply (seeds)
Department of Water Affairs (DWA)	Yes	-Refurbishment of dams -Control water from Lubisi dam to dams
Intsika Yethu Local Municipality	No	-Provides water for domestic use
Eastern Cape Rural Development Agency (ECRDA)	Yes	-Manage funds from the funders - Provide training
PANNAR	Yes	- Provide training on maize production technique
National Department of Agriculture (NDA)	Yes	- Provide Lucerne production technique -Inputs provision
Chris Hani District Municipality	No	Provides for Section 6 (co-operative) - Financial assistance - Auditing - Farm equipment (pivots, planter, etc.)

Source: Field Survey, 2012

8.5.3 Stakeholder Perception Matrix

Apart from specifying the roles of the stakeholders in the value chain, the stakeholder analysis also attempts to examine the scope for the stakeholders to play their assigned roles. Stakeholder perception matrix was used to establish the stakeholders' perception on the reasons the farmers in the scheme are not transcending to large scale production and how they think this situation can be improved. As was the case in respect of the analysis of stakeholder roles, the stakeholder perception matrix was prepared separately for Qamata and Melani areas.

Table 8.11: Stakeholder perception matrix for Melani

Stakeholder	Perception on challenges	Perception on solution
Farmers	Limited support from government institutions Lack of infrastructure Limited access to market	Government should provide funding to build infrastructure and training Farmers should produce at the same time so they can have a reliable market
DRDAR	Lack of government participation in the scheme No visible progress Most of the people working on the scheme are too old and there is lack of youth participation in the scheme Lack of farmer organizations	Government should provide farmers with funding. Social development could assist and other stakeholder to provide them with training and funding. Farmers must form organizations that will help them to have access to government resources.
DWAF	Expectation of irrigation water rights without following the proper channels.	Scheme should be initiated before water rights can be granted

Source: Field Survey, 2012

The indication from the analysis was that while the stakeholders were distinct with perceptions that bore their separate identities in Melani, the boundaries in the case of Qamata were rather blurred and it was more difficult to treat their perceptions as characteristics that were unique to each entity.

Table 8.12: Stakeholder perception matrix for Qamata

Stakeholders	Perception on cause of problem	Perception on solution
Farmers, PA, DRDAR, Land Affairs, Intsika Yethu , Chris Hani , DWA.	-No training and advice by Extension officers	-Resident Extension officers -Training and guidance for the PA -capacitation of people in the Water users Association regards to water use
	-No organized market	- Establishment of organized market - Partnership with Bilatye piggery to build a feed mill
	-Inadequate financial assistance -Production cost is high	-Advertisement of the scheme to attract more funders

Stakeholders	Perception on cause of problem	Perception on solution
	-Inadequate equipment	-More equipment (e.g. tractors)
	-Lack of credit facilities	-Availability of credit facilities
	-Conflict between councilors and chief	-More financial assistance
	-People are not willing to work	- Encouraging farmers to work with reference to times when the scheme was functioning properly.

Source: Field Survey, 2012

The general perception of all the stakeholders in Qamata as indicated in Table 8.12 is that inadequate funds and equipment were the major obstacles to the transition from homestead gardening to smallholder irrigated farming. Lack of organized market was also identified as a factor contributing to farmers not scaling up production and/or commercializing. The farmers emphasized that they lack the motivation to produce on a large scale since there was no target market in which to sell their produce. They are therefore compelled to remain at the level of subsistence farming.

8.6 Contributions to Available Food Value Chains and Improved Livelihoods

Against the background of the stakeholder structure, the roles they play, and their perceptions about challenges faced by the sector and how these can be resolved, a SWOT analysis was performed, drawing material from the perception matrix. This is the means for evaluating the potential of the system to improve livelihoods as seen by those who are most intimately involved in it. The results are presented in Figure 8.8. As Figure 8.8 shows, the strengths identified were vast land, adequate water and rich soils. These natural assets present opportunities of commercial level of production as well as livelihood improvements. In addition, better contribution to food value chain can be derived as an opportunity to improve livelihoods. However, there is a need to address the identified challenges to enable livelihood improvement and farmers meeting up to large scale production.

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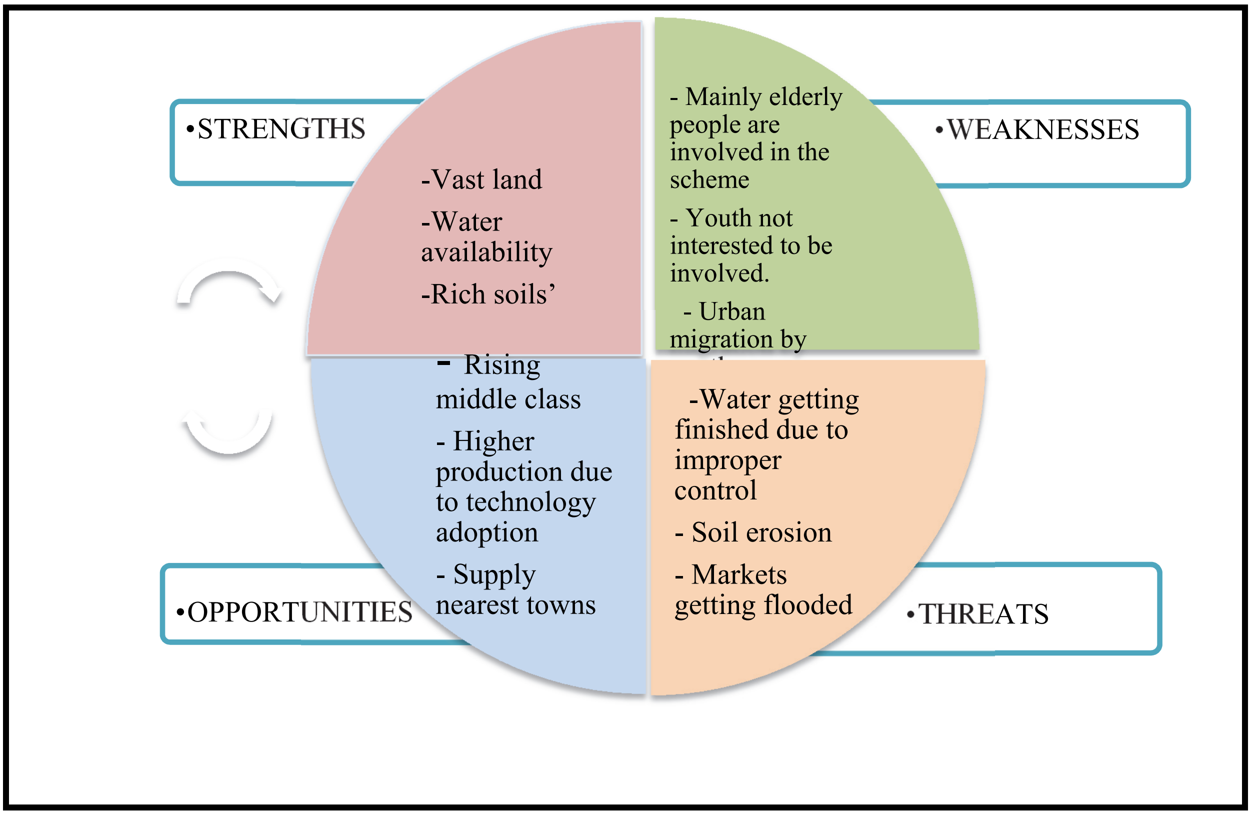

Figure 8.8: SWOT analysis of food value chains

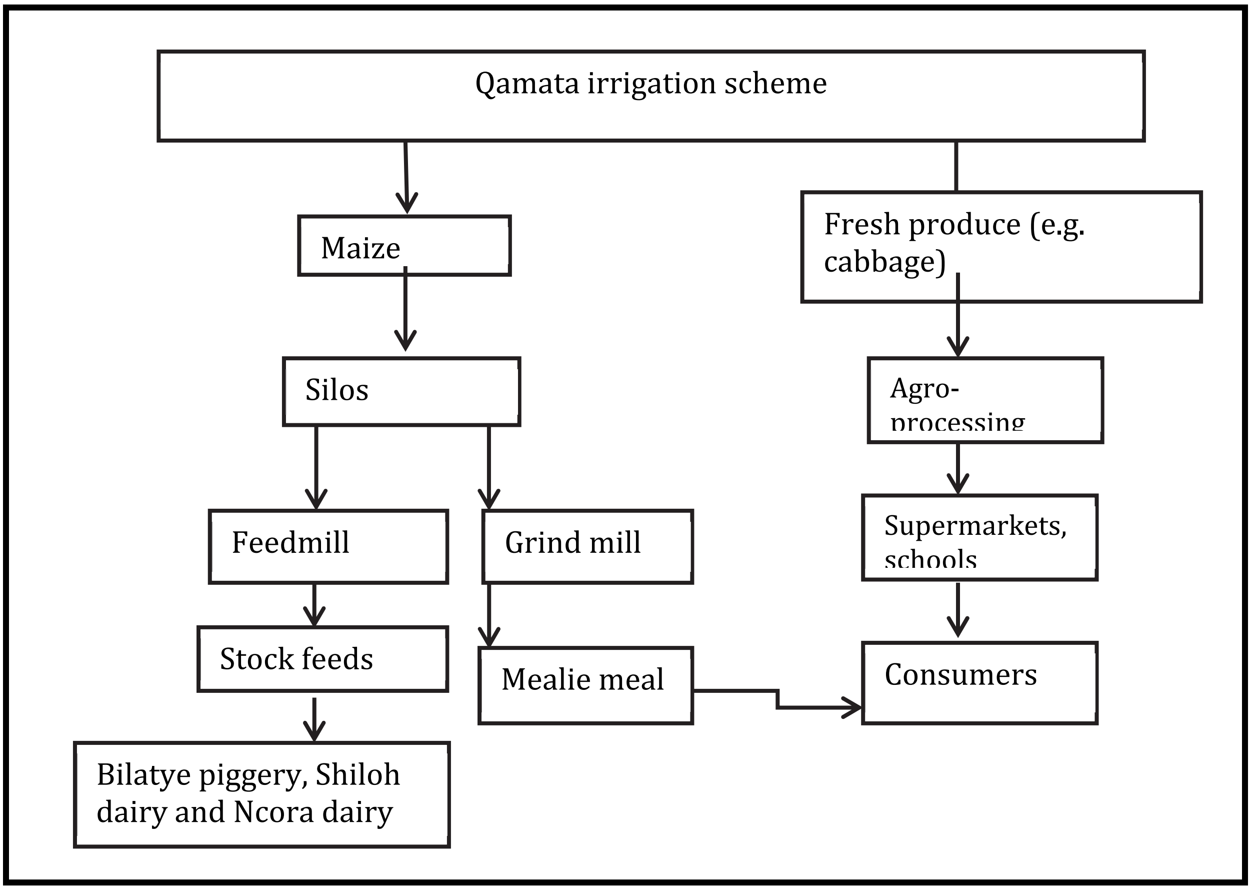

Figure 8.9: Enhancing contribution to available food value chains by the Qamata Irrigation Scheme

8.7 Chapter Summary

This chapter presented findings in relation to the third project specific objective that sought to determine the sources of livelihoods and opportunities to improve contribution by farming within available food value chains. The chapter began by profiling the resource endowments of the study area and how resource ownership is distributed among the homestead gardeners and smallholder irrigators that were enumerated. The chapter then proceeded to outline the occupational structure and employment situation in the study area and the factors that influence livelihoods as well as their outcomes, using econometric, statistical and graphical techniques to elucidate issues of market participation and opportunities to improve the contribution of farming within available food value chains.

CHAPTER 9

ASPIRATIONS AND GOALS FOR TRANSFORMATION OF SMALLHOLDER FARMING

9.1 Introduction

This chapter sums up the findings with respect to the fourth specific objective of the study, namely, the determination of the aspirations and goals of farmers to expand irrigated crop production from homestead gardens to irrigated plots. The concern that is growing among policy makers and development practitioners is that years of implementation of agrarian reform in South Africa is not producing the much anticipated growth in black agricultural entrepreneurship. It had been expected that the change in the legislation regarding land ownership would mean that black South Africans would increase their land holding and become more commercialized and market-oriented. Studies have shown that this is not happening. But the reasons why that is the case remain largely anecdotal as most of the studies have emphasized economic determinants. While questions regarding goals and aspirations have often been asked for the agricultural sector, no such systematic enquiry has been undertaken in the context of the ongoing agrarian reforms in South Africa. This chapter presents results of an attempt to catalogue these aspirations and goals within the farming system of the communal areas enumerated. The resulting data are then analyzed by Factor Analysis procedures to extract principal components which are then regressed against production indices as well as farmer characteristics to determine both their influence on the chosen measures of farm performances well as causal factors.

9.2 Cataloguing Farmers' Aspirations and Goals

In order to effectively catalogue the set of goals and aspirations held by people, it is important to standardize the definition of these terms. To a large extent, this has been done in the first two chapters of this report. The consensus is that the farming goals reflect the production possibilities on the basis of available resources and know-how in the current production period, while the farmer's aspiration refers to what the farmer considers as the options that can be pursued to improve any perceived undesirable current situation. Related to those two concepts is the notion of "values" which

Schwartz (2003), Bilsky and Schwartz (2008) and others see as those goals that are widely accepted by a group of individuals or institutions as standards to regulate human conduct. Given those definitions and conceptions, the farmers were enumerated in accordance with the procedures outlined in the methodology. The goals of the rural smallholder farmers were estimated using a 4-point Likert scale where "1" represents the “least important goal” and "4" stands for “most important goal”. Respondents were asked to indicate the level of importance of the 21 attitudinal statements related to farmers’ goals.

What has emerged is that some farmers desire an enhanced status such as to be recognised as the top producer of a given crop. Often, this can be the starting point for higher goals such as accumulation of wealth. In general, the farmer’s value system defines his/her goals and the goals define the limits and means of attaining a desired endpoint or performance. Most studies assume that farmers’ goals are limited to profit maximization with little or no consideration being given to the possibility of the existence of other goals (Padilla-Fernandez and Nuthall, 2001). This mindset that limits farmers’ goals to profit maximization have implications for official decisions regarding what sort of intervention may be appropriate for a particular rural area or situation. One problem with this prejudicial mindset is that the wrong reasons are adduced for the supply response in the farming system or the rate of adoption of improved practices, etc., with the result that feasible solutions are never explored or introduced. The expectation is that this study would provide a basis for designing systematic investigations to more accurately profile the farming systems and understand the real circumstances of the farmers.

The responses to the 21 questions were analyzed and used to derive scores which are presented in Table 9.1.

Table 9.1: Average item scores of farmers' goals and aspirations

	Smallholder Irrigators (n=75)		Homestead Food Gardeners (n=33)		Overall Sample (n=108)		T-Test
Intrinsic	Mean	SD	Mean	SD	Mean	SD	
Self-employed and independent	3.33	0.53	3.55	0.51	3.44	0.52	-1.98**
Like farming life	3.36	0.48	3.85	0.36	3.61	0.42	-5.79***
Have more leisure time	2.76	0.79	2.36	0.82	2.56	0.81	2.38**
Expressive							
Be recognised as top producer	2.69	0.79	2.58	1.06	2.64	0.93	0.64
Be recognised as a leader in the technology adoption	2.59	0.99	2.33	1.05	2.46	1.02	1.20
Be recognised as a specialist in growing these crop	2.64	0.92	2.61	0.97	2.63	0.95	0.17
Be recognised as owner of the land	2.79	1.02	3.12	0.86	2.96	0.94	-1.76*
Social							
Involve family in decision-making	2.87	1.02	3.46	0.79	3.17	0.91	-3.24***
Leave business for the next generation	2.77	0.83	2.97	0.77	2.87	0.80	-1.19
Provide employment to rural people	2.89	1.03	3.27	0.80	3.08	0.92	-2.07**
Belong to farming community	2.96	0.67	3.03	0.85	3.00	0.76	-0.46
Inherited the farm	3.00	0.96	3.42	0.87	3.21	0.92	-2.18**
It is part of culture (artefacts and adornment)	2.97	0.76	3.30	0.47	3.14	0.62	-2.64***
Contacts with people, transfers of Information	3.08	0.54	3.21	0.82	3.15	0.68	-0.99
Social participation: meetings and rituals	3.24	0.59	3.12	0.86	3.18	0.73	0.84
Avail time to spend with my family	2.84	0.62	2.91	0.91	2.88	0.77	-0.46
Instrumental							
Increase standards of living	2.97	0.66	3.00	0.94	2.99	0.80	-0.17
Increase maximum farm income	3.25	0.64	2.97	0.77	3.11	0.71	1.99**
Expand the business	3.15	0.59	2.82	0.95	2.99	0.77	2.20**
Keep debts as low as possible	3.28	0.69	3.24	0.66	3.26	0.68	0.26
Accumulate wealth	2.99	0.89	2.85	1.09	2.92	0.99	0.69

*Where: ***, **and * represents significance at 1%, 5%, and 10% level, respectively. The four value orientations were taken from Gasson (1973) cited by Padilla-Fernandez and Nuthall (2001), and Harwood (1979) though some questions were restructured to suit Rural farmers of Eastern Cape. Data was elicited using a 4-point Likert scale (1 = not important to 4 very important).*

Source: Results from Field Survey, 2012.

The questions were clustered into the four value orientations reported by Gasson (1973) and now widely used by others (Hansen and Greve, 2014) as "intrinsic", "expressive", "social", and "instrumental". Smallholder irrigators scored highly (>3.0 average mean score) on goals related to instrumental values (business/developmental oriented) while homestead food gardeners attached more importance to social oriented values. Smallholder irrigators treated farming as a business and acknowledged its ability to lift them out of poverty while homestead food gardeners considered farming as cultural, family oriented and a lifestyle. Business oriented goals are instrumental in the transition from subsistence homestead food gardening to commercially-oriented small-scale irrigation farming.

In order to assess the differences in response to attitudinal statements that define a particular farmer's goal between the smallholder irrigators and homestead food gardeners, a comparative analysis based on independent T-test was conducted. The results show that the two groups of farmers are, for the most part, different in terms of their goal and value orientations.

Smallholder irrigators' major goals that have an average score above 3.0 include "self-employment and independence", "like farming life", "inherited the farm", "contacts with people as means of transferring information", and "access to social meetings and ritual". "Increased maximum farm income", "expansion of the business and keeping debts as low as possible" were also among the business oriented goals considered by smallholder irrigators and had an average score greater than 3. For homestead food gardeners, the major goals that have an average mean score of greater than 3 include the intrinsic goals like being "self-employed and independent", "farming as a lifestyle" and "being recognized as owner of the land". The social oriented goals of the homestead food gardeners include "involving the family in decision-making", "inheriting the farm", "belonging to farming community", "farming as part of culture", "making contacts with people", "accessing platforms for social meetings and rituals", and "providing employment to rural people". Further, the business oriented goals for the same category of farmers included "increased standards of living" and "keeping debts as low as possible".

The three goals considered important by smallholder irrigators more than homestead food gardeners and significantly differentiated the two categories are: "having more leisure time", "increased maximum farm income" and "expanding the business". All these were significant at 5% level. Seven goals were considered to be important to a much greater extent by homestead food gardeners than by smallholder irrigators. These goals include: "self-employed and independence", "like farming life", "be recognized as owner of the land", "involve family in decision-making", "provide employment to rural people", "inherited the farm and farming as part of culture". The T-test revealed that the differences between the two classes of farmers were all statistically significant. The expressive values emerged as non-important for both homestead gardeners and smallholder irrigators.

