Analysis of technical efficiency of small-scale maize producers: a case study in Tsolo magisterial district in O.R Tambo district in the Eastern Cape of South Africa

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

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DECLARATION

I hereby certify that this dissertation is the result of my own original work and has not previously been submitted to another university for the purpose of a degree. Where use has been made of the work of others, such work has been duly acknowledged in this text.

Signed ……………………………………………… Date: …………………………..

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This work is dedicated to the glory of God, my parents and my wife "Ntombentle Avuletey".

ABSTRACT

Maize is the most important cereal crop grown in South Africa. This crop is produced throughout the country under diverse conditions and in diverse environments. The study only focuses on technical efficiency because it is an important subject in developing agriculture where resources are limited, but high population growth is very common. In such a setting, increased output will depend more on efficiency improvements and assessing the scope for such efficiency improvements within the system is a crucial need. The objective of the study was to determine the level of technical efficiency and to identify the socio-economic and institutional characteristics as well as the entrepreneurial spirit that influence the technical efficiency of small-scale maize producers in the Tsolo magisterial district. Purposive and Snowball sampling techniques were used to collect primary data from 120 small-scale farmers. The stochastic frontier model was used to determine the level of technical efficiency.

The Multivariate OLS was used to analyze the socio-economic factors and institutional characteristics that have influenced the technical efficiency of maize production. A similar linear regression model was used to estimate the influence of positive psychological capital and entrepreneurial spirit on the technical efficiency of maize production.

The stochastic results revealed that small-scale farmers in Tsolo are technically efficient at 98 percent in maize production and experience increasing return to scale (1.37), which means that increase in the use of inputs, will as well increase their productivity and efficiency. The inefficiency model results indicated that age, years in farming, household size and extension contact significant and 3 variables, namely, as years in farming, extension contact and farm size are significant in the OLS model. Lastly the results of the linear regression indicated that, out of the 4 variables estimated in the entrepreneurial spirit, self-efficacy and resilience were significant with respect to its responsiveness to total maize output.

Key words: Snowball, OLS, Technical efficiency, Stochastic Frontier, return to scale, Entrepreneurial spirit, Positive psychological capital.

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Acronyms and abbreviations

ARC- Agricultural Research Council

ARD- Agricultural Research and Development

CRS- Constant Return to Scale

CSIS- Centre for Strategic and International Studies

DEA- Data envelopment Analysis

DEDEA- Department of Economic Development and Environmental Affairs

DOA- Department of Agriculture

FAO- Food and Agricultural Organization

NGOs- Non Governmental Organization

OLS- Ordinary Least Square

SADC- Southern African Development Community

SFA- Stochastic Frontier Analysis

SPSS- Statistical Package for Social Science

CHAPTER 1: INTRODUCTION

1.1 Background of the study

The global food crisis is increasing with alarming speed and force, necessitating nations and international organizations all over the globe to respond with strategic and long term approaches aimed at curbing the food crisis. The current crisis is caused by a web of interconnected forces involving agriculture, energy, climate change, trade, and new market demands from emerging markets (CSIS, 2008). These have grave implications for economic growth and development, international security, and social progress in developing countries.

South Africa has an essentially dual agricultural economy, comprising a well developed commercial sector and a predominantly subsistence oriented sector in the rural areas. Covering 1.2 million square kilometres of land, South Africa is one-eighth the size of the United States and has seven climatic regions, from mediterranean to sub-tropical to semi-desert. Only about 13% of the country`s land surface area can be used for crop production, of which just 22% can be classified as high potential land. Some 1.3 million hectares are under irrigation. The most important factor limiting agricultural production in the country is the availability of water. Rainfall is distributed unevenly across the country with almost 50% of water being used for agricultural purposes (Nieuwoudt and Groenewald, 2003; Obi, 2013).

Primary agriculture in South Africa contributes about 2.5% to the gross domestic product (GDP) and about 8% to formal employment. However, there is such a strong linkage to the economy that the agro-industrial sector comprises about 12% of GDP. Although South Africa has the ability to be self-sufficient in virtually all major agricultural products, the rate of growth in exports has been slower than that of imports.

The only increase in agricultural export volumes, which came to about nine million metric tonnes, occurred during the period of exchange-rate depreciation in 2002. Major import products include wheat, rice, vegetable oils and poultry meat (DAFF, 2009; OECD/FAO, 2013).

Maize is the largest locally produced field crop, and the most important source of carbohydrates in the Southern African Development Community (SADC) region for animal and human consumption. South Africa is the main maize producer in the SADC region, with an average production of about 8.9 metric tonnes a year over the past 10 years. It is estimated that more than 8 000 commercial maize producers are responsible for the major part of the South African crop, while the rest is produced by thousands of small-scale producers. Maize is produced mainly in the North West, the Free State and Mpumalanga Provinces. A total of 6.9 million metric tonnes of maize was produced in 2006/07 on two million hectares of land (developing agriculture included) (DoA, 2007).

The present study focuses only on technical efficiency because it is an important subject in developing agriculture where resources are limited but high population growth is very common. The food balance sheet in Africa has shifted from positive to negative. For example, between 1970 and the 1980’s food production grew by 1.5 percent while the population grew by 3 percent. This has led to a decline in per capita food consumption, making sub-Saharan Africa the only region in the world where the average calorific intake has declined over time. This problem of stagnation in food production is reflected in growing reliance on food imports, food aid, rising poverty and increasing degradation of the natural resource base (La-anyami, 1986).

Technical efficiency is the ability of the farmer to achieve the maximum possible output with the available resources. There is also allocative efficiency which refers to the ability to obtain optimal output for given resource prices. The combination of technical and allocative efficiencies gives rise to economic efficiency.

Thus, the measurement of economic efficiency is not complete without the study of technical efficiency, which is the premier production function that enables the measurement of the technical efficiency of farmers (Elsamma and George, 2002).

This study analyses the technical efficiency of small-scale maize producers in the Tsolo Magisterial district, a rural community situated in the Eastern Cape Province. There are many small-scale farmers in the Tsolo community who still practice subsistence farming. They own about 1.5 hectares of land on the average, producing maize during the rainfall season and vegetables during winter, when they have harvested their maize. These small-scale farmers at Tsolo produce maize mainly for the purpose of improving their income and standards of living, since they usually produce for their own consumption, and store their surplus with the local silo owner.

1.2 The importance of maize in South Africa food security strategy

In South Africa maize production is carried out using a wide range of farming systems, dominated mostly by subsistence oriented small-scale farmers and emerging medium/large-scale commercial farmers. The production is also generally characterised by low yields, regardless of farm size, which results in high unit costs and leads to low returns (DoA, 2002).

According to ARC (2002), presently, maize is the most important and widely grown cereal crop, and it is a major part of the diet for both rural and urban communities in South Africa. The crop occupies a strategic position in the country’s food security alongside, sugarcane, and potatoes. Maize also provides incomes for all the commodity value chain agents: farmers` households, produce buyers, processors, exporters and transporters. It is therefore an important crop from both the food security and income generation point of view (Ortmann and Machethe, 2003).

Maize meal is eaten as a staple food by the majority of South Africans. Many other everyday commodities such as pharmaceuticals, confectionary, toothpaste, popcorn and soups, also include maize in various forms (Kirsten et al., 1998). The production of maize is composed of maize harvested during a particular season, imports and carryover stock from the previous seasons. Commercial agriculture produces about 98% of maize in South Africa, while the remaining 2% is produced by developing agriculture. Over the past ten years, the area for planting maize has decreased slightly by about 1, 2%, and, contrary to this decrease, the production of maize increased by approximately 5% (Agricultural statistics, 2005). This indicates an improvement in the method of production, as producers are able to harvest more or less maize on the same piece of land (Jiggins et al., 1997).

Maize plays a vital role in the food security of many poor households and is a critical food and cash crop with a per capita consumption of over 100kg per month. Both large and small-scale commercial farmers produce maize. This production is unstable because of erratic rainfall, and yields range from 1 to 4 tonnes/ha. Trends towards lower rainfall in the drier areas of Southern Africa suggest that these areas are becoming increasingly unsuitable for maize production. In South Africa, the area planted to maize has decreased, with the deregulation of the industry, from over 5 million ha in the mid to late 1980's to around 3.5 million ha in 2004 (DoA, 2005).

Grain SA, 2005 states that, South Africa had about 8 000 commercial maize farmers. Since the deregulation of the industry, the price of maize has been derived from international prices and has depended on the exchange rate. The value of the maize crop has varied from below 10% to over 20% of total agricultural production in the country. Large-scale maize production is highly capital intensive and, because of rising input costs, farmers have become increasingly tied to credit, input suppliers and marketing agents (DoA, 2005).

White maize is preferred for human consumption and is also used for animal feed and for some processed foodstuffs such as cereals. The crop is also used to produce starches and syrups used in a vast array of foods and industrial products. African producers (SADC region) are a major processor of maize and purchase about 10% of the annual maize crop, contracting farmers to grow GE free maize. South Africa exports and imports maize and maize products. Maize is also an important input for the poultry industry which is South Africa`s second largest agricultural sector (Quist and Chapela, 2001).

1.3 Problem statement

A decade after the demise of apartheid, it appears that very little concrete improvement has taken place in rural people's livelihoods. Research confirms this by showing that rural people constitute over 70 percent of the poorest people in South Africa. However, the post-apartheid government has been actively attempting to reverse the plight of the rural poor. Amongst several strategies employed by government to reduce poverty in rural areas are land-based development strategies, including agriculture.

In 1996, the national government adopted the Growth, Employment and Redistribution Strategy (GEAR). This strategy entailed the liberalization of imports through tariff reduction and encouragement of export marketing assistance. One of the most recent additions to the government's poverty reduction strategy, which is aligned to GEAR, is the Integrated Development Plans (IDP) which target district and local municipalities (Province of the Eastern Cape, 2003) (see Chapter 2, Section 2.3.3).

It is probably fair to say that, based on the Integrated Development Plans of a number of municipalities in the Eastern Cape, including the OR Tambo District Municipality, agriculture is viewed as a key economic driver (Kepe, 2004).

However, the enthusiasm over the potential of agriculture to boost local economic development that is evident in policy circles is not necessarily matched by evidence from research conducted on this subject in rural areas. According to the Provincial Growth and Development Plan (PGDP) of the government of the Eastern Cape, the province is only 20 percent food self-sufficient and the "public expenditure on agriculture in the country as a whole and the Eastern Cape has continued to decline" (Province of the Eastern Cape, 2003).

In 2003, the Eastern Cape Department of Agriculture, for example, launched the Massive Food Production Program with the intention of reversing the trend of rural areas being net importers of food, to making them self-sufficient (see Chapter 5, Section 5.2.2 for details). Alongside the initiatives of the Department of Agriculture, various district and local municipalities have initiated an array of agricultural programs as aspects of their Local Economic Development strategies.

The O. R. Tambo Municipality has the fourth-largest economy in the province, with agriculture being the major private sector activity. This sector contributes 8% of formal employment in the province (DEDEA, 2010). The Oliver Tambo District has a fairly small formal economy compared to the rest of the province, but the Transkei has a major subsistence and informal economy that has not been assessed statistically (Eastern Cape Tourism Board, Undated). The primary sector in the O.R. Tambo district Municipality experienced growth levels that exceeded 4 percent after emerging from negative territory between 1995 and 2000. Growth in this sector was driven by agriculture, with maize being the commonly cultivated cereal crop in the area. Despite all efforts to eradicate poverty in the district, the number of people living in poverty grew by almost 10 percent between 1995 and 2000 (DEDEA, 2010). Hence, there is a need for subsistence maize production since maize is widely used as a staple crop. In order for subsistence maize production to develop, there is a need for pertinent farming information to be available to farmers.

Small-scale farmers have a tendency of under utilising and over utilising some of the factors of production. Because of poor farming methods and the general poverty in Tsolo, productivity levels are low. This could also be attributed to technical inefficiencies. The study, therefore, investigated the extent to which technical inefficiency contributed to this challenge.

The problems of small-scale agriculture include extension services, which are inadequately funded and a poor distribution of agricultural inputs. Also, inadequate education is considered an important input in agricultural development and is another hindrance to small scale agriculture (Belete et al., 1991). This study, therefore, attempted to determine the technical efficiency level of small scale farmers in the study area.

1.4 Objectives of the study

The broad objective of the study was to investigate the technical efficiency of small-scale maize producers in the Tsolo Magisterial District in the O.R. Tambo District in the Eastern Cape Province of South Africa.

The specific objectives of the study were as follows:

i. To determine the level of technical efficiency of small-scale maize producers in the Tsolo Magisterial district.

ii. To identify and evaluate the socio-economic characteristics that influences the technical efficiency of the small-scale maize producers in the area.

iii. To identify and evaluate institutional factors that influences the technical efficiency of the small-scale maize producers in the area.

iv. To determine the effect of the entrepreneurial spirit and positive psychological capital on the technical efficiency of small-scale maize producers.

1.5 Main research questions

The study sought to address the following questions:

1. Are small-scale maize producers technically efficient

Sub-questions to address

- ✓ What factors of production are available to small-scale maize producers?
- ✓ How many small-scale maize producers are technically efficient given the factors of production in the area?
- ✓ What is the level of technical efficiency in small-scale maize producers in the area?

2. In what way do socio-economic and institutional factors affect the technical efficiency of small-scale maize producers?

Sub-question to address

- ✓ What are the socio-economic and institutional factors that affect the technical efficiency of small-scale maize producers?
- ✓ Do socio-economic and institutional factors negatively influence the technical efficiency of small-scale maize producers?

3. In what way do the entrepreneurial spirit and positive psychological capital affect the technical efficiency of small-scale maize producers?

Sub-question addressed

- ✓ Do the entrepreneurial spirit and positive psychological capital affect the technical efficiency of small-scale maize producers?

1.6 Hypothesis

Hypothesis 1: The small-scale maize producers in the Tsolo Magisterial District are not technically efficient.

Hypothesis 2: There are no socio-economic or institutional characteristics, nor is there the entrepreneurial spirit or psychological capital that influences the technical efficiency of small-scale maize producers in the Tsolo Magisterial District.

Farmers who combine the available factors of production in such a way as to maximize production at a cost effective level are likely to be technically efficient. The farmers' technical efficiency tends to be influenced by socio-economic and institutional factors. The actual socio-economic and institutional factors that influence technical efficiency are specific hypotheses. The specific hypotheses were therefore tested to estimate the extent to which they influenced small-scale farmers for maize technical efficiency.

The specific hypotheses addressed by the study are as follows:

1. Socio-economic factors

- The educational level of small scale farmers positively influences the technical efficiency of small-scale maize producers.

- Farm size affects the technical efficiency of small-scale maize producers.

- Income of the household affects technical efficiency of small-scale maize producers.

- Use of manure has a negative impact on technical efficiency.

- Gender and age influence technical efficiency.

2. Institutional factors

- Access to credit service has a positive effect impact on technical efficiency

- Extension service accessibility affects technical efficiency

- Cooperative membership has a positive impact on technical efficiency

- Market information availability affects technical efficiency

3. Entrepreneurial spirit and positive psychological capital

- Self-efficacy, resilience, optimism and hope have a positive effect on technical efficiency

1.7 Relevance of the study

Since maize is the main staple food in South Africa, high productivity and efficiency in its production are critical to food security. However, there has been a decreasing trend in maize production over the last decade as a result of the technical inefficiency of farmers, which threatens household food security. Determining efficiency status of small-scale maize producers is crucial for policy purposes and as well an important factor for growth in an economy where resources are scarce and the opportunities for new technology are lacking.

Most studies on the estimation and explanation of variation in technical efficiency in agriculture have focused mainly on Asian countries, particularly Pakistan (Parikh and Shah, 1994; Batese et al., 1996), India (Battese and Coelli, 1995) and China (Wang et al., 1996).

For this reason, the present study which identified the socio-economic, institutional, physical and technological factors affecting maize producers' efficiency, as well as evaluating the technical efficiency differentials across different individual farmers in the Tsolo Magisterial district is important. When a simple head count is used, the Eastern Cape Province has 26 percent of the poor of South Africa. This represents the highest incidence of poverty, followed by that in the Northern Province and the Free State (Leibbrandt and Woolard, 1999).

The technical efficiency of farmers in Eastern Cape Province is influenced by factors ranging from social, economic and institutional. Among the factors that influence technical efficiency, farmers' education, extension, credit, market access, farmers' access to improved technologies through the market or public policy interventions and land holding size, have been given priority in most of the studies. Most studies report a positive impact of these variables on technical efficiency (see also Tian and Wan, 2000 ; Reinhard et al., 2002).

The study which evaluated the technical efficiency of small-scale maize farmers as well as factors affecting their production efficiency provides information for the use of government policy makers and other shareholders. This does not only benefit small-scale farmers in Tsolo magisterial district but other district as well in the province.

1.8 Outline of the research

Since the aim of this study was to evaluate the technical efficiency of small-scale maize farmers/producers in the Tsolo Magisterial district, the remainder of the study is structured as follows: Chapter two reviews the literature. Chapter three gives an overview of the geographical location of the study, while chapter four presents the methodology, including sampling procedure, data collection procedure and analytical techniques used to analyze the data.

Chapter five presents the research results of the technical efficiency, socio-economic characteristics, institutional characteristics, the entrepreneurial spirit and positive psychological capital affecting technical efficiency of small-scale maize producers. Lastly, chapter six provides a summary as well as conclusions and recommendations based on the findings of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The study seek to address follows objectives: to determine the level of technical efficiency of small-scale maize producers in the Tsolo Magisterial district; to identify and evaluate the socio-economic and institutional characteristics that influences the technical efficiency of the small-scale maize producers in the area and to determine the effect of the entrepreneurial spirit and positive psychological capital on the technical efficiency of small-scale maize producers. It goes further to address the main research questions as: Are small-scale maize producers technically efficient? In what way do socio-economic and institutional factors affect the technical efficiency of small-scale maize producers? And in what way do the entrepreneurial spirit and positive psychological capital affect the technical efficiency of small-scale maize producers? A comprehensive literature and past research, including official documents and policies were reviewed in line with the objectives and research questions. This chapter firstly presents overview of small-scale agriculture and maize production in South Africa. It goes further to highlight production and farm efficiency among small-scale farmers, focusing on the theoretical and conceptual issues relevant to the subject-matter of the dissertation. The next section focuses on some socio-economic and institutional factors affecting the efficiency of small-scale farmers. The chapter concludes with a section focusing on how hope, self-efficacy, optimism and resilience as a measure of entrepreneurial spirit of farmers affect technical efficiency.

2.2 Overview of small-scale agriculture in South Africa

South Africa is divided into two economies: that of the rich and that of the poor. A Gini coefficient of 0.593 shows that there is a vast gap between the rich and the poor in the country (Vink and D`Haese, 2003). South Africa also has high unemployment in the rural populations of the former homelands and these areas also have a high poverty rate relative to the rest of the country (Vink and D`Haese, 2003).

There is a large rural population and a poorly educated and largely unskilled work force (Lipton et al., 1996). These factors indicate that agriculture could play a key role in uplifting people. According to Rockefeller (1969), agriculture can play a role in uplifting the standard of living of the people in the former homelands. The majority of people who migrate to urban areas originally resided in rural areas. Most young rural men and women leave their home districts in search of employment in the mines and factories (Vink and D`Haese, 2003).

Active participation in agriculture could reduce the level of migration to the cities by young rural people, who might otherwise migrate to urban areas in search of jobs that are not available in rural areas. Agriculture can play a role through the use of natural resources, such as land, that are available to the rural population. Ashley and Maxwell (2001) as quoted by Vink and D`Haese (2003) argue that land is often not the most limiting resource on small farms. The scarce resources are cash to purchase inputs and limited seasonal labour. Lipton et al., (1996) found that small-scale farming has helped in providing employment and in generating income in many other developing countries. In middle-income countries with economic and labour profiles similar to those of South Africa, agriculture accounts for 15% of the GDP and employs 25% of the labour force (Lipton et al., 1996).

However, according to Lipton et al. (1996), in South Africa, agriculture is only a marginal force in the economy, accounting for 5% of the GDP and employing only 14% of labour. One of the Lipton (1996) surveys discovered that, of the 70 countries on which data are available, South Africa is one of the lowest in its reliance on agriculture as a source of employment. Some experts say this is because South Africa is a dry country; however, other dry countries have large agricultural sectors. Lipton’s (1996) main concern is that by 2025 the working age population in South Africa will more than double and, with agriculture contributing to the livelihood of only a few, many could face unemployment.

According to him, the important questions are: why are people abandoning agriculture? Is there a lack of interest in agriculture, and are people more interested in urban employment? Or was the movement away from agriculture caused by Black South Africans being denied access to land, irrigation and technology? (Lipton, 1996).

In an attempt to answer Lipton`s concerns, Aliber (2005) notes that the reason why young people in rural areas are moving away from agriculture is their observation of their parents. Young people have concluded that agriculture is not a promising avenue to self-advancement. Aliber's argument is that even the youth who are raised on commercial farms show a disinterest in inheriting their parents` farms. The difference between this story and the one that applies to the former homeland areas is that, in the commercial farms the disinterest of the youth contributes to land being left unutilized rather than being taken over by others with commercial aspirations, but contribution of the land tenure remains questionable, particularly because there is a low demand for productive land.

According to Aliber (2005) agriculture in the former homelands is on the decline because people have diverted to off-farm employment for economic reasons. If off-farm employment provides better earnings, rural households would readily leave agriculture.

It is well known that access to farming was denied to Black South Africans through the unequal distribution of land, water and technology. One of the most challenging socio-economic problems currently facing South Africa is how the large number of rural African residents can be assisted to establish viable livelihoods. From an international perspective, small-scale agriculture has been proved to generate employment and income opportunities in rural areas. According to Kirsten and Van Zyl (1998) small-scale farmers are potentially competitive in certain activities and, with a proactive policy support; these opportunities could be developed into viable niches for the future smallholder sector.

The challenge in South Africa is to remove the structural constraints that inhibit the growth of a vibrant commercial smallholder sector.

