

**The Sustainability of soil fertilization on small scale farmers in the Estcourt
Area of Kwazulu-Natal Province, South Africa**

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I, **Mzwandile Pius Radebe**, Id no. **7209295843080**, declare that this mini-dissertation submitted for the degree Masters in Sustainable Agriculture is my own, original and independent work that has not been submitted before to any institution by me or anyone else as part of any qualification.

Signature

Date

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ABSTRACT

This is a research project on the sustainability of soil fertilization on the small scale farmers in the Escourt area of KwaZulu-Natal Province. The researcher wanted to find out whether small scale farmers apply recommended fertilizer quantities to their crops or not.

The researcher found it necessary to do literature review to see what others say about this topic. The researcher also interviewed about 30 farmers from Estcourt area to further investigate this topic. The analysis found that farmers to apply fertilizers but not according to according to recommendations from the lab. Other factors that contributed to this are: age of farmers, level of education, income from produce and access to finance.

KEY WORDS: fertilizer, small scale farmers, fertilization, extension officer, soil sampling,

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Chapter 1

1.1. Introduction

The researcher has noted that the small scale farmers in the Estcourt Area in KwaZulu Natal are not applying enough fertilizer to their crops and this leads to low yields. The increasing demand for food has significant impact on fertilizer consumption for small scale farmers. Nutrient mining is a major cause of low crop yields and unsustainable agriculture among the small scale farmers (Setiyono, Walters, et al, 2010).

Soil fertilization is the application of inorganic and/or organic fertilizers, and soil ameliorants with the intended goal of producing profitable crops. The term “fertilizer” refers to a material that guarantees’ a minimum percentage of nutrients of Nitrogen, Phosphorus, Potassium and other trace elements. Fertilizers are expensive and this cause small scale farmers not applying fertilizers accordingly. Manufactured fertilizers are popular with farmers because they are readily available, easy to apply, and generally provide a quick release of nutrients for plant growth. Application rates for any fertilizer depend on the content and the amount of nutrient to be applied. In products containing multiple nutrients, the application rate is always based on the nitrogen content.

The main purposes of fertilizer use are the following (IFA, 1991):

- To supplement the natural soil nutrient supply in order to satisfy the demand of crops with a high yield potential
- To compensate for the nutrients lost by the removal of plant products or by leaching, etc
- To improve unfavourable or to maintain good soil conditions for cropping

Nitrogen is the nutrient required in largest quantities by plants and the one mainly applied as fertilizer. Application rates are important, because too much or too little directly affects crop growth and yield. Phosphorus and potassium are also needed in considerable amounts. For this reason these three elements are always identified on a commercial fertilizer analysis.

According to Tolessa et al, 2009, Nitrogen is the most limiting nutrient for maize production under conventional and minimum tillage systems in western Ethiopia. Thus application of N is essential to sustain production in the region. However, very little is known about the efficiency of the fertilizer N applied.

South Africa's small scale farming sector appears to add minimally to generally agricultural production in South Africa. Research have discovered the contribution made by subsistence production to household food security despite low input nature of this production (Aliber and Hart, 2009)

The decrease in maize fertilizer study is of concern when seen alongside the background of the regional and continental importance of maize. Well designed nutrition study can guarantee food security and nutrition security both locally and in other parts of the continent, provided there are clear goals and direction, adequate funding, proper management and coordination (Van Biljon, 2010)

Abdu-Raheem et al, 2011, stated that food insecurity is still a great concern for many households in South Africa. This situation is connected to the high level of poverty that exists in the country, particularly in rural areas. This statement shows that food production must be increased so that population needs can be met. It can only be done by improving soil fertility as land for cultivation cannot be increased.

According to Kirsten et al, 1998, in South Africa "small-scale" is frequently associated with backward, non-productive, non-commercial, subsistence agriculture that we find in parts of the former homeland areas. It is generally associated with black farmers, as if black farmers do not have the ability to become large-scale commercial farmers. Size is not a good criterion for defining small farms. For example, one hectare of irrigated peri-urban land, suitable for vegetable farming or herb gardening, has a higher profit potential than 500 hectares of low quality land in the Karoo. Turnover, or rather the level of net farm income, determines the farm size category, not the land size.

1.2. Research Question

- ❖ Do the farmers use enough fertilizer for their crops in the Estcourt area?
- ❖ Does the use of fertilizer increase yields?
- ❖ Are the farmers taking soil samples?
- ❖ Which types of fertilizers are being used?

1.3. Research Objectives

It is assumed that using right quantities of fertilizers based on soil analysis results, the yields of the farmers can be increased. It has been observed that farmers are not using enough fertilizers for their lands. It has also been noticed that farmers do take samples but are not using correct fertilizers. The investigation seeks to establish why farmers are not using enough fertilizers.

The objectives of this study are to achieve the following:

- To determine the reasons why farmers use less fertilizer than required
- Assess the input cost of fertilizers on production in relation to selling price and quality of crops.
- To determine whether are the farmers using fertilizers or not.
- To determine which types of fertilizers are being used by farmers.
- To determine the impact of fertilizers supplied by Department of Agriculture

Chapter 2

2. Literature Review

2.1. Definitions:

- ❖ **Sustainable Agriculture** is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare. This form of agriculture helps to produce healthful food without compromising future generations' ability to do the same (Grace Communication Foundation, 2013).

- ❖ **Subsistence farming (Small Scale Farming)** is a system of farming in a small piece of land that provides all or nearly all the goods needed by the family typically without any major surplus for sale. The term may also refer to a system of farming producing minimum and adequate return to the farmer (Giurca, 2008).

- ❖ **Soil fertilization** is the application of any organic or inorganic material of natural or synthetic origins to a soil to supply one or more elements essential to the growth of plants (IFA, 2013).

- ❖ **Conservation agriculture [CA]** can be defined as a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment (FAO, 2007).