9.3 Principal Components for the Perceived Farmers' Goals and Aspirations

As described in the methodology chapter, factor analysis, specifically principal component analysis (PCA) was used to elicit the variables that best mirror the farmers' goals and aspirations from a vast array of attitudinal statements. The principal components distilled from these statements are presented in Table 9.2.

It was necessary to carry out variable reduction due to the large number of attitudinal questions each of which provided some insight into the goal set of the farmers. During the analysis, some statements were dropped because they failed the factorability tests based on the two statistical measures, namely the Kaiser-Meyer-Olkin (KMO) measure and the Bartlett's Test of Sphericity. For factorability, it is required that the KMO lies almost halfway between its range of 0 and 1, with the ideal minimum level being 0.6. In the case of the Bartlett's Test of Sphericity, for the factor analysis to be considered appropriate it was required that it be significant (p <0.05). Since the KMO value for this particular analysis was 0.643 and the Bartlett's Test of Sphericity was significant at 1%, coupled with the correlation matrix being above 0.3, factor analysis was implemented. Further, the Eigenvalue proportions of the variance were above the recommended value of 1.

Table 9.2: Principal components for the perceived farmers' goals and aspirations

	Farm status	**Business Oriented**	**Social Oriented**	**Independence**
Proportion of Variation (%)	25.16	19.70	14.07	9.60
Eigen value	2.767	2.167	1.548	1.056
Farmers' Goals and Aspirations	Factor Loadings			
	PC1	PC2	PC3	PC4
Self-employed and independent	-0.036	**<u>0.516</u>**	0.135	**<u>0.478</u>**
Have more leisure time	-0.070	-0.143	**<u>0.552</u>**	**<u>0.697</u>**
Be recognized as top producer	**<u>0.768</u>**	**<u>-0.352</u>**	0.208	0.044
Be recognized as a leader in the technology adoption	**<u>0.754</u>**	**<u>-0.428</u>**	-0.083	0.085
Be recognized as a specialist in growing these crop	**<u>0.853</u>**	-0.136	0.008	0.053
Be recognized as owner of the land	**<u>0.405</u>**	**<u>-0.323</u>**	**<u>-0.546</u>**	0.185
Contacts with people, and transfers of information	0.077	0.015	**<u>0.792</u>**	-0.278

	Farm status	Business Oriented	Social Oriented	Independence
Social participation: meetings and rituals	0.257	**0.589**	-0.284	**0.345**
Increase standards of living	0.193	**0.776**	-0.191	-0.030
Increase maximum farm income	**0.555**	**0.546**	0.024	**-0.300**
Accumulate wealth	**0.541**	**0.450**	**0.362**	-0.089
Kaiser-Meyer-Olkin Measure (KMO) of Sampling Adequacy = 0.643 Bartlett's Test of Sphericity Approx. Chi-Square = 342.739 df = 55 Model significance level = 1%				

Where: The bold and underlined factors > (0.3) qualify to constitute a given component. (n = 108)

Source: Results from Field Survey, 2012

Eleven out of the 21 goal and attitudinal related statements passed the two mandatory tests and were considered in the factor loading stage. The eleven goal-attitudinal statements yielded four principal components that explained 68.52% of the variation in the explanatory variables. The four principal components are farm status/expressive (PC1), business (PC2), social (PC3), and independence oriented goals (PC4).

The first principal component (farm status) displays a variation of 25.16 % in the farmers' rankings of their goals. The principal component was best described as a farm status, expressive or self-esteem oriented goal. There are six farmers' goal related statements that have estimated coefficients above 0.30 and defined this principal component. Farmers had an interest in being attached to their farm successes. All the four expressive or self-esteem related statements contribute to explaining the first principal component. In this case, the self-esteem or confidence may be of great importance to farmers for better performance as they strive to achieve these goals. Although the principal component was mainly described by the farm status/self-esteem goals, it has some elements of business oriented goals like increased maximum incomes and accumulating wealth.

The second principal component accounted for 19.70% of variation in the variables and mainly comprises business and developmental farmers' related attitudes. These include improved standards of living, increased farm incomes and wealth accumulation. Although smallholder farmers produce low output and less marketable surplus, they still view farming as one of the major sources of livelihood. Farmers at the Qamata and Tyefu irrigation scheme areas grow vegetables and maize and sell them within local markets to earn a living. The major vegetables grown for sale include cabbages, spinach, potatoes and carrots. Farmers' business oriented goals can be of great importance in boosting production and increasing marketable surplus. Farmers' business goals can therefore be incorporated in rural development programmes for improved smallholder incomes and overall welfare of the farm household.

In addition to wealth accumulation, farming activities are used as media of communication among rural communities and this can be of great importance in accumulating social capital. This principal component can be described as farmers viewing farming as a channel for improved interpersonal relations (seeking utility or satisfaction through social relations) within a given community. The farmers' social oriented attitudes form the third principal component which accounts for 14.07% of the variation in the explanatory variables. Farmers' social oriented attitudes facilitate the flow of production and market information within the farming community. Improved information flow has the potential (at least theoretically) to increase the adoption of new technologies and improved access to market information for reduced transaction costs caused by information asymmetry.

The fourth principal component generated from the farmers' goal statements could be best described as farmers' independence oriented goal and explained 9.60% of the variation in the explanatory variable. Farmers viewed farming as a source of self-employment and independence (freedom) which affords more leisure time. In turn, more leisure time and freedom affords more opportunities for farmers to participate in social events within their communities. The majority of the rural population in developing countries engage in smallholder farming as a major source of livelihood and as a source of self-employment. This attribute can be enhanced by promoting smallholder farming as business and source of self-employment among rural communities.

9.4 Aspirations and Goals and Farm/Farmer's Characteristics

Once some measure of goals and aspirations has been agreed and the major motivational dimensions ascertained, it is necessary to evaluate their relationship with key farmer characteristics to see to what extent they can be manipulated exogenously. This was achieved by examining how the farmer's and farm's characteristics are influenced by the goals and aspirations held by the farmer by means of econometric and statistical techniques. As is well-known, the farm and household are intimately linked in the smallholder setting. Therefore, anything that affects one of them also affects the other. Such a relationship can easily be established by fitting a linear model in which the extracted components of aspirations and goals are the dependent variables while the farm/farmer characteristics are inserted as explanatory variables. Four regression models were fitted as shown in Table 9.3, with dependent variables as "Farm Status", "Business Orientation", "Social Orientation", and "Independence".

Table 9.3: Regression of farmers' goals and aspirations and farm/farmers' characteristics

	Extracted Components of Farmers' Goals & Aspirations							
	Farm Status Seeking		**Business Orientation**		**Social Orientation**		**Independence**	
Independent Variables	**β**	**p-value**	**β**	**p-value**	**β**	**p-value**	**β**	**p-value**
Age	-0.010	0.267	0.003	0.755	0.020	0.091*	0.015	0.151
Education	0.061	0.012***	0.040	0.157	0.013	0.673	0.103	0.000***
Farming Experience	-0.013	0.112	0.010	0.317	-0.007	0.493	0.009	0.309
Land size	-0.215	0.028**	0.094	0.402	0.010	0.936	0.164	0.135
Crop incomes	0.000	0.017**	-0.000	0.356	0.000	0.187	-0.000	0.226
livestock Incomes	0.000	0.002***	0.000	0.361	0.000	0.411	-0.000	0.673
Remittances, social grants, pensions	0.000	0.009***	0.000	0.499	0.000	0.946	0.000	0.006***
Source of water for crop production	0.197	0.011***	0.206**	0.021**	-0.119	0.209	-0.000	0.567
Location of irrigation scheme	-0.411	0.133	-0.897	0.005***	0.671	0.049**	0.955	0.002***
(Constant)	0.001	0.999	-0.186	0.841	-1.848	0.065*	-3.124	0.001***
R^2 adjusted p-value	0.354 0.000***		0.131 0.006***		0.004 0.411		0.179 0.001***	

*Where: ****, **, * represents significance at 1%, 5% and 10% level, respectively: β = coefficients and p-value = probability value*

Source: Results from Field Survey, 2012

As Table 9.3 shows, the results point to a significant relationship between the farmer/farm characteristics and key farmer's goals. The three regression models related to farmers' goals of farm status, business, and independence are all significant at 1% level. Farm status, business and independence goals exhibited an average goodness-of-fit of the model, although the R^2 was low which is not unusual (Kisaka-Lwayo and Obi, 2012).

Determinants of farmers' farm status goal (self-esteem) include education level (years in school), crops and livestock incomes, remittance, social grants and pension, source of water for crops and amount of land owned. Education level, livestock incomes, remittance, grants and pension, and source of water for crop farming were positively statistically significant at 1% level. Incomes from crops had a positive and significant influence on farm status oriented goal at 5% level while land size had a negative but significant impact on the same goal at 5% level. Thus, increased farm incomes, remittances, social grants and pension, and access to water improves farmer's farm status/self-esteem while an increase in the amount of land owned might reduce the farmer's self-esteem. While this result is surprising, it could actually have the valid explanation that larger land-holding imposes costs beyond the means of the farmer and leads to plot abandonment and loss of prestige.

The second principal component (business oriented goal) has a positive and significant relationship with the source of water for crop production at 5% level, and a negative and significant relationship with location of the irrigation scheme at 1% level. Thus, farmers who access dam and river water for crop production are more likely to view farming as an income generating activity. Water is one of the primary agricultural resources needed in farm business especially in semi-arid areas like Qamata and Tyefu, and hence, access to more water increases the farmers' ability to diversify for increased farm production. Increased farm output may result in increased farm incomes, higher standard of living, and accumulated wealth. Further, the negative relationship between the location of the irrigation scheme and farmers' business oriented goal might explain the current perverse response to the incentives offered by favourable government policies.

Age of the household head and location of the irrigation schemes were the only farm/farmer characteristics that had a significant impact on farmers' social oriented goal. Both age and location of the irrigation scheme had a positive and significant impact on the social oriented goal at a 10% and 5% level, respectively. This means that the elderly farmers view farming as fulfilling social goals rather than as an economic activity. Such an attitude obviously comes from the experience that the activity does not yield sufficient amounts to meet household needs and those needs are largely met from other sources.

9.5 Chapter Summary

The focus of this chapter was the fourth specific objective that aimed to measure the goals and aspirations of smallholder irrigators and homestead gardeners and determine their relationships with farmer characteristics and measures of farm performance. The respondents were presented with 21 attitudinal statements each of which they scored on a 4-point Likert scale. This exercise allowed for the calculation of average items scores that ranged from 1 to 4. Following Gasson (1973) and Schwartz (2003) and others, the statements were then divided into four groups, namely “intrinsic”, “expressive”, “social”, and “instrumental” based on which the farmer groups were compared to determine statistical significance. The data were subsequently subjected to factor analysis to elicit principal components that best mirror the farmers’ goals and aspirations against which a set of farmer and farm characteristics were regressed. Important insights were derived on the nature of goals and aspirations and their roles in farmer production decisions.

CHAPTER 10

APPROPRIATE DEVELOPMENT PATHS FOR ESTABLISHING SUSTAINABLE FARMING BUSINESSES

10.1 Introduction

This chapter addresses the fifth specific objective of the study that aimed to formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes. At the outset, it was proposed to undertake an on-farm experimentation to test the alternative development paths that would have emerged from the analyses of the four preceding objectives. However, at the penultimate reference group meeting this approach was discussed and it was realized that the required time to mount a successful on-farm experiment was not available. Importantly, it was agreed that the goal of formulating and testing appropriate development paths could still be met by collecting in-depth empirical data. By conducting a counterfactual analysis, it could probably be possible to ascertain whether or not there has been a progression from the subsistence cultivation of gardens around the homestead to a more systematic and market-oriented agriculture based on irrigation water use and application of productivity enhancing technologies. The study was therefore re-designed with more comprehensive questionnaires and other data collection instruments. An important aim of the study was to determine the role of irrigation technology in the possible transition from homestead gardening to more commercial-oriented production. An analysis that precisely detects the impact of irrigation on an index of performance would show whether or not adoption of the technology would enhance the transition. In this respect, the propensity score matching was employed and the results are also presented in this chapter. In general, this chapter presents the results of the re-designed study, providing more detail on the livestock production activities and how they interact with crop production. Indications are provided of feasible enterprises for consideration based on the analysis undertaken and whether or not there is an improvement in production arising from the use of irrigation technology in the agricultural production process.

10.2 Alternative Economic Activities

A key hypothesis of this study is that alternative economic activities can influence the household's ability and willingness to transform from homestead gardening to market-oriented irrigated farming. In order to test this hypothesis, the study examined the range of economic activities carried out by the survey households. As indicated earlier, the system produces both crops and livestock. Although the project's initial focus was crop production, the importance of livestock production became apparent during the implementation of the re-designed study. It was noted that a substantial amount of livestock exchange takes place in the communal areas although this is largely informal within the rural sector. People seek livestock for rituals and other socio-cultural reasons. Households that do not own livestock obtained them from their neighbours in exchange for cash or as gift. Since for all practical purposes, this transactions seems to be the only activity with a reasonable chance of injecting appreciable wealth into the village, it was decided to incorporate livestock into the study.

Since the project explicitly examined the question of entrepreneurship and whether or not there is sufficient levels of this to drive investment behaviour among the smallholders, it was important to look more holistically at what they do rather than focusing on only one part of the system. As stated earlier, evidence was strong on the extent to which livestock contributes to the household economy in a number of ways and each of these needs to be understood and assessed.

It is desired to know for each household, what animals are being kept, how many of them, and the structure of ownership. Also, what costs are involved in the enterprise and how they are distributed across the activities related to the production of that commodity. Of course, it is crucial to understand the nature of the livestock being produced. The study therefore collected a wide range of information from the farming households on livestock kept, the number of each livestock, the difference between actual and expected stock levels, and the reasons for the current status. The livestock included in this phase of the study are cattle, sheep, goat, pigs and poultry based on preliminary studies which showed they are the main animals kept by smallholder farmers. The findings on the livestock ownership pattern is provided below.

10.2.1 Cattle Ownership

Cattle are a highly regarded asset that the people use for diverse purposes. It is slaughtered for meat and sales and widely used in the farm as a work animal and for transporting items for the farm household. Traditionally, it is highly valued as the currency for the payment of bride prices, known as *lobola*. Marriages are incomplete without the payment of *lobola* which is graduated according to the value placed on the bride by the family; brides who have never been married before and do not have a child out of wedlock are usually priced higher than those who have had a child or children or have been divorcees. The number of cows asked as bride price is usually determined by this consideration among others. When households keep cattle, they have all the foregoing uses in mind and for this reason animal offtake for market sale may often be lower than what would ordinarily be considered optimal. Table 10.1 presents the cattle ownership pattern by gender of the head of the household and suggests that more men than women keep cattle in the farming system.

Table 10.1: Cattle Ownership by gender

		Cattle keeping		Total
		No	Yes	
Female	Count	7	32	39
	% within Gender	17.9%	82.1%	100.0%
Male	Count	12	45	57
	% within Gender	21.1%	78.9%	100.0%
Total	Count	19	77	96
	% within Gender	19.8%	80.2%	100.0%

Source: Field Survey 2015

10.2.1.1 Size of Intended Cattle Herd

While the number of cattle kept by a household is indicative of the household's current socio-economic status, it does not tell much about the potential of the household for enterprise and the possibilities that the family can explore. It was therefore decided to ask the respondents whether or not they are satisfied with the number of cattle they currently keep and how much more they would want to keep should they have the opportunity to do so. The results are displayed in Table 10.2.

Table 10.2: Distribution of households by number of cattle they wish to keep and Gender

No. cattle wished to keep	Male Respondents	Female Respondents	Total
0	6	6	12
2-5	2	3	5
6-10	12	13	25
11-20	19	9	28
>20	14	3	17
Total	53	34	87

Source: Field Survey, 2015

As Table 10.2 shows, many households desired to keep more cattle than they currently hold, although it seemed that women were less enthusiastic about larger herds than their male counterparts. Given the arduousness of cattle husbandry in the traditional system, this gender effect seems reasonable. A statistical test of significance was conducted (Table 10.3) and the indication is those differences are indeed very important both for the Likelihood Ratio referring strictly to the number classes, and the linear by linear association (p=0.046 and p=0.013, respectively).

Table 10.3: Chi-Square Tests of differences between men and women in herd size Preferences

Analytical Tools	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.445[a]	22	.233
Likelihood Ratio	34.268	22	.046
Linear-by-Linear Association	6.214	1	.013
N of Valid Cases	87		

Where: [a]41 cells (89.1%) have expected count less than 5. The minimum expected count is .39.

Source: Based on SPSS Analysis of Field Survey Data, 2015

10.2.1.2 Reasons for Difference between Actual and Intended Herd Size

In order to better appreciate what motivates the households in relation to herd size preferences and what obstacles they perceive as binding constraints, an open-ended enquiry was posed to the respondents to indicate why they responded in the way they did. The respondents provided a wide variety of reasons for the differences as presented without annotation in Table 10.4. As the results show, a total of 29 different reasons were proffered by the respondents. These reasons relate to income needs, farming constraints, environmental concerns, skills and knowledge, socio-cultural reasons, support to children and family, difficulties experienced with the production process, and a plethora of other reasons.

Table 10.4: Reasons for differences on number kept and wish to keep

Codes used	Reasons provided by respondents
1.	Income
2.	Assist in farming activities
3.	For manure
4.	Home consumption
5.	Ritual purpose
6.	Entertainment
7.	For social status
8.	Payment of school fees
9.	Only when necessary
10.	Sell more in the village because it is cost effect
11.	Livestock feeding
12.	Highly demanded
13.	Insufficient land
14.	Shortage of grazing land
15.	Drought
16.	Difficult to keep and expensive to care for
17.	Theft
18.	Satisfied with the current number
19.	Not at the stage to be sold
20.	Use as work animals
21.	No market
22.	Not produce enough
23.	Lack of resource
24.	Old age constraints
25.	Need to keep a manageable number
26.	Difficult to manage and control
27.	To increase number
28.	4 and 11
29.	Expensive to cultivate

Source: Field Survey, 2015

These reasons were subsequently clustered around four main categories, namely income/market reasons, social/cultural reasons, technical constraints, and institutional constraints. The clustering was based on a workshop held in the Learning Centre on Monday, 16 February 2015 with the participation of the Project Leader, a Reference Group member, and all the post-graduate students supported under the project. These responses and the clustering were similarly tested at the Feedback session held on Thursday, 26 February 2015 at the Melani village where villagers who had been enumerated during the field survey were presented with the preliminary findings of the study and provided opportunity to discuss their veracity and make recommendations as to how the emerging problems could be addressed. The clustered reasons are presented in Table 10.5.