In developing economies, small-scale agriculture is often the sector of that presents the most difficult development problems. These include piped water, land redistribution and access to credit. There are two types of agriculture in South Africa: subsistence farming which is practiced in the former homelands and large-scale commercial farming. White farmers dominate the large-scale commercial sector, and this is not the case only in South Africa. In the rest of the world, farmers also range from subsistence farmers to agribusiness farmers (Kirsten and Van Zyl, 1998). There are different views on the way people differentiate between subsistence and commercial farming.

2.3 Maize production in South Africa

Maize is produced throughout South Africa, with the Free State, Mpumalanga and North West provinces being the largest producers, accounting for approximately 85% of the total production. Maize is produced mostly on dry land, although there is about 10% that is produced under irrigation. South Africa is divided into 36 grain producing regions. Region 1 to 9 is winter rainfall areas (Western Cape, as well as Eastern Cape and Karoo) where no commercial maize is produced.

Region 10 is Griqualand West and region 11 is Vaal Harts in the North West. Regions 12 to 20 are all in the North West province. Regions 21 to 28, which are in the Free State and North West, contributed 63% of the total maize production in SA during 2002/2003. Regions 29 to 33 are within Mpumalanga, which is the third largest maize producing province. Region 34 falls within Gauteng, region 35 within Limpopo and region 36 within Kwazulu-Natal (Agricultural statistics, 2003).

The maize industry is divided into the commercial and developing agriculture sectors. Commercial maize farmers are estimated at 8,000 but the number of developing agricultural farmers is unknown.

During 2002/2003 the Free State province produced 35% of all the commercial maize in South Africa, of which 75% was white maize and 25% yellow maize. The North West produced 28% of all the commercial maize grown in the country, of which 82% was white maize and 18% yellow maize. During the same period, Mpumalanga produced 20% of the total commercial maize, of which 25% was white maize and 48% yellow maize (DoA, 2003).

The majority of maize farmers are small-scale, farming on less than 3ha. But many small-scale farmers along with subsistence producers follow low input cultivation practices using landraces and saved seed for planting. Small-scale farmers plant mostly their own varieties, which are typically robust and have qualities important to them. As these are open pollinated varieties (OPV), they can replant the seed without experiencing yield reduction as with hybrids (ARC, 2002).

The use and development of OPVs is not officially encouraged or supported. One recent exception is the release of two OPV maize varieties developed by the International Maize and Wheat Improvement Centre, specifically with the needs of small-scale farmers in mind. These qualities include early maturation, and higher yield under drought and low soil fertility conditions. For instance, ZM521 has been shown to yield 34% more than currently grown varieties (ARC, 2000).

2.4 Production and farm efficiency

Case, et al. (2009) defined efficiency as the condition in which the economy is producing what people want at the least possible cost. Thus, the concept of efficiency is primarily concerned with the relative performance of the processes used in transforming given inputs into outputs. The economic theory propounded by Farrell (1957) identifies at least three types of efficiency. These are allocative, technical and economic efficiencies. Allocative efficiency refers to the choice of the best combination of inputs consistent with the relative factor prices. That is, allocative efficiency is the ability of a firm to use inputs in optimal proportions, given their respective prices.

Technical efficiency shows the ability of firms to employ the 'best practice' in an industry, so that no more than the necessary amount of a given set of inputs is used in producing the best level of output (Carlson, 1968). The product of technical and allocative efficiencies yields economic efficiency. The manager or the farmer is thus concerned with producing higher levels of output at the lowest possible cost. Therefore, the firms or farms make efforts to either reduce the cost of a certain level of output or increase the output with a certain level of costs. These two optimization problems provide the same rule for the allocation of inputs and selection of technology. Because there are alternative means of achieving the production goals, the production theory gives the theoretical and empirical framework which helps in the selection of the best among alternatives for anyone or a combination of the farmer's objectives to be achieved.

Agricultural productivity is a measure of efficiency, since the aggregate productivity of an economic system is proportional to the efficiency of production of the components within the systems (Olayide and Heady, 1982). Further, potential resource productivity means getting the maximum output from the minimum possible set of inputs. Thus, the optimal productivity of resources demands an efficient usage of resources in the production process. Agricultural productivity can, therefore, be defined as a measure of the efficiency with which the agricultural system utilizes land, labor, capital and other resources.

2.4.1 Technical Efficiency

Technical efficiency is defined as the physical ratio of product output to the factor input; the bigger the ratio, the greater the size of the technical efficiency. This implies the existence of 86 variations in technical efficiency among firms or farms. The production function presupposes technical efficiency, whereby the maximum output is obtained from a given level of inputs combination; hence, it is a factor-product relationship.

Generally, technical efficiency is the ability to minimize the input used in the production of an output vector, or the ability to obtain maximum output from an input vector (Kumbhakar and Lovell, 2000). An important assumption underlying the efficiency concept is that firms operate on the outer bound of the production function (i.e., on their efficiency frontier). Developments in cost and production frontiers are attempts to measure productive efficiency. The frontier defines the limit or boundary to a range of possible observed production (cost) levels, and identifies the extent to which the firm lies below (above) the frontier (Farrell, 1957).

It means that firms or farms become technically inefficient when they fail to operate on the outer bound of their production function. Such firms can improve their technical efficiency in three ways: (a) improved production techniques, which implies a change in factor proportions through factor substitution under a given technology, thus representing a change along the given production function; (b) an improvement in production technology, which represents a change in the production function itself in such a way that the same amount of resources produce more output, or the same amount of output is derived from smaller quantities of resources than before, and (c) a simultaneous improvement in both production techniques and technology (Amaza, et al. 2001).

The technical efficiency of individual farmers according to Ogundari and Ojo (2007) refers to the ratio of observed output to the corresponding frontier's output, conditional on the level of input used by the farmers. Olayide and Heady (1982) however, defined technical efficiency as the ability of a firm to produce a given level of output with a minimum quantity of inputs under a given technology. Efficiency can, as such, be seen as a vital determining factor of the productivity growth of an individual farmer.

2.4.2 Review of technical efficiency studies among small-scale farmers

Technical efficiency is a component of economic efficiency and reflects the ability of a farmer to maximize output from a given level of inputs (e.g. output-orientation).

One can trace the beginning of theoretical developments in measuring technical efficiency back to the works of Debreu (1951 and 1959). Since then, however, there has been growing literature on the technical efficiency of smallholder agriculture. Notable works focusing on smallholders include (Basnayake and Gunaratne, 2002; Barnes, 2008; Duvel, et al. 2003; Shapiro and Muller, 1977; and Seyoum, et al. 1998). The average technical efficiency of small-scale reported in these studies ranges between 0.49 among maize farmers in Kenya and 0.76 among Tanzanian sugarcane farmers. This shows that small-scale farmers have low and highly variable levels of efficiency, especially in developing countries.

Most studies have associated the following variables with technical efficiency: farmers` age, farmers` education level, access to extension, access to credit, agro-ecological zones, land holding size, number of plots owned, farmers` family size, gender, tenancy, market access, and farmers` access to improved technologies such as fertilizer, agro-chemicals, tractor and improved seeds.

Farmers` age and education, access to extension, access to credit, family size, and tenancy, and farmers access to fertilizer, agrochemicals, tractors and improved seeds variables are reported by many studies as having a positive effect on technical efficiency (Amos, 2007; Ahmad, et al. 2002; Tchale and Sauer 2007; and Basnayake and Gunaratne, 2002).

A clear-cut conclusion on the influence of land holding size on efficiency has not been reached as discussed in the work by Kalaitzadonakes, et al. (1992). Although studies by Amos (2007), Raghbendra, et al. (2005), and Barners (2008) found the relationship between land holding size and efficiency to be positive. On the other hand, the influence of the number of plots on efficiency has been reported by the Raghbendra, et al. (2005) to be negative. This implies land that fragmentation (as measured by number of plots) has a negative impact on yields. There are conflicting results on the influence of socio-economic variables such as gender on efficiency.

Tchale and Sauer (2007) point out that, while some studies (in Lesotho) report that the gender of the farmer has no significant influence on efficiency, other studies found that gender plays an important role.

Literature on technical efficiency in African agriculture is emerging. Globally, however, there is a wide body of empirical research on the economic efficiency of farmers in both developed and developing countries (for reviews see Battese and Coelli, 1995). While the empirical literature on the efficiency of farmers is vast in developed countries and Asian economies, few studies focus on African agriculture. Heshmati and Mulugeta (1996) estimated the technical efficiency of Ugandan *matoke*-producing farms and found that they face a decreasing return to scale with a mean technical efficiency of 65%. On the other hand, they found no significant variation in technical efficiency with respect to farm size; nor did they identify the various sources of technical efficiency among *matoke*-producing farmers.

Seyoum, et al. (1998) considered the technical efficiency and productivity of maize producers in Ethiopia and compared the performance of farmers within and outside the programme of technology demonstration. Using the Cobb-Douglas stochastic production functions, their empirical results show that farmers who participated in the programme were more technically efficient, with a mean technical efficiency equal to 94% than those outside the project, whose mean efficiency equaled 79%.

Also in Ethiopia, Weir (1999) investigated the effects of education on farmer productivity of cereal crops using average and stochastic production functions. This study found substantial internal benefits of schooling for farmer productivity in terms of efficiency gains, but it also found a threshold effect, which implies that at least four years of schooling are required to lead to significant effects on farm level technical efficiency. Using different specifications, the average technical efficiency ranges between 0.44 and 0.56, and raising education from zero to four years in the household leads to a 15% increase in technical efficiency.

Moreover, the study found evidence that average schooling in the villages (external benefits of schooling) improved technical efficiency.

The impact of education externalities on production and technical efficiency of farmers in rural Ethiopia was the subject of Weir and Knight (2000). They found evidence that the source of externalities to schooling is in the adoption and spread of innovations, which shifts the production frontier. The mean technical efficiency of cereal crop farmers is 0.5. For instance, a unit increases in years of schooling increases technical efficiency by 2.1 percentage points. One limitation of the Weir (1999) and Weir and Knight (2000) studies is that they investigate the levels of schooling as the only source of technical efficiency. Using data envelopment analysis, Townsend, et al. (1998) investigated the relationships among farm size, returns to scale and productivity for wine producers in South Africa. They found that most farmers operate under constant returns to scale, but the inverse relationship between farm size and productivity is weak.

Mochebelele and Winter-Nelson (2000) assessed the impact of labour migration on the technical efficiency performance of farms in the rural economy of Lesotho. Using the stochastic production function (translog and Cobb-Douglas), the study found that households that sent migrant labour to SA mines were more efficient than those that did not, with mean inefficiencies of 0.36 and 0.24, respectively. In addition, there was no statistical evidence that the size of the farm or the gender of the household head affected the efficiency of farmers.

These authors conclude that remittances facilitate agricultural production, rather than substitute for it. Their study does not, however, consider the many other household characteristics that may affect technical efficiency, such as education, farmers experience, access to credit facilities (capital) and advisory services and extent to which households that export labour receives remittance.

Sherlund, et al. (2002) investigated the efficiency of smallholder rice farmers in Côte d'Ivoire while controlling for environmental variables that affect the production process. Apart from indentifying factors that influence technical efficiencies, the study found that the inclusion of environmental variables in the production function significantly changed the results: the estimated mean technical efficiencies increased from 0.36 to 0.76. Binam, et al. (2004), examined factors influencing the technical efficiency of groundnut and maize farmers in Cameroon. They used a Cobb-Douglas production function and found the mean technical efficiency to be in the range of 73% and 77%. They also conclude that access to credit, social capital, distance from the road and extension services are important factors explaining the variations in technical efficiencies.

2.5 Some Socio-economic factors and efficiency

2.5.1 Gender issues and efficiency

The prevalence of female headed households in rural areas inevitably affects household and community livelihood strategies. It is estimated that three quarters of households' income in the former Bantustans in South Africa is from remittances and 10-15 percent is from informal activities such as crafting and street vending (Levin and Weiner, 1997). The latter activities are largely undertaken by women and children since remittances from migrant labour are not always reliable and are frequently controlled by the males.

In addition to rural women's involvement in income generation, they have the primary responsibility for domestic tasks and agricultural production, burdens which place significant pressure on their time and physical well-being.

Consequently, informal sector activities have become increasingly important for households, especially in rural areas. Although some attention has been given to small and medium micro enterprises, there is relatively little emphasis in the South African gender and development literature on the gendered nature of these types of activities or the economic potential of women's groups, especially in rural areas.

For some women, formal employment outside the home is not a feasible income generating strategy for reasons which include lack of access to transport, domestic responsibilities, inadequate job training or previously work experience, and other barriers to entering the workforce (Orberhauser, 1993).

The role of gender in agriculture cannot be overemphasized. The pervasiveness of gender stratification in the distribution of production resources, information and even access to appropriate technologies is an issue of great importance. According to Akanji (1991), the gender of the agricultural worker is significant not only to total subsistence food output in which they predominate but also to the performance of cash cropland, mainly managed by men. Findings by the FAO (2008) on women in agriculture shows that women make up over half of the agriculture labour force yet they are frequently subjected to discrimination, poverty and hunger.

Hjorts (2005) also reported that compared to men, women, especially those from small and marginal farming families, perform over 60% of all on-farm activities in sub-Saharan Africa and comprise a major driving force in the economic and social fabric of rural South Africa, with major responsibilities in agricultural and non-agricultural business enterprises. The ability of women to obtain agricultural inputs is directly constrained by gender discrimination (Hughes, 2005).

According to Masterson (2007), the most important resource is land; others are education, credit and technical assistance. Recently, agricultural policies and programmes in Nigeria have focused on ways of increasing the productivity of rural farmers through the development and transfer of appropriate technologies. However, the level of productivity of women is a constraint because most agricultural technologies have being designed on the assumption that farm managers are men (Balakrishnan, 2004). Empirical studies on farm household productivity outcomes by Okoye, et al. (2009) and Dimelu, et al. (2009) have yielded evidence of the inefficient allocation of resources and low productivity along gender lines, to the detriment of women.

Therefore, for the effective transfer and adoption of technologies for increased food production in rural areas, gender has become the most important determinant of the distribution of rights, resources and responsibilities among individuals, families and communities (Ironkwe, et al. 2009). In Ghana, it has been estimated that, if women and men had equal rights to land, and if women had equal access to fertilizer, profits per hectare would double (FAO, 2008).

2.5.2 Farm size and efficiency

According to Nieuwoudt (1990), small-scale farmers may use land much more intensively than do large-scale farmers. The same opinion was supported by Latt and Nieuwoudt (1988), in the 'Discriminate Analysis of Input Use' study, where they revealed that farms with less than one hectare applied inputs much more intensively than farms with more than one hectare, thus suggesting that smaller farms may maximize returns on land (their scarce resource); while larger farms maximize returns on labour and capital.

The effect of farm size on efficiency is a controversial issue. Small-scale farms may be more efficient in terms of transaction costs than large ones. On the other hand, large farms have the advantage of attaining economies of scale by spreading fixed costs over more land and output, getting volume discount for purchased inputs or by achieving better markets and higher prices for their produce (Ogolla and Mugabe, 1996).

2.5.3 Labour issues and efficiency

The high labour use issue on small-scale farms is that, in the land market, smaller peasants face higher effective purchased prices for land. This skewed resources position of smaller farmers has several implications for their use of labour vis-à-vis larger farmers: they use the land more intensively for each crop; they use more of the available land; they choose more labour intensive crops, and they use their own labour for land improvements.

All of these factors lead to the conclusion that small-scale farmers have a higher resource use per unit of land. This factor-use intensity gives small-scale farmers a productivity advantage over larger farmers (Cornia, 1985).

Another explanation for the greater intensity of family labour among small peasants is desperation. If small-scale farmers are struggling at the edge of survival, they are more likely to work hard. It would not be prudent to equate the welfare of the small peasant household with its productivity if that productivity is the result of poverty. Dualistic labour markets have also been proposed as an explanation. If family labour is cheaper, then there should be a higher labour to land ratio on small-scale farms. There are logical economic reasons for the gap between the supply prices of family and hired labour; there is less uncertainty about the effort of family labour than of hired labour, making the opportunity cost for family labour lower (Mazumdai, 1965). In addition, workers may prefer to work for themselves, or at least for their own family, than to work for someone else (Sen, 1975). The control large land owners have over factor markets, especially, means that different size farms face different factor prices: for small-scale farms land and capital are more expensive than for larger farms, while labour is less expensive.

This leads to an excess supply of labour in the labour market, which implies that wage in agriculture will tend towards zero. This is not observed, however, since the wage does not drop below some minimum caloric requirements. Larger farms will hire labour only until the marginal product of labour is equal to this minimum wage. Thus, there will be unemployed labour and the opportunity cost of employing family labour will be low on small-scale farms (Verma and Bromley, 1987; Cornia, 1985).

Such labour market theories of the high family labour use of small-scale farms and its contribution to the inverse relationship have relied on labour market dualism, but the fact remains that small-scale farmers both hire in and hire out labour (though this is not to say that they are perfect substitutes).

In addition, hired labour is necessary on larger farms, so family labour is an unlikely explanation for the inverse relationship between 15 and 50 acres, for example. Thus, it is important not to go too far in identifying farm size with characteristics such as capitalization, mechanization, and use of wage labour (Dyer, 1996). Feder (1985), offers an alternative explanation for the more intense use of family labour, based on three propositions: first, that family labour is more efficient than supervised labour; second, that family labour is more motivated than hired labour and can supervise the latter; and third, that the supply of working capital is directly related to farm size.

The greater efficiency of family labour on small-scale farms may be the result of two factors; first, as the ratio of hired labour to family labour rises, supervision becomes more time consuming and less effective; second, as the social distance between the supervisors and the hired labour increases, the effectiveness of supervision will decrease (Boyce, 1987).

Another common refrain is that, due to the stochastic effects of the weather (and other factors) on agricultural output, farmers cannot use output to monitor the effort of employees. Thus, farm wage labour requires supervision and this results in the inverse relationship (the larger the farm, the thinner the family labour is spread, the greater the monitoring problems), as well as the structure of agrarian land and labour contacts, and the adoption of labour saving technology by larger farms. These suggest that family labour and hired labour are not substitutes.

Carter and Wiebe (1990) argue that small-scale hyper productivity is eventually overwhelmed by capital constraints. As farm size increases, it becomes less easy to substitute family labour for hired labour and other purchased inputs. Since credit markets in many less-developed countries are characterized by undeveloped financial institutions (which means that local money lenders marking high interest rate “institutional” credit goes to the richer peasants), the cost of and access to credit are inversely related to farm size (Cornia, 1985).

2.5.4 Age and education level of farmer and efficiency

The age of the farmer is used as a proxy for measuring general farming experience and, thus, has an effect on efficiency. It is assumed that, older farmers are more experienced in farming activities and are better able to assess the risks involved in farming than younger farmers are. This may contribute to an improvement in technical efficiency. However, the opposite may also be true, that older farmers, who did not receive a good education, may be technically more inefficient than younger ones (Tchale, 2009). The education of the farmer is expected to have an effect on farm resource use and the ability to adopt new technology and, hence, have a positive impact on technical efficiency.

2.5.5 The use of fertilizer and efficiency

In the early 80's in Kenya, the maize yield started to increase following the adoption of hybrid maize varieties and the accompanying high fertilizer use, to the extent that by 1986, the average national yields were over 2 tons per hectare (Nyoro, 2002). However, this growth was not sustained. Yields started to fall gradually and stagnated at 1.85 metric tonnes per hectare by the end of 1989 (Karanja, et al. 1998).

Oluwatayo, et al. (2008) examined resource use efficiency among maize farmers in rural Nigeria. Their results of the regression analysis showed that farm size, labour, pesticides, herbicides and fertilizer usage are positively related with maize output and these variables are equally significant in determining the output of the farmers. Farmers who use fertilizers are found to obtain a higher yield than those who did not use any.

The use of chemical fertiliser is known to be a commonly used method of improving productivity and in the intensification of agricultural production as a whole. Chemical fertilisers play a big role in regions where the scarcity of farm land is a big problem and traditional fallow periods are either very short or are no longer in existence.

However, the appropriate use of these fertilisers is very important in achieving the desired results. A disproportionate use of fertilisers is usually common among farmers with little knowledge about them, or with little access to extension agents. In such cases, productivity may be affected negatively and, hence, lower technical efficiency (Hopper, 1965).

2.5.6 Purchased hybrid maize seed and efficiency

Using improved seed in crop production is one way of increasing productivity in terms of quantity and quality (Kiplang, et al. 2003). Despite the low level of production technology used by smallholder farmers in developing countries, the use of improved seeds is said to be on the increase (Kiplang, et al. 2003).

The availability of these seeds is usually via extension agents or in the markets. Thus, farmers with more access to extension agents may have an increased potential of using them appropriately, and subsequently improve the productivity of their crop. Traditionally, farmers have always saved their resilient traditional seeds from season to season. During the 2004/2005 season however, the Monsanto Seed Company convinced traditional leaders in South Africa to abandon their traditional seeds in favour of its patented pesticide-producing 'B*t*' maize by using an extensive and multimedia conference-style marketing campaign entitled "iyasihluthisa" (the Xhosa word for "it fills our stomachs"). Though the Eastern Cape has a high diversity of "indigenous" maize varieties, the campaign resulted in the proliferation of B*t* maize seed (Wells, 2004).

Since food products absorb a relatively larger share of the income of poor families, the yield effects of 'B*t*' maize and the resulting lower prices will be relatively more beneficial to poorer consumers. Zilberman et al. (2007) suggest that the introduction of 'B*t*' maize will improve the overall market surplus and will likely have positive distributional impacts, in the sense that the relative gain to poorer individuals is likely to be greater.

The results of Anderson (2005) and Evenson (2005) suggest a significant potential of economic welfare gains to low-income countries from the introduction of existing transgenic varieties.

2.5.7 Effects of mechanization on efficiency

According to Binswanger (1986), agricultural mechanization implies the use of various power sources and improved farm tools and equipment, with a view to reducing the drudgery of farm work. Ultimately, farm mechanization aims to enhance the overall productivity and production at the lowest cost. Mechanization apart from its contribution to increased productivity also leads to an overall increase in the employment of human labour (Chatizwa and Khumalo, 1996).