- ❖ **Food Security** is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2010).

2.2. Small Scale Farmers in Africa

Thamaga-Chitja and Hendriks, 2008, stated that organic farming is increasingly seen as a possible production system for sustainable agriculture and is considered a suitable production method for smallholder farmers. It is extensively promoted as a chance for small scale farmers in Africa at subsistence and commercial levels. Certified organic goods fetch premium market prices, and their production and marketing could ease food insecurity for small scale farmers (Thamaga-Chitja and Hendriks, 2008).



Figure 1

A farmer field school in the Democratic Republic of Congo encourages farmers to learn about sustainable farming practices from visiting teachers as well as from each other's on-the-ground experiences.

© 2011 [Nature Education](#)

Conservation Agriculture (CA) is anticipated as a cure to agricultural problems in smallholder farming systems in the tropics (Giller et al, 2009). It particularly aims to address the problems of soil degradation resulting from agricultural practices that reduce the organic matter and nutrient content of the soil. Minimal tillage was born out of a necessity to fight soil degradation and has been extensively adopted by farmers of different scale in the world. With the continuing poor productivity of small scale agriculture in the Sub-Sahara Africa and high incidents of soil degradation due to nutrient reduction and soil erosion, Conservation Agriculture appears to suggest great potential to tackle these problems.

In a study by Adjei-Nsiah (2012), it was found that Agricultural productivity in the smallholder farming systems in Ghana is under danger due to deteriorating soil fertility. In the past, smallholder farmers in Ghana relied on the total bush fallow system for maintaining the productivity of their farmlands. Most farmers, especially the smallholder farmers, do not have access to formal credit and therefore cannot afford to buy commercial fertilizers even when it has been verified to be profitable. Furthermore, due to the volatility of rainfall in some areas, farmers consider fertilizer application as risky (Adjei-Nsiah, 2012).

According to Zingore et al (2008), Soybean varieties are likely to contribute extensively to income generation, food security and soil N budgets on smallholder farms. One of the main factors preventing this potential is farmers' preference to assign nutrient resources to food security cereal crops on the most fertile fields, leaving grain legumes to grow on residual fertility on infertile fields. It was found that application of manure to soybean on the clay was more profitable than application to maize for individual crops. They further state that for smallholder farmers to maximize benefits from legume production they need to focus attention on the more fertile plots, although production should be optimized in relation to maize. Targeting nutrients to maize as currently practiced by farmers was more efficient and economic under poor soil fertility conditions, whilst potential exists to increase income by targeting manure to soybean on the more fertile soils

2.3. Small Scale Farmers in Asia and Brazil

Li et al, 2010, stated that maize is one of the most important food and forage crops worldwide and plays an important role in economic development. About 70% of maize grain is used as animal feed in China. Maize stalk is also used as silage. The maize stalk occupies over 50% of the biologic yield of the plant and is the most essential source of roughage for ruminants. Nitrogen (N) fertilization remains an important agronomic practice for maize production to obtain high yield under low nitrogen conditions or when converting N fertilizer efficiency into yield under high nitrogen conditions.

Nitrogen (N) fertilization of sugarcane crops is a common practice used to reach sustainable levels of productivity, both for plant cane and especially for the ratoon (Franco et al., 2011). Brazil is the largest producer of sugarcane in the world. In 2009, the cultivated area of sugarcane was 8.6 million hectares with production of 690 million tons of sugarcane (instituto Brasileiro de Geografia e Estatistica, 2010). In Brazil, fertilizer consumption by sugarcane was 2.9 million tons in 2008, behind those of soybeans and corn, representing respectively 13%, 33% and 20% of Brazilian fertilizer consumption (Associacao Nacional para Difusao de Adubos, 2008).

The increasing cost of nitrogen (N) fertilizer and environmental degradation caused by excess N are reasons for farmers to increase nitrogen-use efficiency (NUE), defined as the additional crop yield per unit applied N. Information about the N status of soil and crop is important for farmers and advisers in making decisions about N fertilizer application. When N fertilizer is applied at or before the time of sowing, the only source of information is from soil test (Li et al, 2010).

Sarker et al, 2012, mentioned that Conservation farming (CF) is an important profitable and competitive agriculture. It is essential for smallholder farming in South Asia. Small farmers use two wheeled tractor small seeders due to the fact that they are more cost effective. Two-wheeled tractor operated small no-till seeders have increased in the last decade. Two wheeled power tiller operated seeders, zero till-seeders, strip till-seeders and bed planter had been tested in the farmer's field and

crop yields were found more than farmer's conventional practice. The field performances of these small seeders were found satisfactory as compared to farmer's conventional practice. Considerable amount of planting cost could be saved by introducing CF. Crop residue controls weed growth and N uptake was found considerably higher under mulching as compared to conventional tillage practices. Increased sustainability of conservation farming systems can be established through implementation of development strategies for profitable production with concern of ecological and socioeconomic conditions in Bangladesh.



Figure 2

A clover and grass cover crop adds biodiversity to an almond orchard, which aids in nutrient cycling and provides habitat for beneficial insects, while also building soil organic matter.

Source: [Nature Education: 18 November 2013](#)

Haefele and Konboon (2009) stated that average grain yields of rain fed lowland rice in Northeast Thailand are the lowest in the region and they have barely changed in

the past decade. Improved fertilizer management is one of the few options to improve cropping system productivity. The three main pillars for increased productivity of rice in Asia during the last decades were germplasm improvement, increased irrigation capacity and improved nutrition based on inorganic fertilizer.



Figure 3.
Example of Conservation Agriculture practices.