Table 10.5: Clustered reasons for differences on number kept and wish to keep (cattle)

Clustered Reasons	No. of households	Valid Percent	Cumulative Percent
Income/Market	49	81.7	82.0
Social/Cultural	1	1.7	83.6
Technical reasons	6	10	93.4
Institutional reasons	4	6.7	100.0
Total	61	100.0	

Source: Field Survey 2015

As the results show, the main reason for the differences were income/market, social/cultural, technical as well as institutional reasons. The interesting finding is that income/market related matters are the major considerations in whether or not the smallholder scales up the cattle herd. According to the results, about 82% of the respondents were influenced by income and market factors in deciding the size of their herd and mentioned related factors as reasons for the difference between what they currently hold and how much they would have wished to hold. Farmers who responded to this question mentioned such reasons as income, home consumption, payment of school fees, entertainment, to meet high market demand, to expand production, to increase herd numbers, among others. These responses are either directly or indirectly related to income and market questions. If for instance a farmer made a decision in order to be able to entertain guests, it was surmised that this decision was aimed at generating sufficient output to enable him or her to pay for entertainment of guests which invariably relates to income. In the same way, decisions made to be able to pay school fees are considered an income-based decision. A small number of respondents gave reasons that were clustered around technical constraints or motivations. According to the results, 10% of the sample that responded was either constrained by lack of capacity and skills, or by drought or the physical arduousness of the tasks. These were clustered as technical reasons. Institutional and socio-cultural reasons ranked high among the smallholders. Without a doubt, the incentive effect of income and livelihoods enhancement is very high among the smallholders enumerated in the survey period. Such a pattern of response to economic incentives points to the economic rationality of the respondents and the fact that they motivated by the need for increased income and improved livelihoods. The response pattern in the case of the other stock types and the cropping system will need to be similarly evaluated in order to come to a conclusion about the behavior of the smallholders with respect to those. But even in respect to one commodity, the fact that farm allocation and production and marketing decision would depend on the motivation for enhanced income spoke eloquently of the extent of entrepreneurship in the system.

10.2.2 Sheep Husbandry

Sheep plays a very important role in the farming system of the people of the province. Sheep is kept for meat and for wool. In 2011, it was estimated that there were 17 000 wool sheep farmers living in the former Transkei and Ciskei regions. According to the literature, each of these small farmers keep between 20 and 30 sheep on average.

10.2.2.1 Sheep Ownership

In view of the economic and cultural significance of sheep, this study examined the ownership patterns among the smallholder farmers enumerated. The results are presented in Table 10.6. As in the case of cattle, the ownership pattern among men and women was specifically explored. As expected, more men than women kept sheep in the survey period. The preponderance of men among the owners of sheep is not surprising given the pattern in other areas of rural economic life where it seems that men are dominant in activities with reasonably good prospects of income. But as Table 10.7 shows, these relationships are not significant statistically.

Table 10.6: Sheep ownership by gender

Gender	Sheep Keeping		Total
	No	Yes	
Male	11 55.0%	40 64.5%	51 62.2%
Female	9	22	31
	45.0%	35.5%	37.8%
Total	20	62	82

Source: Field Survey 2015

Table 10.7: Chi-Square tests of differences between men and women in the survey area

Test statistics	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.582[a]	1	.445
Continuity Correction	.248	1	.618
Likelihood Ratio	.575	1	.448
Fisher's Exact Test			
Linear-by-Linear Association	.575	1	.448
N of Valid Cases	82		

Source: Based on SPSS Analysis of Field Survey Data, 2015

10.2.2.2 Difference between Actual and Intended Sheep Herd

Given that households often do not meet their own expectations in terms of the stocking levels, the question was included in the interviews regarding the number of sheep they kept and how many they wished to keep. The responses were recorded as the total number that they actually kept and wished to have in their herds and this was recorded against the number of households reporting those levels. The results, along with the associated tests of significance, are presented in Tables 10.8 to 10.11. Significant gender differences were observed in these numbers as the tables clearly show.

Table 10.8: Gender distribution of number of sheep actually kept

Number Class	Male	Female	Total
Up to 20	22	8	30
21-40	6	5	11
21-60	5	6	11
>60	10	8	18
Total	43	27	70

Source: Field Survey 2015

Table 10.9:Chi-Square Tests for numbers of sheep households actually kept

Test statistics	**Value**	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	50.691[a]	42	.168
Likelihood Ratio	67.718	42	.007***
Linear-by-Linear Association	2.730	1	.098
N of Valid Cases	70		

Source: Based on SPSS Analysis of Field Survey Data, 2015

Table 10.9: Gender distribution of number of sheep wished to keep

Number Class	Male	Female	Total
Up to 20	9	8	17
21-100	23	8	31
101-200	11	3	14
>200	1	7	8
Total	44	26	70

Source: Field Survey 2015

Table 10.10: Chi-Square Tests for numbers of sheep households wished to keep

Test statistics	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.166[a]	25	.184
Likelihood Ratio	38.982	25	.037**
Linear-by-Linear Association	3.928	1	.047**
N of Valid Cases	70		

Notes: [a]. 51 cells (98.1%) have expected count less than 5. The minimum expected count is .37.

Source: Based on SPSS Analysis of Field Survey Data, 2015

10.2.3 Production of Other Livestock Types

Apart from cattle and sheep, the study examined the production activities of the survey households in relation to other economically and culturally important domesticated animals. On the basis of the preliminary investigations, it was decided to include goats, pigs and poultry. In the case of poultry, the information was disaggregated by type of poultry that is chicken, duck, guinea fowl, ostrich, etc. However, for reason of time, those results will be presented later during finalization of the report. At this stage, Tables 10.12 to 10.17presents the finding in respect to the actual stock levels and the prospective stock levels. The clear indication is that households were generally keeping less stock than they would have wished to keep. As to their reasons for the difference between what they did and what they would have wished to do, the results in Table 10.4 equally applied as it was found that income and market considerations generally ranked highest. The disaggregated results in respect to the reasons would be presented in the final documents following initial review of the present report.

Table 10.11: Gender distribution of households based on number of goats kept

Number Class	Male	Female	Total
Up to 10	35	20	55
11-20	7	4	11
21-40	3	2	5
>40	1	2	3
Total	46	28	74

Source: Field Survey 2015

Table 10.12: Gender distribution of households based on number of goats wished to keep

Number Class	Male	Female	Total
Up to 10	20	14	34
11-20	13	7	20
21-40	5	3	8
41-100	5	3	8
>100	1	0	1
Total	44	27	71

Source: Field Survey 2015

Table 10.13: Gender distribution of households based on number of pigs kept

Number Class	Male	Female	Total
Up to 5	34	26	60
6-10	8	2	10
11-20	1	1	2
21-40	1	1	2
Total	44	30	74

Source: Field Survey 2015

Table 10.14: Gender distribution of households based on number of pigs wished to keep

Number Class	Male	Female	Total
Up to 10	20	14	34
11-20	13	7	20
21-40	5	3	8
41-100	5	3	8
>100	1	0	1
Total	44	27	71

Source: Field Survey 2015

Table 10.15: Gender distribution of households based on number of poultry kept

Number Class	Male	Female	Total
Up to 10	23	12	35
11-20	25	15	40
21-40	5	3	8
>40	3	2	5
Total	54	32	86

Source: Field Survey 2015

Table 10.16: Gender distribution of households based on number of poultry wished to keep

Number Class	Male	Female	Total
Up to 10	7	4	11
11-20	16	10	26
21-40	10	9	19
41-60	11	7	18
61-200	7	2	9
Total	51	32	83

Source: Field Survey 2015

The findings in respect of the actual and prospective stock levels were further explored by aggregating actual numbers reported by the respondents. These results are presented in Table 10.18 and show that the smallholders actually have high expectations and goals that seemed to be motivated by the desire to make more money to improve their circumstances.

Table 10.17: Comparison of actual and preferred stock levels by smallholders in survey period

Livestock Type	**Actual stock level**	**Preferred stock level**
Cattle	675	1377
Sheep	3749	7261
Goats	661	1416
Pigs	278	504
Poultry	1416	3015

Source: Field Survey 2015

As Table 10.18 shows, the respondents wished that they could maintain larger herds of all the livestock types they did keep. The striking thing was that the numbers they gave for sheep and poultry reflected their clear appreciation of the relatively higher market values and profitability of these animals. As Figure 10.1 shows, the expectation for sheep and poultry outstripped those for the other animals. In the traditional Xhosa setting, mutton is generally preferred as a source of meat for household consumption while goats are kept for ritual slaughters to the ancestors. Detail economic analysis would be performed to provide more substantiation of this information but it would seem that smallholders were consistent in terms of their impression about the relative profitability of the animal. Same can be said for poultry which is easier to keep and commands high market demand due to their relative cheapness to the consumer, their relatively lower cost of production as well as their association with healthier food choices.

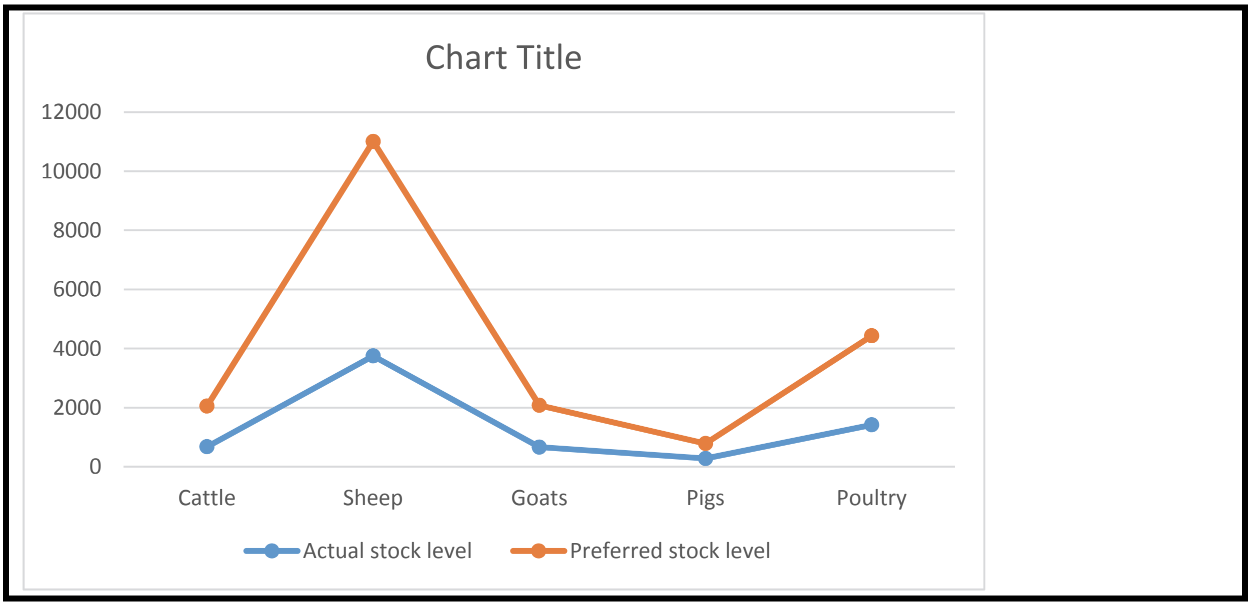

Figure 10.1: Comparison of actual and preferred stock levels for major livestock types kept by households

10.2.4 Crop Production

Crop enterprises include field crops and vegetables. Information on the range of crops grown was obtained along with their ranking to determine the relative importance. Furthermore, the resource use patterns in respect to individual crops were examined. The results are presented in the sections that follow.

10.2.4.1 Crops Grown in the Farming System

The findings of this study point to considerable diversity in the range of crops grown by the smallholders. According to the results, the following crops were grown by the survey farmers during the survey period:

1. Maize
2. Beans
3. Potatoes

4. Pumpkins
5. Butternut
6. Vegetables

Table 10.18: Households growing crops as percentage of total no. of household

Crop grown	No of households	Percent of total
Maize	85	80
Beans	62	58
Potatoes	78	73
Pumpkin/Butternut	73	68
Vegetable	77	72

Source: Field Survey 2015

As Table 10.19 indicates, the maize crop is the most popular in the farming system. The crop has both high cultural and economic significance within the study area as in the rest of Southern Africa where it features prominently as a key dietary staple. Maize is followed in popularity by potatoes which is another key staple that is widely consumed in the area. Almost all meals are accompanied by vegetables and understandably, the farming system features high participation in vegetable production among the smallholders.

10.2.4.2 Reasons and Motivations for Growing Crops

An important part of the investigation is to ascertain the reasons and motivations for choice of individual crops grown and the level of investment in the particular crop. The reasons identified in Table 10.4 and clustered in Table 10.5 were also applied in the case of crops. Table 10.20 presents that proportion of the crop farmers who responded to the enquiry about reasons for growing individual crops and for wishing to expand area under the crops. As in the case of livestock, the current hectarage devoted to the crop was noted and the farmer was asked if he or she would wish to grow larger hectarage and why.

Table 10.19: Proportion of households giving reasons for crop investment

Crops grown	Number giving reasons	No of households	Per cent of total growing crop
Maize	36	85	42
Beans	21	62	34
Potatoes	30	78	43
Pumpkin	21	73	29
Vegetables	23	77	30

Source: Field Survey 2015

In terms of the reasons given by the farmers for the decision regarding the crops under investigation, income/market featured in all cases as the most important. As Table 10.21 shows, 50% of the respondents clearly identified income as their reason for wishing to expand.

Table 10.20: Proportion of households giving reasons for crop expansion plans

Reasons for growing or wishing to expand crop enterprise	No of households	Per cent
Income	18	50
Home consumption	2	5
To sell more in the village	1	3
To feed livestock	2	5
To meet local demand	2	5
Shortage of grazing land for livestock	1	3
In response to drought	1	3
Lack of resources	5	15
Incapacity due to old age	3	8
To increase business	1	3
Total	36	100

Source: Field Survey 2015

But a number of the other reasons given were either directly or indirectly related to income. For instance, the reason such as “to sell more in village”, “to feed livestock”, “to meet local demand”, “to increase business”, and even to meet home consumption needs, are all related to income. From that point of view, it is safe to say that the smallholders had strong income motivation to expand areas under maize crop. This is consistent with the status of maize as both a food security crop and a source of rural employment for income generation and enhanced livelihoods in a modern money economy. As is well known, maize has both cultural and economic significance in the project area.

However, the farming system is a multi-crop one in which a number of other crops feature prominently. For that reason, it was decided to also examine the level of investment in those other crops and their relative popularity in the system as well as their market potential. One indicator identified to have relevance to the relative importance of the crop and its degree of commercialization was the portion of the crop sold. This result is shown in Table 10.22. According to the results, the mean portion sold of potato is the highest and this is followed by maize and pumpkin/butternut combination.

Table 10.21: Descriptive statistics of portions of crops sold

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Maize Portion sold	53	0	30	4.57	5.082
Beans Portion sold	22	.0	10.0	1.932	2.9126
Potato Portion sold	43	0	80	10.27	14.247
Pumpkin Portion sold	32	0	20	4.53	4.697

Source: Field Survey 2015

It would seem that, despite the importance of maize, it comes second in terms of commercialization because of its high dietary value. People who grow maize for sale also grow a lot of it for home consumption whereas the growers of potato would normally be those who grow it primarily for sale and only consume the damaged portions of the harvested crop. It is clear that beans is not grown for the market to the same extent as the other crops, which makes it more of a subsistence crop that the other crops. An area in which the popularity and market possibilities of a crop is demonstrated is the level of investment in the crop. For the purpose of this study, the area planted to the identified crops was enumerated and a t-test of equality of means was conducted to determine the extent to which the observed differences in the hectarage are statistically significant.

10.3 Assessment of Available Market Opportunities

From a poverty alleviation standpoint, market sales of farm produce are crucial to the success of the farming business. This study therefore hypothesized that farmers' assessment of the available market opportunities would determine the extent to which they scaled up their operations so as to take advantage of the favourable policy environment in the country since the end of Apartheid. As is well-known, under the new political dispensation, the government has established a comprehensive land reform programme which promises to transfer about 30% of land previously held by white commercial farmers to the black smallholders by the middle of the Millennium. Recent statements suggest that this target is still far from being achieved and the government is now considering other measures to speed up the transition (SONA, 2015). It is for this reason, among many others, that the question of market opportunities takes centre stage.

The main questions that addressed this hypothesis are whether or not the household sold produce, what produce was sold, how much of the produce was sold and how much the household wished to sell. Also, the study interrogated the households regarding the market channels they used and their reasons for differences in what they did and what they wished to do. The intention of the household matters a lot and gives an idea of the household's assessment of the available market opportunities for its produce and whether or not it is safe to invest in scale expansion. In this respect, the questionnaire asked households to indicate how much of produce was sold and how much they wished to sell and the results are presented in Table 10.23. The mean values of produce sold and quantity farmers wished to sell are presented.

Table 10.22: Comparison of crops sold and what household wished to sell

Pairs compared		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Maize Sold	4.13	38	3.648	.592
	Maize Wished to Sell	6.039	38	6.0274	.9778
Pair 2	Beans Sold	2.026	19	3.0390	.6972
	Beans Wished to Sell	3.237	19	3.9943	.9164
Pair 3	Potato Sold	10.28	39	14.851	2.378
	Potato Wished to Sell	16.82	39	31.578	5.056
Pair 4	Butternut Sold	2.75	24	3.274	.668
	Butternut Wished to Sell	4.54	24	4.324	.883
Pair 5	Vegetable Sold	15.18	20	41.418	9.261
	Vegetable Wished to Sell	16.78	20	41.414	9.260

Source: Field Survey 2015

According to Table 10.23, the households wished to sell more than they currently sold of their various farm produce. In all cases, the mean values sold were less than the mean values the households wished to sell. This suggests that the households considered there were good opportunities to sell their produce and by their own assessments it was profitable to sell the produce in the available markets. Correlational analysis of the variables above are presented in Table 10.24 and clearly indicate that the values were highly correlated in all cases except in the case of potato. Looking at the values in Table 10.23 it is possible to surmise why this is the case; while the differences between what is sold and what could be sold are not much in the cases of maize, beans, butternut and vegetable, it was found to be substantial in the case of potato. A narrow gap would mean that farmers see a market opportunity which can be exploited but do not see themselves being able to meet all of that from current production. The crops for which the margins are narrow are also dietary staples which means that household consumption needs must be met before market sales can be increased above current levels.

Table 10.23: Correlation analysis of crops sold and wished to sell

Paired comparisons	N	Correlation	Sig.
Maize Sold & Maize Wished to Sell	38	0.490	.002
Beans Sold & Beans Wished to Sell	19	0.811	.000
Potato Sold & Potato Wished to Sell	39	0.081	.625
Butternut Sold & Butternut Wished to Sell	24	0.763	.000
Vegetable Sold & Vegetable Wished to Sell	20	0.996	.000

Source: Field Survey 2015

The indication from the results is that for potato, households see tremendous opportunities for profitable sales of the produce and are confident that the expansion of sales will not hurt home consumption. The intended sales in that case will normally not relate to current levels and it is therefore understandable that there is non-significant correlation between what is sold now and what could be sold.

The situations with respect to livestock sales and intentions were also examined. The results are presented in Table 10.25. According to the results, the mean sales and intended sales for cattle were the same, suggesting that the households did not see much market opportunities for cattle in the survey period. Cattle is also a heavy investment and well-known store of value in the system. For this reason, the low sales possibilities or seeming poor market potential may actually not reflect the reality of the situation. When cattle owners do not sell their stock, it is likely to represent a decision to save rather than consume and to store value in an alternative form.