As Mellor (1984) noted, the role of farm machinery in shortening land preparation time has often made it possible for households to plant a second crop within the year, thus providing year-round employment for labour that would otherwise have been redundant for much of the time.

Sub-Sahara Africa continues to have very low levels of mechanization and available data indicate declining rather than increasing levels of adoption, even among the countries that were early trendsetters such as Kenya and Zimbabwe (Binswanger, 1978, FAO/UNIDO, 2008). According to the FAO (2000), the general trend is that agricultural production in most African countries still relies on old hand tool technology.

The result from similar work in Kenya (Kibaara and Kavoi, 2012), revealed that mechanizing farming operations is a very important step toward increasing production efficiency, in this case, producers that used tractors increased their level of technical efficiency by 26% , and this can be converted to approximately 4 bags of maize per acre. The opposite is the case in the current situation in Zimbabwe.

Despite the introduction of the Fast Track Land Reform Program (FTLRP) and the agricultural mechanization program, Zimbabwe continues to experience a drop of 30 percent in agricultural production, a hyper-inflationary situation, and a 15 percent contraction of the economy to an unemployment rate estimated to exceed 80 percent (Zikhali, 2008). What seems to be lacking as confirmed by a large number of other studies (Obi, 2010; Obi and Chisango, 2011) is proper planning and also a national allocation principles devoid of political influence.

2.6 Institutional factors affecting efficiency

2.6.1 Credit accessibility of small-scale farmers

A farmer`s ability to purchase farm inputs may depend on the non-farm income received by the household. This may have an effect on crop production since it makes the farmer capable of purchasing farm inputs and paying for hired labour and machinery, which could positively affect productivity (Heidhues, 1995).

Problems of financing range from a lack of adequate financing for medium-term operational purposes, to exceedingly high interest rates where finance is available. Considerable effort has been made to make financing available to the smallholder sector, mainly through state enterprises. However, very limited security is available for loans to smallholders. Access to credit from formal and informal institutions is important for agricultural productivity. Many poor rural farmers rely heavily on informal credit institutions to cope with food insecurity and its effects as well as to finance the purchase of farm inputs (Heidhues, 1995; Heidhues and Buchenrieder, 2004).

The credit granted by state enterprises has been almost entirely on a short-term basis for the purchase of seasonal inputs, with very little being made available for medium and long-term productive investment. This means that no meaningful development has taken place in terms of land improvement and other capital projects required in order to increase productivity.

2.6.2 Market accessibility for smallholder farmers

Market accessibility with regards to input and output supply has been identified as providing an incentive to farmers to expand production. Among the other factors that influence technical efficiency, the following have been reported to positively influence technical efficiency: farmer's education, extension, credit, market access, farmers' access to improved technologies through the market or public policy interventions (Tian and Wan, 2000 ; Reinhard, et al. 2002). Obi and Chisango (2011) concluded that increased technical efficiency at the production level is meaningless in the absence of enhanced market access and profitable marketing is impossible in the absence of goods and services.

In the Eastern Cape Province, the majority of smallholder farmers live in areas with poor road networks which render transport services not only unavailable, but also highly priced. This then presents the province with marketing problems ranging from high input costs, low producer prices due to unfair grading by commodity buyers to push down prices, to limited processing capacity which would have added value and reduced the transport costs of bulky raw materials. According to Obi and Chisango (2011), anything that chokes off the supply of physical output is bound to weaken the primary markets serving the poor.

2.7 Effect of entrepreneurial spirit and positive psychological capital on the productivity of small-scale maize producers

2.7.1 Entrepreneurial spirit

Recently, the necessity of an entrepreneurial culture in agricultural land has been recognized. Farmers can increase their production through an improvement in their productivity, in order to ensure their survival and the enrichment of their environment. For these purposes, farmers can either get integrated vertically inside a chain of value or diversify their economic activities.

In spite of the importance of entrepreneurship in economic growth, it has been little studied in emerging economies, especially in the agricultural sector.

In some countries, such as those composing the European Union, researchers have taken on the task of investigating the factors and educational processes that could contribute to the development of the entrepreneurial capacities of farmers, with the aim of experiencing successful growth in agricultural business. Although, apparently, it is necessary to develop a certain way of handling diverse entrepreneurial techniques, such as marketing, production and accounting, these are not enough for a business to succeed. Entrepreneurial attitudes, such as innovation, orientation to growth, and risk taking, could be equally important.

Now, more than ever, the entrepreneurial spirit is what is required to bridge the divides that exist in the world today; an entrepreneurial spirit that transforms challenges into opportunities and creates a more vibrant future for us all. The entrepreneurial spirit is one of creativity and innovation, ambition and goal driven action, value creation, willingness to take risks and learn from failure and most of all, a sense of play that includes both freedom and responsibility. To build this spirit, is to build a more entrepreneurial culture and it is through education that the entrepreneurial spirit can best be ignited, developed and nurtured.

Psychological characteristics (positive psychological capital) are used to measure farmers' entrepreneurial spirit capability and such variables include hope, resilience, optimism and self-efficacy. These four psychological characteristics are used as the variables to measure the entrepreneurial spirit of the farmers.

2.7.2 Psychological Capital (PsyCap)

Each of the four positive psychological capacities described above has been theorized as an independent concept (Luthans, et al. 2007a; Snyder, 2002). Theoretical differences exist in relationship to the treatment given to the outcome value, goal-related thinking, perceived capacities for agency-related thinking, and perceived capacities for pathways-related thinking (Snyder, et al. 2002).

Further empirical and statistical evidence supports the notion that the four capacities each make a unique contribution in explaining human behavior (Bryan, et al. 2007). At the same time, researchers considered the notion that the positive psychological states may have even more predictive power as a higher-order core factor (Luthans, et al. 2007; Stajkovic, 2006). This factor is known as Psychological Capital, or simply PsyCap, and is defined as: an individual's positive psychological state of development that is characterized by: (1) having confidence (self-efficacy) to take on and put in the necessary effort to succeed at challenging tasks; (2) making a positive attribution (optimism) about succeeding now and in the future; (3) persevering toward goals and, when necessary, redirecting paths to goals (hope) in order to succeed; and (4) when beset by problems with adversity, sustaining and bouncing back and even beyond (resiliency) to attain success (Luthans, et al. 2007a). PsyCap has a strong theoretical base, drawing from the rich research that supports the four positive constructs to be described next in this chapter.

The term Psychological Capital was introduced in the scholarly literature by Luthans and Youssef (2004) as a way to invest in people for competitive advantage. Several conceptual papers and books have been put forth to further describe PsyCap and its component parts (Luthans, et al. 2007; Luthans, et al. 2006; Luthans, et al. 2007a, 2007b; Youssef and Luthans, 2010).

2.7.2.1. Hope

Much of the academic research on hope over the last 20 years has been associated with C.R. "Rick" Snyder, one of the pioneers of the Positive Psychology movement, who proposed his cognitive theory of hope (Snyder, 1989). Conceptualized as expectations or feelings about goals and the future (Edwards, 2009), hope is defined as "a positive motivational state that is based on an interactively derived sense of successful (1) agency (goal-directed energy) and (2) pathways (planning to meet goals)" (Snyder, Irving, & Anderson, 1991). Hope is described as a motivational state that is based on three primary components: goals, pathways, and agency goal directed thinking (Snyder, 1994).

Put another way, people with high levels of hope have the "will" (agency) and the "ways" (pathways) to achieve goals (Snyder, et al. 1991). In these instances, people with high hope are able to move on to other pathways towards goal achievement (Snyder, 1994). Agency and pathways thinking work together, and may reciprocally feed off one another in the process of goal pursuit (Snyder, et al. 1991). Several valid and reliable measures of hope have been developed (see Lopez, et al. 2003, for a review). Among the most widely used measures of hope among adults are the "Goals Scale" to measure the dispositional or individual differences attributed to hope (Snyder, et al. 1991) and the State Hope Scale to measure ongoing, goal-directed thinking (Snyder, et al. 1996). The current study utilizes the State Hope Scale, as described later in this paper.

2.7.2.2 Self-efficacy

This study of perceived competence was first defined and articulated under the heading "self-efficacy" by Albert Bandura in an influential *Psychological Review* article (Bandura, 1977a). Self-efficacy beliefs are not beliefs about an individual's level or type of skill set, but rather what they can accomplish by utilizing the skills that they do have (Bandura, 1986). They are not concerned with what an individual intends to do, but rather with beliefs about what one has the capacity or ability to do (Maddux, 2009).

Self-efficacy beliefs have been noted as a contributing factor for individuals who take higher levels of initiative, exert more effort and motivation to accomplish tasks, and more readily persist in the face of failure or significant obstacles (Bandura, 1986and 1997a; Luthans, 2002a). Many studies have illustrated the theoretical and empirical relationships between self-efficacy and work related performance in a variety of areas including leadership development (Chemers, et al. 2000), goal choice and task performance (Locke et al., 1984), decision making (Lam, et al. 2002), work attitudes across cultures (Luthans, et al. 2006), creativity (Tierney and Farmer, 2002), entrepreneurship (Boyd and Vozikis, 1994; Luthans and Ibrayeva, 2006).

2.7.2.3. Optimism

Like hope, optimism is commonly used in everyday language and in positive psychology. It has a very specific meaning, with theory and research addressing this positive construct. Drawing from attribution theory, Seligman (1998) defines optimists as those who make internal, stable and global attributions regarding positive events (e.g task accomplishment). Simply put, optimists are "people who expect good things to happen to them; pessimists are people who expect bad things to happen to them" (Scheier & Carver, 2009). The strong theory and research backup for optimism dates back to the early 20th century expectancy-value theories of motivation (Scheier & Carver, 2009).

Prior experience with success and failure may play a role in nurturing increased levels of optimism, as previous experiences with success may raise anticipations of future success. Additionally, adaptive coping skills and positive modelling may help individuals increase their level of optimism expectancies over time (Scheier & Carver, 2009).

2.7.2.4. Resilience

In positive psychology, resilience is defined as 'the capability of individuals to cope successfully in the face of change, adversity, and risk' (Stewart, Reid and Mangham, 1997). Applied to the workplace, resilience is defined as the "positive psychological capacity to rebound, to 'bounce back' from adversity, uncertainty, conflict, failure, or even positive change, progress and increased responsibility' (Luthans, 2002a).

More recently, a growing number of scholars have studied resilience and its relation to workplace performance (Luthans, et al. 2005; Youssef and Luthans, 2007).

Given that resilience may act in concert with other positive psychological capacities, such as optimism and hope, to allow individuals to thrive in the face of challenge (Tennen and Affleck, 1998), it seems that resilience will continue to serve as a contributing POB capacity into the future.

CHAPTER 3: DESCRIPTION OF THE STUDY AREA

3.1 Introduction

This chapter provides a brief description of the study area (Tsolo). Tsolo, a small town, is situated in the Mhlontlo local Municipality in the O.R. Tambo District Municipality of the Eastern Cape Province. The description of the characteristics of the study area includes its geographical location, topography and climate, socio-economic factors, agricultural potential and infrastructure.

3.1.1 Eastern Cape Province

The Eastern Cape Province is one of the nine provinces of South Africa, bordering with the provinces of the Western Cape, the Free State, KwaZulu-Natal and Lesotho in the north (Eastern Cape Provincial Government, 2003). The province prides itself on being the only one of South Africa's nine provinces to have all the country's biomes or ecological zones within its boundaries, giving it a tremendous diversity of climates. The vast interior of the Province ranges from the dry Karoo in the west to the rolling hills and cascading rivers of the Transkei in the East.

While the population of the Eastern Cape grew by a meagre 1.6 percent between 1996 and 2001, it is the third most populous province after KwaZulu-Natal and Gauteng, with an estimated population of 6.6 million people (Census, 2011). Women constitute 52.9 percent of the provincial population with 49.6 percent female headed households. This is a reflection of the migrant labour system, and is particularly evident in labour supplying areas such as Alfred Nzo and OR Tambo. Furthermore, Mhlontlo, one of its local municipalities, had more female headed households than male headed ones, with a percentage of 51.6. In contrast, Cacadu District Municipality and Nelson Mandela Bay had a low percentage female headed household of 38.5 and 40.6 respectively based on the report of the 2011 census.

More than half of the province’s population is under the age of 21, with both the 2001 and 2011 census revealing that a high proportion of people aged between 35 and 64 years are being found in urban areas such as Cacadu, Nelson Mandela Bay, and Amatole.

The manufacturing base of the province follows a distinct spatial pattern with the two automotive manufacturing areas, the Nelson Mandela Metro and Buffalo City, predominating. Areas with potential for agriculture and agro-processing currently reflect limited linkages between primary extractive and secondary processing sub-sectors.

In the poorer districts, which do have fairly significant levels of primary sector activity (albeit underdeveloped), such as forestry and logging in Alfred Nzo and OR Tambo, the corresponding secondary processing sectors are notably underdeveloped and consequently the economic value accruing from secondary processing is realized outside these economies” (Eastern Cape Provincial Government, 2003:30).

Based on the 2001 population statistics (Census, 2001), the Eastern Cape Provincial Growth and Development Plan (2003), estimates the poverty rate to be 67.4 percent compared to 34 percent in 1996.

3.1.2 Description of the O.R. Tambo District Municipality

The O.R. Tambo District Municipality is one of the six (6) districts of the Eastern Cape Province and located along the eastern side of the former Transkei homeland area. It is located within the well-known wild coast of the Eastern Cape (DEDEA, 2010). The District incorporates five local municipalities and eight magisterial districts with a total population of 1,364,947 (Census, 2011).

The district has a land area of 12,096 square kilometres, 92 percent of which is rural, 8 percent urban and covers both the wild coast and Pondoland. Pondoland is one of the most fertile areas of South Africa with warm temperatures, frost-free conditions and good soils (DEDEA, 2010). With Mthatha as the main centre, the district is well drained, has many rivers and rainfall above 700mm per annum in most areas. The district has a relatively small informal economy compared to the rest of the province, providing 11 percent of value added. The Transkei, however, has a significant subsistence and informal economy that has not been measured statistically. Agriculture is the major private sector activity, contributing 13 percent of value added and 8 percent of formal employment.

Beyond statistics, there are significant numbers of small commercial farmers in the area, concentrating on mixed farming of livestock and crops mostly maize. Subsistence agricultural makes a major contribution to households through an increase in food security and as a source of income.

According to Eastern Cape Socio-economic Consultative Council (ECSECC) (2008), the O.R Tambo district has a human development index (HDI) of 0.4. King Sabata Dalindyebo, which is the most urbanized area in the O.R. Tambo District Municipality, has an HDI of 0.47, with Mhlontlo having the second highest HDI (0.42). Table 3.1 shows total population and information on the human development index (HDI) of the 5 Local Municipalities in the OR Tambo District.

Table 3.1: Local municipalities of OR Tambo District Municipality with their respective populations and Human Development Index (HDI).

Local Municipality	Magisterial Districts	Total population/ municipality	HDI
Ngquza Hill (EC 153)	Lusikisiki, Flagstaff	278,481	0.37
Port St Johns (EC 154)	Port St Johns	156,136	0.36
Nyandeni (EC 155)	Libode, Ngqeleni	290,390	0.39
Mhlontlo (EC 156)	Qumbu, Tsolo	188,226	0.42
King Sabata Dalindyebo (EC 157)	Mqanduli, Mthatha	451,710	0.47
Total		1,364,943	

Source: Census 2001

(OR Tambo District Municipality, Updated, based on 2011 Stats SA and Mhlontlo Integrated Development Plan 2010-2011 Review)

3.1.3 Overview of Mhlontlo Local Municipality

Mhlontlo Local Municipal where the study was carried out is one of the five (5) local municipalities of the O.R. Tambo district. It lies on the North East side of the Eastern Cape Provincial border alongside the N2 route between Mthatha and Mt. Frere and R396 between Tsolo and Maclear. It is bordered by King Sabata Dalindyebo Local Municipality to the South, Nyandeni Local Municipality to the East, Umzimvubu Local Municipality to the North, and Elundini Local Municipality to the West. The municipal area covers 2,826km^2 and has a population density of 67 people per km^2.

According to the 2011 census, the municipality has a total population of 188,226 constituting 13.8 percent of the total population of the O.R. Tambo district. The municipality, with an average household size of 4.2 is made of more females than males, and 56.9 percent female headed households. The unemployment rate in the municipality stands at 49.2 percent, which is higher than both the O.R Tambo district and Eastern Cape Province average of 44.4 and 37.5 percent respectively. The Mhlontlo municipality is further divided into Tsolo magisterial district and Qumbu magisterial district, with Qumbu as the main centre.

3.1.4 Description of Tsolo

Tsolo town is situated 42 km northwest of Mthatha and 22 km southwest of Qumbu (with grid reference of 31.3^0S28.7^0E). Tsolo is a magisterial district in the Mhlontlo local municipality. The district covers an area of $46.74km^2$. According to the 2011 census, the area has a total population of 7,794 with a population density of 166.76 per km^2, constituting 4.1 percent of the total population in the Mhlontlo municipality. The majority of people are black African (96.3 percent), with females dominating the population, with a percentage of 56.6 as reported in the 2011 census.

This area has a varied climate which plays a vital role in agricultural production ranging from cereals including maize, and vegetables such as potatoes, tomatoes, cabbage and onion. Tsolo town normally receives about 599mm of rain per year, with most rainfall occurring mainly during mid summer. Hence, in order to allow the maize plants to grow well, planting needs to start in early February. The highest average rainfall (98mm) is received in January while the lowest rainfall (5mm) occurs during winter, in June. The rainfall pattern suggests that this area is well suited for maize production although the Eastern Cape Province as a whole contributes less than 5 percent of South Africa's harvest. Maize production dominates rain-fed cropping systems of small scale farmers in the Eastern Cape Province (EC) in South Africa (Mkile, 2001; Gichangi, 2007; Obi, 2013).

The average midday temperature which is also a contributing factor in crop production in the area, ranges from 18.2°C in June to 25.5°C in February. This indicates that planting maize during the winter season would not be profitable as most of it would be damaged by frost. Furthermore, maize production requires sufficient soil moisture. During drought periods, high temperatures regularly cause crop failure, resulting in famine. Maize is an important crop cultivated amongst smallholder farmers in the area as it helps supplement their low incomes.

Most of this crop is grown in home gardens which are fertilized with manure from animal droppings. Since irrigation is not commonly practiced in the area, farmers depend mostly on rainfall for their cultivation. This also indicates a lack of capital to purchase irrigation infrastructure by farmers. However, the smallholder farmers in the Tsolo therefore have the potential to boost their production size if production challenges are reduced. Figure 3.1 shows the location of Tsolo in the Eastern Cape Province of South Africa.

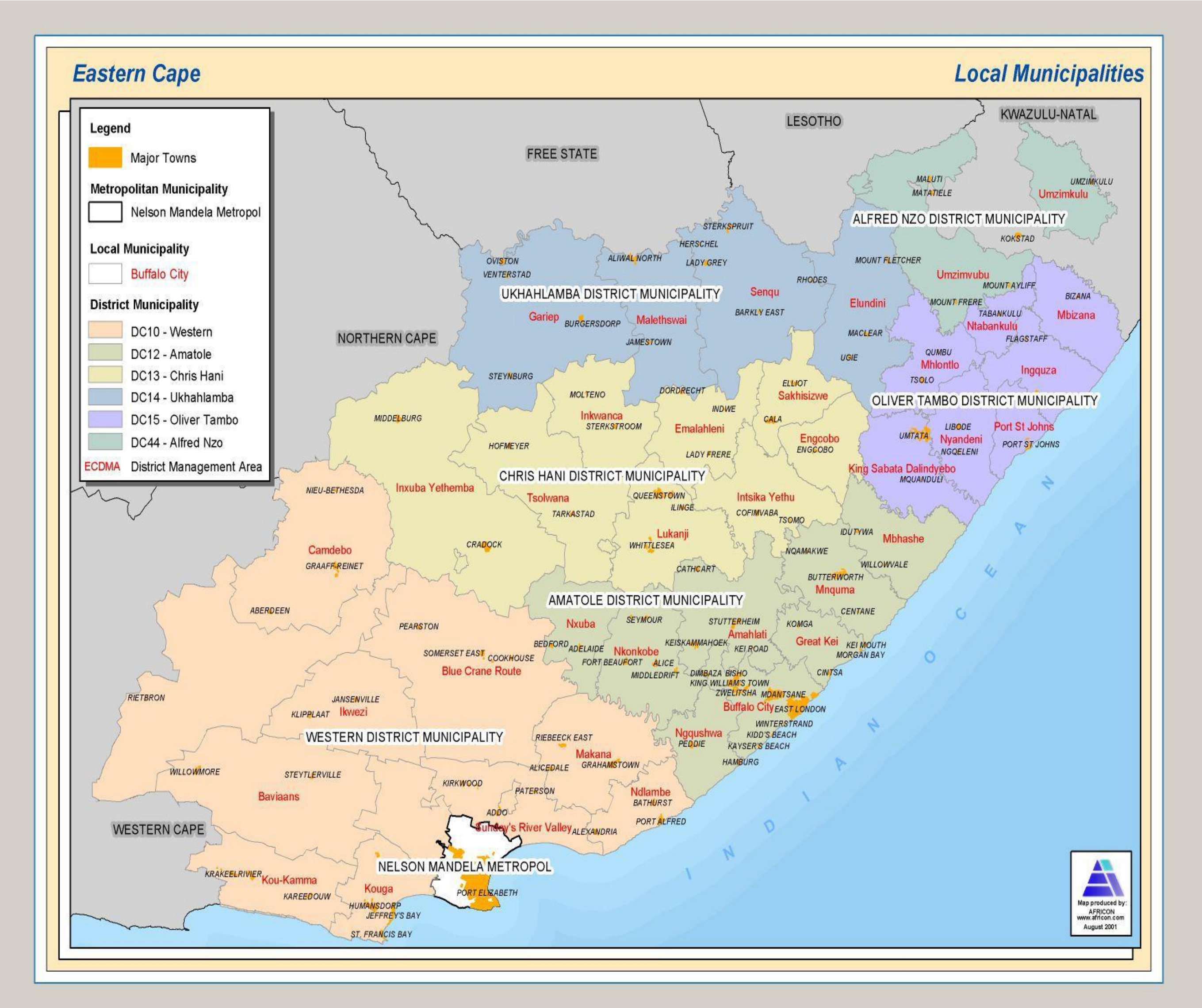

Figure 3.1: Map showing location of Mhlontlo Local Municipality in the O.R Tambo district.