According to Huang, et al, 2012, the development of China as a global economic power is one of the most dramatic stories of recent decades. China's economy has been the fastest growing in the world since 1980. Rapid growth has occurred in all

sectors, including agriculture, accompanied by rapid poverty reduction. In the past 30 years, based on China's official poverty line, the absolute level of rural poverty fell from 260 million (36 per cent of rural population) in 1978 to 26.9 million (2.8 per cent of rural population) in 2010 (NSBC, 2011). Furthermore, the general welfare of most of the population has increased noticeably. Many indicators of nutritional status have improved. Actually, by the middle of 2007, China had achieved many of its Millennium Development Goals.

China has made an outstanding jump from being a small apple producer to becoming the world's largest apple producer and exporter. In the early 1980s, China produced less than three million tons of apples per year. By 2007, more than 42 percent of all apples produced in the world originated in China (FAO, 2008). Due to its fast development of apple orchards in the late 1980s, particularly in Shandong and Shaanxi provinces, China is now the leading producer with a 13.5 percent share of the international apple exports by volume; ahead of other apple exporters such as Italy (10.4 percent), Chile (10.3 percent), France (9.2 percent) and the US (8.8 percent)(UN COMTRADE, 2007). But the value of China's exports ranked fourth behind Italy, France and the US, since China's apples sell at lower prices in global markets (Zhang, et al, 2009).

According to WTO, the agricultural circumstances in India have undergone a remarkable change in the light of liberalization and establishment of World Trade Organization (WTO). Responding to issues of globalization, and keeping farmers, agribusiness people, and extension educators in a state of awareness it is vital to address the challenges posed by globalization. It is important, therefore, to recognize approaches that can supply continuous, appropriate, and export oriented technologies to small and marginal farmers (Radhakrishna, et al, 2008).

The winter wheat-maize crop rotation is an important agricultural method for meeting local food security in China. Wheat and maize are grown in succession. Phosphorus fertilization is one of the important measures to improve crop yield. Phosphorus is one of the main limiting factors for crop production in China. The use of P fertilizers is the most effective way to improve the P supply for crop production and to increase wheat and maize yields (Tang, et al, 2008).

Valle et al (2011) stated that yield and grain of wheat in Chile are strongly conditioned by soil characteristics mostly linked with the accessibility of resources and the incidence of constraints. The impact of acidic soils and Al toxicity on the nutrient economy of wheat have been barely researched although these soils are common in wheat producing areas of the world, affecting crop productivity and its profitability due to higher production costs. Al toxicity may also affect grain quality of wheat due to its impact on both uptake and partitioning of soil elements. Higher soil Al concentrations may decrease nitrogen availability to growing grains and increase Al concentration of harvestable organs with the consequence of lower bread quality.

According to Golam, et al, 2007, some three quarters of the world's poor people live in rural areas, and their livelihoods are mainly linked to agriculture. Like other developing countries, the economy of Bangladesh draws its major strong point from agriculture because of the potentiality to produce multiplier effects on the growth of other sectors of the economy. It is the most important source of livelihood for most of the poor and plays a major role in building their household food security. Integrated soil fertility and nutrient management is an alternative to preserve soil fertility and to improve crop productivity. Although it is an age-old practice, its importance was not very much realized in the pre-green revolution era due to the low nutrient demand of the existing subsistence agriculture in Bangladesh (Golam, et al, 2007).

2.4. Small Scale Farming in South Africa

Maize is the most important grain crop in South Africa and is produced right through the country under different environments. About 60% of the maize that is produced in South Africa is white mostly for human consumption and about 40% is yellow maize mostly for animal feed (Department of Agriculture and Land Reform, 2007). Maize is the main staple and a cash crop for the majority of small scale farmers in South Africa. Despite the dry and drought prone areas in much of the Limpopo Province, maize is the leading cereal grain. A survey conducted in the central region of the

Limpopo Province suggested that most of the land cultivated by small scale farmers is under maize, with 84% of households attempting to grow this staple food crop. Maize yields in the dry areas of Limpopo are normally low, due to a combination of low and unpredictable rainfall, late planting, poor pest control, poor soil fertility and soil acidity resulting in very low water-use efficiency (Ayisi and Mpangane, 2004). Small scale farmers in these areas normally harvest only 0.5 to 1 ton/ha resulting in constant food insecurity, lack of marketable surpluses and poverty (Kgonyane et al, 2013).

Most soils in the dry regions of Limpopo are low in nitrogen (N) and phosphorus (P) due to natural low fertility status and continuous maize production over many seasons without replacing depleted nutrients. The use of monoculture cropping systems in dry areas can result in reduced yields, particularly when a field is cropped every year and it is reported that nutrients are often the most limiting factor for crop growth in the drier parts of the world (Kgonyane et al, 2013).

Small-scale production systems in South Africa and other countries in sub-Saharan Africa engage a mixture of both crops and livestock. The crops and livestock add considerably to the livelihoods of the people. One of the most important hazards to the sustainability of small scale crop production systems is the decline in soil fertility linked with falling levels of organic matter and soil nutrients. Even though inorganic fertilizers have played a major role in maintaining and increasing soil fertility in most areas of the world, a range of factors mitigate against the widespread use of inorganic fertilizers by small scale farmers (Mkhabela, 2002).

Mkhabela (2002) further states that the high price of inorganic fertilizers is a major factor against their use by small scale farmers given their limited financial resources. Fertilizer has also been shown to produce variable crop yield responses under small scale farming, which makes the technology risky and difficult to use by farmers in this sector. The amount of inorganic fertilizer used by the small scale farming sector in South Africa is generally small and significantly below the levels recommended for

the agro-ecological regions of the country (FSSA, 2003). As a result, manure will continue to play a vital role in the maintenance of soil fertility in South Africa.

The Fertilizer Society of South Africa estimated that in 1989, there was approximately 3 million tons of manure available in South Africa from various feedlots (FSSA, 2003). The value of this manure calculated in terms of nitrogen, phosphorus and potassium was R29.7 million. It was also estimated that the manure was sufficient to meet 13.3%, 9.9% and 27.6% of the country's requirements of N, P and K respectively. However, it was estimated that only 25% of the 3 million tons of available manure were being used for soil fertility management. The bulk of the remaining 75% of the available manure was mostly wasted with a small portion used as energy for heating. These numbers are not expected to have changed much since then.