Table 10.24: Comparison of livestock sold and what household wished to sell

Paired comparisons		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Cattle sold	.25[a]	8	.707	.250
	Cattle wished to sell	.25[a]	8	.707	.250
Pair 2	Sheep sold	.90	10	2.025	.640
	Sheep wished to sell	1.30	10	3.199	1.012
Pair 3	Goat sold	.60	5	1.342	.600
	Goats wished to sell	1.00	5	1.414	.632
Pair 4	Pigs sold	3.40	10	4.300	1.360
	Pigs wished to sell	4.10	10	4.909	1.552
Pair 5	Poultry sold	.88	8	2.475	.875
	Poultry wished to sell	.38	8	1.061	.375

a. The correlation and t cannot be computed because the standard error of the difference is 0

The situation of sales and intended sales of stock is different in the cases of the other livestock such as sheep, goats, pigs and poultry where there were differences picked up by the study. The results show that sheep and goats were seen as having good market potential as the households expressed intention to sell more stock than they are currently selling. In the case of sheep, there is more average sales of stock currently than in the case of goats, reflecting the value of sheep meat (mutton) in the diet relative to goat meat. In fact, goats are more important for ritual slaughter than for consumption in the daily diet which means that sales will not necessarily be aligned with the changes in purchasing power and conditions in the macro economy. There are indications that pig sales and intended sales are a reflection of their dietary significance and positive market potential. The situation for poultry where it is observed that less is intended to be sold in future than at present may reflect the fact that there is not enough current production to meet current needs. Table 10.26 presents the results of the correlational analysis of the foregoing variables in respect to sheep, goats, pigs and poultry.

Table 10.25: Correlation analysis of livestock sold and wished to sell

Paired comparisons	N	Correlation	Sig.
Sheep sold & Sheep wished to sell	10	.983	.000
Goat sold & Goats wished to sell	5	.791	.111
Pigs sold & Pigs wished to sell	10	.924	.000
Poultry sold & Poultry wished to sell	8	1.000	.000

Source: Field Survey 2015

10.4 Entrepreneurial Skills and Implications for System Transformation

The hypothesis is that entrepreneurial skills are lacking among the smallholders and that is the reason the pace of transformation from homestead to irrigated farming oriented to markets is slow. It was therefore the aim of this study to investigate this question by more intensive analysis of the production activities of the households. There is no denying the difficulty in measuring this attribute which will always be manifested in several ways. What is crucial is for the investigator to have a clear idea of what the intricacies of entrepreneurship are and be able to define it effectively. A very detailed and comprehensive definition by the UK Centre for Bioscience of the University of Leeds (2013) and Cingula (2013) identifies the following skills, knowledge and personal traits as indicators of entrepreneurial skills:

- Management skills – the ability to manage time and people (both oneself and others) successfully
- Communication skills (e.g. the ability to sell ideas and persuade others)
- The ability to work both as part of a team and independently
- Able to plan, coordinate and organise effectively
- Financial literacy
- Able to research effectively (e.g. available markets, suppliers, customers and the competition)
- Self-motivated and disciplined
- Adaptable
- An Innovative and creative thinker
- The ability to multi-task
- Able to take responsibility and make decisions
- The ability to work under pressure
- Perseverance
- Competitiveness

- Willingness to take risks (or at least not risk averse)
- Ability to network and make contacts
- Being able to draw up a business plan for a new venture
- Being able to market and sell a new product or idea
- Financial skills, such as book-keeping and calculating tax
- Awareness of intellectual property and possibly patent law

The question is which of the foregoing is relevant in the smallholder farming context. As might be obvious, the farmer can demonstrate entrepreneurship more practically by expanding the cultivated area in line with positively assessed market potential. The results in Table 10.27 show that for crops and livestock with high market value, households have demonstrated eagerness to enlarge the hectarage cultivated and livestock kept and sold. More research will continue in this direction to establish the true nature of the entrepreneurial behaviour of the farmers and in what forms they manifest as well as how best to detect and measure that attribute. But for now, it is not safe to conclude that farmers lack entrepreneurial skills when we take a broad view of the subject.

Table 10.26: Independent samples test for areas planted to different crops

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Maize Area Planted	Equal variances assumed	4.642	.044	-1.065	20	.300	-5.7727	5.4227	-17.0844	5.5389
	Equal variances not assumed			-1.065	10.079	.312	-5.7727	5.4227	-17.8425	6.2970
Beans Area Planted	Equal variances assumed	9.288	.009	1.528	14	.149	.5750	.3764	-.2324	1.3824
	Equal variances not assumed			1.528	7.107	.170	.5750	.3764	-.3124	1.4624
Potato Area Planted	Equal variances assumed	13.396	.002	2.154	16	.047	.767	.356	.012	1.521
	Equal variances not assumed			2.154	8.253	.062	.767	.356	-.050	1.583
Pumpkin/Butternut Area Planted	Equal variances assumed	.003	.960	.490	14	.632	.250	.510	-.844	1.344
	Equal variances not assumed			.490	13.968	.632	.250	.510	-.844	1.344
Vegetable Area Planted	Equal variances assumed	6.357	.023	1.886	16	.078	.938	.497	-.116	1.991
	Equal variances not assumed			2.110	9.515	.062	.938	.444	-.059	1.934

10.5 Evidence of Attractiveness of Irrigation Schemes

One of the objectives of this empirical study is to ascertain the extent of technical efficiency among the smallholder farmers and for the principal crops grown in the farming system. With the explicit consideration of livestock farming in order to provide a sound basis for assessing entrepreneurial spirit, the estimates will also be conducted for livestock both as a group and for individual types. For purposes of the present report, the technical efficiency estimate is limited to the principal crop maize because of its importance in the dietary, cultural as well as economic lives of the people. The hypothesis is that government irrigation scheme governance determines the attractiveness of the scheme. In that case, all those factors that either constitute or influence governance of a scheme or are results of governance, one way or another, become candidate measures of performance in that respect and will be included among the independent variables to explain the variations in a particular dependent variable.

The dependent variable was the measure of performance of the maize enterprise which could be quantity produced, quantity harvested (which will account for losses before harvest), quantity sold, and amount realized. A series of regressions were run on Stata-13 with different dependent variables. The results with quantity harvested as dependent variable are presented in Table 10.28 based on the Cobb Douglas production function stochastic modelling procedure on Stata. This procedure incorporates both the efficiency and inefficiency models and provides insights into the factors influencing the observed level of technical efficiency.

Table 10.27: Estimate of technical efficiency of smallholder maize production

Variable	Coefficient	Z	P>z
Constant	11.618	1.13	0.259
Gender	2.914	2.22	0.026***
Age	-0.111	-2.15	0.031***
Schooling	-0.356	-2.08	0.038***
Hired Maize Labour	0.263	0.83	0.408
Marketing channel	-0.037	0.06	0.949
Sigma-Square	6.397		
Lambda	0.028		

Number of observations = 19; Wald chi^2 = 10.35; Prob > chi^2 = 0.0658; Log likelihood =- 44.586

Source: Computed from Field Survey Data, 2015.

As Table 10.28 shows, gender, age, and schooling are significant determinants of the level of technical efficiency in the smallholder maize farming system of the study area. The evidence points in the direction of a negative relationship between technical efficiency and the two factors of age and years of schooling while a positive relationship may exist between TE and gender. As to the extent of the technical efficiency, while the model does not seem to have explained all the possible influences, it does suggest a very high technical efficiency that could be in the region of 99% which is consistent with results obtained elsewhere in the vicinity of the study area.

Table 10.29 presents results of the efficiency analysis with respect to area planted to maize. The area cultivated mirrors the production of the crops under investigation although a wide divergence can still exist between farms with the same holding to reflect differences in management and other factors. Similarly, the area brought under cultivation is a governance issue and relates to the institutional arrangements in place to mediate the allocation of resources within the farming system. In this analysis, the former view of area cultivated is employed. The results show that the system is highly efficient in the use of the land resource. The determinants of the technical efficiency were shown to be mainly the cost of hired labour and the marketing channel used. This is intuitively correct in that the use of hired labour is expected to be a limiting factor in smallholder systems where the widespread and optimal use of machinery is hampered by cash constraints. It is also understandable that the households would adjust farm size if they positively assess the market potential of the produce which will normally depend on, among other things, the marketing channel chosen. Some marketing channels are undoubtedly more profitable than others and the farmers will be expected to select the channels that promise better returns on their investments.

Table 10.28: Estimate of technical efficiency of smallholder maize production with respect to maize area planted

Variable	Coefficient	Z	P>z
Constant	11.618	1.13	0.259
Gender	.0018684	0.19	0.847
Age	0009707	1.00	0.320
Schooling	-.0023903	-0.70	0.481
Hired Maize Labour	-.0053956	-3.47	0.001***
Marketing channel	-0.037	13.27	0.000***
Sigma-Square	6.397		
Lambda	0.028		

Likelihood-ratio of sigma_u = 0: chibar2 (01) prob >=chibar2 = 1.00

Source: Computed from Field Survey Data, 2015.

These indicators have also been found to be strongly influenced by the gender of the decision maker in the household. In the case of farm size allocated to different crops, the evidence is that women may have a harder time expanding scale through that due to a number of cultural and customary constraints which border on the institutional framework and the institutional arrangements within which these resources are governed. As is well-known, women do not normally own land in the traditional system and are only able to access this resource through a male family member. This limits the extent to which women are able to make decisions on resource allocation in the traditional farming system. Table 10.30 presents the results of the technical efficiency estimates with respect to the area allocated to maize production and the indication is that gender plays an important role, just as age, educational attainment, and maize production. It was revealed that amount realized from sales may not be as important as the other factors since this is influenced by a number of other factors. Without question, the farmers will relate more to the quantity of produce generated by the system than by the revenue obtained in deciding whether or not to expand his or her operations.

Table 10.29: Estimate of technical efficiency of smallholder maize production with respect to maize area planted by women

Variables	Coefficient	Standard Error	Z	P>[z]
Household member	0.92	0.631	1.46	0.144
Gender	-.549	.140	-3.93	0.000***
Age	.018	.005	3.32	0.001***
Number of years spent in school	-.016	.022	-2.76	0.006***
How much of maize harvested	.059	.003	17.20	0.000***
Amount realized	.001	.00006	-1.70	0.090**
Constant	-.449	.726	-0.62	0.536
Insig2v	-3.955	.489	-8.09	-4.913
Insig2u	-10.829	343.130	-0.03	-683.352
Sigma_v	.138	.034		.086
Sigma-u	.004	.764		4.1e-149
Sigma2	.019	.010		-0.0005
Lambda	.032	.773		-1.483

Likelihood-ratio of sigma_u = 0 : chibar2(01) prob >=chibar2 = 1.00

Source: Computed from Field Survey Data, 2015

Table 10.31 presents the results in the case of land controlled by men themselves. It is clear in this case that gender effect is minimal since the decision here is culturally determined. The default situation is male ownership and control of land and it is unlikely to follow any particular order or pattern.

Table 10.30: Estimate of technical efficiency of smallholder maize production with respect to maize area planted by men

Variables	Coefficient	Standard Error	Z	P>[z]
Household member	.222	.286	0.77	0.439
Gender	.838	.441	-1.90	0.057*
Age	0.162	.010	-0,98	0.325
Number of years spent in school	.016	.029	-0.55	0.580
How much of maize harvested	.007	.006	1.17	0.243
Amount realized	.00005	.00001	-0.41	0.678
Constant	1.671	1.003	1.67	0.695
Insig2v	-2.598	.439	-6.04	0.000***
Insig2u	-10.217	318.742	-0.03	0.944
Sigma_v	.273	.059		.179
Sigma-u	.006	.936		1.3e-138
Sigma2	.074	.033		.011
Lambda	.022	.973		-1.884

Where: Likelihood-ratio of sigma_u = 0 : chibar2(01) prob >=chibar2 = 1.00
Stochastic. Frontier normal/half normal model
Log likelihood = 11
Number of obs. = 10.36
Wald chi2 = 0.11
Prob7chi2 = 0.110
Source: Computed from Field Survey, 2015.

In Table 10.32, the combined resource allocation of both men and women is presented and show that gender effect is strong. This closely mirrors the situation observed in the case of women as the sole decision makers. This might mean that this result is strongly influenced by the decision making outcomes of the female respondents included in the sample.

Table 10.31: Estimate of technical efficiency of smallholder maize production with respect to maize area planted by both men and women

Variables	Coefficient	Standard Error	Z	P>[z]
Household member	0.92	0.631	1.46	0.144
Gender	-.549	.140	-3.93	0.000***
Age	.018	.005	3.32	0.001***
Years in school	-.016	.022	-2.76	0.006***
Amount of maize harvested	.059	.003	17.20	0.000***
Amount realized	.001	.00006	-1.70	0.090*
Constant	-.449	.726	-0.62	0.536
Insig2v	-3.955	.489	-8.09	-4.913
Insig2u	-10.829	343.130	-0.03	-683.352
Sigma_v	.138	.034		.086
Sigma-u	.004	.764		4.1e-149
Sigma2	.019	.010		-0.0005
Lambda	.032	.773		-1.483

Where: Likelihood-ratio of sigma_u = 0 : chibar2(01) prob >=chibar2 = 1.00
Stochastic. Frontier normal/half normal model
Log likelihood = 5.026
Number of obs = 9
Wald chi2 =4608.43
Prob7chi2 = 0.000
Source: Computed from Field Survey, 2015.

As has been highlighted earlier, the intention of the household is much more predictive indicator than the actual action taken by the household. Although intention may not always herald action (Abraham and Sheeran, 2003), it provides the framework needed to set priorities and allocate resource in the best possible manner to achieve set goals (Downey, 2010). In the light of the foregoing, intended maize area was set as the dependent variable to estimate the technical efficiency of the system. The results are presented in Table 10.33 which show that, while the system is clearly operating efficiently within constraints set by scale and knowledge and skills, it was only amount realized that seemed to influence the level of technical efficiency. The amount realized is again a reflection of the market possibilities as well as the quantity and quality of the produce, in addition to the nature of the infrastructure that serves farm people.

Table 10.32: Estimate of technical efficiency of smallholder maize production with respect to maize area household wished to planted

Variables	Coefficient	Standard Error	Z	P>[z]
Household member	-.164	1.197	-0.14	0.891
Gender	-.1.264	2.149	-0.59	0.556
Age	.042	.061	-0.70	0.486
Years in school	-.091	.244	-0.37	0.709
Amount of maize harvested	.004	.018	0.20	0.845
Amount realized	.003	.00009	2.95	0.003***
Constant	2.685	6.799	0.39	0.633
Insig2v	3.341	.224	14.93	2.903
Insig2u	-5.487	195.187	0.03	-388.046
Sigma_v	5.315	.595		4.268
Sigma-u	.064	6.280		5.46e-85
Sigma2	28.258	6.340		13.832
Lambda	.012	6.334		-12.403

Where: Likelihood-ratio of sigma_u = 0 : chibar2(01) prob >=chibar2 = 1.00
Stoc.frontier normal/half normal model
Log likelihood   = 123.583
Number of obs = 40
Wald chi2   =10.72
Prob7chi2   = 0.0976
Source: Computed from Field Survey, 2015

The final estimation carried out at this phase of the study looked at the production of potato which seemed to be the dietary staple a considerable amount of which the household still wants to sell (see Table 10.23). Again the system appears highly technically efficient with a large number of factors most likely influencing the technical efficiency. According to the results (Table 10.24), the most important variables are household size, gender, years of schooling, potatoes harvested and potatoes sold.

Table 10.33: Estimate of technical efficiency of smallholder potato production

Variables	Coefficient	Standard Error	Z	P>[z]
Household member	.366	.153	2.40	0.016**
Gender	-453	.214	-2.11	0.035**
Age	.0003	.003	0.09	0.925
Years in school	-.045	.017	2.69	0.007***
Potatoes harvested	-0.008	.004	-.2.21	0.027***
Portion sold	.061	.026	-2.32	0.020**
Constant	-.288	.511	-0.56	0.573
Insig2v	-4.932	.529	-9.32	0.000
Insig2u	-11.167	242.450	-0.05	0.963
Sigma_v	.085	.022		
Sigma-u	.004	.456		
Sigma2	.007	.004		
Lambda	.044	.464		

Where: Likelihood-ratio of sigma_u = 0: chibar2(01) prob >=chibar2 = 1.00
Stoc.frontier normal/half normal model
Log likelihood = 8.373
Number of obs = 8
Wald chi2 =12.62
Prob7chi2 = 0.050
Source: Computed from Field Survey, 2015

10.6 Estimation of Impact of Irrigation Technology

This section presents the results of the *ex-post* impact assessment of farmers' irrigation support programmes in order to determine the appropriate development paths in the transition from homestead gardening to irrigation farming by smallholder scheme participants. To evaluate the impact of irrigation on smallholder farmers' crop income, Tobit and the propensity score matching estimator were employed. The propensity score is estimated using various socio-demographic characteristics of farmers, namely: age, years of education, cohort dummies, years in farming, off-farm income, livestock income, gender and human capital as years in school, household size and institutional characteristics such as credit access, market access, distance to market, market support and organizational membership. The propensity score matching estimation results show that improved agricultural technology adoption is positively and significantly correlated with farmers' surplus crop production to the market. This is an encouraging result given the fact that farmers in South Africa are small-scale and they produce cereal crops on small land holdings. Hence, sustainable intensification of modern technology is a good option to increase food production and smallholders' participation into output marketing. As many empirical studies indicated the effect of improved agricultural technologies such as irrigation positively correlate with poverty reduction through marketed surplus crop production for the households' income. Bezu et al. (2014) found that adoption of improved maize positively correlated with the per capita income for the poorer households. The income from surplus crop sale enables the rural poor to spend for other consumption goods besides their own consumption.

10.6.1 Estimation of the treatment effects

Table 10.35 present the logit regression result used to estimate the propensity scores. The propensity score is generated using 10 explanatory variables includes gender, age, years in school, farm size, years in farming, cooperative membership, market support, distance to market, off-farm income and credit access. Variables such as years in school, off-farm income, credit access and distance to market were significantly related to irrigation technology adoption. Years in school, distance to market and credit were significant but negatively influence irrigation adoption. Off-farm income was positive and significant at 5% level to irrigation adoption. The negative effect of years in school and credit access contradict with Spielman (2008) who reported the importance of rural credit service, education and training for smallholders in rural South Africa.

Table 10.35: Logistic regression result for propensity scores

Dependent variables; irrigation adoption (1=irrigators, 2=non irrigators)				
Explanatory variables	**Coefficient**	**Std. Err.**	**Z-value**	**P-value**
Gender Household head	0.3665117	0.5077152	0.72	0.470
Age household head	-0.0016509	0.0276998	-0.06	0.952
Years in School	-0.2687289	0.0748168	-3.59	0.000***
Farm Size	0.0669451	0.2728728	0.25	0.806
Years Farming	-0.0116158	0.0334615	-0.35	0.728
Coop Membership	-0.8054625	0.7063746	-1.14	0.254
Market Support	-0.0895038	0.5738507	-0.16	0.876
Off Farm Income	0.0001728	0.0000821	2.10	0.035**
Distance to Market	-0.5341085	0.0999826	5.34	0.000***
Credit Access	-1.652471	0.9098927	-1.82	0.069*
Constant	-5.315247	1.689301	-3.15	0.002***
No. observations	151			
LR chi2(10)	68.08			
Prob > chi2	0.0000			
Pseudo R2	0.3605			
Log likelihood	-60.375014			

Where ***, ** and * represents significance at 1%, 5% and 10% level respectively; Std. Err.= Standard Error.

Source: Computed from Field Survey, 2016.

10.6.2 Estimation average treatment effect using propensity scores

Based on the generated propensity scores, the study estimated the average treatment effect on the treated (ATT) of the outcome variable. In application of PSM, logit regression was first estimated in which the dependent variable equals one if the household adopted irrigation technology, zero otherwise. The logit regression was used to generate the propensity scores for the average treated effects estimation. The balancing property of the propensity scores was checked.