Source: Census 2011

CHAPTER 4: RESEARCH METHODOLOGY

4.1. Introduction

This chapter shows how the study area was selected and the sampling techniques used to draw the sampling frame from which data were collected. The chapter also reviews the research methods used in collecting and analyzing data from smallholder farmers in the Tsolo magisterial district in the O.R Tambo district of the Eastern Cape Province. Furthermore, it describes the variables that were considered in analyzing the technical efficiency of small-scale maize producers and show how the data were collected using research instruments. Besides describing how the data were collected, an analytical framework is presented, outlining the descriptive statistics and the model for data processing and giving reasons why the model was chosen.

4.2. Selection of the study area and data sampling technique

Tsolo was chosen as the study area based on the results from a preliminary survey conducted in the study district. The survey showed that the majority of the small-scale maize producers were from Tsolo. The majority of small-scale producers from this area receive assistance from Non-governmental organizations (NGO's) through the department of Agriculture. This area is divided into eleven municipality wards, each with an appointed extension officer deployed to offer various forms of services to farmers. Improving the output of farmers in this area will mean an increase in food security in the entire province. Four wards with the main villages of Ntshiqo, Nombizo, Manka and Main town were selected purposively based on the information obtained from the Department of Agriculture (DoA) extension service officials.

A sample size of 120 households was used in the study. Sampling is a process of selecting units from a population of interest, so that by studying the sample, the results obtained from the sample may be generalized to the population from which the sample was drawn (Leedy & Ormrod, 2004).

Since the data obtained from a sample is generalized to the whole population, the manner in which the sample units are selected is important. A sample should be representative; therefore, the sample size should be large enough to conduct reliable statistical analysis. According to Bless and Smith (2000), in order to get reliable prediction, a sample should have at least 30 units.

In order to select sample households, a multi-stage sampling technique was followed. In the first stage Mhlontlo local municipality was purposefully selected from the O.R Tambo district based on the extent of maize production in the area. In the second, four villages were selected from Tsolo based on a discussion with the agricultural extension service officers in the Mhlontlo local municipality. Finally, 120 sample farmers were selected to administer the survey to.

Snowball sampling was employed to identify households that produce maize; once a household had been identified, it became easier to identify others who also produced maize as they knew who engaged in what activity in the community.

4.3 Data collection

Primary data was used in this study and was collected through a field survey and household interviews using a structured questionnaire. The questionnaire was structured in such a way that the first part dealt with the socio-economic variables such as farm size, age of the household head, size of the household, gender of the farmer, purchase of hybrid maize seed, education of the farmer, farming experience of farmer, use of pesticide, is maize profitable, marital status, use of manure, use of tractor, income of the household and frequency of extension visit.

The second part covered the factors of production such as, land, labour, cost of tractor hours and materials use such as fertilizer and seed, the third part dealt with the collection of institutional information such as credit access, cooperative membership and market access regarding where they bought their inputs and where they sell their output and the last part dealt with the entrepreneurial spirit and positive psychological capital of small-scale maize producers in the area.

4.4 Analytical methods

The main instrument that was used in this study to gather data was the questionnaire. The statistical package for social scientists (SPSS) version 21 was used to run the data collected from the small-scale farmers in the Tsolo magisterial district. The data collected was analysed to test the hypothesis using the Stochastic Frontier Analysis (SFA) and Ordinary Least square (OLS).

4.5 Descriptive statistics

The basic features of the sampled farmers were described by means of simple summaries and measures of central tendency using descriptive statistics. The study employed three major characteristics of variables, namely: distribution, central tendency and dispersion. These were useful in analysing household characteristics as well as the relationship between variables.

4.6 Technical Efficiency and its Determinant

Technical efficiency analysis is the ratio from actual productivity and frontier productivity. Therefore, it requires technical data for analysis. The estimation of technical efficiency follows non-parametric and parametric techniques. The non-parametric technique constructs a frontier and measures efficiency relative to the constructed frontier using linear programming techniques such as Data Envelopment Analysis (DEA).

The parametric technique estimates frontiers and provides efficiency using econometric methods such as the Stochastic Frontier Approach and distance functions. The determinants of technical efficiency were independently analysed using the stochastic production frontier model and multivariate ordinary least square (OLS).

4.7 DEA and stochastic production frontier approach to technical efficiency

The study applied the Stochastic Production Frontier Analysis (SPA) since there is no consensus on whether DEA or SPA is the best tool for efficiency measurement (Folland, 2001). Each of these approaches has its advantages and disadvantages in technical efficiency analysis. The stochastic frontier production function has the disadvantage of imposing an explicit functional form and distribution assumption on the data. In contrast, the DEA does not impose any assumptions on the functional form, and is, hence, less prone to a misspecification error.

However, since DEA cannot take account of statistical noise, the efficiency estimates may be biased if the production process is largely characterized by stochastic elements. The DEA is also disadvantageous, in that, when there is no relationship between the inputs and outputs, each farm will be viewed as unique and fully efficient, resulting in the loss of discriminating power (Thiam, et al. 2001; Alene and Zeller, 2005).

4.7.1 Stochastic Production Frontier Analysis (SPA)

The Stochastic production frontier function can be specified in different forms as linear, polynomial, Cobb-Douglas and translog.
Most studies (e.g Saur, et al. 2004) have indicated a preference for translog over other functions because it is the best-investigated second order flexible functional form and certainly one with most application.

Another reason is that this functional form is convenient to estimate and has proved to be a statistically significant specification for economic analysis as well as a flexible approximation of the effect of input interaction on yield.

Studies have criticized the use of the Cobb-Douglas production function as imposing a severe prior restriction on the farm's technology by restricting the elasticities to be constant and the elasticities of input substitution to unity (Wilson et al., 2001, Liu and Zhuang, 2000, Awudu and Eberkin, 2001).

Despite criticism from other studies about the Cobb-Douglas, most researchers (e.g Salau et al., 2012, Essilfie et al., 2011, Obi and Chisango, 2011), including the present one, continue to use it because of the flexibility in its analysis.

The stochastic Frontier Model is implicitly defined as:

$Y_i = f\ (X_i,\ \beta_i)\ \exp\ (V_1 - U_1)$, i=1, 2, n ....(1)

Where:

Y_i is the output of the ith farmer,

X_i is the vector of input quantities used by the ith farmer;

β_i is the vector of unknown parameters to be estimated,

f (.) represents an appropriate function

V_1 is a symmetric error, which accounts for random variations in output due to factors beyond the control of the farmer,

U_1 is a non negative random variable representing inefficiency in production relative to the stochastic frontier.

Specifically, the production technology (Technical efficiency) of maize farmers in Tsolo was estimated using the Cobb Douglas functional form of the stochastic frontier production function model defined as follows:-

$$Ln\ Y_i = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \ldots \beta_5 LnX_5 + (V_i\text{-}U_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where:

Y_i = maize output in kilogram,

X_1 = farm size in hectare

X_2 = labour input in work-days

X_3 = maize seeds in kilogram,

X_4 = quantity of fertilizer in kilogram,

X_5 = capital input in rand measured in terms of depreciation of farm tools and equipment, interest on borrowed capital, repairs and rent on land;

β_o, β_1, β_2, β_3, β_4, B_5, are the regression parameters to be estimated.

V_1 and U_1 are as defined in equation (1)

Elasticities: According to Onumah et al. (2010), the estimated parameters β_1, $\beta_2 \ldots \beta_5$ are output elasticities of the corresponding inputs in the Cobb-Douglas stochastic frontier production function (2). However, the elasticities of output based on different inputs are functions of the level of inputs employed in the Cobb-Douglas stochastic production function.

Moreover, when the output and input variables have been normalized by their respective sample means, the first order coefficient can be interpreted as elasticities of output in relation to the different inputs.

Returns to scale (RTS) decision rule: The summation of the output elasticities is the estimated scale elasticity (ε). It is defined as the percentage change in output from 1% change in all input factors. It is a measure of returns to scale (RTS) for a farm or industry.

($\boldsymbol{\varepsilon}$) > 1 implies increasing returns to scale (IRS)

($\boldsymbol{\varepsilon}$) < 1 implies decreasing returns to scale (DRS)

($\boldsymbol{\varepsilon}$) =1 implies constant returns to scale (CRS).

Description of the variables in the model:

Output- is the total quantity of maize harvested in that year and it is measured in kg.

Land – is the area of the farm which is devoted to the production of maize and this variable is measured in hectares (ha).

Labour – it is expressed in adult equivalent days per ha and is the sum of family labour and hired labour. Male and female labour is counted equally and individuals who did not spend their holidays on the farm were not considered. The unit of measurement for this variable is man days.

Capital – to represent capital, a cost of tractor hours is used. This variable is measured in rand.

Fertilizer – it includes both basal and top dressing fertilizers.

Although some of the Small scale farmers use kraal manure, this has been left out for problems of aggregation. It is measured in kilograms (kg)

Seed – is the usage of both certified seed and home produced or recycled seeds. Both are considered. It is measured in kg.

4.8 Stochastic Production Frontier and Multivariate Ordinary Least Square approach to the estimation of the determinants of technical efficiency

4. 8.1 Stochastic Production Frontier and determinants of technical efficiency

The determinants of the technical efficiency of maize farmers were estimated jointly with equation (2) in a single stage maximum likelihood estimation procedure using computer software frontier version 4.1 (Coelli, 1996). The Battese and Coelli (1995) technical inefficiency effects model is an extension of the more usual stochastic error component frontier function which allows for the identification of factors which may explain differences in efficiency levels between observed decision-making units.

The conventional stochastic frontier approach involves the estimation of a function with a composite error term, including a symmetric and a one-sided component (following Aigner et al. (1977) and Meeusen and Van den Broeck (1977).

In the case of the frontier production function, the symmetric component, $V_{i,}$ represents random variations in production due to factors outside the control of the farmer (such as climate and measurement error) and is assumed to be independently and identically distributed as $N(0, \sigma_v^2)$.

The one-sided component, U, is associated with the technical inefficiency of production and measures the extent to which observed output deviates from potential output given a certain level of inputs and technology. Commonly, it has been assumed that this component has an identical and independent half-normal distribution, although a variety of other distributional specifications are possible (Greene, 2002).

The one sided component reflects technical inefficient relative to the stochastic frontier and that $U_i = 0$ for any production unit whose output lies on the frontier and $U_i > 0$ for any output lying below the frontier.

A number of studies have explored the determinants of technical efficiency using a two-step procedure (Parikh and Shah, 1994; Karanja, 2002). However, Battese and Coelli (1995) developed a one-step procedure for estimating the parameters of the stochastic production frontier and the inefficiency model simultaneously given that the technical inefficiency effects are stochastic. In this case, the $U_{i,}$ are assumed to be non-negative random variables, independently distributed and arising from the truncation at zero of the normal distribution with variance σ^2 and mean $z_i \delta_i$ where z_i is a vector of variables which are assumed to explain technical inefficiency and δ is a vector of coefficients to be estimated.

$TE = Y^*$

$Y^* = f(X, B) \exp(V_i - U_i)$ ……………………………………………………………………3

But $f(X, B) \exp(V_i) = \exp(-U_i)$ ………………………………………………………………4

Where:

Y_i is the observed output

Y^* is the frontier output

$TE = a_o + a_1Z_1 + a_2Z_2 + a_3Z_3 + \ldots\ldots a_{17}Z_{17}$ …………………………………………………5

Where:

TE is the technical efficiency of the ith farmer

Z_1 is household income,

Z_2 is household size,

Z_3 is membership of cooperative, a dummy variable which takes the value of unity for member and zero for otherwise,

Z_4 is extension visit, in number,

Z_5 is age in years,

Z_6 is marital status, a dummy variable which takes the value of unity for married and zero for otherwise,

Z_7 is educational status in years,

Z_8 is credit access, a dummy variable which takes the value of unity for access and zero for otherwise,

Z_9 is farming experience in years,

Z_{10} is farm size in hectare,

Z_{11} is gender of farmer, a dummy variable which takes the value of unity, for male and zero for otherwise,

Z_{12} is use of tractor, a dummy variable which takes the value of unity, for yes and zero for otherwise,

Z_{13} is market access, a dummy variable which takes the value of unity for accessible and zero for otherwise,

Z_{14} is purchase hybrid seed, a dummy variable which takes the value of unity for yes and zero for otherwise,

Z_{15} is usage of manure, a dummy variable which takes the value of unity for yes and zero for no otherwise,
Z_{16} is usage of pesticide, a dummy variable which takes the value of unity for yes and zero for otherwise,
Z_{17} is maize profitable, a dummy variable which takes the value of unity for yes and zero for otherwise,
a_0 is of unit intercept
a_1 ………….a_{17} are parameters to be estimated.

4. 8.2 Multivariate Ordinary Least Square (OLS) and determinants of technical efficiency

The Multivariate Ordinary Least Square was used as a follow up to the stochastic frontier model to also estimate the effect of socio-economic and institutional factors influencing technical efficiency.

The results from the two models were used to establish the technical efficiency of the farmers and also to analyze the socio-economic and institutional characteristics affecting their technical efficiency. Ordinary Least Square (OLS) was chosen for the reason that the Cobb-Douglas functional form cannot definitively be predicted by visual inspection and hence the need for the usage of the OLS to present insight into the determinants of technical efficiency.

CHAPTER 5: RESULTS AND DISCUSSION

5.1 Introduction

This chapter presents the results of the field survey that was carried out in the villages of Ntshiqo, Nomhala, Manka and Main town. The data under analysis were collected from 120 smallholder maize farmers. The aim of the chapter is to profile the sample and present findings in relation to the assessment of the technical efficiency of the small-scale maize producers in the area and finally highlight socio-economic characteristics, production characteristics, institutional support and the entrepreneurial spirit and positive psychological capital that influence productivity and technical efficiency. Hence, the chapter begins with a brief description of the demographic and socio-economic characteristics of the sampled households, which is then followed by the production characteristics and institutional support of farmers. It goes on to discuss the positive psychological factors and entrepreneurial spirit of the smallholder maize farmers in the area. Finally, the information on the assessment of the technical efficiency of the small-scale maize producers is presented.

5.2 Demographic and socio-economic characteristics of sample farmers

The study looked at some demographic and socio-economic characteristics which the research felt are important for the overall analysis of technical efficiency of the farmers in the area. These characteristics are discussed bellow fully in descriptive format, figures and tables.

5.2.1. Gender distribution of household heads

Small-scale farming is mainly dominated by females as most households are female headed. Thus, small-scale farmers in most Africa countries are women who farm to support their families.

The results in Figure 5.1 indicate that the majority (54.2%) of households of sampled farmers in the area were female-headed. This indicates that there are more female headed households in the area than male headed ones.

The probable reason is that females engage in farming to ensure the sustainability of the family since a number of men even married ones migrate to other towns to find work to support their families leaving females as heads of the households. The results support similar findings in Ghana by Essilfie, et al. (2011) who gave the reason that females dominate small-scale production because males are involved in the production of other cash crops, particularly pineapple. On the other hand, it contradicts the finding of Salau, et al. 2011 (Nigeria) who found more male headed households as a result of the cultural beliefs of the people in the area, which prohibits women going out freely to engage in activities such as farming. Women in this area are not allowed to own land and where they do own land, they usually delegate its administration to their senior male child or one of their male relations.

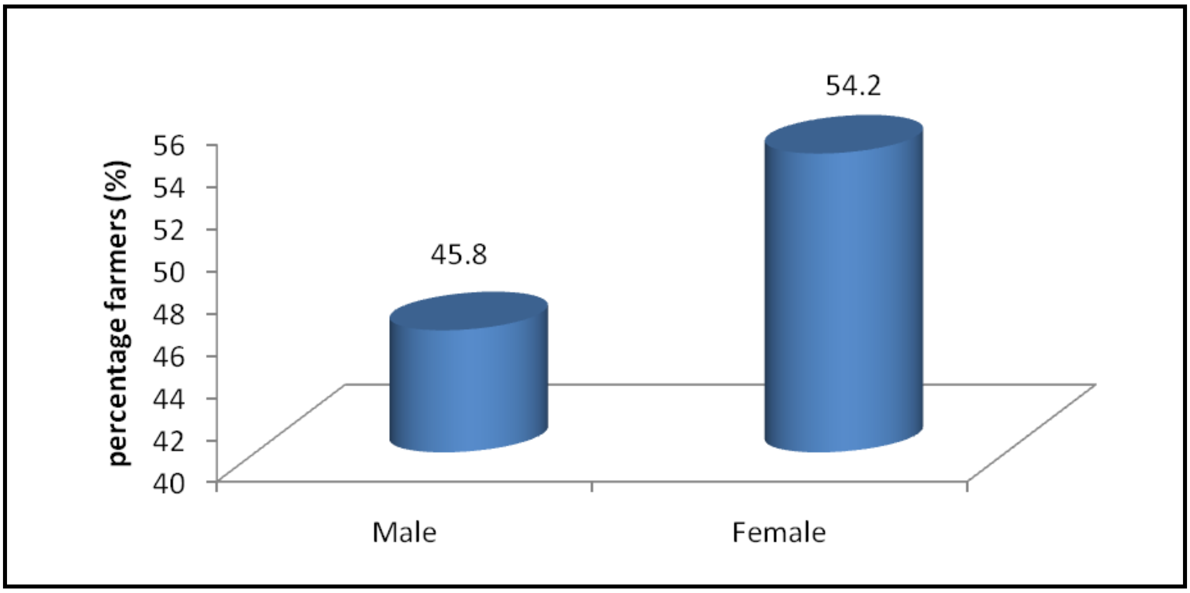

Figure 5.1: Distribution of household heads by gender

5.2.2. Age distribution of household heads

Another important aspect as far as technical efficiency of maize farmers that was captured is the age of household heads.

The age of the farmer is used as a proxy for measuring his or her general farming experience and thus has an effect on efficiency. It is assumed that, older farmers are more experienced in farming activities and are better able to assess the risks involved in farming than younger farmers. This may contribute to the improvement of technical efficiency.

The age of the sampled farmers was classified into different groups, where each farmer belonged to one age class. The age distribution of farmers in the area was from 36 to 89 years of age. The percentage distribution of the study respondents by age is summarized in Figure 5.2.

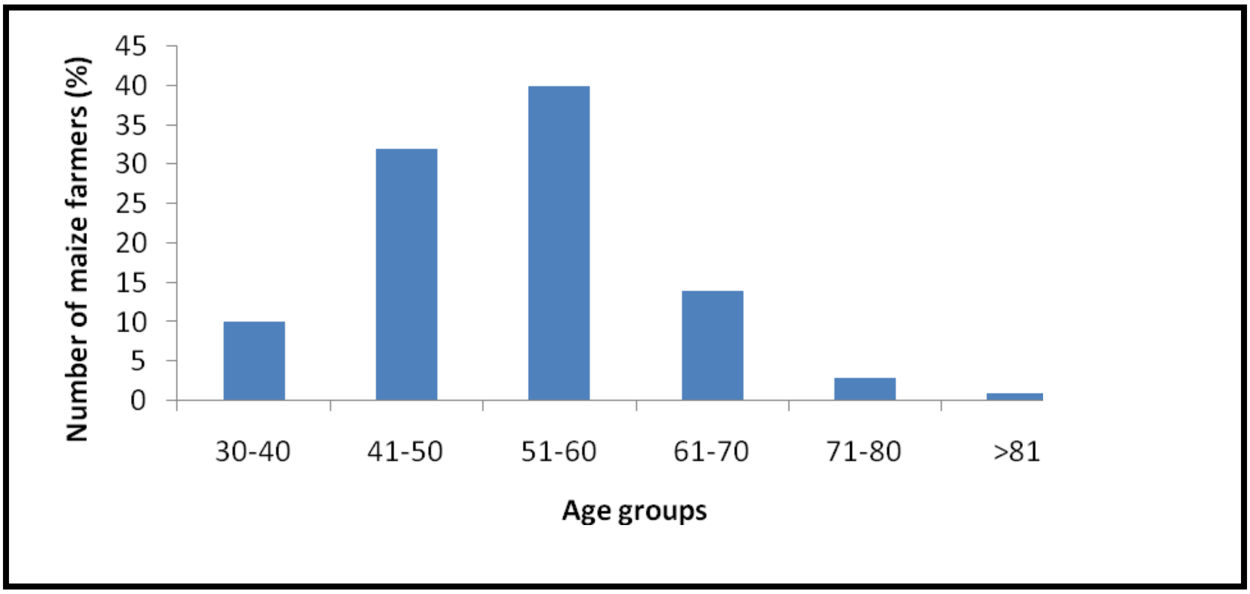

Figure 5.2: Distribution of household heads by age

The graph shows that very few (1%) of the respondents are above 80 years, with the most farmers (40%) between the age range of 51-60 years. The results further reveal that 90% of the farmers are over 40 years of age. This indicates that farming in the area is chiefly practiced by older people. This can be attributed to the fact that, younger household heads migrate to Mthatha, Durban, Cape town and other surrounding cities to have better employment opportunities and sources of income other than farming.

The present finding is consistent with the finding of Jacinta Lemba, et al. 2011 that younger and more educated populations are more likely to migrate to urban centers in search of non-farm employment opportunities which offer a higher and more stable income. These empirical results also agree with an observation by Beniam, et al. (2004) that, the older a farmer gets, the more experienced he or she is.

It was observed that older farmers appeared to be more efficient than younger farmers due to the good managerial skills they have learnt over time (Essilfie, et al. 2011) and also their efficiency in resources and certain agronomic practices (Beniam, et al. 2004).