Maize is the most important crop grown in the Midlands region of KwaZulu-Natal province (KZN), especially among small-scale producers, since it provides food for the family. Intensive farming by mostly large commercial farmers produces beef and dairy, chicken, sheep and maize (Mkhabela, 2002)

African biofuels industrial strategy grown on a reasonable scale in the province of KwaZulu-Natal (KZN). Given recent criticisms of the South African biofuels industrial strategy, an analysis of the economic viability of producing biodiesel from soybeans grown by small scale farmers in KZN was conducted and some areas have started planting their soybeans to improve food security. Soybeans are believed to require low quantities of fertilizer as compared to crops like maize, since soybeans can make their own nitrogen which is required by other crops in big quantities (Sparks et al, 2011).

2.5. South African Policies and Small Scale Farmers

In South Africa, decades of policy discrimination against the small-scale farming sector during the apartheid regime resulted in the small-scale sector being extremely neglected. Until recently, national agricultural programmes and policies were

oriented largely to the large commercial sector. Recently however, agricultural policies have been reoriented to accommodate small farmers in the rural and peri-urban areas of South Africa. The Reconstruction and Development Programme (RDP) of the post apartheid Government, for example, considers the economic development of small scale agriculture as the vehicle for raising the level of incomes and reducing the vulnerability of rural households to food insecurity (ANC, 2009). Under this programme, land will be redistributed to provide the disadvantaged with access to land in order to expand the small scale farming sector. The emphasis by the government on small scale agriculture has resulted in a marked surge in the numbers of small scale crop farmers. This increase can also be a reflection of rising unemployment in the country. In South Africa the small scale farming sector represents a large proportion of the country's population and has the potential to become an important contributor to household food security (FSSA, 2003).

The potential of small scale agriculture to create employment in rural areas, generate income, and contribute to food security has been proven in many developing countries. This is recognized by the new South African Government and reflected in the new Agricultural Policy (Ministry of Agriculture and Land Affairs, 1998).

To promote development in small scale agriculture support services are restructured and new programs and projects are implemented. Agricultural research, extension and finance institutions are today to a much larger extent targeting small scale farmers. Extension in particular plays an important role to communicate information from research institutes and policy makers to farmers. Extension agents can facilitate joint action among farmers (e.g. in inputs supply, marketing, sharing of equipment and labour). Unfortunately, unfavorable structures and lack of financial resources, skills and motivation of personnel often limit the impact of agricultural extension on development (Hedden-Bunkhorst & Mollel, 1999).

Sparks et al (2011) stated that the South African government currently encourages the use of cooperatives as organizations that have the potential to promote the development of small-scale farmers and other local communities. Cooperatives have been endorsed in numerous developing nations as a means to stimulate agricultural

growth and rural development, and are a prominent form of business organization around the world. Since the primary objectives of the South African biofuels industrial strategy are poverty alleviation and the stimulation of economic activity in the former homelands, it is not surprising that the biofuels industrial strategy explicitly states that the South African government intends using cooperatives as the preferred organizational vehicle to integrate smallholders into the domestic biofuels industry.

Small scale farmers' in South Africa have been subject to years of official neglect, despite numerous policies and programmes that proclaim the opposite. In particular, dismantling Bantustan agricultural development corporations in the 1990s left a vacuum in production and marketing support for the now-estimated 200,000 commercially-oriented small scale farmers and 2.5 million households practicing agriculture mainly for subsistence purposes (Aliber & Hall, 2010).

Rural development, food security and land reform' was one of the five priority areas listed in the ANC's election manifesto of 2009, which also committed the party to address food security and to expand access to food production schemes in rural and peri-urban areas to grow their own food with implements, tractors, fertilizers and pesticides' (ANC 2009). South Africa's development policy focuses on economic growth, reducing income inequalities and eliminating poverty. Agriculture is central in achieving these imperatives. It can contribute to these objectives by increasing agricultural productivity and output, which will enhance the sector's contribution to national economic growth; increasing the incomes of the poorest groups in society, through the creation of opportunities for small scale farmers to raise their production for their own consumption and the market (National Department of Agriculture, 2007).

According to Drimie and Ruysenaar, 2010, the world summit in 1996 revitalized the commitment to focus on the poor and reducing the number of food insecurity. World leaders have committed themselves to halving the number of hungry people before 2015 (Millennium Development Goals). Despite national and international commitments such as the South African Constitution, the MDGs and Rome

Declaration to meet the rights of all South Africans to adequate food, many of these obligations have not been met in reality.

Altman, et al, 2009, stated that South Africa is ranked among the countries with the highest rate of income inequality in the world. They say that the link between poverty, incomes and household food security is not at all clear. In order to understand household food security status in this country, it is important to investigate how the mechanisms of the food distribution system and resources of a household determine its access to food. There are distributional and accessibility problems that need to be understood. Ideally, poverty and insecurity would be addressed by expanding employment opportunities, thereby enhancing household incomes.

2.6. Conclusion

Currently, 2.6 billion people, 40% of the world population are small scale farmers and these farmers produce most of the food being consumed (IAASTD, 2009). According to Magingxa et al, 2009, market access is one of the most important factors for the viability of small scale agriculture in South Africa. A major reason why even those farmers who can produce a surplus remain trapped in poverty is lack of access to profitable markets. There is a need for investment for skills development for small scale farmers to improve their competitiveness. And these farmers must be encouraged to form co-operatives or associations so that land size can be increased.