The results (Table 10.36) reveals the average effect of the treatment on the treated (ATT), i.e. the difference in the level of support between participants and non-participants. The estimated results based on the three matching algorithms, propensity score matching (PSM), Kernel method (KM) and nearest neighborhood (NNM), are reported in Tables 10.36 and 10.37. According to the results, irrigation adoption has a significant positive impact on crop income following Psmatch2 (NNM and KB) and *teffects* psmatch (PSM and NNM) propensity score matching test. Specifically, crop income gain based on the average treated estimation (ATT) for NNM and KM in psmatch2 technique was R11,138.72 and R11,188.75 respectively for irrigation adoption. This means that irrigators increase crop income of R11,138.72 (NNM) and R11,188.75 more than those of non-irrigators. Similar result was obtained for ATET using *teffects* psmatch technique. According to *teffects* psmatch technique, smallholder farmers positively and significantly increased crop income sale by R10,425.11 and R10,530.76, respectively for PSM and NNM when they adopt irrigation technology compared to the counterpart non-irrigators. Both (PSM and NNM) estimates were significant at 1% level. Thus, the causal effect of improved agricultural technology adoption on poverty reduction is greater by improving the rural households' income through surplus crop sale. The result is consistent with previous poverty analysis measuring the differential impact of agricultural technology adoption on poverty reduction among the rural households. Becerril and Abdulai (2010) reported that adoption of improved maize reduces the probability of falling below poverty line roughly between 19 to 31 percent in the two study areas of Oaxaca and Chiapas, Mexico. Similarly, Mendola (2007) found adoption of HYVs has a positive and robust effect on households' income and the way out of poverty in rural Bangladesh. Bezu *et al.* (2014) found that the adoption of technology correlated with the per capita income for the poorer households. The income from surplus crop sale enables the rural poor to spend money on other consumption goods besides their food consumption needs.

Table 10.36: Estimation of treatment effect of expected crop income

Matching technique used (psmatch2 and teffects psmatch), outcome variable (crop income), indicator variable (irrigation technology; 1-irrigators, 2-non irrigators)						
Psmatch2 technique						
Method	**Sample**	**Treated**	**Control**	**Difference**	**S.E.**	**T-stat**
Nearest neighbour matching (NNM)	Unmatched	15795.65	5897.50	9898.15	5020.95	1.97
	ATT	15795.65	3922.18	11873.47	4266.07	2.78
	ATU	5897.50	15459.58	9562.08		
	ATET			11138.72		
Kernel-based matching (KBM)	Unmatched	15795.65	5897.50	9898.15	5020.95	1.97
	ATT	16276.50	4491.38	11785.12	3989.68	2.95
	ATU	5897.50	16340.79	10443.29		
	ATET			11188.75		
Teffects psmatch						
Method	**Sample**		**Coef.**	**Std. Err.**	**Z-value**	**P-value**
PSM	ATET		10425.11	3183.89	3.27	0.001
NNM	ATET		10530.76	3316.53	3.18	0.001

Source: Results from STATA (Version 14) generated from field survey, 2016. Coef.=coefficient and Std. Error = Standard Error.

Source: Computed from Field Survey, 2016.

Table 10.37: Result of common support from psmatch2

psmatch2: treatment assignment	Nearest neighbour (NNM)		Kernel-based (KBM)		
	psmatch2: common support on support	Total	psmatch2: common support off support	on support	Total
Untreated	48	48	0	48	48
Treated	103	103	43	60	103
Total	151	151	43	108	151

Source: Computed from Field Survey, 2016.

The robustness of these findings is supported by the Tobit regression results presented in Table 10.38. The results also agree with findings from Chirwa *et al.* (2005) who also looked at the impact of farmer support programmes on smallholder farmers in Malawi. According to the Tobit result in Table 10.38, household size, years in farming, hired labour and market participation were significantly related to crop income for both smallholder irrigators and non-irrigators. Specifically, household size showed positive and significant effect on crop income for both irrigating and non-irrigating farmers at 1% and 10% levels, respectively. This means that larger-sized households received lower income from crop sales. An explanation for this is probably that larger households consume most of their farm produce leaving little surplus to offer for sale. Essilfie *et al.* (2011) suggests, in a study in Ghana, that larger-sized households increase the population pressure on the farmers' limited resources due to increase in household spending on health, food, education, clothing, etc. and thereby reducing the timely operation of farming activities resulting in low overall output of crop. The finding contradicts the findings of Ellis, (1998) who contends that large household size contributes positively to labour on the farms. Smallholder farmers in rural areas are mostly dependent on household labour for production purposes and thus are said to be economically efficient in labour use.

Further, education is another variable that was found to be significant at 1% level for the irrigating farmers. The result could mean that educated farmers can be easily trained on various methods of farming through extension services and workshops which enhance their capability to access information on markets and market access in rural areas. Another variable that was significant among irrigators is the distance to the nearest market. Most smallholder farmers in the province are located in deep rural areas infrequently served by public transportation and it is very difficult for residents to access markets in urban areas. Distance to the market was significant at 5% level for smallholder irrigator farmers. This illustrates the importance of distance to crop income. The shorter the distance to the market the lower the transaction costs and higher the income (Ogunleye and Oladeji, 2007).

The overall sample coefficient estimates showed significance in variables such as household size, years in school, farm size, distance to market, hired labour, market participation and irrigation technology adoption. Irrigation adoption was positive and significant in relation to smallholder farmers' crop income at 1% level. The positive coefficient suggests that irrigation adoption increase crop income by increasing the level of market participation. This suggests that smallholder irrigators sell more produce which leads to higher income for the irrigators than for the non-irrigators. This is because irrigation increases the efficiency and productivity of farmers. Higher output from irrigation adoption allows farmers to generate more surpluses for sale in the market, and this is made easier if the markets are in close proximity of the farms and the farmers have some education that allows them to access information needed to increase their production. The finding is consistent with an earlier study on the contribution of subsistence farming to food security in South Africa by Baiphethi and Jacobs (2009) which concluded that to achieve a significant impact on food security, the low productivity of smallholder/subsistence agriculture sector needs to be improved through use of improved technology (e.g. irrigation).

Table 10.38: Result of impact of irrigation technology on crop income using Tobit regression

Explanatory variables	Dependent variable; crop income (in rand)					
	Overall		Irrigation adopters		Non irrigator adopters	
	Coef.	t	Coef.	T	Coef.	t
Household size	-2232.726	-2.45***	4096.75	-2.99***	-433.2986	-1.69*
Age household head	-104.720	-0.54	23.1984	0.09	-47.85183	-0.59
Yrs in sch	1145.16	2.28***	1919.78	2.62***	78.85901	0.41
Farm size	6559.84	2.49***	6453.02	1.76*	959.6412	1.01
Yrs farm	470.36	2.11**	484.375	1.67*	215.8106	2.19**
Dst mkt ce	802.15	2.93***	867.242	2.68***	-298.6799	-0.86
Gend hhd	6327.80	1.45	7949.03	1.23	-17.87203	-0.01
Hire lab	10743.59	2.06**	14267.76	2.01**	4520.082	2.50***
Mkt supt	-3167.70	-0.64	5626.65	-0.81	-306.8631	-0.19
Credt aces	-3676.02	-0.44	-11136	-0.79	2908.629	1.24
Mkt partn	48339.60	5.30***	60952.42	4.62***	8589.75	3.12***
Corp mem	4389.34	0.69	11266.85	1.09	1453.268	0.93
Irrig adopt	10251.61	2.23**				
Constant	-75946.66	-5.05***	84807.79	-3.90	-4708.633	-0.88
/sigma	24930.57		28944.78		4025.956	
Observations	200		133		67	
LR chi2	100.41		67.10		64.33	
Prob > chi2	0.0000		0.0000		0.0000	
Pseudo R2	0.0259		0.0249		0.0616	
Log likelihood	-1888.8639		-1314.7358		-489.901	
Left censored	36		20		16	
Uncensored	163		112		50	
Right censored	1		1		1	

Where: ***, ** and * represent significance at 1%, 5% and 10% levels, respectively.
Source: Computed from Field Survey, 2016.

The result of PSM is consistent with the Tobit regression estimates that irrigation increases level of market participation and crop income. The Tobit regression estimates indicate that, irrigating smallholder farmers realize a higher crop sale income of R10,251.61 than their counterpart who are not irrigating, at 5% significance level. This result could mean that irrigation enhances farmers' technical efficiency and productivity of farming thereby improving their quality and increasing the volumes and crop income through enhanced market participation.

10.7 Chapter Summary

The chapter presented the results of the empirical analysis conducted to address the five hypotheses outlined around the effect of sociocultural contexts, the role of alternative economic activities, the assessment of available market opportunities, the role of entrepreneurial skills and whether or not governance of government irrigation schemes play a role in the attractiveness of schemes. In the case of socio-cultural factors, the study examined a range of demographic and socio-economic characteristics of the survey households, including gender, age of household head, the occupational category to which the household head belongs, the educational level attained by household head, the size of the household and the fertility rates observed, asset ownership patterns and the nature and extent of access to basic amenities. The overall finding in respect to these factors indicated that there are important differences in behaviour regarding the transition from homestead gardening to irrigated farming. There was also evidence that involvement in alternative economic activities influenced the choices made by the households which have implications for transforming to more commercialized farming. Again, gender played an important role in the activities undertaken and how these influenced the possibility of transformation. There was evidence that the households cared a lot about whether or not they could sell their produce and actively sought opportunities to market profitably. It was clear that for both livestock and crops, households made efforts to produce above subsistence needs and there was positive intention to expand production and sales. Entrepreneurship and how it influences the transition possibilities was explicitly examined and the indication is that the survey households possessed entrepreneurial skills to a reasonable extent and this was manifested in intention to expand hectarage cultivated and animal numbers for value storage and sales. To test whether governance of the scheme influenced their attractiveness, a series of technical efficiency estimates were conducted and the indication was that the system operated at reasonably high technical efficiency which was influenced by a wide range of factors.

CHAPTER 11

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

11.1 Introduction

This chapter concludes the consolidated research report of the WRC-funded research that investigated the appropriate entrepreneurial development paths in the transition from homestead food gardening to smallholder irrigation crop farming in the Eastern Cape Province of South Africa. Without question, this has been an arduous process of trying to give form and content to concepts that have been widely used but have been quite widely misunderstood. That misunderstanding has sometimes arisen from the fact that little prior quantification and empirical measurement has been attempted of concepts such as entrepreneurial spirit, goals and aspirations within a farming system that is still very traditional. The other problem is the fluidity of the policy terrain that makes the subject-matter of the research more of a moving target that adds to the difficulty of precisely measuring the changes that have taken place since the onset of the agrarian reforms and whether or not a trend or progression is discernible. Having said that, the research revealed a large amount of information and insights which should hold some interest to researchers and policymakers as the efforts continue to achieve sustained transformation of the smallholder sector in the country and integrate the black farming class into the nation's agricultural economy. The chapter will first summarize the main findings documented in this report and then draws some conclusions which will form the basis for a set of recommendations.

11.2 Summary

The approach here is to attempt a concise summary that focuses only on the key points touched upon in the main text so that they are fresh in the readers' minds as they reflect on the conclusions and recommendations that follow. The section will be subdivided in a manner that makes it easier to follow the research logic. For that reason, the research problem that motivated the research will be summarized. This will be followed by a summary of the research objectives as agreed in the signed agreement between the UFH and Water Research Commission. The broad outlines of the methodology will then be presented, followed by the key findings for each of the five specific objectives of the research.

11.2.1 Research Problem and Motivation

The concern that drove the original WRC call for proposals was the decades of implementation of a comprehensive land reform and agrarian transformation policies were not producing the desired results in better resourced black farming class while poverty and unemployment were becoming worse in the rural areas. That those questions have not been raised in a systematic manner to date in the context of small farming in the communal areas was seen as a significant gap about which research needed to be conducted. The case is made stronger by the political developments in the country which are almost wholly attributable to the socio-economic conditions that have been deteriorating in recent years.

11.2.2 Research Objectives

The broad objective of the project was to review and evaluate appropriate development paths for expansion from homestead food gardening to smallholder irrigation farming, increased water use productivity of crop production and improved livelihoods on selected smallholder irrigation schemes in South Africa. More specifically, the project aims:

1. To evaluate natural, physical and financial assets with specific attention to irrigation farming potential.

2. To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organizational structures.

3. To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains.

4. To determine the aspirations and goals of farmers to expand irrigation crop production from homestead gardens to irrigation plots and/or from one to more than one irrigation plot.

5. To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

11.2.3 Methodology

A participatory methodology was stressed as a requirement in the original call and in pre-project briefings following acceptance of the proposal. To the maximum extent possible therefore, the research applied the methodology of the Agricultural Research for Development (ARD) which the University of Fort Hare has partnered with the International Centre for development-oriented Research in Agriculture to promote in South Africa. This approach was handy especially in respect to designing the research, selecting sites for the study and collecting and analyzing the qualitative data for which it was appropriate.

For purposes of more quantitative and empirical analysis, the study made use of more conventional data collection procedures and wherever necessary, undertook a multistage stratified sampling technique was used to select a predetermined number of respondents who were then enumerated by means of a structured questionnaire. Detailed model structures involved in the analysis of the data were specified and described in the text.

11.2.4 Socio-economic and Demographic Characteristics of Sample

The socio-economic and demographic profile of the smallholder irrigators and homestead gardeners was presented. In respect to gender distribution, it was found that men dominated, the farmers were generally older, and had some education on average. The production environment of the farmers were then described by presenting details of land ownership and utilization, input use patterns and associated cost relationships, and their output and revenue situations. Average land holding was small, generally less than one hectare, and input use was also low. The final part of the chapter focused attention on the poverty profile of the sample farmers, presenting details on the measurement of poverty and establishment of a poverty line on the basis of which the depth and severity of poverty were measured. On the basis of the Lorenz

Curve plotted and Gini Coefficient computed, it was clear that poverty is as high as ever and that income inequality was serious.

11.2.5 Natural, Physical and Financial Assets and Irrigation

The definition of the natural, physical and financial assets was provided based on the conclusions drawn at the ICID Conference in 2007. The chapter evaluated the state of availability and ownership patterns for natural, physical, and financial assets in the study area and how these influence the performance of homestead gardeners and the smallholder irrigators. There was clear evidence that the majority of homestead gardeners were disadvantaged in terms of ownership or access to these assets. The designation of the farmers in these communal areas as resource poor therefore derives from this situation and it is not surprising that they are generally not in a position to take advantage of the ample opportunities to fit into the nation's agricultural economy. Quantitative information of the extent of their deprivation is provided in the main text in the chapter.

11.2.6 Human and Social Assets, Entrepreneurial Spirit and Management Capabilities

A procedure for quantifying the human and social assets and entrepreneurial spirit was developed based on a set of attitudinal and value statements which farmers rated on a 4-point Likert Scale. This allowed for quantitative scores to be obtained which where then subjected to factor analysis that allowed for extraction of principal components. It emerged that there were varying endowments of social and human assets and entrepreneurial spirit between the homestead gardeners and the smallholder irrigators and these influenced production performance of the different groups of farmers. In general, smallholder irrigators were found to be better endowed with assets that emphasized scale enlargement and business development while the homestead gardeners seemed to emphasize values that promoted more social orientation of production.

11.2.7 Livelihoods and Opportunities to Improve the Contribution of Farming

The sources of livelihoods and the way local people take advantage of those have been well-researched generally but it was important to examine differences between smallholder irrigators and homestead gardeners. The farm and non-farm activities could be clearly delineated but it appeared that diverse strategies are pursued by both smallholder irrigators and homestead gardeners. Social Grants emerged to be very important and seemed to have surpassed remittances as public transfer to rural people.

11.2.8 Aspirations and Goals for Transformation of Smallholder Farming

The study found important differences between homestead gardeners and smallholder irrigators. The respondents were presented with 21 attitudinal statements each of which they scored on a 4-point Likert scale. This exercise allowed for the calculation of average items scores that ranged from 1 to 4. Smallholder irrigators had more business development goals than homestead gardeners. The data were subsequently subjected to factor analysis to elicit principal components that best mirror the farmers' goals and aspirations against which a set of farmer and farm characteristics were regressed. Important insights were derived on the nature of goals and aspirations and their roles in farmer production decisions.

11.2.9 Appropriate Development Paths for Establishing Sustainable Farming Business

The overall finding in respect to these factors indicated that there are important differences in behaviour regarding the transition from homestead gardening to irrigated farming. There was also evidence that involvement in alternative economic activities influenced the choices made by the households which have implications for transforming to more commercialized farming. Again, gender played an important role in the activities undertaken and how these influenced the possibility of transformation. There was evidence that the households cared a lot about whether or not they could sell their produce and actively sought opportunities to market profitably. It was clear that for both livestock and crops, households made efforts to produce above subsistence needs and there was positive intention to expand production and sales. Entrepreneurship and how it influences the transition possibilities was explicitly examined and the indication is that the survey households possessed entrepreneurial skills to a reasonable extent and this was manifested in intention to expand hectarage cultivated and animal numbers for value storage and sales. To test whether governance of the scheme influenced their attractiveness, a series of technical efficiency estimates were conducted and the indication was that the system operated at reasonably high technical efficiency which was influenced by a wide range of factors. Overall, the analysis confirmed the positive contribution of irrigation technology in smallholder transformation by boosting farm output which can lead to expanded market sales within an environment that features supportive infrastructure and conducive socio-economic and demographic, including institutional, conditions.

11.3 Conclusions

Based on the foregoing, a number of conclusions can be drawn in respect of the major questions that this research addressed. These are aligned to the objectives outlined in the Terms of reference and which have guided the research, namely:

a. To evaluate natural, physical and financial assets with specific attention to irrigation farming potential.

b. To evaluate human and social assets with particular attention to entrepreneurial spirit and management capabilities within incentives of secure land tenure, water use rights and leadership in organisational structures.

c. To determine sources of livelihoods and opportunities to improve contribution by farming within available food value chains.

d. To determine the aspirations and goals of farmers to expand irrigation crop production from homestead gardens to irrigation plots and/or from one to more than one irrigation plot.

e. To formulate and test appropriate development paths for establishing sustainable farming businesses with crop enterprises to increase food security, profitability and employment opportunities on smallholder irrigation schemes.

11.3.1 Conclusions on Natural, Physical and Financial Capital

While the province is endowed with abundant natural resources, including land, water, forest products, and wildlife, the strong evidence from the study is that of a highly skewed distribution. In fact, only a small proportion of these assets are available to the majority of the poor households. Physical assets were durable items owned or accessed by the household and included such items as irrigation equipment, ploughs, and structures for storage and other post-harvest activities. The evidence was that access to these was also limited among the smallholder farmers. In relation to financial assets, the story is the same and, except that the local people are able to partially overcome this handicap through the social grants, remittances and pensions which were major sources of financial resources for the farmers enumerated. This was true for both smallholder irrigators and homestead food gardeners. Income from crops came next, followed by livestock incomes, with assorted off-farm activities being the least. In general, smallholder irrigators received more income from crops than homestead garden owners while, the homestead gardeners made more income from off-farm activities than smallholder irrigators which makes economic sense in terms of time usage.

11.3.2 Conclusion on Human and Social Assets

In the context of the objective of this deliverable to evaluate the human and social assets with particular attention to entrepreneurial spirit and management capabilities, it is safe to conclude that their important role is incontestable. The smallholders enumerated in this study exhibited clear signs of acute shortage of human and social assets based on the definitions that put emphasis on education, training, networks, and the like. Insufficient investment in these aspects in the project area might be one reason the levels of entrepreneurial spirit and management capabilities are modest and farm productivity is not increasing sufficiently to make a noticeable dent on poverty.