5.2.3. Marital status of farmers

The marital status of farmers plays a very vital role in their production. Generally, farmers from a stable home are more likely to increase the efficiency of the farm than those from broken homes. It determines the stability of households in Africa, and also their economic status. The result of the marital status for household heads in figure 5.3 divides marital status into four categories namely: single, married, widowed and divorced.

Figure 5.3 indicates that 75.8% of the farmers were married, and the percentage of divorced farmers was as low as 2.5 percent. Few farmers were reported as single 10% and only 11.7 % were widowed. The results indicate that the majority of farmers are from stable homes and high economic status families since most farmers in this study area were married. It is noted that, there is a direct relationship between marital status and the size of household. Married farmers are expected to have large household size and, as a result, have access to more family labour than single farmers.

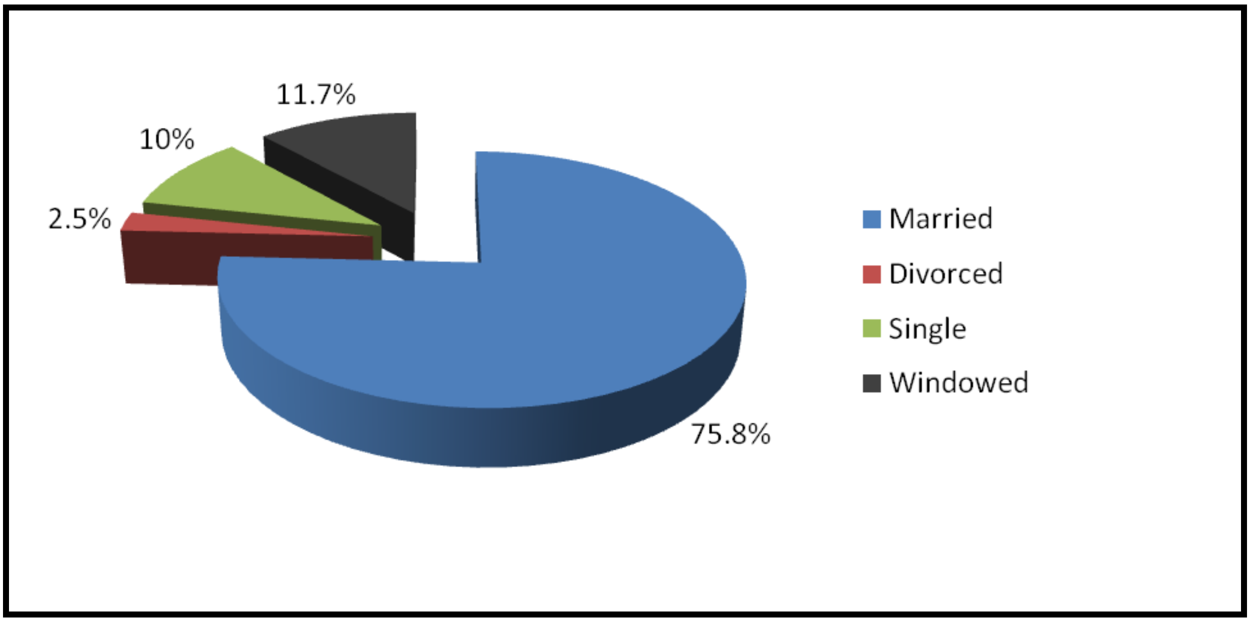

Figure 5.3: Distribution of household heads by marital status

5.2.4. Household size of respondents

The household serves as a source of labour for most small-scale producers. Family labour is one of the most important inputs to small-holder farm production since it saves on the cost of hiring labour which is scarce and expensive. The size of the household therefore influences the efficiency of a farmer's production.

The descriptive analysis revealed a mean household size of 5.7 and standard deviation 2.37 with minimum and maximum of 2 and 6 respectively. The results confirm that, the bigger the household size, the more its supply of family labour and less the cost of hiring labour. The study results are consistent with the findings of earlier studies (Byerlee and Collinson, 1980; Collinson, 2000) that a larger household size tends to supply family labour for farming and as a result lowers the cost of hiring labour which may be expensive.

Table 5.1: Household size distribution in the survey area in 2013

Class	Total (%)	Ntshiqo (%)	Nomhala (%)	Manka (%)	Main town (%)
1-4	24.2	31.0	24.1	13.8	31.1
5-9	70.8	22.4	25.9	28.2	23.5
10-14	3.3	25.0	25.0	50.0	0.0
≥15	1.7	50.0	0.0	0.0	50.0

Source: Field survey (2013).

According to Table 5.1, the majority (70.8%) of the farmers had a household size range of 5-9 members followed by 24.2% farmers, who had a household size range of 1-4 members. Thus 95% of the farmers had a household size of 9 or fewer members with only 5% ranging from 10 and more members in the household.

5.2.5. Educational background of household heads

Farmer education level is important in that it enhances farmer's efficiency and knowledge with regard to agricultural production. In this study, the highest educational level achieved by a farmer was recorded to determine the human capital level of households and their ability to interpret information.

The results on the educational level of respondents revealed that the mean number of completed years of education recorded was 8.6 and standard deviation 6.28 with a minimum of 0 and maximum of 20 years. This suggests that the level of education of the sample was low, with the farmers not managing to complete secondary education. Figure 5.4 gives more detailed information on the educational background of the farmers from the various villages sampled.

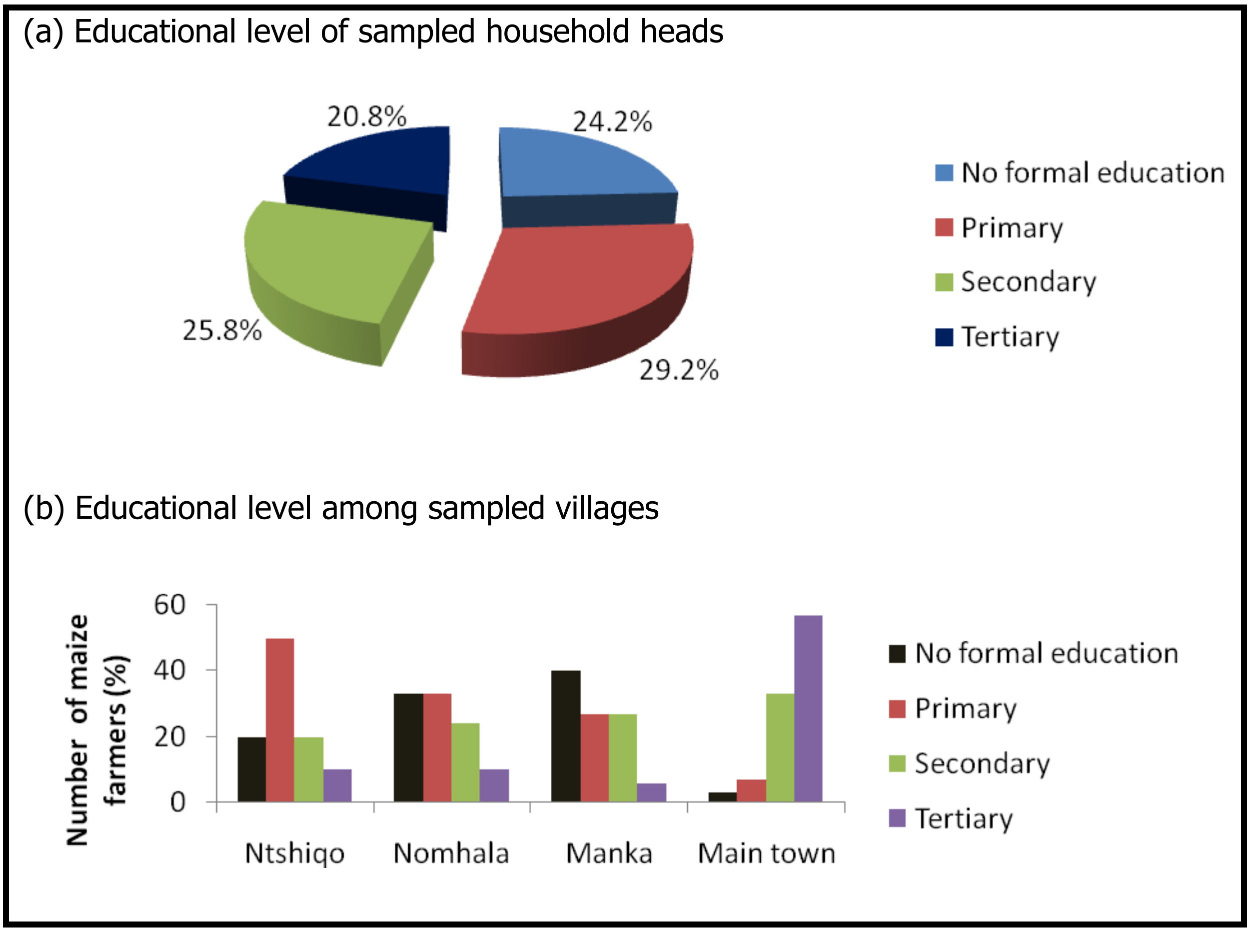

Figure 5.4: Level of education of the household head

This section, which categorizes the sampled farmers into four educational level groups shows that 24.2% of the farmers had no formal education (indicated by 0) with the majority of this group coming from Manka (see Figure 5.4b). The majority (75.8%) of the farmers had formal education with most (29.2%) of such farmers managing secondary level. The percentage of respondents with a tertiary level education was 20.8%, the majority of whom came from Main town where such farmers are employed full-time. These findings support of Bembridge (1988), who indicated that the education levels of smallholder farmers are generally low in South Africa. Educated farmers are able to apply better farming methods, utilize input efficiently and are also better placed to try newer forms of farming. The level of education is strongly correlated with poverty. Thus, it is noted that poverty decreases as education increases. This is because educated people are more easily employed and earn a salary, which helps in increasing their farm production.

The education of farmers is expected to have an effect on farm resource use and the ability to adopt new technology and, hence, have a positive impact on technical efficiency. This is consistent with the findings of Tchale (2009) that older farmers, who did not receive a good education, may be more technically inefficient than younger ones. According to Lyne (1985), improved education services enhanced the adoption of new farm technologies in Kwazulu-natal. Venter et al. (1993) came to the same conclusion that a low level of educational training is the most limiting factor in technology adoption among small-scale commercial farmers in Venda. According to Saha, Love and Schwart (1994a), formal education and training in agriculture improves farmers' ability to acquire accurate information, evaluate new production processes, use new agricultural practices and understand the benefits of adopting appropriate farm practices.

5.2.7 Household income of farmers and their sources

Income plays a vital role in maize production as farmers have to invest in capital inputs such as hiring tractors, labour and purchasing seed every season. Without these financial inputs farmers cannot maintain the required standard of technical efficiency. In this section, households were divided into four categories depending on the levels of their earnings per month (see Table 5.2).

Table 5.2: Monthly household income of respondents in the villages sampled

Variable	Ntshiqo (%)	Nomhala (%)	Manka (%)	Main town (%)	Total number	% Total
<1501	33.3	31.7	30	5	60	50
1501-3000	33.3	0	66.7	0	3	2.5
3001-4500	25	25	25	25	4	3.3
>4500	15.1	18.9	17	49	53	44.2

Source: Field survey (2013).

The results from Table 5.2 indicate that most respondents (50%) receive an income of less than R1501 with the majority (33.3%) coming from Ntshiqo village. No farmer from Main town was indicated to have fallen under this group of earnings.

Of the 44.2% that earn above R4500, 49% come from the Main town. These income levels were obtained from different sources by farmers and the results showing this information are indicated in Figure 5.5. It can be concluded from the study that, farmers with high income earnings stand a better chance of increasing their production through the adoption of new technology purchases of farm inputs for production. The present findings are similar to those from past studies (Just and Leathers, 1994; Adesina and Zinnah, 1993) that showed a significant influence of income on the adoption of improved agricultural technologies by smallholder farmers in developing countries. According to Essa and Nieuwoudt, 2001 and Strauss, et al. 1991, farmers with relatively more wealth and liquidity may be better able to finance the adoption of technologies and appropriate practices. These farmers are better able to bear risk, therefore more likely to try new technologies (Doss and Morris, 2001).

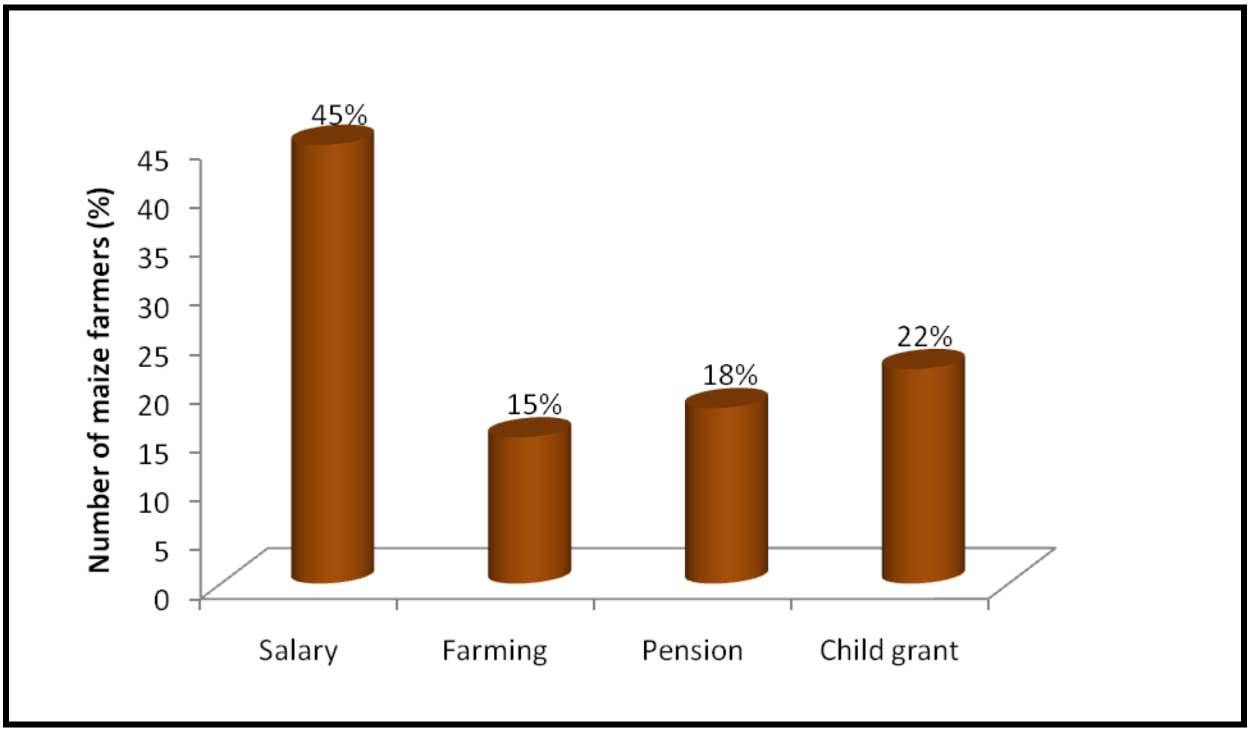

Figure 5.5: Source s of monthly income of household heads

As demonstrated in Figure 5.5, the majority (45%) of household incomes of the sampled farmers come from salaries, followed by 22% from child support grants and 18% from the pension grant. The high percentage coming from salaries was boosted by farmers from Main town, since the majority of this group earn monthly salaries from their employment.

5.2.8. Profitability of maize

In this study, the profitability of maize production was examined because it is believed to contribute to the technical efficiency of farmers. If there is no profit, naturally the farmers will not invest. Farmers' motives for maize production range from income generation, sources of food for family and livestock and cost savings to improve standard of living.

This section tried to gather information about farmers' perception of maize production and the results are presented in Figure 5.6. More than half the farmers (84.2%) perceived maize as profitable. Only 15.8% of the sampled farmers perceived maize production as not profitable.

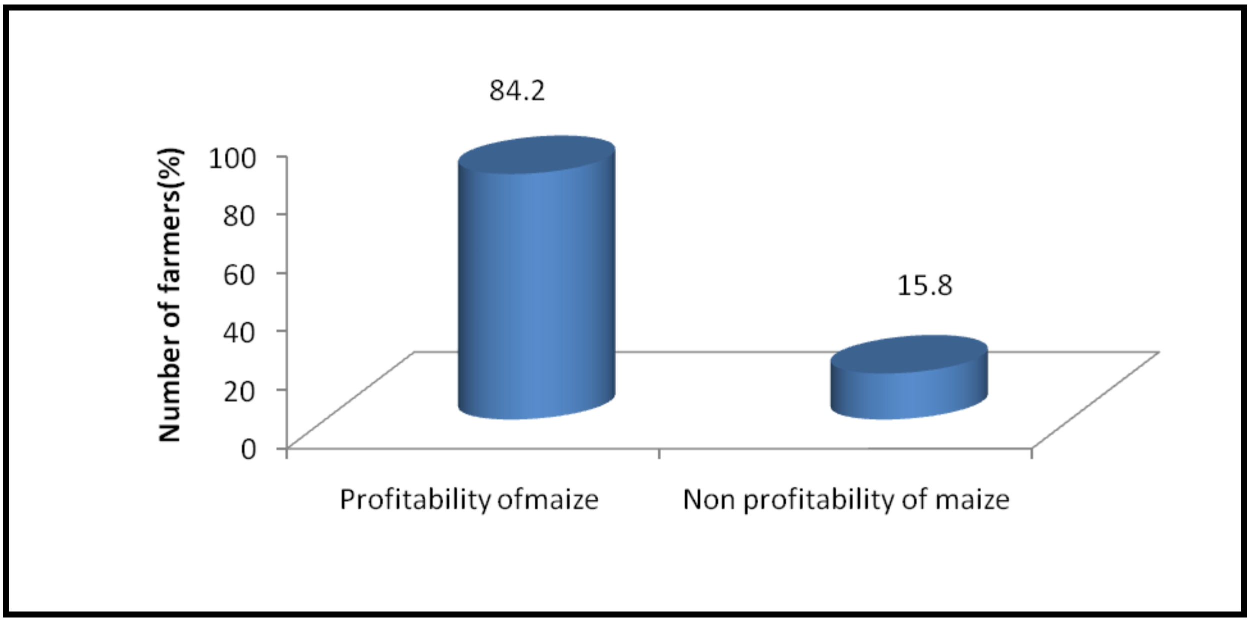

Figure 5.6: Farmers perception of maize profitability

5.3 Production characteristics of the farmers

5.3.1. Land ownership (Land tenure) of sampled farmers

Land rights are the backbone of a land tenure system, that is the system of rules, rights, institutions and posses, under which land is held, managed, used and transacted (Cotula, 2006). Noronha (1987) and Abulu (1977) have demonstrated that the rights that farmers have over natural resources can be important in determining whether they take a short or long-term perspective in managing resources. For example, farmers who feel that their tenure is insecure, with or without formal rights are less likely to be interested in conserving resources or in making investment that improve the long-term productivity of resources.

This study investigated land ownership under four main categories as ownership by traditional authority, lease (rented), bought and inherited. The results are shown in Figure 5.7.

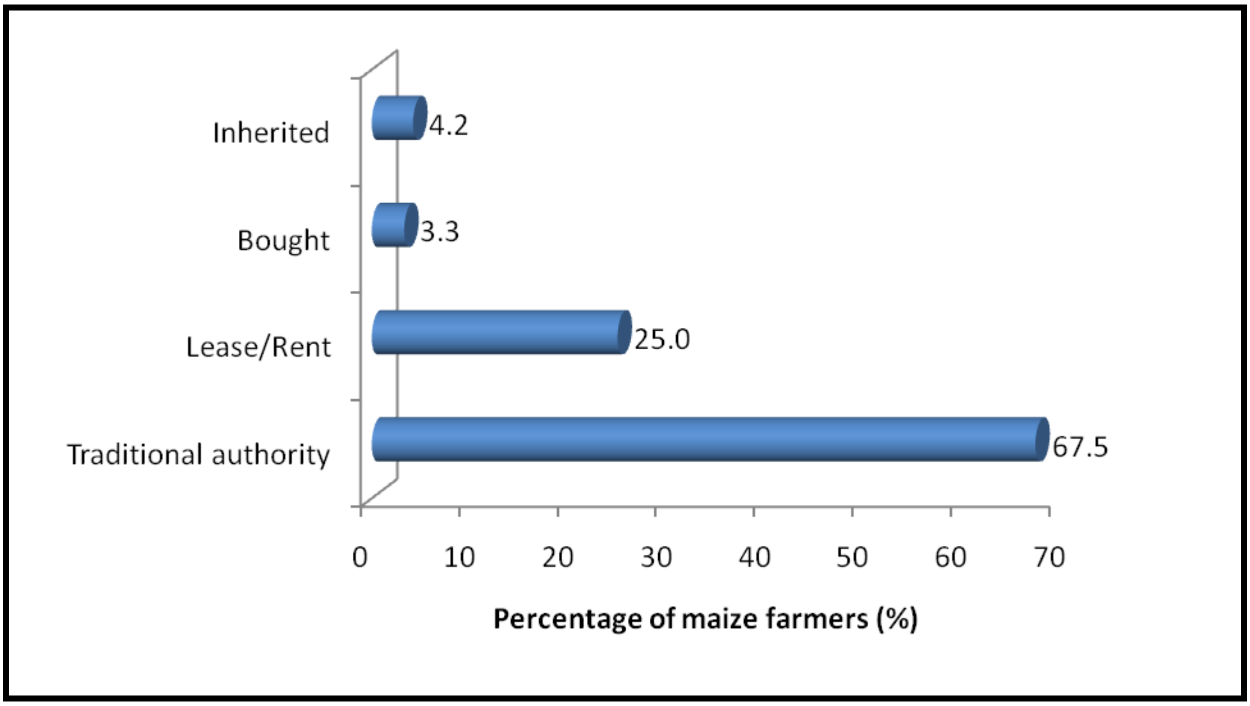

Figure 5.7: Land tenure system of respondents

Figure 5.7 shows that 67.5% of the farmers in Tsolo use communal land by traditional authority and 25% lease (rent) the land they use for farming activities.