Studies suggested that legumes used as green manures can provide enough nitrogen to replace the entire amount of synthetic nitrogen fertilizer currently in use, without losses in food production (Badgley et al, 2007). Ramanjaneyulu et al, 2008, mentioned that sustainable agriculture can increase farmer's income while crop yields remained stable.

Chapter 3

3. Methodology

3.1. Introduction

The researcher is going to use qualitative research method to collect data from farmers. The researcher will want to understand the reasons and attitudes of the farmers on using fertilizers. The cost and quantity of fertilizer used in the production of crops will also be determined. About 30 farmers will be interviewed for the purpose of this research.

3.2. Research Instruments

Literature

Literature concerning the usage of fertilizers small scale farmers is going to be consulted. Findings in the research will be used together with the literature in order to make deductions and conclusions.

Questionnaire

It will be used to gather information from the small scale farmers who are using fertilizers. The farmers will be interviewed to get the required information. The questionnaire that is going to be used is attached to this Thesis.

3.3. Study Area

Estcourt (Umtshezi) Municipality is a town in the uThukela District of KwaZulu-Natal Province, South Africa. The study was undertaken in two areas within the Estcourt Municipality: Emangweni and Ntabamhlophe. The main economic activity is farming with large bacon and processed food factories situated around the town. The N3 freeway passes close to the town, linking it to the rest of South Africa. The area is about 1,972km².

Umtshezi Local Municipality is located approximately 165km north-west of Durban and 400km south-east of Johannesburg. Umtshezi Municipality comprises parts of the Magisterial Districts of Weenen and Estcourt and Colenso. Estcourt is the largest commercial centre in the Midlands region. Weenen is a small agricultural town that is starting to emerge as a tourist destination. The majority of the people are concentrated in urban and farming areas but there are a few patches of high-density settlements within the informal areas (The Local government Handbook, 2012).

3.4. Demographic Information

- Population: 83 153
- Households: 19 25
- Population Growth: 3.25% p.a
- Unemployment Rate: 36.90%

Estcourt normally receives about 589mm of rain per year, with most rainfall occurring mainly during midsummer. It receives the lowest rainfall in June and the highest in January. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Estcourt range from 18.7°C in June to 26.4°C in January. The region is the coldest during June when the mercury drops to 1.7°C on average during the night (saexplorer, 2011) Maize, soya Beans, and Dry beans are the most plants planted in the Estcourt area.