11.3.3 Conclusion on Sources of Livelihoods and Opportunities in Smallholder Farming

Livelihood strategies identified confirm what is known about the dominant rural strategies over much of South Africa today and suggest that social grants and pensions are important off-farm sources of income although farming income remains important for the farming population. Growing entrepreneurship was noted but the vulnerability of the homestead gardeners on account of their weaker organization and high need for credit support confirms anecdotal evidence about their relative disadvantage.

11.3.4 Conclusion on the Aspirations and Goals of Farmers

The major finding was that smallholder irrigators have more monetary goals and view farming as a source of income while homestead food gardeners view farming mainly as a social activity. The smallholder irrigators are focused on expanding their farm business, increase maximum farm income and accumulate wealth while homestead food gardeners viewed farming as a lifestyle and social medium with less focus on business/development oriented goals. It was shown that increased farmers' access to dam and river irrigation water has a positive and significant influence on farmers' business oriented goal while location of the irrigation scheme has a negative and significant impact on farmers' business oriented goals. All told, these findings in respect to entrepreneurial spirit shown and psychological, social, institutional and technical constraints are clearly interesting.

11.3.5 Conclusion on Entrepreneurial Development Paths

The main conclusions are drawn in respect to the effect of sociocultural contexts, the role of alternative economic activities, the assessment of available market opportunities, the role of entrepreneurial skills and whether or not governance of government irrigation schemes plays a role in the attractiveness of schemes. In the case of socio-cultural factors, the study examined a range of demographic and socio-economic characteristics of the survey households, including gender, age of household head, the occupational category to which the household head belongs, the educational level attained by household head, the size of the household and the fertility rates observed, asset ownership patterns and the nature and extent of access to basic amenities. The overall finding in respect to these factors indicated that there are important differences in behaviour regarding the transition from homestead gardening to irrigated farming. There was also evidence that involvement in alternative economic activities influenced the choices made by the households which have implications for transforming to more commercialized farming. Again, gender played an important role in the activities undertaken and how these influenced the possibility of transformation. There was evidence that the households cared a lot about whether or not they could sell their produce and actively sought opportunities to market profitably. It was clear that for both livestock and crops, households made efforts to produce above subsistence needs and there was positive intention to expand production and sales.

In respect to livestock, it can be concluded that households keep livestock comprising chickens, sheep, goats, donkeys, pigs, and cattle. While commercial livestock rearing cannot be discounted, these households mainly keep the livestock for socio-cultural reasons and not necessarily as a source of income. What happens is that, since the animals are there anyway, they become a potential source of income because there are frequent requests from friends and neighbours which allows the household head to exchange some animals for cash. That way, the livestock become a potential source of diversification of the household's economy. The notion of livestock being kept as a status symbol did not emerge to be true, because everything points to a hidden commercial motive – if a household is keeping livestock so that it will have a pool from which to select animals for ritualistic slaughter and can also exchange some for cash, then there is some commercial motive. If the household did not own the livestock, it would have had to purchase from the market or neighbours. The reason these transactions are not easily picked up by researchers is that they are informal.

Entrepreneurship and how it influences the transition possibilities was explicitly examined and the indication is that the survey households possessed entrepreneurial skills to a reasonable extent and this was manifested in intention to expand hectarage cultivated and animal numbers for value storage and sales. To test whether governance of the scheme influenced their attractiveness, a series of technical efficiency estimates were conducted and the indication was that the system operated at reasonably high technical efficiency which was influenced by a wide range of factors. It is evident that smallholder farmers will be motivated to sell their produce in the villages to rural residents if the cost and time savings of such a choice are clearly demonstrated. The fact that some farmers will still choose to sell in towns despite relative cost and time disadvantage calls for more concerted efforts to influence mindsets around respecting contracts between parties and also to introduce structures that protect producers against loss due to non-payment of debts when they sell to their neighbours in the villages.

11.4 Recommendations

Tying the multi-locational findings together, it is possible to identify elements for a farmer support structure that will enhance the livelihoods situation of the local population. South Africa's situation as a water-deficit country means that water utilization in agriculture must be part of any policy framework to strengthen farmers and enhance their livelihoods. One of the irrigation schemes studied, namely Qamata Irrigation Scheme, affords a good basis for a recommendation that builds on effective use of a revitalized irrigation scheme. Considering the vast land, adequate water and rich soils, the scheme has the potential of contributing to the food value chain and more broadly, the agricultural value chain, even if featuring only at the production level of the value chain. Currently the scheme is not contributing optimally to the food value chain. However, there are plans in place which include the establishment of a feed mill at Qamata to supply Bilatye piggery with crushed maize; this could provide a ready market for farmers as maize is the major produce. Another plan in place is in agro-processing, whereby the farmers will be able to sell their fresh produce to value adding unit such as soups-making and tomatoes (although not grown currently) to the agro-processing unit. Value added food products such as soup packs and tomato paste can be derived and sold to the communities around including nearby schools and supermarkets with positive implications for the food value chain. Other opportunities that could add to the food value chain, are the establishment of a grinding mill which can serve the purpose of maize processing (maize into mealie meal), provision of more durable and reliable access to the markets through improvement of the road network.

Similar studies will be done on the other irrigation schemes to derive a basis for more effective intervention to make the schemes for relevant to the local economies.

The finding that smallholders will be willing to sell their surplus produce in the villages calls for the development of functional village markets for selling fresh produce with the facilities that will be necessary to ensure that produce are handled efficiently and to the benefit of the farmer. As the findings also reveal a highly significant influence of irrigation technology, subject to a conducive socio-economic and demographic environment, the physical structures need to be provided, in addition to institutional arrangements for managing the facilities to deliver value. This will entail governance arrangements that are participatory and innovative. Such an arrangement is being implemented by the Forum for Agricultural Research in Africa (FARA) under the Sub-Saharan Africa Challenge Programme for the implementation of the Integrated Agricultural Research for Development (IAR4D) and designated Innovation Platforms (IPs) which are aggregations of the relevant stakeholders involved in any particular value chain. For a crop, this would include the producers, agro-input dealers, the transporters, the storage facility operators, the processors and millers, the retail traders, the government/policy level, non-governmental entities, and all whose interests are accommodated within the value chain.

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APPENDICES

Appendix 1: QUESTIONNAIRES

Village Name--------------------------------------; Village No.---------; HH No. -------; Page -------of-------; Enumerator Name-----------------------------

1. Household Size, Composition and Characteristics

Names of family and other HH members (HHH First)*	Relation to HHH (Code)	Gender (M/F)	Yr. born	No. yrs. spent in school	Occupation. (Code)	If F, No. Children Born	If not born in HH		
							Yr. came	From where (Code)	Province (Code)
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									

13.									
14.									
15.									

- Do not count grandchildren who are not in the HH.

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

Relation to HHH	Occupation	Where	Province
1. Husband 2. Wife 3. Mother 4. Father 5. Son 6. Daughter 7. Cousin 8. Niece 9. Nephew 10. Uncle 11. Aunt 12. Brother 13. Sister 14. Friend 15. Grandson 16. Grand daughter 17. Grand Father 18. Grand mother 19. Other: specify 20. ________	1. Farmer 2. Wage employment 3. Unemployed 4. Other: specify 5. ___________	1. Town 2. Township 3. Another village 4. -------------------	1. Eastern cape 2. Gauteng 3. Northern cape 4. Free state 5. Western cape 6. KZN 7. Limpopo 8. Mpumalanga 9. North west

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

2. Name your spouse and any of your children, who do not live in the household at present, year left, where to and what he or she is doing.

Names of family members	Relation to HHH (Code)	Gender (M/F)	Yr. Left	Where to (Code)	Doing what (Code)	**Relation to HHH**	**Occupation**	**Where**	**Province**
1.						1. Husband 2. Wife 3. Mother 4. Father 21. Son 22. Daughter 23. Cousin 24. Niece 25. Nephew 26. Uncle 27. Aunt 28. Brother 29. Sister 30. Friend 31. Grandson 32. Grand daughter 33. Grand Father 34. Grand mother 35. ________	6. Farmer 7. Wage employ 8. Unemployed 9. __________	5. Town 6. Township 7. Village 8. ------------	1. E. cape 2. Gauteng 3. N. cape 4. Free state 5. W. cape 6. KZN 7. Limpopo 8. Mpumalanga 9. North west
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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3. What does HH have?

Item	Answer		Codes	
1. House	No. of Houses		**House Tenancy** 1. Own 2. Rent **Type of roof** 1. Zinc 2. Thatch 3. Asbestos **4.** ________ **Type of Wall** 1. Mud 2. Brick 3. Zinc 4. Wood	**Drinking Water** 1. Tap/windmill/borehole 2. Tanker 3. River 4. Well 5. Rain 6. Spring/stream **Toilet** 1. Flash 2. Pit 3. Bucket 4. Bush **Type of transport** 1. Bus/bakkie/car 2. Scooter/motor bike 3. Bicycle 4. Animal/drawn carts
	Total No. rooms			
	Tenancy (O/R)			
	Roof type (Code)			
	Wall type (Code)			
2. Water source (Code)				
3. Electricity (Y/N)				
4. Toilet type (Code)				
5. Transport veh. type (Code)				
6. Phone (Y/N)				
7.				

8.			
9.			

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name--------------------------
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4. Do you keep any livestock? If Y, which ones and how many of each do you keep at present, how many do you wish to keep and reason for the difference, if nay?

Livestock	**Y/N**	**No.**		**Reason for difference between No. kept and No. wished to keep.**
		Kept at present	**Wish to keep**	
Cattle				
Sheep				
Goats				
Pigs				
Chicken				
Other1 (sp.)				
Other 2 (Sp.)				

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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5. How many of each HH livestock are owned by men and how many are owned by women?

Livestock	**No.**	
	Owned by men	**Owned by women**
Cattle		
Sheep		
Goats		
Pigs		
Chicken		
Other1		
Other2		

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

6. How do you keep these animals?

Livestock	**Method (Code)**	**Method Code**
Cattle		1. Free range 2. Paddock 3. Feed lot 4. Free range & paddock 5. Free range & feed lot 6. Feed lot & paddock 7. All three 8. Battery cage 9. Dip litter
Sheep		
Goats		
Pigs		
Chicken		
Other1		
Other2		

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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7. Of animals of each category born on the farm in the last 12 months, how many were sold, how many died and how many are in the farm now?

Livestock	**No.**			
	Born	Dead	Sold	In farm today
Cattle				
Sheep				
Goats				
Pigs				
Chicken				
Other1				
Other2				

8. Do you employ hired labor in keeping any of your livestock (Y/N)? If Y, what gender do you hire more frequently, what is method of payment, if cash how much did you spend on hired labor in the last 30 days for each livestock?

Livestock	**Y/N**	**If Y**			**Payment mode code**
		Gender (M/F)	**Payment**		
			Mode (Code)	**Amt. (if cash)**	
Cattle					1. Cash 2. Kind
Sheep					
Goats					
Pigs					
Chicken					
Other1					
Other2					

Village Name-------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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9. Do you use HH labor in keeping any of your livestock (Y/N)? If Y, which activity do you use HH labor most?

Livestock	**Y/N**	**If Y, activity (Code)**	**Code**
Cattle			1. Feeding 2. Dipping 3. Grazing
Sheep			
Goats			
Pigs			
Chicken			
Other1			
Other2			

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name--------------------------
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10. If Y in 9 above, name maximum of three HH members who worked on each livestock yesterday, gender of each and number of hours worked yesterday.

Livestock	**HH member 1**			**HH member 2**			**HH member 3**		
	Name	**Gender**	**Hrs. worked**	**Name**	**Gender**	**Hrs. worked**	**Name**	**Gender**	**Hrs. worked**
Cattle									
Sheep									
Goats									
Pigs									
Chicken									
Other1									
Other2									

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

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11. hat other inputs than labor did you apply to each livestock and how much did you spend on each input?

Livestock	**Feed**	**Vet. supplies**		
Cattle				
Sheep				
Goats				
Pigs				
Chicken				
Other1				
Other2				

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

12. In the last 12 months, did you acquire any animal under each livestock (Y/N)? If Y, what is method of acquisition, how many animals and how much did you spend, total under each livestock?

Livestock	**Y/N**	**Method (Code)**	**No. Animals**	**Amt.**	**Method Code**
Cattle					1. Purchased 2. Inheritance 3. Lobola 4. Exchange/barter 5. Donation
Sheep					
Goats					
Pigs					
Chicken					
Other1					
Other2					

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------

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13. In cases of cattle, sheep, goats and pigs how many animals in each category do you have today by sex and age range?

Livestock	**Age range**	**Sex**	
		Male (No.)	**Female (No.)**
Cattle	<2 yrs		
	>2 yrs		
Sheep	**<6 mths**		
	>6 mths		
Goats	<6 mths		
	>6 mths		
Pigs	**<5 mths**		
	>5 mths		

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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14. In cases of chicken how many birds do you have today by broiler and layer categories and by age range?

Age range	**Category**	
	Broiler	**Layer**
<6 wks		
>6 wks		

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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15. In the last 12 months, for each livestock category, how many animals did you sell, how much did you realize, how many would you have liked to sell? If you sold less than you would have liked to sell, what is the reason?

Livestock	**Sold**		**Wished to sale**	
	No.	**Amt. realized**	**No.**	**Reason for difference between No. sold and No. wished to sell**
Cattle				
Sheep				
Goats				
Pigs				
Chicken				
Other1				
Other2				

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------

16. If you sold animals, under each livestock category,
where did you sell and to whom did you sell and reason for not selling all?

Livestock	Where (Code)	To whom (Code)	Codes	Reason for not selling all
Cattle			**Where** 1. Town 2. Township 3. Village **To Whom** 1. Individual 2. Large-scale farmer 3. Middlemen/traders	
Sheep				
Goats				
Pigs				
Chicken				
Other1				
Other2				

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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17. In the last 12 months, for each livestock category, how many animals did you slaughter, how many would you have liked to slaughter? If you slaughtered less or more than you would have liked to, what is the reason?

Livestock	**No. Slaughtered**	**No. Wished to slaughter**	**Reason for difference between No. slaughtered and No, wished to slaughter**
Cattle			
Sheep			
Goats			
Pigs			
Chicken			
Other1			
Other2			

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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18. Under each livestock category, the meat you obtained from the animals you slaughtered in the last 12 months, how many portions out of 10 did you sell, how much did you realize, how many portions out of the 10 would you have liked to sell? If you sold less or more than you would have liked to what is the reason?

Livestock	**Sold**		**Wished to sell**	
	No. out of 10	**Amt. realized**	**No. out of 10**	**Reason for difference between No. out of 10 sold and No. wished to sell**
Cattle				
Sheep				
Goats				
Pigs				
Chicken				
Other1				
Other2				

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------

19. If you sold meat, under each livestock category,
where did you sell and to whom did you sell and why were some not sold?

Livestock	**Where (Code)**	**To whom (Code)**	**Codes**	**Reason for not selling all**
Cattle			**Where** 1. Town 2. Township 3. Village **To Whom** 1. Individual 2. Large-scale farmer 3. Middlemen/traders	
Sheep				
Goats				
Pigs				
Chicken				
Other1				
Other2				

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

20. If you produced milk, wool or egg, how many out of 10 portions of each did you sell within specified period, how much did you realize? How many portions out of 10 would you have liked to sell? What is the reason for difference, if any?

Product	**Sold**		**Wished to sell**	
	No. out of 10	**Amt. realized**	**No. out of 10**	**Reason for difference**
Milk (7 days)				
Wool (12 months)				
Egg (7 days)				

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

21. If you sold milk, wool or egg, where did you sell and to whom did you sell mostly?

Product	**Where (Code)**	**To whom (Code)**	**Where code**	**Whom code**
Milk			**Where** 1. Town 2. Township 3. Village	**To Whom** 1. Individual 2. Large-scale farmer 3. Middlemen/traders
Wool				
Egg				

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------

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22. Do you have individual HH **RAIN FED**plot of any of listed crops (Y/N)? If Y, what are area, rank in terms of cash income (1 most important), rank in terms of food security (1 most important) for each crop?

Crop	**Y/ N**	**Area (Ha) planted**	**Rank in terms of cash**	**Rank in terms of food**
Maize				
Beans				
Spinach				
Cabbage				
Potato				
Carrot				
Pepper				
Tomato				
Butternut				
Pumpkin				
Onion				
Other1 (sp.				
Other2 (sp.				

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------

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23. Would you have liked to plant more or less of each crop than stated in **RAIN FED** plot of 22 above (Y/N)? If Y, what area would have liked to plant, what is reason for difference?

Crop	**Area like to plant (Ha)**	**Reason for difference**
Maize		
Beans		
Spinach		
Cabbage		
Potato		
Carrot		
Pepper		
Tomato		
Butternut		
Pumpkin		
Onion		
Other1		
Other2		

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name--------------------------
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24. Do you have individual HH **IRRIGATED** plot of any of listed crops (Y/N)?
If Y, what are area, rank in terms of cash income (1 most important), rank in terms of food security (1 most important) for each crop?

Crop	**Y/N**	**Area (Ha) planted**	**Rank in terms of cash**	**Rank in terms of food**
Maize				
Beans				
Spinach				
Cabbage				
Potato				
Carrot				
Pepper				
Tomato				
Butternut				
Pumpkin				
Onion				
Other1 (sp.				
Other2 (sp.				

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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25. Would you have liked to plant more or less of each crop than stated in **IRRIGATED** plot of 25 above (Y/N)? If Y, what area would have liked to plant, what is reason for difference?

Crop	**Area like to plant (Ha)**	**Reason for difference**
Maize		
Beans		
Spinach		
Cabbage		
Potato		
Carrot		
Pepper		
Tomato		
Butternut		
Pumpkin		
Onion		
Other1		
Other2		

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------

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26. Do you belong to a **COOP** that grows any of the listed crops in group (Y/N)? If Y, what area planted of each crop in the current (or last) season; what area would the coop wanted to plant; what is reason, if any difference?

Crop	**Y/N**	**Area (Ha) planted**	**Area would like to plant**	**Reason for difference**
Maize				
Beans				
Spinach				
Cabbage				
Potato				
Carrot				
Pepper				
Tomato				
Butternut				
Pumpkin				
Onion				
Other1				

Other2				

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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27. How much (Ha) of HH crop area is owned by men and how much is owned by women?

Crop	**Area (Ha)**	
	Owned by men	**Owned by women**
Maize		
Beans		
Spinach		
Cabbage		
Potato		
Carrot		
Pepper		
Tomato		
Butternut		
Pumpkin		
Onion		
Other1		

Other2		

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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28. In the last season, how much of each crop did you harvest from **INDIVIDAUL HH** plot? How many portions of harvest did you sell? How many portions would you have wished to sell, what is reason for difference, if any?

Crop	**Qty harvested**	**Measure (Code)**	**Sold**		**Wished to sell**	
			Portion out of 10	**Amt. realized**	**Portion out of 10**	**Reason for difference**
Maize						
Beans						
Spinach						
Cabbage						
Potato						
Carrot						
Pepper						
Tomato						
Butternut						
Pumpkin						
Onion						

Other1						
Other2						

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

29. In the last season, did you use hired labor for any crop in **INDIVIDAUL HH** plot of any crop (Y/N)? If Y, for what activity (mostly),what gender of hired labor mostly, what source of hired labor? Did you use as much hired labor as you wanted (Y/N)? If N, what is the reason?