Only 3.3% and 4.2% farmers bought and inherited the land they use respectively. According to Randel et al., (2000) agricultural activity can be influenced by land ownership because farmers who do not own the land they use can be reluctant to develop and maintain the land. This concurs with the findings in Tsolo, where most farmers did not own the land they used for production and were, therefore, reluctant to develop and maintain the land with proper fencing. This is a probable reason making it difficult for most farmers to obtain loans for agricultural purposes, such as purchasing of inputs like seeds. They cannot use the land as collateral, since they do not have title deeds for it.

5.3.2. Land devoted to maize production and yield produced

Farm size has an influence on technical efficiency and the total output of maize production. The size of the farm is based on the size of land used by the household for maize production. The size of the land a farmer owns is usually associated with the amount of produce, though this is not always the case since most farmers might not utilize all the land allocated to them (Muchingura, 2007). The results obtained with regards to farm size held by farmers in the area are presented in Table 5.3 and Figure 5.8.

Table 5.3 shows that the average farm size per farmer in the four different villages sampled. It also presents the average maize yield harvested and marketed for each of the four villages sampled. According to the table, the farmers in the area owned a total farm size of 156.6 hectares of land and produced a total of 3375 bags of maize. Of these bags harvested, 1569 bags were marketed for income and this represent 46% of the total harvest. This generally implies that, farmers produce to feed the family. On the other hand, the results showed more yield marketed than consumed by farmers from Main town (56.1%) and Nomhala (55.9%). Each farmer in the area on the average held a farm size of 1.3ha and gave an output of 21.5 bags. Individual farmers were also asked to report on their farm size. Figure 5.8 reveals that the distribution of farmers according to the farm size.

Table 5.3: Average farm size per farmer in the different villages sampled and the utilization of harvested yield

Village	Average farm size (ha)	Total bags harvested (50kg bag)	Bags marketed	Percentage bags marketed
Ntshiqo	1.67	54.9	22.8	41.5
Nomhala	1.27	21.3	11.9	55.9
Manka	0.99	14.2	5.2	36.6
Main town	1.30	22.1	12.4	56.1
Total	156.8	3375	1569	46.5

Source: Field survey (2013).

The land sizes were categorized into five main groups and the results are shown in Figure 5.8. More than half (77%) of the farmers indicated that their farm size was 1ha and the second largest (24%) group had a farm size of 2ha. However, the results show that very few farmers (2%) owned a farm size of 3 hectares or more. The result of the present study is consistent with the finding of Nieuwoudt (1990) that small-scale farmers may use land much more intensively than do large farmers. The same opinion was supported by Latt and Nieuwoudt (1988) that farms with less than one hectare applied inputs much more intensively than farms with more than one hectare; thus, suggesting that smaller farms may maximize returns to land (their scarce resource); while larger farms maximize returns to labour and capital. These small farms constitute the backbone of traditional agriculture throughout the developing countries including South Africa (Devendra and Pun, 1983).

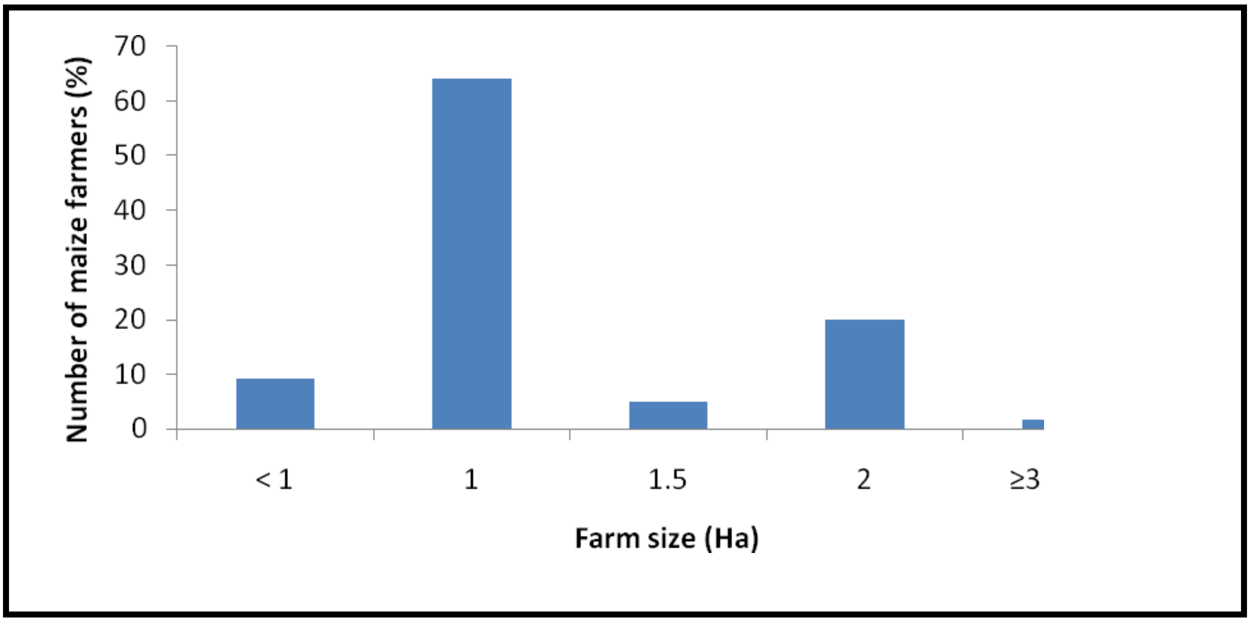

Figure 5.8: Distribution of farmer size

5.3.3. Labour supply for maize production in the study area

This section reports on the availability of labour, which is supplemented by hired labour when needed. Even though small-scale farmers mainly depend on family labour, they still hire labour help the family. It is noted that farmers with a smaller family size are mostly the ones to hire additional labour, since the major part of the labour used by small-scale farmers is sourced from family.

This section reports on the availability of labour. The results of the interview with the respondents revealed that a farmer could use either family or hired labour of both (see Figure 5.9). From the information obtained and presented in the Figure, most farmers (83.3%) hired labour while 16.7% did not hire labour but instead depended only on family labour. As shown in Figure 5.9, all the farmers from Ntshiqo and Main town depended on hired labour. The results indicate a 83% and 50% dependency on hired labour from Ntshiqo and Manka respectively.

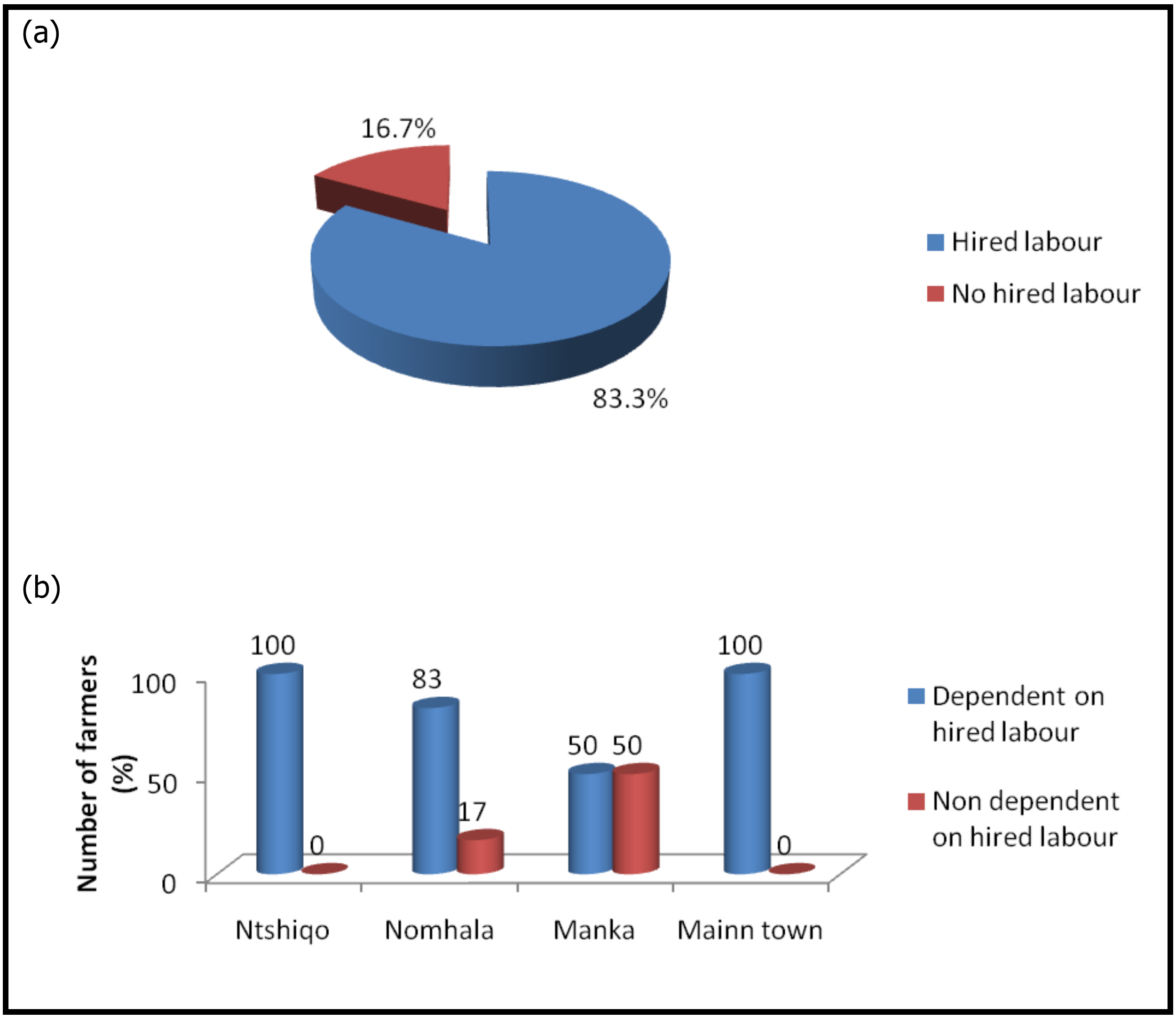

Figure 5.9: Labour usage among farmers for maize production

5.3.4. Fertilizer and manure application in maize production

Fertilizer and manure play a vital role in maize production and for that matter increase the efficiency of farmers. The use of fertilizer in maize production increases yield no matter how large or small the farm size. However, small-scale farmers have difficulties in obtaining fertilizer as they lack the financial means.

Table 5.4 and Figure 5.10 present information on fertilizer manure usage among the maize farmers sampled in the area. The mean amount of fertilizer used was 170,4kg (S.D=91.8) per hectare with the minimum and maximum being 0 and 300kg per hectare respectively (see Table 5.4).

The information shown in figure 5.10 indicates that 89.2% and 54.2% of the farmers applied fertilizer and manure respectively for maize production. About 10.8% of the farmers have no access to fertilizer. This may be the result of a lack of funds to buy and transport fertilizer. The non-application of fertilizer certainly influences technical efficiency.

Table 5.4: Farmers application of fertilizer and manure for maize production

Variables	Description	Min	Max	Mean	Std. Deviation
Manure	Used manure on the maize field (1=yes, 2=no)	1	2	1.46	0.500
Fertilizer	Fertilizer (Kg/ha)	0	300	170.42	91.783

Source: Field survey (2013). Where: Min=minimum and Max= maximum

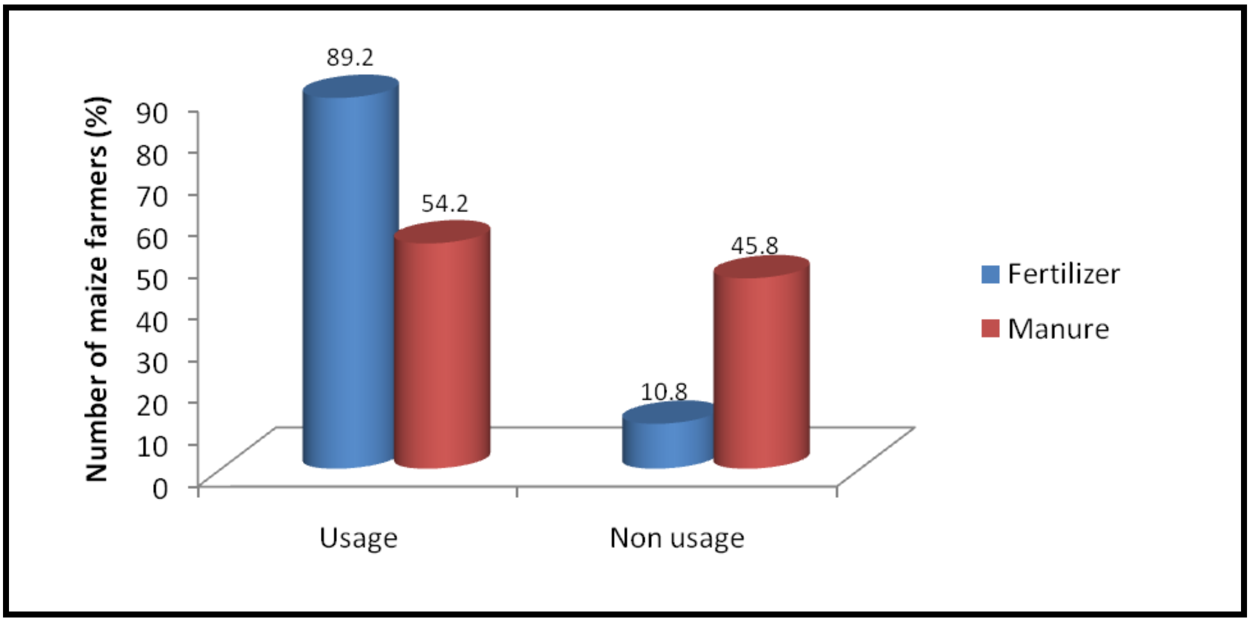

Figure 5.10: Farmers fertilizer and manure usage in maize production

5.3.5. Seed usage per hectare and their sources

Smallholder farmers are used to the tradition of saving the grain from the previous season as seed for the next planting season. But in order to improve efficiency, it is required that farmers purchase seed yearly. This practice of using the previous season's seeds affects the crop output every year in terms of quantity as well as quality.

Farmers are not obliged to use a specified amount of seed per hectare but, instead, are encouraged to seek advice from extension personnel about the type of variety they intend to plant. Excessive seed utilization may lead to a decrease in yield due to overcrowding.

Figure 5.11a shows the number of kilograms of seeds applied per hectare in the sample area and the source where these seeds were obtained. As demonstrated in Figure 5.11a, farmers from Ntshiqo on the average applied 14.4kg of seeds per hectare, while the Manka farmers applied the least quantity of seed (12.6kg).

According to the sources where maize seeds are obtained, the results in Figure 5.11b show that very few (8%) farmers used seeds from the previous harvest. The majority (82%) obtained their seeds from the local shop with only 10% farmers obtaining their seeds from cooperatives.

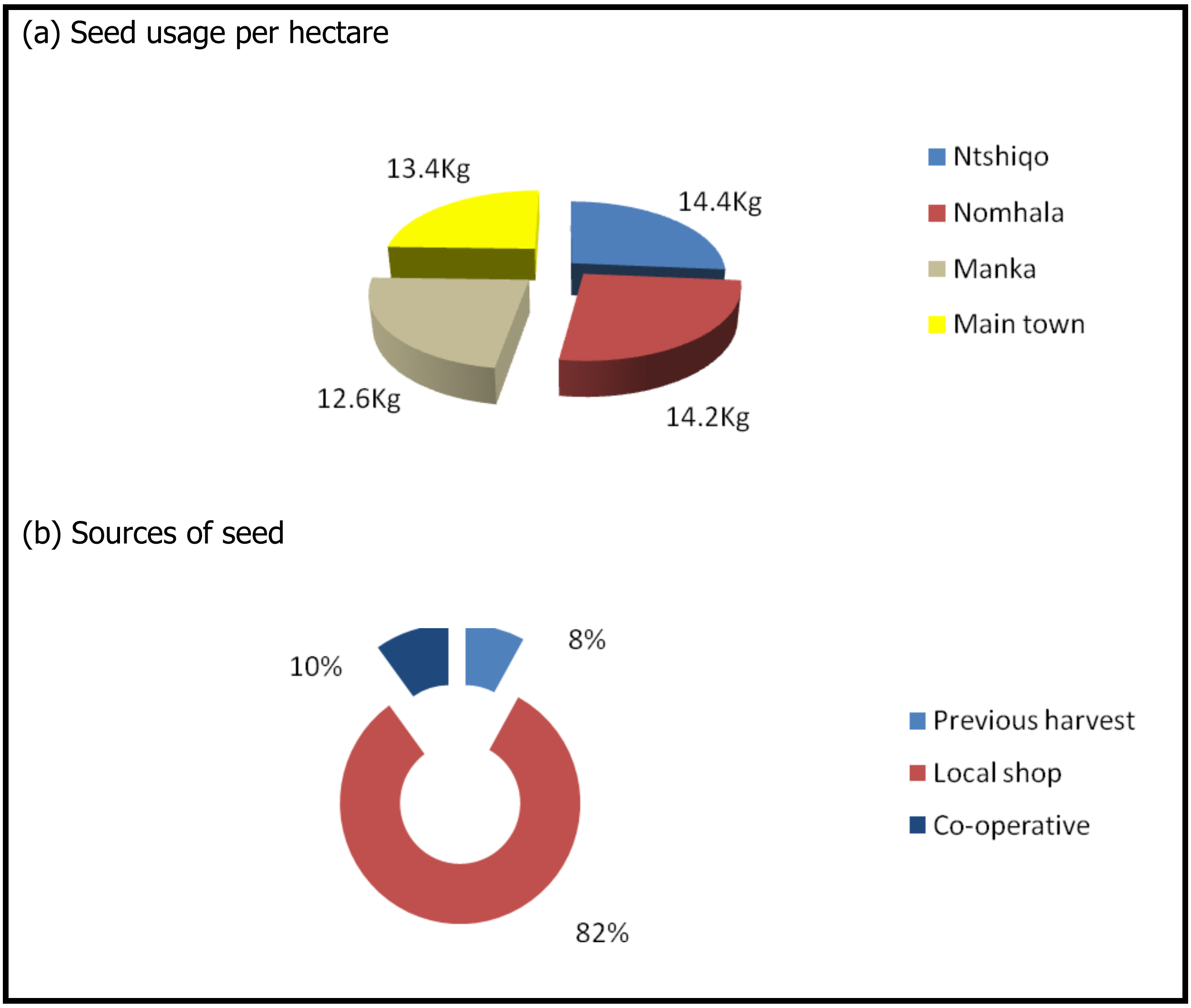

Figure 5.11: Seeds usage per hectare and their sources

5.3.6. Purchased of hybrid seeds

Hybrid maize seeds play an important role in maize production since it has been assumed that 1 ha of land produces 1 tonne of maize with the use of hybrid seeds which are fortified to increase the yield of maize. Most small-scale farmers use the seed they used previously, a practice which hampers the effort of trying to increase productivity.

The information presented in Figure 5.12 was obtained from the sample farmers and showed that the majority (91.7%) of the farmers buy hybrid seeds. About 8.3% of the farmers do not purchase hybrid seeds. This small group of farmers use their own recycled seeds.

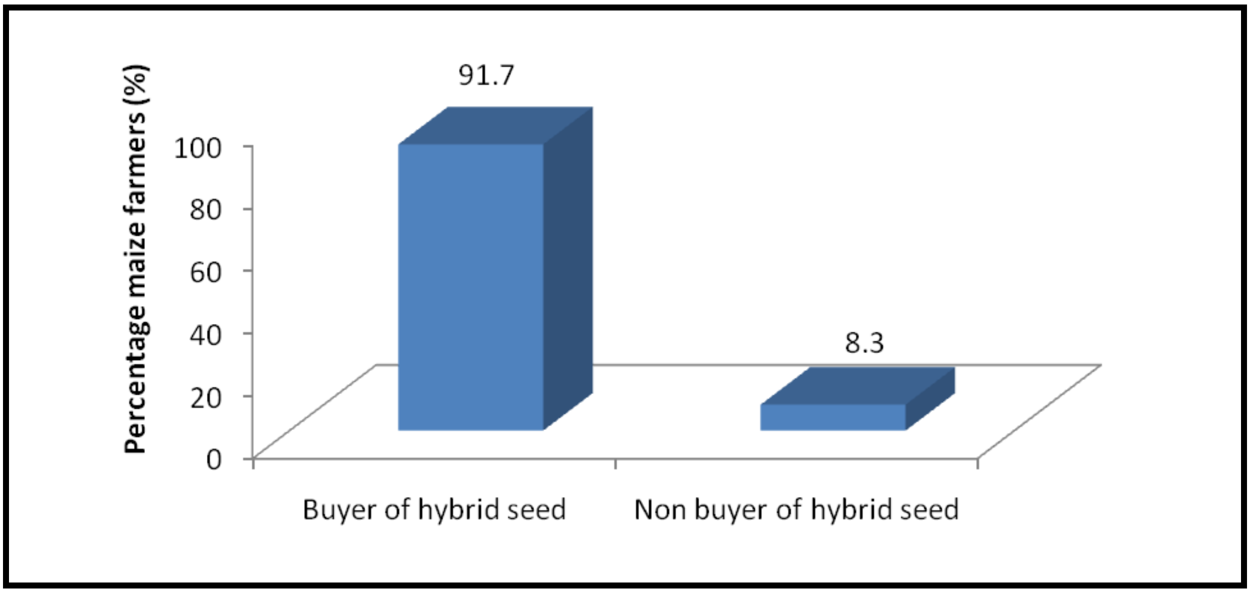

Figure 5.12: Purchased hybrid seeds for maize production

5.3.7. The use of pesticide among maize farmers and their sources

Insect pests are a significant production constraint for maize in South Africa. Smallholder farmers in South Africa use both cultural and chemical control measures to fight against pests. This section investigated into the use of pesticides and the source from which they are obtained. The results are presented in Table 5.5 and Figure 5.13.