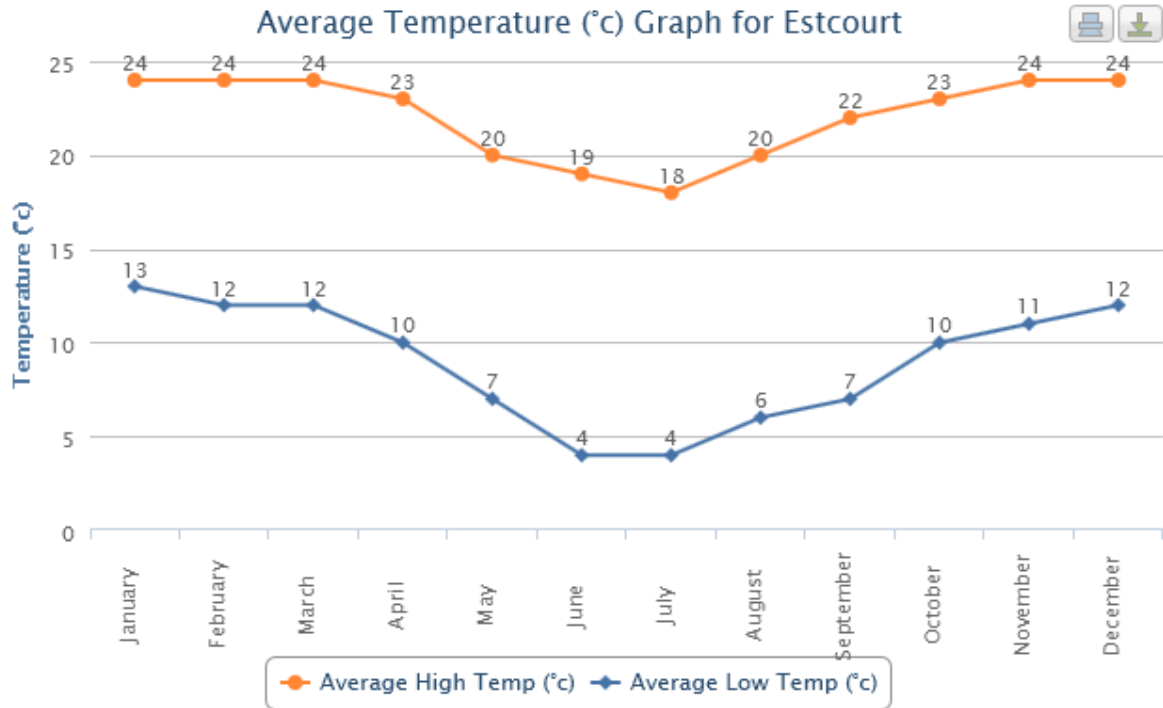


Figure4. Average Temperature for Estcourt. Source: World Weather Online

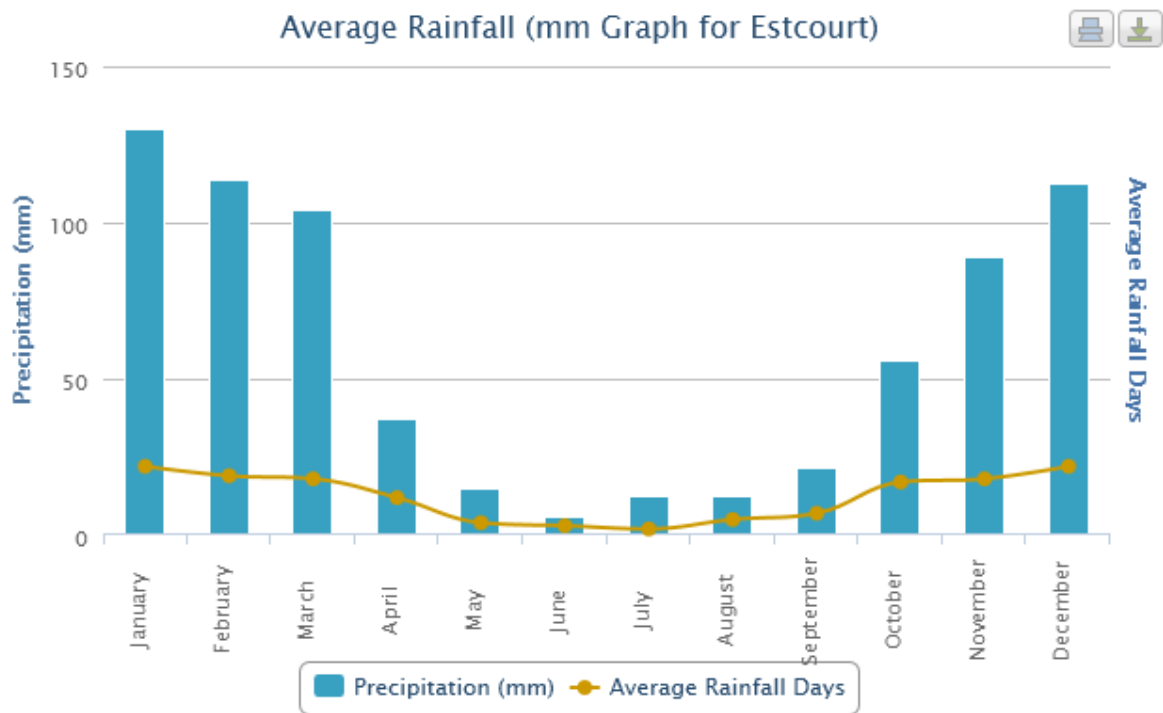


Figure5. Average Rainfall for Estcourt. Source: World Weather Online.



Figure6. Estcourt area (Red area) in the Map of KwaZulu-Natal (Source: Estcourt Municipality)



Figure7. Map of Estcourt (Mtshezi) Municipality

Source: Estcourt Municipality

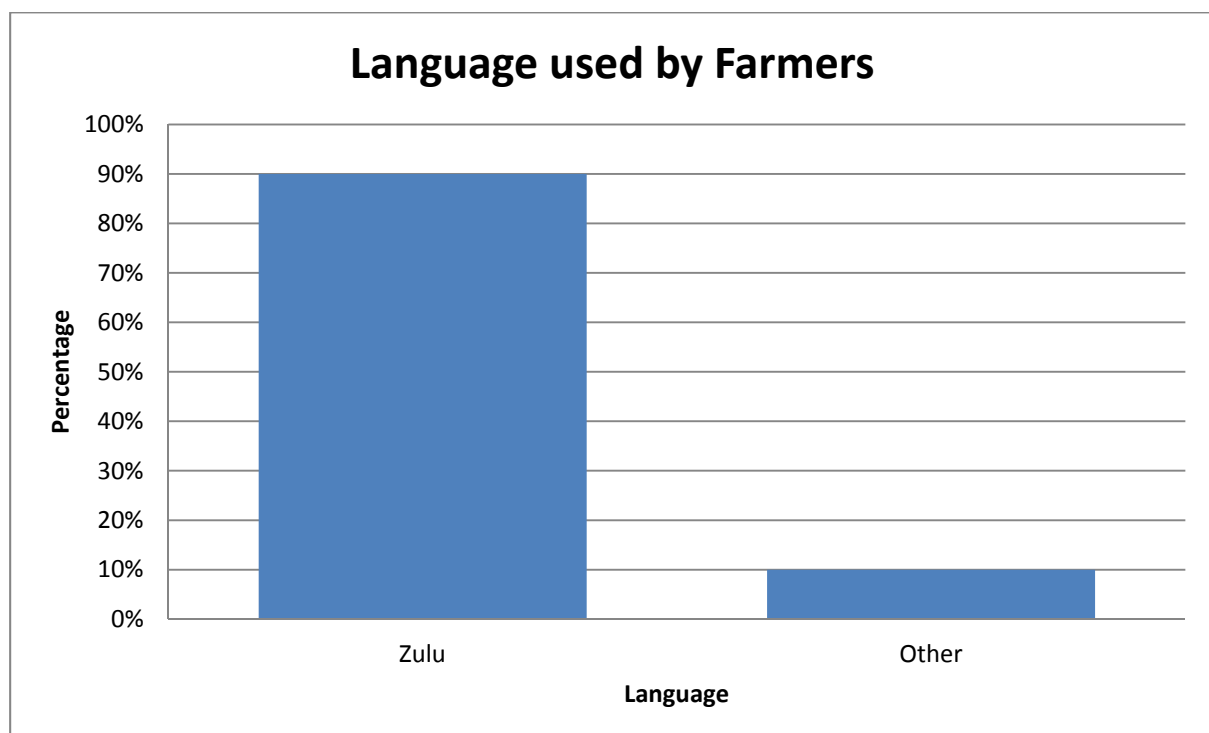
CHAPTER 4

4. RESULTS AND DISCUSSIONS

The main aim of the study is to check whether the small scale communal farmers do they apply enough fertilizer to their crops. Interviews were conducted to 30 farmers, 15 of them were females and another 15 were males.