Crop	**Used hired labor?**				**Used as much as wanted?**		Codes
	Y/N	**Activity (Code)**	**Gender (M/F)**	**Source (Code)**	**Y/N**	**Reason, if N**	
Maize							**Activity** 1. Land preparation 2. Planting 3. Weeding 4. Harvesting 5. Chemical application 6. Transportation **Source** 1. Village
Beans							
Spinach							
Cabbage							
Potato							
Carrot							
Pepper							
Tomato							
Butternut							
Pumpkin							

Onion							
Other1							
Other2							

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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30. If you sold any crop in the last 12 months,
where did you sell and to whom did you sell mostly?

Crop	**Where (Code)**	**To whom (Code)**	**Codes**
Maize			**Where** 1. Town 2. Township 3. Village **To Whom** 1. Individual 2. Large-scale farmer
Beans			
Spinach			
Cabbage			
Potato			
Carrot			
Pepper			
Tomato			

Butternut			3. Middlemen/traders
Pumpkin			
Onion			
Other1			
Other2			

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

31. Do you use HH labor in production of any crop in **INDIVIDAUL HH** plot (Y/N)? If Y, which activity do you use HH labor most?

Crop	**Y/N**	**If Y, activity (Code)**	**Code**
Maize			**Activity** 1. Land preparation 2. Planting 3. Weeding 4. Harvesting 5. Chemical application 6. Transportation
Beans			
Spinach			
Cabbage			
Potato			
Carrot			

Pepper			
Tomato			
Butternut			
Pumpkin			
Onion			
Other1			
Other2			

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name---------------------------
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32. If Y in 31 above, name maximum of three HH members who worked on each crop IN **INDIVIDAUL HH** plot in the last 30 days, gender of each and number of hours per day worked by each.

Crop	**HH member 1**			**HH member 2**			**HH member 3**		
	Name	**Gender (M/F)**	**Hrs. worked**	**Name**	**Gender (M/F)**	**Hrs. worked**	**Name**	**Gender (M/F)**	**Hrs. worked**
Maize									
Beans									
Spinach									
Cabbage									
Potato									
Carrot									
Pepper									
Tomato									
Butternut									
Pumpkin									
Onion									
Other1									
Other2									

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

33. If you applied any of listed inputs to **INDIVIDAUL HH** plot of any crop how much did you spend on each input?

Crop	**Hired labor**	**Seed**	**Fert lizer**	**Chem ical**	**Other1**	**Other2**
Maize						
Beans						
Spinach						
Cabbage						
Potato						
Carrot						
Pepper						
Tomato						
Butternut						
Pumpkin						
Onion						
Other1						
Other2						

Village Name-------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name--------------------------

34. How much farmland by type is available to you to use today, for how long can you use it, how did you acquire it, how much do you pay per period?

<table>
<tr><th rowspan="2">Farmland type</th><th rowspan="2">Area (Ha)</th><th rowspan="2">Available for (Yrs)</th><th rowspan="2">Acq. Method (Code)</th><th colspan="2">Payment</th><th colspan="2" rowspan="2">Codes</th></tr>
<tr><th>Amt. (Rands)</th><th>Per period (Code)</th></tr>
<tr><td>Rain fed arable</td><td></td><td></td><td></td><td></td><td></td><td rowspan="6">Method of acquisition
1. Inheritance
2. Purchased
3. Rented
4. Allocated by chies/ PTO
5. Communal
6. Tenure</td><td rowspan="6">Payment periods
1. Once off
2. Monthly
3. Yearly</td></tr>
<tr><td>Rain fed grazing</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Irrigated arable</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Irrigated grazing</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name--------------------------
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35. Is farmland of each type available sufficient for you (Y/N)? if N, what is the reason?

Farmland type	**Y/N**	**If N, Reason**
Rain fed arable		
Rain fed grazing		
Irrigated arable		
Irrigated grazing		

Village Name--; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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36. Other than farmland, what other fixed assets are available for your use?

Fixed farm asset	No. available	Period Avail. (Code)	Acq. Method (Code)	Payment		Period code	Method code
				Amt. (Rands)	Period (Code)		
Tractor						1. Once off 2. Monthly 3. Yearly	1. Inheritance 2. Purchased 3. Rented 4. Allocated by chies/ PTO 5. Communal Tenure
Work cow							
Work horse							
Work donkey							

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------

37, Did you take credit in the last 12 months (Y/N)?
if Y, for what purpose, how much, from what
source, for what period, and what is interest?

			Purpose	Source
Y/N			**Purpose** 1. Farming 2. Wedding 3. Funeral 4. Education 5. Building 6. Ritual/sangoma 7. Food 8. Entertainment 9. Transport 10. Furniture 11. ------------	**Source** 1. Stokvel 2. Mashonisa 3. Microlenders—Nerpo 4. Friends/relatives/neighbours 5. ------------------------------
Purpose (Code)				
Amount				
Source (Code)				
Period (Code)				
Interest	Rate (%)			
	Per (Code)			

38. Did you take enough loan (Y/N)?--------; if N, what is the reason?--

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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39. In the last 12 months, how much were the HH cash income from different sources?

Source	**Amount**
Livestock	
Crop	
Wage	
Farm labor	
Casual labor	
Social grant	
Remittance	

Village Name---------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name----------------------------
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40. In the last 12 months, on what did you spend your cash income?

Item	**Amount**
Farm	
Food	
Drink	
Funeral	
Savings	
Entertainment	
Rituals	
Education	

Village Name---------------------------------------; Village No.---------

41. What does the village have?

Item	**Answer**
Nearest urban center (name)	
Distance to nearest urban center (km)	
Market center in the village (Y/N)	
If N to above, distance to a market place (km)	
Distance to upper mkt (km)	
Any primary school in the village (Y/N)	
If N to above, distance to nearest one (km)	
Any secondary school in the village (Y/N)	
If N to above, distance to nearest one (km)	
No. of HH in the village	
Frequency of commercial veh. In village (No./week)	
Distance to nearest employer of more than 10 persons (km)	

Electricity	

Village Name--------------------------------------; Village No.---------; HH No.-------; Page -------of-------; Enumerator Name-----------------------------
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42. Regulatory and Legal Environments

(a) Do policies exist for exporting any of these agricultural products

Crop	Pricing	Approval	Licensing	SPS guidelines	Inspection Timeframe	Proportion of containers inspected
Maize						
Citrus						
Beans						
Spinach						
Cabbage						
Potato						
Carrot						
Pepper						
Tomato						
Butternut						

Pumpkin						
Onion						
Other1						
Other2						

Exporting agricultural products (export pricing policies in place, existing export approval, licensing requirements, ease of compliance with sanitary/phytosanitary approval requirements, time taken to undergo inspection, proportion of containers inspected, what procedures are entailed)

(b) Which of these is/are involved when you are trying to access agricultural inputs

Crop	**Imported**	**Subsidized**	**Taxed**	**Time**	**Approvals**	**Type of input**
Maize						
Citrus						
Beans						
Spinach						
Cabbage						
Potato						
Carrot						
Pepper						
Tomato						

Butternut						
Pumpkin						
Onion						
Other1						
Other2						

Accessing agricultural inputs (procedural requirements to import inputs, licenses required, approvals required, time and procedures involved, documentation needed, import taxation/subsidization required).

(c)When trying to obtain credit for agribusiness, what conditions apply?

Crop	**Collateral Needed**	**Warehousing Available**	**Insurance Needed**	**Membership of farmer organization**	**Type of credit sought/received**
Maize					
Citrus					
Beans					
Spinach					

Cabbage					
Potato					
Carrot					
Pepper					
Tomato					
Butternut					
Pumpkin					
Onion					
Other1					
Other2					

Getting credit for agribusiness (regulatory issues directly pertinent to access to finance for agricultural activity, ease of leasing equipment, rules and regulations concerning use of moveable assets as collaterals, existence of warehousing facilities, export contracting as collateral for financing, restrictions on the method of valuing agricultural land to be used as collateral, kinds of insurance accessed by farmers)

(d) Is any of these applicable to your efforts to access agricultural land?

Crop	Purchase	Lease	Inheritance	Chief's Permission	Land Registration	Time involved
Maize						
Citrus						
Beans						
Spinach						
Cabbage						
Potato						
Carrot						
Pepper						
Tomato						
Butternut						
Pumpkin						
Onion						
Other1						
Other2						

Accessing agricultural land (time and procedures involved in purchasing agricultural land and effect transfer of ownership, conflict resolution issues involving land, leasing possibilities and costs, security of access to land as indicated by the level of protection offered by land registries, whether land boundaries are clear, and level of compensation in the event of expropriation).

(e) Accessing water (what water pricing and distributional policies/regulations are in place?).

Crop	Price policy	Subject of control by Chief/Community	Subject of control by Water Users Association	Subject of control by Water Affairs Dept.	Subject of control by Local Municipality	Restriction on Quantity of Water	Restriction on Duration of Irrigation
Maize							
Citrus							
Beans							
Spinach							
Cabbage							
Potato							
Carrot							
Pepper							
Tomato							
Butternut							
Pumpkin							
Onion							
Other1							
Other2							

(f) Storage of agribusiness products

Crop	Cost/unit	Is Licensing Required?	What facilities are available?	What treatment before storage?	How much time required to process storage contract?
Maize					
Citrus					
Beans					
Spinach					
Cabbage					
Potato					
Carrot					
Pepper					
Tomato					
Butternut					
Pumpkin					
Onion					
Other1					
Other2					

Storing, handling and transporting agribusiness products (availability and efficiency of storage and transport services for agricultural sector)

(g)Transportation of agribusiness products

Crop	Cost/unit	Is Licensing Required?	What facilities are available?	What treatment before transport?	How much time required to process transport contract?
Maize					
Citrus					
Beans					
Spinach					
Cabbage					
Potato					
Carrot					
Pepper					
Tomato					
Butternut					
Pumpkin					
Onion					
Other1					
Other2					

(h) Other handling (specify) of agribusiness products

Crop	**Cost/unit**	**Is Licensing Required?**	**What facilities are available?**	**What treatment before handling?**	**How much time required to process handling contract?**
Maize					
Citrus					
Beans					
Spinach					
Cabbage					
Potato					
Carrot					
Pepper					
Tomato					
Butternut					
Pumpkin					
Onion					
Other1					
Other2					

(i) Contract Farming

Crop	Membership of association	What association does for farmer			Do disputes arise?	How are disputes resolved?
		Input	Info	Market		
Maize						
Citrus						
Beans						
Spinach						
Cabbage						
Potato						
Carrot						
Pepper						
Tomato						
Butternut						
Pumpkin						
Onion						
Other1						
Other2						

Contract farming (existence of cooperatives of smallholders or other farmer groups that distribute inputs and facilitate provision of extension services, do disputes arise and how are they resolved and at what costs and by what mechanisms?)

NOTE: The data arising from the use of the questionnaires have been coded and stored in spreadsheet format and kept in the Department of Agricultural Economics & Extension of the University of Fort Hare. Similarly, all the field notes and reports on the basis of which the final consolidated report was prepared are held within the Department.

APPENDIX 2: CAPACITY BUILDING ACHIEVEMENTS – LISTS OF STUDENTS SUPPORTED ANNUALLY

Project Title: WATER USE PRODUCTIVITY ASSOCIATED WITH APPROPRIATE ENTREPRENEURIAL DEVELOPMENT PATHS IN THE TRANSITION FROM HOMESTEAD FOOD GARDENING TO SMALLHOLDER IRRIGATION CROP FARMING IN THE EASTERN CAPE PROVINCE OF SOUTH AFRICA

Project Leader: Professor Ajuruchukwu Obi
Organisation: University of Fort Hare, Alice

Table 2: Students identified and registered in 2012

S/No.	Student's Name	Programme	Tentative Topic
1	Miss Nandipha Mbizana	MSc	Role of natural and physical assets
2.	Mr. Lungile Gidi	MSc	Assessment of trends in entrepreneurial development
3.	Miss Zoleka Ncoyini	MSc	Trends in commercialization of communal agriculture
4.	Miss Itumeleng Mathlo	MSc	Assessment of Risk Preferences
5.	Mr Sinampula Sakhumzi	Honours	Livelihood sources
6.	Miss Tabisa Finiza	Honours	Food Security Implications
7.	Miss Thandoluhle Ndlovu	Honours	Alternative entrepreneurial paths
8.	Mr Douglas Kibirige	PhD	Human Dimensions
9.	Mr. Isaac Agholor	PhD	Alternative Extension Models

CAPACITY BUILDING FOR 2014/15

STUDENT NAME AND SURNAME	GENDER	RACE	DEGREE	UNIVERSITY	COUNTRY OF ORIGIN	STATUS
Qaqamba Lumka Ndlazi	Female	Black	MSc	Walter Sisulu University	South Africa	New Registration
Brighton Shumba	Male	Black	MSc	Walter Sisulu University	Zimbabwe	New Registration
Nandipha Mbizana	Female	Black	MSc	University of Fort Hare	South Africa	Completed
Itumeleng Mathlo	Female	Black	MSc	University of Fort Hare	South Africa	Completed
Thandoluhle Ndlovu	Female	Black	MSc	University of Fort Hare	Zimbabwe	Completed
Christian Mzuyanda	Male	Black	MSc	University of Fort Hare	South Africa	Completed
Femi Fakunle	Male	Black	PhD	University of Fort Hare	Nigeria	Completed
Gilbert Chitsa	Male	Black	MSc	University of Fort Hare	Zimbabwe	Completed
Nyarai Mujuru	Female	Black	PhD	University of Fort Hare	Zimbabwe	Completed
Tina Mnonopi	Female	Black	MSc	University of Fort Hare	South Africa	New Registration
Sive Bota	Female	Black	MSc	University of Fort Hare	South Africa	Deceased
Lesala Mahali	Female	Black	PhD	University of Fort Hare	Lesotho	On-going

CAPACITY BUILDING FOR 2015/16

STUDENT NAME AND SURNAME	GENDER	RACE	DEGREE	UNIVERSITY	COUNTRY OF ORIGIN	STATUS
Nomalungisa Mbangcolo	Female	Black	Honours	Walter Sisulu University	South Africa	Completed
Masanele Mangaliso	Female	Black	Honours	Walter Sisulu University	Zimbabwe	Completed
Yokwana Aphelele	Female	Black	Honours	University of Fort Hare	South Africa	Completed
Luwando Nkamisa	Male	Black	Honours	University of Fort Hare	South Africa	Completed
Zandile Kondlo	Female	Black	MSc	University of Fort Hare	South Africa	Completed
Sinovuyo Magqibelo	Female	Black	MSc	University of Fort Hare	South Africa	Completed
Sibongile Funde	Female	Black	MSc	University of Fort Hare	South Africa	Completed
Sive Bota	Female	Black	MSc	University of Fort Hare	South Africa	Deceased
Thandoluhle Ndlovu	Female	Black	PhD	University of Fort Hare	Zimbabwe	Continuing
Christian Mzuyanda	Male	Black	PhD	University of Fort Hare	South Africa	Continuing
Gilbert Chitsa	Male	Black	PhD	University of Fort Hare	Zimbabwe	Continuing
Nyarai Mujuru	Female	Black	PhD	University of Fort Hare	Zimbabwe	Completed
Lesala Mahali	Female	Black	PhD	University of Fort Hare	Lesotho	Continuing

Table 2: Direct Capacity Building Achievements for 2016/17

STUDENT NAME AND SURNAME	GENDER	RACE	DEGREE	UNIVERSITY	COUNTRY OF ORIGIN	STATUS	E-mail address
Nomalungisa Mbangcolo	Female	Black	Masters	University of Fort Hare	South Africa	On-going	201200872@ufh.ac.za
Masanele Mangaliso	Female	Black	Masters	University of Fort Hare	South Africa	On-going	201202135@ufh.ac.za
Zandile Kondlo	Female	Black	Masters	University of Fort Hare	South Africa	Completed	zandilekondlo@ymail.com
Sinovuyo Magqibelo	Female	Black	Masters	University of Fort Hare	South Africa	Completed	Sinovuyo.magqibelo@yahoo.com
Aphelele Lucia Yokwana	Female	Black	Masters	University of Fort Hare	South Africa	On-going	201202616@ufh.ac.za
Roland Onomu	Male	Black	Masters	University of Fort Hare	Nigeria	Completed	roland.onomu@yahoo.com
Christian Mzuyanda	Male	Black	PhD	University of Fort Hare	South Africa	On-going	mzuyanda1990@gmail.com and 200906483@ufh.ac.za
Gilbert Chitsa	Male	Black	PhD	University of Fort Hare	Zimbabwe	On-going	gilbertchitsa@gmail.com
Lungile Gidi	Male	Black	PhD	University of Fort Hare	South Africa	Completed	lungilegidi@gmail.com
Taofeek Balogun	Male	Black	PhD	University of Fort Hare	Nigeria	Completed	btaofeekayodeji@yahoo.com

APPENDIX 3: KNOWLEDGE DISSEMINATION – TITLE OF PAPERS, CONFERENCES AND JOURNALS.

The 5th International Research Conference on "*Implementation Science in Green Economy", Walter Sisulu University, East London South Africa, 22-24 August, 2012*

- The Role of Aspirations and Goals of Households in the Decision to Expand Scale of Operation from Homestead Gardening to Smallholder Irrigation Farming".

- "Evaluating alternative development paths for sustainable crop farming enterprise in the Tyefu Irrigation Scheme in Eastern Cape, South Africa".

The 52nd Annual Conference of the Association of Agricultural Economists of South Africa, Bela-Bela, Limpopo, 30 September-03 October 2013.

- "Trends in commercialisation of communal agriculture in the Eastern Cape province".
- "Rural households' livelihoods strategies and opportunities with regard to farming: a case of Intsika Yethu Local Municipality".

The 24th Annual International Food and Agribusiness Management Association (IFAMA) Forum & Symposium, June 16-17, 2014, in Cape Town, South Africa

"Comparing Efficiencies of Smallholder Irrigation Farms under the Land Reform Programme in the Eastern Cape Province of South Africa".

The 25th Annual International Food and Agribusiness Management Association (IFAMA) Forum & Symposium was held in St. Paul, Minnesota, USA, during June 14-27, 2015.

- Smallholder Development and Participation in Output Markets: The Case of the Eastern Cape Province.
- Examining the Contribution of Entrepreneurial Spirit to the Performance of Smallholder Maize Producers in Mhlontlo Local Municipality in the Eastern Cape Province of South Africa.
- Analysis of Profit Efficiency for Smallholder Irrigated Crop Enterprises in the Eastern Cape Province of South Africa.

The 10th Africa Farm Management Congress 20-25th November 2016 | Pointe aux Piments, Mauritius

- Evaluating Technical Efficiency of Smallholder Farmers in South Africa. A case study of the Qamata Irrigation Scheme in the Eastern Cape Province of South Africa.

APPENDIX 4: TECHNOLOGY EXCHANGE THROUGH STAKEHOLDER CONSULTATIONS

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CHAPTER 1
INTRODUCTION

1.1 Background

A distinguishing feature of the present study is the explicit use of participatory methodologies for the key phases of the research. The original call had specified the methodology as a key requirement and eligibility criterion. In submitting the proposal, the team specifically highlighted its familiarity with the ARD (Agricultural Research for Development) Procedure and concept and detailed the steps in the proposal. In line with that proposal, the study adopted the participatory approach right from the inception of the project.

In the proposal, the study described the 6 steps as follows:

1. Organizing the team
2. Putting the problem in context
3. Identifying strategies
4. Formulating joint action plans
5. Implementing joint action plans
6. Institutionalizing the ARD concept.

Without a doubt, only the first five of these steps is relevant for this study and this was clearly stated in the proposal since the institutionalizing of the ARD concept is not a goal of the project. In fact, the goal of institutionalizing the ARC concept was already being pursued by another project under the same project management and it was expected that the present project would benefit from that arrangement.