As revealed in Table 5.5 and Figure 5.13, 79.2% of the farmers used pesticides for maize production with only 20.8% who did not use pesticides. Of those who used pesticides, 71.6% obtained them from local shops. Only 28.4% indicated to source their pesticides was a co-operative (see Table 5.5).

Table 5.5: Pesticide application in maize production among sampled farmers

Variable	Total farmers (N)	Sources of farmers' pesticide	
		Local shop (%)	Co-operative (%)
Non-pesticide users	25	0	0
Users of pesticide	95	71.6	28.4

Source: Field survey (2013).

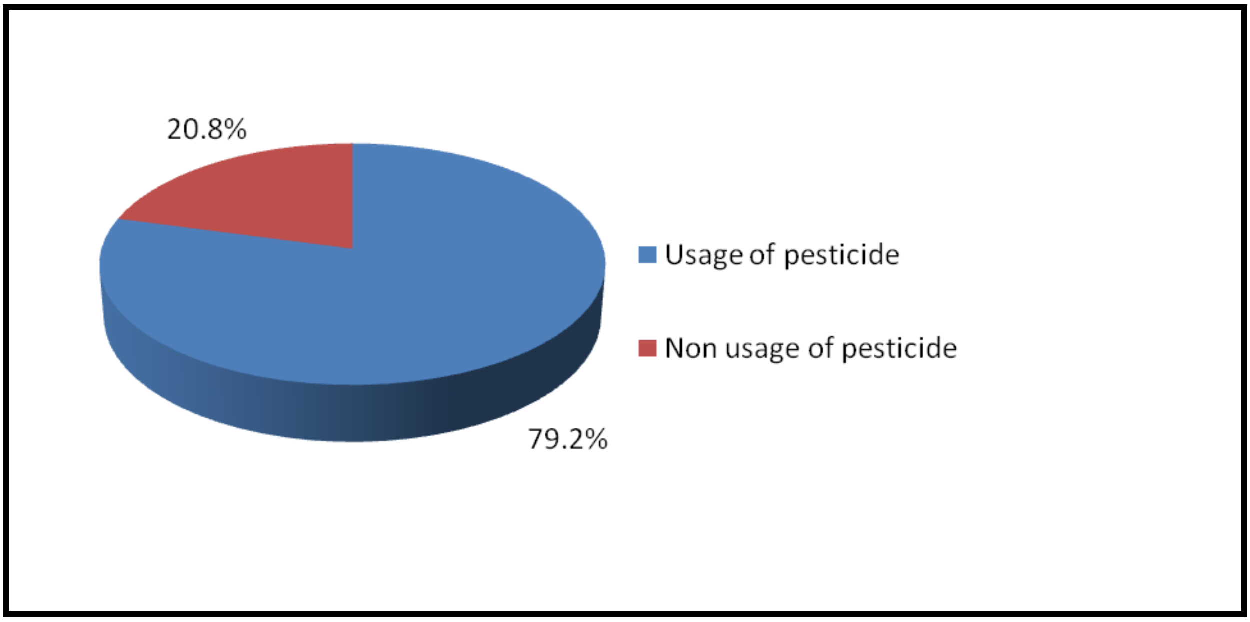

Figure 5.13: Pesticide application in maize production

5.5 Institutional characteristics of farmers

Farmers' productivity is boosted by numerous institutions such as financial institutions, farmers' organizations, input, output and labour market. These institutions assist farmers to obtain and combine the various factors of production that increase their efficiency in production. Organizational affiliation of farmers assists them in obtaining services such as credit, input and output market information and access to extension services from the department of agriculture (DoA).

5.5.1. Farmers organization and extension service

Farmers' membership of organizations assists them in accessing financial services from state and non-government organization (NGO) sectors and in seeking access to other financial development agencies. This is a very crucial factor affecting the technical efficiency of maize farmers' productivity. Cooperative organizations for farmers further aid with services such as marketing of farmers commodities as agents for various marketing boards, providing grain storage, transport services and extension services. Frequency of extension services plays a vital role in maize production.

It is expected that farmers who receive extension services better combine the factors of production to increase yield. On the other hand, extension officers prefer to help farmers as a group than as individuals; hence, the need for farmers' organizations.

The results shown in Table 5.6 and Figure 5.14 present detailed information about farmers' organizational affiliations and their access to the extension service. Table 5.14 shows a mean of 3.01 years of organizational membership and standard deviation 2.99 with minimum and maximum of 0 and 10 respectively. Farmers affiliated to organizations better access extension services than non-members. The mean frequency of extension visits per month was shown to be 2.13 (S.D=1.88) with the minimum and maximum of 0 and 5 respectively.

Table 5.6: Farmers membership to organization and their access to extension services

Variables	Description	Minimum	Maximum	Mean	Std. Deviation
Extension service	Frequency of extension visit per month	0	5	2.13	1.877
Organizational member	Years of membership (years)	0	10	3.01	2.989

Source: Field survey (2013).

Figure 5.14 basically shows that more than half of the farmers (58.3%) belong to farmers' organizations with 41.7% being non-members.

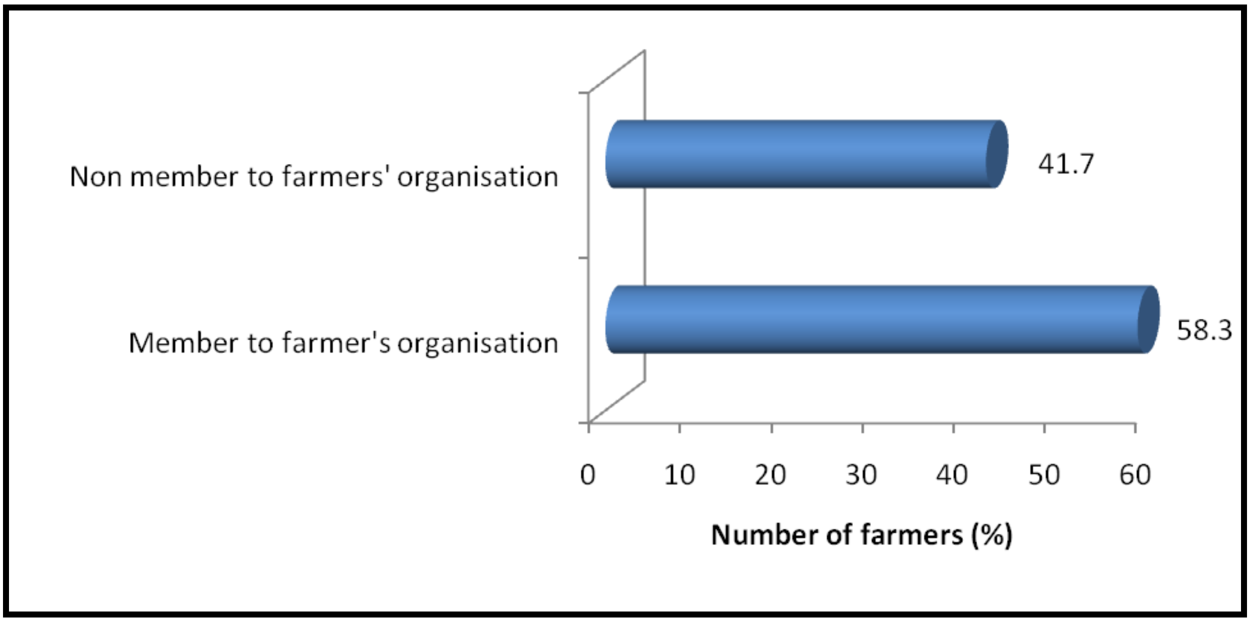

Figure 5.14: Organizational membership of sampled farmers

5.5.2. Credit accessibility of small-holder maize farmers

Farmers' access to credit assists their productivity through its use in input purchase, seed, labour hire and marketing cost. The existence of agricultural income sources allows farmers to better manage the cost of some technology such as mechanization equipment.

The information obtained in this section revealed that all maize farmers in the area had access to the market (input and output market). On the other hand, few farmers (40.8%) interviewed indicated that they had access to credit (see Figure 5.15).The remaining 59.2% of farmers did not have access to credit.

The results in this section indicate that not all the 58.3% who belong to farmers' organization had access to credit.

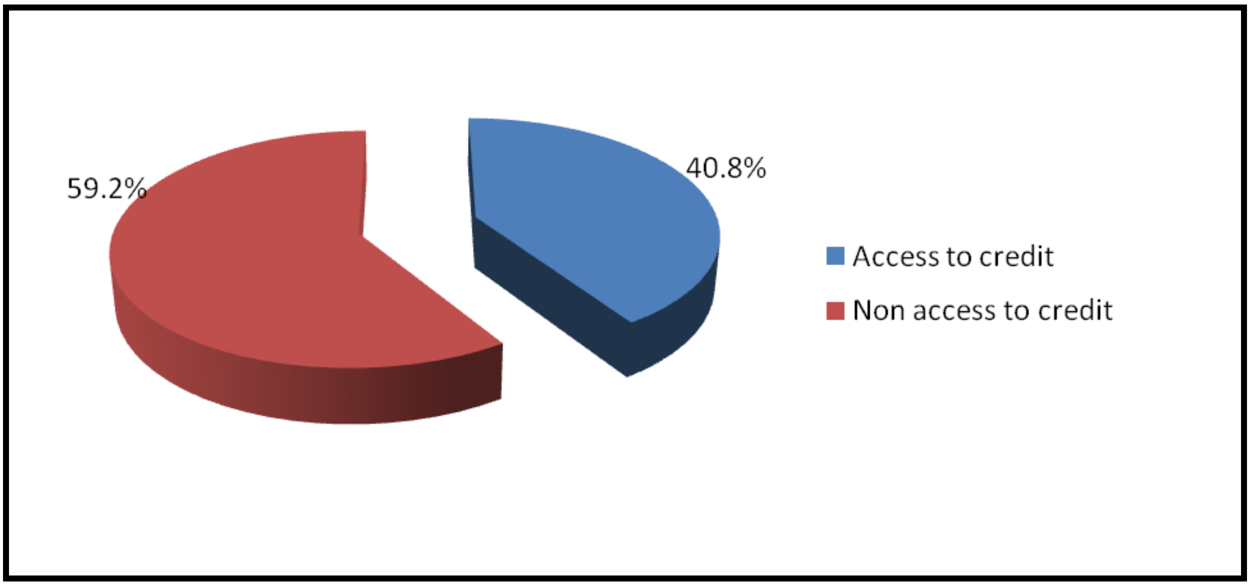

Figure 5.15: Credit accessibility among sampled farmers

5.7. Entrepreneurial spirit and positive psychological capital of small-scale maize producers

This section of the study investigates the effect of the entrepreneurial spirit of farmers in the study area. Positive psychological capital was analyzed to measure the entrepreneurial spirit of farmers.

The psychological characteristics (positive psychological capital) that were used to measure the entrepreneurial spirit capability of the farmers include hope, resilience, optimism and self-efficacy. These four psychological characteristics were evaluated to measure the entrepreneurial spirit of the farmers using several questions developed into a questionnaire (PsyCap questionnaire).

The study selected three questions each for the four psychological characteristics and used it to develop the PsyCap questionnaire which was administered to the target farmers. A 4-point Likert-type scale (1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree) was used to scale each question. The response from the survey was analyzed and is presented in Table 5.7 and Figure 5.16.

The result presented show averages of the scores from the four measures for positive psychological capital. Self-efficacy was scored the highest with a mean of 3.6 (S.D=0.51) followed by failure tolerability (resilience) and hope scoring an equal mean of 3.58 (S.D=0.50).

The least scored psychological characteristic is optimism (mean= 3.47, S.D=0.50) with the minimum and maximum score of 3 and 4 respectfully.

Table 5.7: Descriptive analysis of the response from the positive psychological capital measures of the respondents

Variables	Description	Min	Max	Mean	Std. Deviation
Self-confidence	Self-confidence level among farmers (1=strongly disagree, 2=disagree, 3=agree 4=strongly agree)	2	4	3.60	0.509
Failure tolerability	Failure tolerability among farmers (1=strongly disagree, 2=disagree, 3=agree 4=strongly agree)	3	4	3.58	0.496
Need to success	Need to success spirit among farmers (1=strongly disagree, 2=disagree, 3=agree 4=strongly agree)	3	4	3.47	0.501
Hope	Hope spirit among farmers (1=strongly disagree, 2=disagree, 3=agree 3=strongly agree)	3	4	3.58	0.496

Source: Field survey (2013). Where: Min=Minimum and Max=Maximum

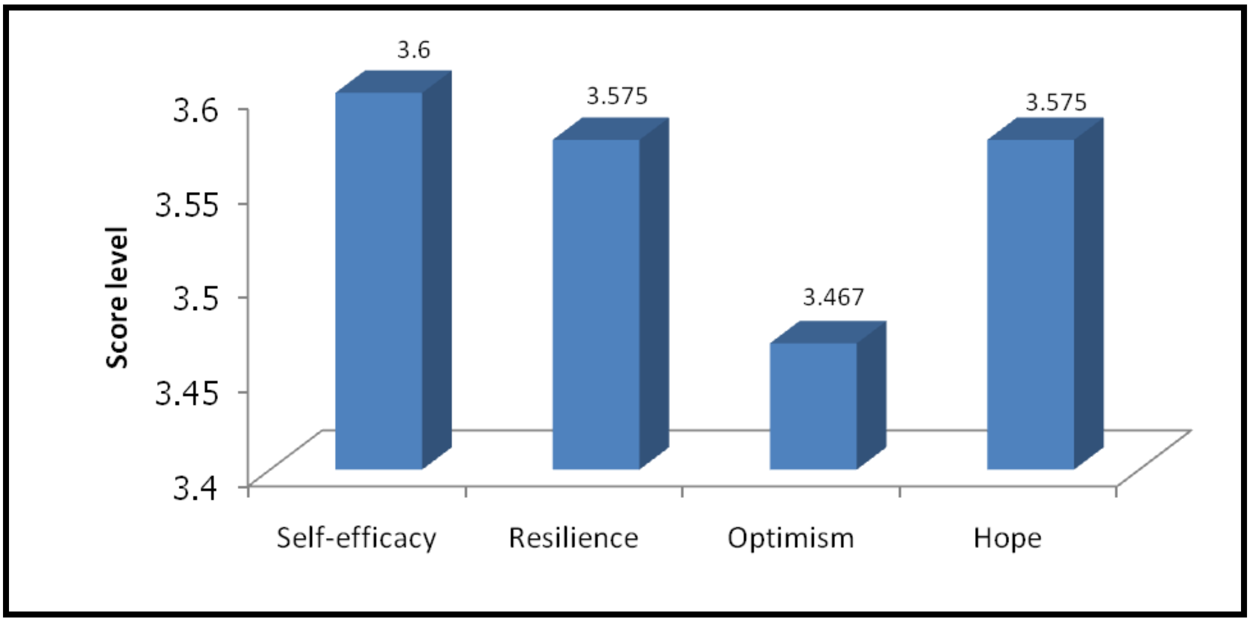

Figure 5.16: Positive psychological capital measures response of farmers

5.8: Technical efficiency of maize producers

The Cobb-Douglas stochastic production frontier approach was used to estimate the production function and the determinants of technical efficiency among smallholder maize-based farming households. Given the potential estimation bias of the two-step procedure for estimating technical efficiency scores and analyzing their determinants, the one-stage procedure is adopted following Battese and Coelli (1995). Although this approach has its own limitations, it remains one of the popular estimation procedures in production frontier studies (Salau, et al. 2012).

5.8.1. The estimates of the stochastic production frontier

The parameters and related statistical results obtained from the stochastic production frontier production function are presented in Table 5.8. The stochastic production frontier was assumed to be half-normally distributed although a variety of other distributional specifications are possible (Greene, 2002). The coefficients (β's) presented in this table represent the elasticities of the various inputs used to the maize production because of the double log transformation of the data use in the model (Kumbhaakar, 1994).

Table 5.8: The technical efficiency from Cobb-Douglas production function

Variable	Parameter	Coefficient	Std. Err.	Z	P-value
Stochastic frontier					
Intercept	β_0	8.7798	1.7598	4.99	0.000*
LnQtyseed	β_1	0.9549	0.2947	3.24	0.001*
LnQtyfert	β_2	0.0443	0.0244	1.82	0.069*
LnLabour	β_3	0.0382	0.0352	1.09	0.277
Inefficient model					
Age	δ_1	-1.659	0.4637	-3.58	0.000***
Yrssch	δ_2	-0.043	0.0517	-0.84	0.402
Hushdsize	δ_3	0.3273	0.1285	2.55	0.011***
Yrsfarm	δ_4	0.4329	0.1069	4.05	0.000***
Extcontact	δ_5	0.1544	0.0799	1.93	0.053**
Variance parameter					
Sigma-square	σ^2	0.2150	0.0544		
Gamma	γ	0.0017	0.2215		
Lambda	λ	0.0200	0.4577		
Log likelihood			-77.95		
Mean technical efficiency			99.8%		

Source: Model results (***, **,* are 1, 5 and 10% significant levels, respectively)

5.8.1.1. Seed used per hectare (Kg)

The elasticity of seeds is positive and significant at 1 percent level. The results indicated that the use of this input was profitable. It further means that, 1 percent increase in the quantity of seed for maize, holding all other inputs constant, will result in 95 percent increase in maize output. Seed is a sensitive variable in the total output of maize, which means that there is an input to output relationship.

This result confirms the findings of Essilfie, et al. (2011) that seed is positive and significant and as such a unit increase in this input will eventually result in an increase in maize output of the farmers.

5.8.1.2. Fertilizer used per hectare in maize production

The elasticity of fertilizer is positively significant at 5 percent level, even though not all small-farmers have access to fertilizer. The implication is that input contributes positively to the production of maize in Tsolo. The results show that output is sensitive to fertilizer, which implies that a one percent increase in the quantity of fertilizer used will lead to 4 percent increase in the total output of maize. It simply means that fertilizer used by small-scale farmers in the production of maize is more effective and efficient, though it has low responsiveness. This result is consistent with a recent study (Geta, et al. 2013) which established a positive and significant effect of fertilizer on maize yield and showed that farmers who apply higher rates of chemical fertilizer receive higher maize yield. Therefore, increasing the level of fertilizer use would significantly increase maize productivity. Essilfie, et al. (2011) whose result showed an insignificant effect of fertilizer on yield contradict the findings of the present study.

5.8.1.3. Labour used per work-day for maize for production

The results for the elasticity of labour show that labour is positive but low, and not significant in the production of maize. It means that input is not used efficiently. These results indicate that farmers are under utilizing this variable, and therefore need to increase its use, as it responds more to output.

This implies that an increase of 1 percent of this variable will result in a 4 percent increase in output gain. This result is similar to the study (Geta, et al. 2013) that indicated a positive and significant effect of human labour on maize production and suggested that increased labour utilization in maize production in operations such as land preparation, planting, fertilizer application and weeding would significantly increase maize production.

5.9 Technical efficiency in the study area

In the study area, the predicted technical efficiencies vary substantially among the maize farmers, with the mean estimated to be 99 percent (Table 5.8).

The results indicate that there is wider distribution of technical efficiencies among the small-scale farmers in the study area which reveals that more can be done for effecting improvements in such efficiencies of the small-scale maize farmers in the area (Essilfie, et al. 2011). The results further revealed that, on average, about 1 percent of the maize yield is lost because of inefficiency. This implies that farmers are utilizing production inputs efficiently to maximize yield.

5.10. Technical inefficiency and socio-economic characteristics

The null hypothesis specifies that each small-scale maize farmer in the study area is technically efficient in production and that variations in actual maize output are due to random variations. This is rejected among the small-scale maize farmers in favour of the presence of inefficiency effects. These are demonstrated by the estimate of alambda (λ) of 0.02 though low and a log likelihood ratio of 77.954 (Table 5.8). Lambda (λ) which is the ratio of variance of u (σ_u) over variance v (σ_u) is an indication that a one sided error term (u) dominates the symmetric error (v,) so variation in actual maize yield comes from differences in the farmers' practice rather than random variability (Kibaara and Kavoi, 2012). Gamma (γ) which is also a measure of the inefficiency in the variance parameter ranges between 0 and 1. For the Cobb-Douglas model used for the study area, gamma was estimated at 0.02 (Table 5.8). This indicates that 2% of the total variations in maize output are due to technical inefficiencies in the study area.

Given the differences in efficiency levels among farm units, it was appropriate to determine why some producers were able achieve relatively high efficiency while others were technically less efficient.

Variation in the technical efficiency of producers may arise from socio-economic or managerial decisions, situational characteristics, the entrepreneurial spirit of farmers and farm characteristics that affect the ability of the farmers to use adequately the existing technology.

The parameter estimates for the inefficiency model presented in Table 5.8 suggest a number of factors which may explain part of the variation in observed efficiency levels.

The results revealed that age (Age), household size (Hushdsize), years in farming (Yrsfarm) and extension contact (Extcontact) have the most important effect in determining level of technical efficiency for the sampled farmers and are discussed below.

5.10.1. The influence of household size on technical efficiency

Household size is positive and significant at 1 percent level, which makes it the most important variable. This means that household size is negatively related to technical efficiency and that an increase in household size will results in a decrease in farmer's technical efficiency and vice versa.

As a result, it eases the labour constraint faced by most smallholder farms. The result of the present study is consistent with the findings of Essilfie, et al. (2011) that large household size increases 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.

Earlier literature (e.g Dimelu, et al. 2009) on the other hand disagrees with the present finding, and claims that a large household size is a source of labour for most farm operations. This implies that, household size provides access to family labour which is an important catalyst for increasing yield and technical efficiency.

5.10.2. Effect of farmers farming experience on technical efficiency

The variable "farmers' farming experience" has a positive sign and significant at 1 percent level, with the implication that there is a negative relationship between this variable and technical efficiency of smallholder maize producers.