4.1. Language of farmers

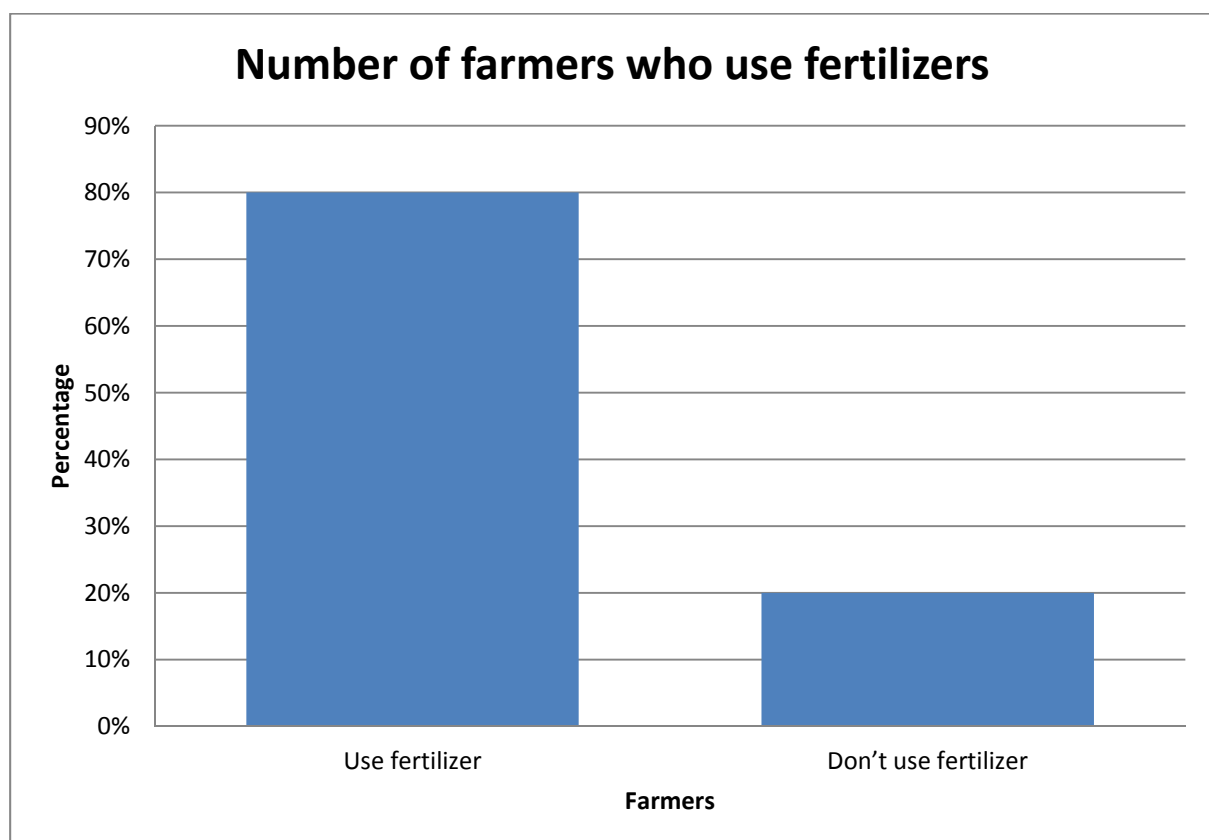
Farmers were asked about which language they use, as language is main barrier in communication. Of the farmers interviewed, 90% of them said they use Zulu language as their medium of communication and 10% said they use English. Kashem (1988) stated that language can cause communication failures. Information may not be received by the recipient or farmer, who is the decision maker. This will lead to new information to being lost because the language used to transfer the information is not understood by the farmer (Kashem, 1988). According to FAO (1993), the extension officer is responsible for providing the knowledge and information that will enable a farmer to understand and make a decision about a particular innovation.



Graph 1.

4.2. Fertilizer Use

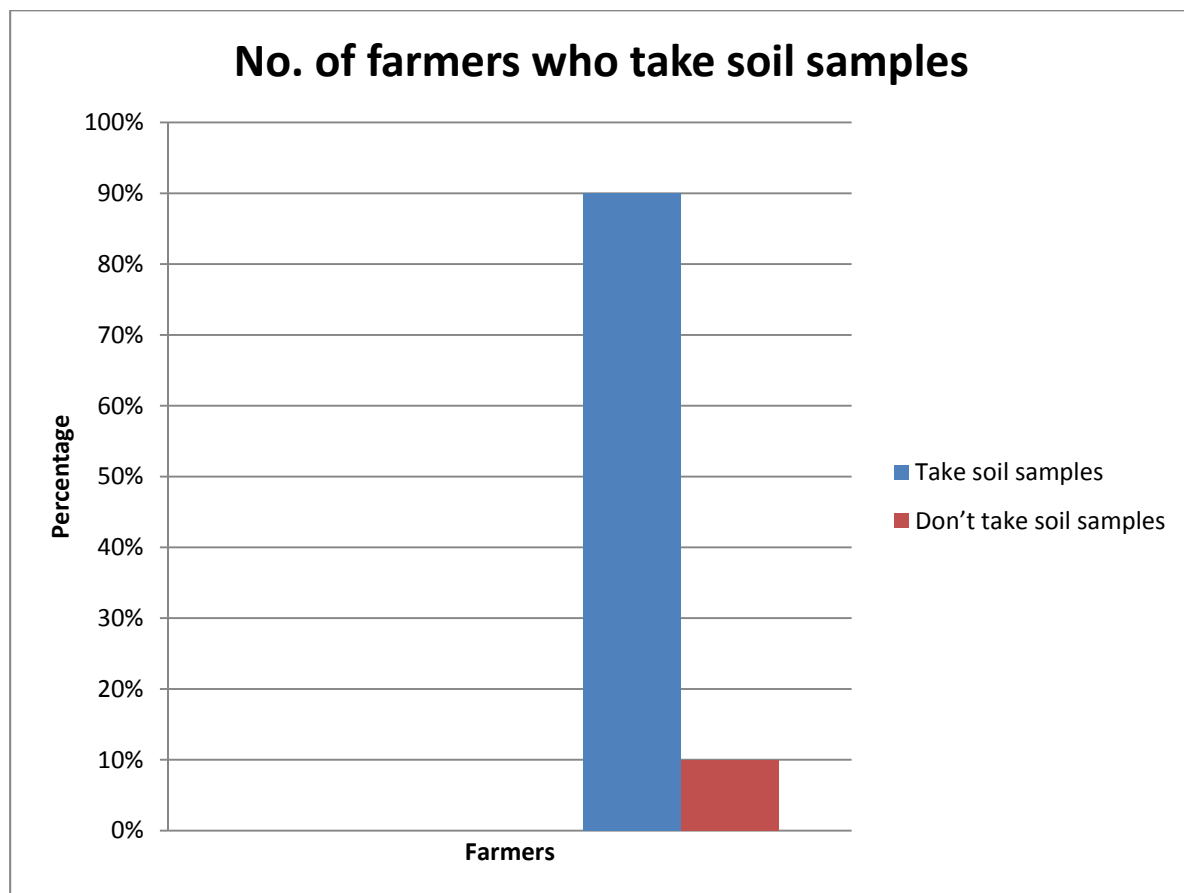
Farmers were asked about their fertilizer use and their response to this question was that 80% of them use fertilizers and 20% said they don't use fertilizer. According to Fertilizer handbook, fertilizer is an absolute essential input for modern agriculture and as such, it is one of the basic cornerstones of food and fibre production. Soil fertility is the ability of the soil to make plant nutrients available to the plant. Plant nutrients should occur in dissolved form in the soil solution, as that is when they are available to the plant (FSSA, 2007). International Fertilizer Association stated that use of fertilizer is needed for all types of long-term crop production in order to achieve yield levels which make the effort of cropping worthwhile. Modern fertilizer practices have contributed very widely to the immense increase in agricultural production and have resulted in better quality food and fodder. Use of fertilizer improves the plant resistance to diseases and climatic stress, and also increases the economic returns of the farmer due to more effective production (IFA, World fertilizer Use Manual).