One of the key issues raised by farmers who are selected to be interviewed by researchers is the fact that they hardly know the outcome of the interviews they grant to the researchers. Not only do the researchers fail to return to the same communities for follow-up, they do not even remember to send the research results to the community and to ask their opinion as to the veracity of the conclusions drawn. As a result of this, farmers are getting increasingly reluctant to cooperate with researchers to implement research programmes because they feel neglected and abused. Many research administrators have erroneously diagnosed the reluctance of communities to be interviewed as arising from "research fatigue". Nothing can be farther from the truth because rural people, more than any other category of people, like to host visitors from the cities and to feel a sense of worth. As a result, many research organizations have begun to improve their engagement with farmers and to adjust their operations to ensure that there is more healthy and friendly interaction between them and the farmers who provide them with information.

1.2 Objectives

The objective of this report is to document the experience with providing feedback to farmers on the research findings and the lessons learnt from that process that inform future research designs. More specifically, the report

(a) Clarifies the nature and relevance of the participatory methodologies in social research and agricultural development,

(b) Presents actual cases in which the team in the present study interacted with farmers and

(c) Draws conclusions on the basis of these experiences.

CHAPTER 2
NATURE AND PURPOSE OF PARTICIPATORY METHODOLOGIES

2.1 Introduction

Several studies have employed the Agricultural Research for Development (ARD) concept to generate more participatory, inclusive, and meaningful research outcomes (Hawkins *et al.,* 2009). The ARD aims at innovations for improved agricultural productivity through engagement of multiple actors in contextualizing the problem, identifying strategies, formulating and implementing joint action plans (Hawkins *et al.,* 2009). The ARD innovations evolve where interaction among players, response to feedbacks, analysis and generated solutions from the feedbacks are incorporated in the different processes (Hawkins *et al.,* 2009). According to Hawkins *et al.* (2009), the ARD approach accommodates the technical, social, and institutional constraints, with all their inherent complexities, in an environment that facilitates learning and not mere research products. A brief background on its origin and antecedents is necessary at this juncture.

In a recent review for the Forum for Agricultural Research in Africa (FARA), Obi, Ajayi and Mugabo (2013) have observed that a dominant image of the research and farmer support environment of continent is its linear and top-down orientation. Their views are in line with the findings of the International Centre for development-oriented Research in Agriculture (ICRA) which suggest that the research élite and the local levels they are intended to serve are widely separated (ICRA, 2009). This has grown out of a research and support tradition that is long-standing. For instance, according to Eicher (2001), most of the research systems and extension services in the immediate post-colonial era in Africa were immersed within the Ministry of Agriculture. Figure 2.1 illustrates the typical format encountered in almost all the existing research systems on the continent prior to the emergence of the participatory thinking.

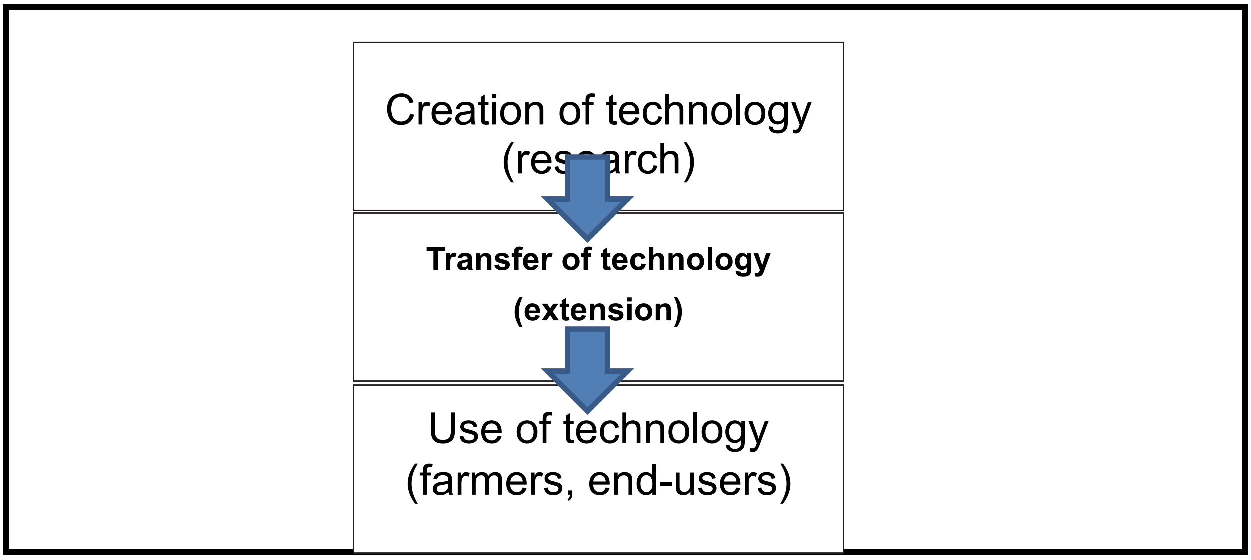

Figure 2.1: Linear format of the conventional research and extension systems

The top-down orientation has been widely seen as removing elements of feedback and ensuring that research priorities incorporate the perspectives of the grassroots (ICRA, 2009). Some of the arguments against the linear model, often referred to as "vertical one-way communication model" (Asiabaka, 1994 and Asiabaka and Mwangi, 2001), include the fact that it limits the role of extension to merely transferring information to farmers and ensures that it tended to be skewed towards research interests instead of reflecting farmers' problems and circumstances. In an earlier international review incorporated in a training manual for people associated with various national agricultural research systems (NARS) in sub-Saharan Africa, the International Livestock Centre for Africa (ILCA), the precursor of the International Livestock Research Institute (ILRI), noted that the format of the agricultural research and extension systems on the continent has led to failures in technology development (ILCA, 1988). According to ILCA (1988), these failures were traceable to a wide range of factors, notably:

iv. The weak links between research establishments and entities operating at the level of the traditional farm sector which skews technologies towards the priorities of the research confraternity rather than those who actually use them;

v. Emphasizing performance criteria developed and applied to high-income, industrialized countries and that are out-of-touch with situations in developing countries;

vi. Insufficient knowledge of small farmer conditions and circumstances.

ILCA was naturally one of the first institutions to call for the application of farming systems research approach to take care of the afore-mentioned deficiencies. In its view (ILCA, 1988), a well-designed and applied FSR should have the following features:

vi. Be neutral with respect to the nature of the system by beginning without pre-conditions, that is having an open-mind about the existing situations and the eventual outcome of any programming efforts;
vii. Focus on improvements
viii. Exhaustively examine interactions and relationships and linkages among the various units and entities making up the system under investigation;
ix. Put the farmer at the centre of the entire process, from the conception, description and diagnosis of the system to the development of solutions; and
x. Emphasize the evaluation of the identified solutions in terms of their broader effects on a wide range of indices of welfare, including productivity, equity, stability, and sustainability.

It is apparent that the sector has been the victim of gross mis-diagnosis of the core problem. According to Asiabaka (1994), one attempt to address the top-down orientation of the extension and research system has been the focus on constraints research and interventions to address identified constraints, culminating in the introduction of the farming systems research (FSR) programmes. But this approach has failed to produce the desired changes in adoption behaviour of smallholders and improve livelihoods of African resource-poor farmers, with new insights now showing that this was because the central role of farmers in adoption of improved practices was not recognized by the FSR approach. Maxwell (1986) saw the main problem with FSR as attempting to “hit a moving target” which definitely resulted in failures. According to Maxwell (1986), both the concept of FSR and the way it was implemented did not give sufficient recognition to the fact that the system itself is constantly changing and evolving and not one that can be productively engaged by ones-off methodologies or contacts.

According to Obi, Ajayi and Mugabo (2013), the wider development literature presents numerous indications of the erstwhile structure and organization of the agricultural research system on the continent. According to Taylor (1991), the structure of these systems has been influenced largely by the colonial backgrounds of these countries. Especially for the Anglophone countries, the strong influence of colonial thinking is evident (Taylor, 1991), in contrast with the situation in the Francophone countries where there has been some attempt at nationalization of the research systems to better reflect national circumstances and priorities right from the early days., although in many instances this development has been lagged up to 10-15 years after the attainment of political independence. Some of the most comprehensive studies on the origin of agricultural research in Anglophone Africa have demonstrated that there was never an intention to forge a link between the research system and the local farming system (Taylor, 1991; Eicher, 1999).

As has been made clear over the years, the first efforts at conducting research of any type into agricultural systems revolved around the botanical garden concept where the new commodities were "studied, evaluated … (and prepared for)…distribution, dissemination and production…" (Taylor, 1991). Given this focus, it was not necessary to expect that the research system would aim to achieve "balanced and efficient development of the natural resource base or…concern for food or improved nutrition of the peoples" (Taylor, 1991). Attention to food crops only began in the late 1950s, becoming significant only around the 1970s as population pressures became a more serious problem than previously (Taylor, 1991). When all the foregoing are taken into account, the differences between the conventional research tradition and the ARD methodologies become quite glaring as shown in Table 2.1.

Table 2.1: Comparison of conventional research and agricultural research for development

Conventional Research	**Agricultural Research Development**
Commodity driven/disciplinary oriented	Systems-oriented, inter-disciplinary
Reductionist	Holistic, constructivist
Aims at increasing yield	Aims at multiple objectives
Simple high input technology	Complex knowledge-intensive technology
Science driven	Responding to clients' needs
Publication oriented	Development oriented
Conducted in isolation	Inter-institutional collaboration
Limited farmer involvement	Participation, empowerment

Source: ICRA, 2009

Against the foregoing background, this study employed the ARD participatory processes as a way of incorporating views of the key players in the rural agricultural sector and ensuring that the findings are policy-relevant to the maximum extent practicable. Three steps of the ARD were considered in data collection and these included organizing the research team, putting the research problem in context and identifying authentic data collection strategies. The key players that constituted the research team included technocrats from the University of Fort Hare, officials from the Department of Rural Development and Agrarian Reforms of the Eastern Cape Province, governmental irrigation scheme managers, and leaders of the farmers' cooperatives, individual farmers and university students.

Team bonding was strengthened during the process of problem contextualization. During the process of problem contextualization, the study area and specifications of the units of analysis in respect to the study objectives were identified. This was achieved through engaging personnel at the Department of Rural Development and Agrarian Reforms, government extension officers, community development officers, irrigation scheme managers, leaders of farmers' cooperatives, managers of private farms and individual farmers. Intensive consultative meetings were carried out to equip the research team with the knowledge regarding farmers' perceptions and attitudes towards farming, societal values and norms, and the best approaches needed to extract the relevant information. In addition to consultative meetings, the research team endeavoured to visit some of the proposed study sites physically and interviewed the technocrats and community leaders to ascertain the feasibility of the study sites.

Different strategies were used to address the set objectives linked to the contextualized problem. These strategies were based on the participatory methods of data collection. There several participatory methods used in data collection and they include group and team dynamics, sampling, sensitive interviewing and dialogue as well as diagramming and visual construction (Pretty and Voudouhe, 1994; Pretty, 1995). Among the mentioned participatory methods, group and team dynamics, sampling and sensitive interviewing were used in this study. The research team established the rules, norms and working principles to create a better working environment that minimize group conflicts. Visiting the proposed study site as a team, work sharing, rapid report writing and shared presentations all these provided a better understanding and appreciation of the problem situation. Participants in the sensitive interviews included key informants, farmer groups and individual farmers.

The most common primary sources of knowledge in social research employ a combination of observable/measurable and unobservable/non-measurable factors needed to answer the research questions and hypothesis (Kodua-Agyekum, 2009). The researcher used proxies and asked questions that addressed the characteristics of the unobservable factors. This was achieved through face to face interviews with individual farmers and technocrats and responses were recorded. Some physical and physiological components of social factors can be observed and measured to qualify the unobservable/non-measurable information. Use of both, measurements and observation is thought to yield better results (Kodua-Agyekum, 2009).

The researcher used observation method to elicit information concerning the biophysical characteristics of the study area such as vegetation, topology, economic activities, social interactions, infrastructure available especially the irrigation system facilities, and farm layout on the irrigation schemes and homestead gardens. Also the method was used to carefully study individual responses towards certain questions that called for understanding farmer's perception and attitudes on farming. Qualitative research uses this method to assess the accuracy of documented and oral information like the status of the irrigation scheme and farming systems present in the research area.

According to Adler and Adler (1994) cited by Kodua-Agyekum (2009), observation research has the ability to extract in-depth information regarding physical/tangible, economic and social behaviours of a given community. However, despite its efficacy, results generated by this method only represent a specific location/environment/social group and can hardly be extrapolated to other locations/environment/social settings.

CHAPTER 3
PRESENTATION OF ACTUAL CASES OF FEEDBACK TO FARMERS

3.1 Introduction

As has been highlighted earlier, farmers were becoming uncooperative with researchers that something needed to be done. At the same time, the development community was becoming aware that the linear development process was not leading to effective transfer of know-how. The integrated agricultural research for development was therefore developed as one response of the development community to this need.

The participatory tools applied in development and research studies generally include key informant interviews, focus group interviews, transect walk, stakeholder analysis matrix, Matrix scoring, Venn diagram and chapatti or use of pie chart. These tools facilitate the identification and analyses of the area of focus, also referred to as the 'systems of interest', development options and opportunities for the schemes, the problem at hand and potential solutions to the problem identified by the stakeholders and the team. In this particular study and for purposes of the limited aim to provide feedback on the research results to those who responded to the interviewer, the tools relevant to feedback of this nature were applied. The specific instances where this was done are described below.

3.2 Stakeholder workshop in Ndlambe

This was done to share information gathered within two weeks with the farmers without giving opinion or recommendation but as a means of reaching consensus on interpretation thereof. The workshop was also organized to create a platform for stakeholders involved within the scheme to strengthen their linkages and identify strategies to enhance production in the scheme in future. The meeting was held in the Ndlambe scheme hall and was attended by representatives from all villages that fall under the scheme, a non-governmental organization by the name of RULIV which is active within the community, a representative of the Department of Rural Development and Reform as well an extension officer from the Ngqushwa Local Municipality.

Figure 3.1: Illustrative Flow of Field Study Activities

3.3 Feedback Session in Melani.

The structure of this session was different from the first one held in Ngqushwa Local Municipality. The Melani village is located within Nkonkobe Local Municipality within 10-15 minutes drive from the University of Fort Hare. On the basis of experiences gained from earlier sessions in Ngqushwa Local Municipality and Qamata in Insika Yethu Local Municipality, the feedback session held on 26 February 2015 was carefully planned. Initial contact was made with the Village Head who then deputed the Secretary of the Village Council to participate with the team to draw up an agenda for the day. This is shown in

Table 3.1: Agenda for the Day

1. Opening remarks (Prayer) – Mr Billy
2. Reason for visit – L. Gidi
3. Welcoming – Mr Sigunu
   Tea break
4. Feedback :- Presentation of results
   (L. Gidi and M. Christian)
5. Group interaction
   Input from members
   Recommendations
   Suggestion and expectations
6. Closing : Prayer – Member
   Lunch!!!!!

The UFH Team introduced themselves and presented the agenda of the meeting to the farmers (or the villagers). The attendance register was completed (see Appendix). According to the register, 17 farmers from Melani village and 10 farmers from Binfield area participated in the feedback session.

Mr L Gidi (PhD candidate) and Mr Christian (MSc candidate) presented the summary of the key findings of the research. A fip-chart was used to display the points more clearly. The presentation was interpreted in *Xhosa* language so as to enhance the farmers' understanding of the results.

After the presentations were made, the farmers present were given the chance to air their views on the findings. Agreements and disagreements with the results were equally entertained and discussed. Reacting to the report, Mr Sigunu, on behalf of the entire farmers accepted that the results are a true representation of what is on ground in Melani and Binfield. Based on the results and the agreement reached, the team opened the floor for further discussions as follows:

3.3.1 Gender differences

The reason given by the farmers for more farming households being female-headed was that the women are mostly single parents or are widowed. In addition to that, the farmers pointed out that women have the capacity to exercise perseverance in farming activities than the men. The issue of men migrating to big cities in search of work in non-agricultural sectors and leaving their wives to cater for their families does not apply to the sampled villages.

3.3.2 Age groups (40-70 years)

The reasons given for farmers falling within the age range of 40-70 years old goes beyond the fact that the elderly ones still practice traditional farming methods to the fact that they have become used to ‘empty promises’ of the government in assisting them. They expressed much concern that the younger generation, who lack diligence in their civic duties manifest indolent attitude regarding farming. Also, they gave reasons that the younger generation lack motivation to engage in agricultural activities as a result of hardship which they have witnessed their parents or older farmers face over the years.

3.3.3 Land size

The lands in the villages are allocated by headmen through the chiefs. Farmers emanating from these two (2) villages are characterized by small portions of land which they cultivate. The reason which they gave for using pocket portions of land for planting is that they are old and as a result do not have the energy to engage in enormous farming. Furthermore, they gave reasons for little or no money to hire labour as they depend strictly on social grants.

3.3.4 Social grants and high dependency

In the sampled villages, there is a high rate of unemployment amongst the working population age bracket, hence depending solely on social grants. Due to the enormity of high rate of unemployment in the villages, the children who are zealous for acquiring education discontinue from schooling talk less of attending tertiary institutions when they have attained the age.

3.3.5 Input markets

Basically, there is a lack of access to input markets for the farmers in the study area. This is as a result of wide distance from the towns to the rural area where the farmers are situated. The nearest town to these areas is Alice, which is about 25 km away. Also, the transport fare to the town is quite high and unaffordable due to poor road infrastructure to areas serving the communities.

3.3.6 Output markets

There is also a lack of produce market for farmers due to the unavailability of information about market prices and procedures they follow in order to get to the market. Another shortcoming regarding accessing of the markets is the quality of produce. Due to very poor and inadequate storage facilities for the produce, selling them becomes very difficult.

3.3.7 Services

Mrs Tukani who is the chairperson of ImizamoYethu Project in Binfield expressed her blames on the extension officers for failure to disseminate information and relevant ideas to the farmers. Still on the issue of extension officers' inadequacy, Mr Feni further remarked that the extension officers' role is a dead one. The extension officers who pay visits to the farmers in the villages do that only when they have gone to Bisho area to lodge their complaints. Their understanding is that extension officers should visit them from the onset of the season to the period of harvest.

Also, there is problem of inaccessibility of credit for the farmers, who are afraid of the interest rates associated with borrowing money from the lenders. The lenders are also reluctant in giving the farmers loans, since they are unreliable in paying back.

Figure 3.2: Feedback Session in pictures at Melani Village


5 Old age pension and
grants were the main
sources of income for the
majority of villages
6 Most farming households had
only few members employed, leading
to high dependency
7 Farm sizes are still very low, ranging
from 0.1-2ha on average in
Homesteads & 0.5-6ha on
irrigation schemes
8 Few households generate any
surplus for market sales
MCH
10

CHAPTER 4
CONCLUSIONS

The new mood of enthusiasm and friendship is palpable. The villagers in all cases were effusive with praises for the initiative. New information emerged from the sessions that helped in interpreting the results of the analysis and gaining better understanding of the system under study. There is also the promise of more sincerity in responses to interview questions since the farmers are now better informed about the research and the need to contribute to national policy formulation. In the past, research budgets did not make provisions for this component, but with realization of its value, it is imperative that adequate arrangements be made to accommodate these. It is also necessary for academics and research organization to start to prepare guidelines for conducting feedback sessions so they can become more effective sessions.

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