It indicates that, the more experienced a farmer is, the less his efficiency is in the use of the available resource to maximize output. The finding contradicts the result of Salau, et al. (2012) that an increase in farming experience, ceteris paribus, increases technical efficiency.

5.10.3. Relationship between extension contact and technical efficiency

This variable is significant at 5 percent level and positively related to technical inefficiency. It implies that, extension contact negatively influences technical efficiency. This, then, means that an increase in the frequent of extension contact will lead to a decrease in technical efficiency. Kuwornu, et al. (2013) also identified a negative relationship between this variable and technical efficiency and gave the reason that the extension agent probably did not offer enough reproductive advice to the farmers or the farmer were conservative and therefore did not imbibe and apply innovations of farm management practices taught them, and that increments of this sort of contact raise the farmer's inefficiency in maize production. This is probably the case in the present study where most farmers are illiterate and unable to adopt innovations in farming that enhance efficiency in production. The present results contradict the findings of Simonyan, et al. (2011) and Dimelu, et al. (2009) that knowledge and orientation on maize technologies from extension contact have a strong positive influence on technical efficiency.

5.10.4. Farmers' age and technical efficiency

The coefficient of age showed a negative sign and was significant at 1 percent level of probability. This means that older farmers were less inefficient than younger ones. It implies that age is positively related to technical efficiency.
This is because older farmers in Tsolo own most of their farming implements and do not depend much on hiring when compared to the young farmers who are yet to acquire their own implements. In addition, the older farmers appear more efficient than younger farmers due to their good managerial skills, which they have learnt over time.

However, results of earlier studies (e.g Okoye, et al. 2007; Simonyan, et al. 2011) contradict the present findings. They found that ageing farmers are less energetic at work. Consequently, younger farmers are technically more efficient than their older counterparts.

In addition, Obi and Pote (2012) suggested that younger farmers are expected to be more innovative and receptive of new technology than aged farmers.

5.11. Multivariate (OLS) regression model estimates

Previous studies (e.g Obi and chisango, 2011) and the present one attempted to investigate the effect of some factors (determinants) influencing the technical efficiency of farmers using the ordinary least square (OLS). The OLS was used to confirm the results obtained from the inefficiency estimates in the stochastic frontier model. The results of the OLS model are presented in Table 5.9. The table shows the estimated coefficients, standard error, t-value and the significant levels (p-values). According to Gujarati (1992), coefficient values measures the expected change in yield for a unit change in each independent variable, all other independent variables being equal. The sign of the coefficient shows the direction of influence of the variable on the OLS. The results showed an adjusted R^2 value of 0.69 and point to the fact that, at least, 69 percent of the variations in maize yield are explained by the variation of the independent variables predicted and estimated to affect yield and technical efficiency. The closer the Adjusted R^2 value to 1, the better the fit of the estimated regression line.

The OLS model included in its analysis determinants such as age (Age), years of schooling (Yrssch), household size (Hushdsize), farming experience of farmers (Yrsfarm), extension contact (Extcontact), farm size (Farmsize), years of farmer’s oerganizational membership (Yrsorgmemb), and household income (Hushdincm).

Variables such as farm size (Farmsize), years of farmer's organizational membership (Yrsorgmemb), and household income (Hushdincm) were excluded from the stochastic frontier model and as a result, from the main focus in the OLS analyses.
The results of the OLS model (Table 5.9) display the estimates for the OLS regression to explain the socio-economic factors and institutional characteristics influencing the technical efficiency of maize producers.

The results indicate that, of the 8 variables included in the model, only 3 showed significance (i.e farming experience, extension contact and farm size).

This results of OLS contradict the result from the stochastic frontier model which showed significance in age, household size, farming experience and extension contact but both results indicated insignificance in the variable 'years of schooling'. This section pays particular attention to variables such as farm size, years of farmer's organizational membership and household income since they were excluded from the inefficiency model in the stochastic frontier. Since is only farm size that is significant, the section goes on to discuss this variable further.

Farm size (in Table 5.9) showed positive and the most important variable influencing technical efficiency with a coefficient value of 0.999 (P=0.000). The positive sign indicates that an increase in farm size is expected to increase technical efficiency. This result contradicts earlier findings that, the smaller the farm size, the easier it is for smallholder farmers to manage the farm well (Salau et al., 2012).

This present result is consistent with the result of the findings of Peterson (1977) in the Corn Belt States in the USA, which indicated a positive influence of farm size on technical efficiency. The present results indicate that farmers with larger farms make better use of economies of scale and have the opportunity to be efficient in production. This is again similar to the empirical finding that revealed a positive relationship between farm size and technical efficiency.

Table 5.9: Multivariate regression (OLS) results

Variable	Coefficient	Std. Err.	t	P-value
Age	-0.4916	0.3445	-1.43	0.156
Yrssch	0.0676	0.0478	1.42	0.160
Hushdsize	0.0976	0.0931	1.05	0.297
Yrsfarm	0.2218	0.0808	2.75	0.007**
Extcontact	0.2610	0.1226	2.13	0.035*
Farmsize	0.9989	0.0884	11.30	0.000*
Yrsorgmemb	-0.1311	0.0905	-1.45	0.150
Hushdincm	-0.0681	0.0437	-1.56	0.122
Constant	7.5976	1.3250	5.73	0.000*
R-squared		0.721		
Adj R-squared		0.690		
F(12,107)		23.08		
P-value		0.000*		

Source: Model result (*, ** are 1 and 5% significant levels respectively).

5.12. Input elasticity and return to scale

Determination of elasticity is necessary for the estimation of responsiveness of yield to inputs. The inputs on the stochastic frontier are statistically significant and have the expected signs. The results in Table 5.10 show the results of the input elasticities for each input in the Cobb-Douglas frontier production function. It indicates that a 1 percent increase in the quantity of fertilizer applied will increase maize output by 0.44% (P = 0.069), ceteris paribus.

Again, a 1 percent increase in seed and labour, increased output by 0.955% (P = 0.001) and 0.038 (P=0.277) respectively. According to the results, yield has the highest responsiveness to seed, followed by fertilizer.

The results are consistent with the result of Essilfie, et al. (2011) and Kibaara (2005) that there is a high tendency by some maize farmers to increase their yield due to the use of more quality varietal seed in production. The prior assumption was that yield is more responsive to seed than to labor. The results confirm this assumption and agree with the results of Kibaara (2005) that there is a high tendency by some maize farmers to increase their maize yield as a result of their use of more quality varietal seeds in production. As shown in the above results, all the input elasticities are inelastic. This indicates that a one percent increase in each input results in less than a one percent increase in yield (Kibaara, 2005).The summation of the partial elasticity of production with respect to every input for a homogeneous function (all resources varied in the same proportion) is 1.37. This represents the return to scale (RTS) coefficient, also called the function coefficient or total output elasticity. If all factors are varied by the same proportion in the long-run, the function coefficient indicates the percentage by which output will be increased (Kibaara, 2005). In this case, the production function can be used to estimate the magnitude of returns to scale. Constant returns-to scale hold if the sum of all partial elasticities is equal to one. If this sum is less than one, the function has decreasing returns to scale: if more than one, as shown in this result, an increasing returns-to-scale exists.

In the regression results shown in Table 5.10, the sum of β's is more than one (1), simply indicating an increasing return to scale. This may imply that the resources used for small-scale maize production at household level are priced above marginal cost. It means that they are efficiently utilized, which results in their technical efficiency in the production of maize.

It means that the cost per unit of input used in the production process of an output of maize is less than the returns from that output of maize. This indicates some efficiency, as farmers spend less on inputs than they should in view of the output, given that their livelihoods depend on farming. As a result, they invest resources with the assumption that they can maximize output and, thereby, returns.

Table 5.10: Input elasticity and return to scale

Variable input	Elasticity
Seed	0.95
Fertilize	0.04
Labour	0.38
Return to scale (RTS)	1.37

Source: Model results.

5.13. The effect of Psychological capital (as a measure of entrepreneurial spirit) on farmer's performance in maize producer

The study used the amount of maize produced (in kilograms) as a measure of farmer's performance. Linear regression results estimated variables of psychological capital on farmer's performance in productivity. The low R-square and Adjusted R-square values (0.061 and 0.028 respectively) indicated that only 6 percent of the variations in maize yield are explained by the variations of the independent variables estimated in the model. This indicates that factors other than the four variables are also responsible for the variations in maize yield.

The results in Table 5.11 show that, of the four variables measuring farmers' entrepreneurial spirit, only two (Self-efficacy and Optimism) were indicated to be significant at 5 and 10 percent respectively. Self-efficacy showed a negative sign, which implies that, as the confident level of farmers increased, their performance in productivity dropped by 19.4 percent. On the other hand, optimism was positively related to performance.

This means that, as the optimism level rose among farmers, their level of performance also increased in this model by 17 percent. According to the table, hope and resilience were estimated to be the least effective psychological characteristics in entrepreneurial spirit of the farmers. This finding is consistent with the result of similar work by Khosravipour and Soleimanpour (2012), which ranked optimism and self-efficacy as the most effective psychological capital in entrepreneurial spirit. This implies that the effects of these characteristics in the farmers' entrepreneurial spirit were more important than others.

Table 5.11: The results of linear regression of farmer's entrepreneurial spirit on their performance in maize production

Variable	Std. Error	Coefficient	t	Sig
Constant	650.288	-	0.843	0.401
Self-efficacy	-275.104	-0.194	-2.020	0.046*
Resilience	244.848	0.168	1.737	0.085**
Optimism	176.776	0.123	1.270	0.207
Hope	-36.873	-0.025	-0.267	0.790
R-squared	0.061			
Adj. R-squared	0.028			

Source: Field survey (2013) (*, ** are 5 and 10% significant levels respectively).

CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

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

6.2. Summary

The main aim of the study was to analyze the technical efficiency of small-scale maize producers in Tsolo. The first objective was to determine the technical efficiency of small-scale maize producers and the second one was to identify the socio-economic characteristics that influence the technical efficiency of maize production in Tsolo in the Eastern Cape Province. The third objective was to identify the institutional characteristics that influence technical efficiency and lastly to determine the influence of farmers entrepreneurial spirit on their performance in maize production. Production of maize by small-scale farmers in Tsolo plays a vital role in alleviating poverty and generating income. Since maize is the staple food in the province, South Africa and in other Africa countries as a whole, high productivity and technical efficiency in its production are critical to food security in the country. The Tsolo area was used as the study area.

The study used a set of analytical techniques to analyze the data: the descriptive statistics, stochastic frontier model in a Cobb-Douglas production function and OLS regression model in which significant and the non-significant variables were identified.

The descriptive statistics revealed that some small-scale maize producers in Tsolo used different quantities of seeds and fertilizers, while others did not use fertilizer at all. Also, some of the farmers did not have access to some of these variables (inputs) while others did. They all hired tractors for the production of maize and many of them depended mainly on family labour.

The majority of the farmers interviewed fell under the old age pension group, since there were few young farmers. Descriptive statistics were used to summarize the data of the study through frequency and mean description. The Cobb-Douglas production function results indicate that some of the variables were found to be positively significant, while others were negative but significant, and some were positive but non-significant. Even though some variables were not significant, it still shows that the variables used in the analysis have a positive effect on the output (the total quantity of maize produced) which simply means that there is a good inputs-output relationship, and the small-scale maize producers in Tsolo are experiencing increasing returns to scale.

OLS regression model was employed to identify the socio-economic and institutional characteristics that influence the technical efficiency of small-scale maize producers in Tsolo. The findings from the OLS and stochastic frontier model indicate that there are socio-economic factors, institutional characteristics and the entrepreneurial spirit and psychological capital influencing the technical efficiency of small-scale maize producers. These are: years of schooling, household size, farmer's farming experience, farm size, years of membership to farmers' organization, income of the household on a monthly basis, age and extension contact. Most of these factors were found to be significant. However, some of the variables showed a negative relationship to small-scale maize producers' technical efficiency.

6.3. Conclusion

Hypothesis 1: Small-scale maize producers in Tsolo are not technically efficient. The findings of this study are not consistent with this hypothesis. Therefore, the hypothesis is rejected since the empirical analyses have indicated that there is increasing returns to scale which means that farmers used efficiently and cost effectively some of the factors of production/resources in the production of maize.

Hypothesis 2: There are no socio-economic, institutional characteristics and entrepreneurial spirit and psychological capital that influence technical efficiency of small-scale maize producers in Tsolo Magisterial District.

The hypothesis is rejected as the empirical results show a positive influence of socio-economic factors, institutional characteristics and entrepreneurial spirit and psychological capital on technical efficiency. Variables that were found to be highly significant are: household size, farm size, age, income of the household on monthly basis and extension contact. In general, the study concludes that the farmers were technically efficient, since they were efficient in resource utilization at farm level, and that farmers' technical efficiency can be determined through the influence of certain socio-economic factors, institutional characteristics and entrepreneurial spirit and psychological capital.

6.4. Recommendations

The recommendations discussed below are made on the basis of the findings of this study.

To avoid technical inefficiency amongst small-scale maize producers, the study recommends the adoption of modern agricultural technology such as improved maize varieties/purchased seed.

Hybrid maize and fertilizer usage should be governed by a complex set of factors such as human capital improvement and institutional support.

This will ensure that people in rural areas, specifically small-scale farmers who practice subsistence farming, and are mainly found in the Eastern Cape Province, improve their standard of living. The study also recommends that the government not only include the Land redistribution and restitution for agricultural development project in the capacity building programme, but it should also include those farmers who practice subsistence farming by training them and giving them skills on how to allocate efficiently resources such as fertilizers and seeds during the production periods. Farmers also need to have access to enough arable land and tractor services.

It also recommended that extension officers in the Eastern Cape Department of Agriculture intensify their efforts to assist small-scale farmers to overcome the challenges of the economies scale and technical efficiency. Also they should help farmers with the creation of farmers' organizations, since the findings show that not all farmers have membership in farmers' organizations. Small-scale farmers need help in a number of areas such as education and credit facilities. Subsistence farming in South Africa and indeed in many developing countries provides employment as well as food. In other words, this type of farming contributes significantly to the economic health of a country. It is therefore important that the government fully participate in assisting such community efforts.

6.5. Suggestions for further studies

This present study estimated the technical efficiency of smallholder maize producers in the Tsolo magisterial district and the determinants that affect their efficiency. However, further studies could be conducted to estimate the other efficiency measures such as allocative and economic efficiency of the farmers in the same study area.

The result of this study showed that there are more female than male household heads among families that produce maize. Future study could therefore try to identify the areas of gender involvement and role of each member of the farm family in order to plan holistic agricultural programme that will address the problem of gender differentials in agricultural production for food sufficiency. In short, future research should therefore determine the level of technical efficiency of maize farmers in the study area as it relates with their gender.

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ANNEXURE 1

QUESTIONNAIRE

UNIVERSITY OF FORT HARE
FACULTY OF SCIENCE AND AGRICULTURE
DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

Title of Research study: Analysis of Technical Efficiency of Small-scale Maize Producers: A Case Study in Tsolo Magisterial District in O.R. Tambo District in the Eastern Cape of South Africa.

The main aim of the study is to analyze the technical efficiency of small-scale maize producers in Tsolo Magisterial District, and to identify the socio-economic and institutional characteristics that influence the technical efficiency of maize production in the area.

Please be aware that the survey is completely non-discriminatory and the information that you are about to give merely helps in the interpretation of the results.

Researcher: Richard Avuletey

BACKGROUND INFORMATION

NAME OF HOUSEHOLD HEAD:..
QUESTIONNAIRE NO:...
NAME OF VILLAGE:...
DATE OF INTERVIEW:..

PART ONE: SOCIO-ECONOMIC QUESTIONS

1. Gender of the household head:

1: MALE		2: FEMALE	

2. Age of the household head:……………………………………………………………………….

3. Marital status of the household head:

1:Married		2:Divorced		3:Single		4:Widowed	

4. Highest educational qualification (of household head):

1:No formal education		2:Primary		3:Secondary		4:Tertiary		5:Abet	

4.1. How many years of education did you complete?...

5. Number of people in the household…………………...

6. How long, in terms of years, have you been involved in farming (years)………………

7. Main sources of income of household head?

Salary	Farming	Pension	Child grant	Remittance
1	2	3	4	5

PART TWO: PRODUCTION INFORMATION

1. Do you own the land which you use for ploughing/cultivation?

1: YES		2: NO	

1.1. If (yes), where did you get the land from?

Traditional Authority	Lease	Bought	Inherited	Other
1	2	3	4	5

2. When did you start ploughing maize?..

3. What was the motive for start ploughing maize?

1:Income generation		2:Employment		3: Pastime		4:Home consumption		5:Other	

4. How many bags of maize do you normally get in a year?.....................................

5. How many kilograms of maize do you normally get in a year?……………………………

6. How many hectares of land do you have?...

7. How many hectares do you use to produce maize?..

8. Do you normally hire labour for the production of maize?

1: YES		2: NO	

8.1. If (yes), how many labourers do you normally hire?

Type of employee	Full-time		Part-time		Unpaid family members		TOTAL

8.2. How much do you pay them per day?..

8.3. How work-days of labour for maize production?...

9. Do you normally hire a tractor for ploughing maize?

1: YES		2: NO	

9.1. If (yes), how much does it cost per hour or per ha?...

10. Do you apply fertilizer for the maize production?

1: YES		2: NO	

10.1. If (yes), how many kilograms do you apply per hectare?..................................

10.2. How much do you spend on fertilizer?...

11. How many kilograms of seeds do you normally use per hectare of maize?

SEEDS USED	Certified		home produced		Recycled		TOTAL

11.1. How much does it cost?...

12. Production cost

Farm Inputs	**Unit**	**Quantity**	**Price (R/Unit)**	**Amount (R/Ha)**
Input Cost				
Operational cost:				
Seed: Maize	Kg			
Fertiliser	Kg			
Manure	Kg			
Pest and disease control	Litre			
Tractor hire	Hour			
Labour	work-day			
Marketing Cost				

Packaging cost	Bag			
Transportation cost	Rand			
TOTAL PRODUCTION COST				

13. Do you want to increase your production?

1: YES		2: NO	

13.1. If (yes), explain the reason you want to increase your output:
……
……

14. What is the income of the household head per month?......................................

15. Has producing maize become profitable to you?

1: YES		2: NO	

15.1. If (yes), explain in details?
……..
……..

16. Do you use manure?

1: YES		2: NO	

17. Do you normally use any type of pesticides for maize?

1: YES		2: NO	

17.1. If (yes), how much is the cost of pesticides per hectare?……………………………

17.2. How do you obtain your pesticide?

SOURCE OF PESTICIDES					
1: Local shop		2: Co-operatives		3: Other	

18. Do you purchase hybrid maize seed?

1: YES		2: NO	

18.1. If (yes), how much does it cost per kg?.......................…………………………………

18.2. How do you obtain your seeds?

SOURCE OF SEED							
1: Previous harvest		2: Local shop		3: Co-operatives		4: Other	

18.3. Which seed variety do you grow and where do you obtain it?

1: Bt maize/Yieldgard		2: Hybrids		3: Landraces		4: Open pollinated variety	

19. Do you receive assistance from extension officers?

1: YES		2: NO	

19.1. If (yes), how many times are you visited in a month?......................................

20. Do you use tractor for ploughing maize?

1: YES		2: NO	

20.1. If (yes), how much does it cost per hour to use a tractor to plough maize?.......

21. How much farm size is allocated for maize production (in hectares)?…………………

PART THREE: INSTITUTIONAL INFORMATION

1. Do you belong to any farmers` organization?

1: YES		2: NO	

1.1. If (yes), which organization do you belong to?

1: Government	
2: International non-governmental organisations (NGOs),	
3: Private sector	
4: National/provincial NGOs,	
5: Other	

1.2. How long have you been a member of the organisation?...

1.3. Which of the following services do you receive from the organisation as a farmer?

1: Agricultural inputs	
2: Extension services	
3: Credit	
4: Marketing	
5: Mechanization	

2. Do you have access to credit facility?

1: YES		2: NO	

2.1. If (yes), how much do you usually get per annum?...

2.2. Where do you get the credit from?

Financial Institution	Relative or friend	Money lender	Output buyer	Supplier	Other
1	2	3	4	5	6

2.3. What do you use the money for?

1:Farming		2: General maintenance/ household purchase		3:Food	

2.4. How is the interest rate?

1:Expensive		2:Affordable		3:No interest rate	

3.1 Utilization of harvested maize (kg)

Marketed	Home consumed	Gifts	Livestock use	other	Total

3.2 Do you have access to markets?

1: YES		2: NO	

3.3. Are you left with surplus output after consumption?

1: YES		2: NO	

3.3.1 If (yes), do you sell the surplus output for income?

1: YES		2: NO	

3.3.2. If (yes), what are your main market outlets?

1:Hawkers		2:Contractors		3:Shops		4:Consumers	

3.4. Who are your main inputs suppliers?

1: Local shops		2: Stores in town		3:Cooperatives		4: Friends/ family relatives	

3.5. How much does it cost to reach the inputs market?..

PART FOUR: Entrepreneurial spirit and positive psychological capital of small-scale maize producers.

Description	**Please rate/Rank as indicated below with a tick [√]**			
	Strongly Disagree 1	*Disagree 2*	*Agree 3*	*Strongly Agree 4*
Self-confidence (self-efficacy)				
I feel confident analyzing a long-term problem to find a solution				
I feel confident helping to set targets/goals in my farm				
I feel confident contacting people outside my				

farm (e.g. colleague farmers) to discuss problems				
Failure tolerability (Resilience)				
I usually manage difficulties one way or another at work				
I usually take stressful things at work in stride				
I can get through difficult times at work because I have experienced difficulty before				
Need to success (optimism)				
When things are uncertain for me at work, I usually expect the best				
I always look on the bright side of things regarding my job				
I am optimistic about what will happen to me in the future as it pertains to work				
Hope (will to succeed)				
At the present time, I am energetically pursuing my work goals				
There are lots of ways around any problem				
I can think of many ways to reach my current work goals				

THANK YOU VERY MUCH FOR PARTICIPATING IN THIS SURVEY