Graph 2.

4.3. Soil Sampling

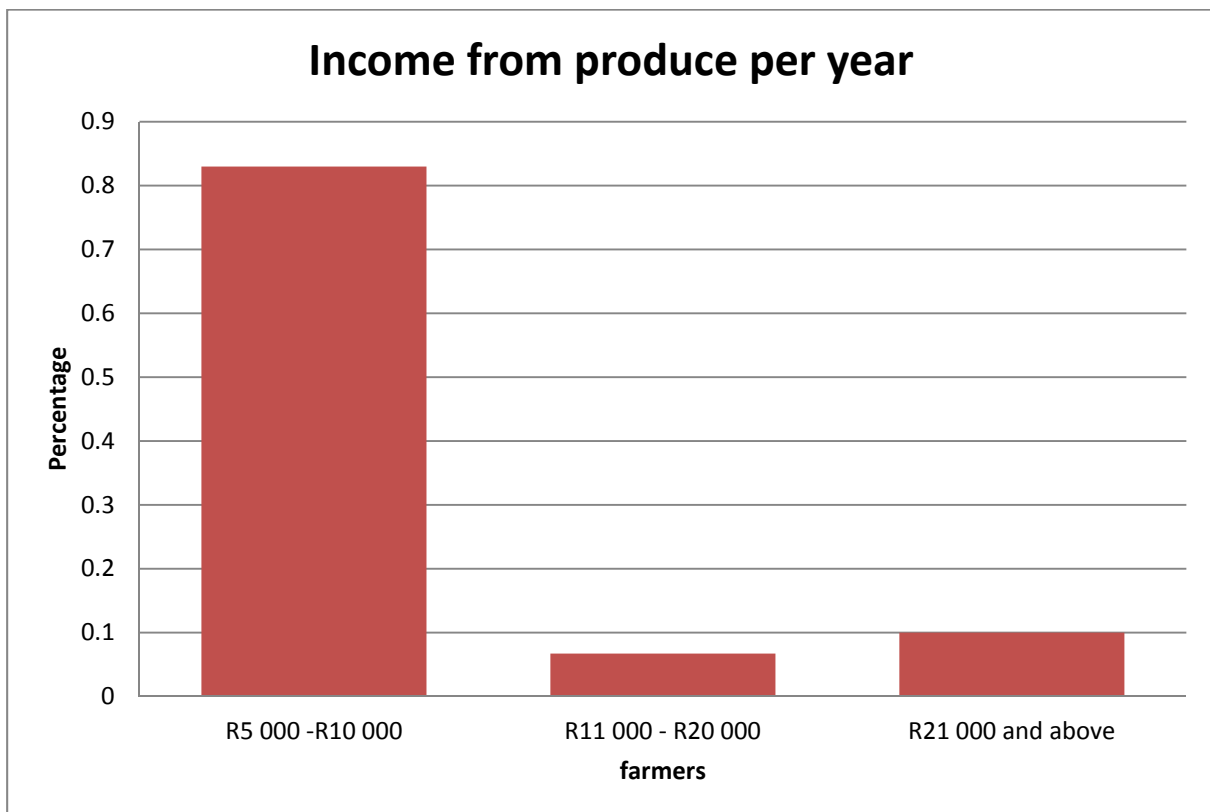
Farmers were also asked whether do they take soil samples, about 90% said they take soil samples and another 10% didn't respond on this question. According to Fertilizer handbook (2003) it is essential that soil samples are taken as accurately as possible in order to ensure that the soil analysis can be interpreted meaningfully. Analysis is as good or as bad as the sample. Franzen and Cihacek (1998) further stated that soil tests measure the relative nutrient status of soils and are used as a basis for profitable and environmentally responsible fertilizer application. The accuracy of a soil test result is influenced by the laboratory analysis but may be influenced even more by the quality of the soil sample.



Graph 3.

4.4. Income from Sales

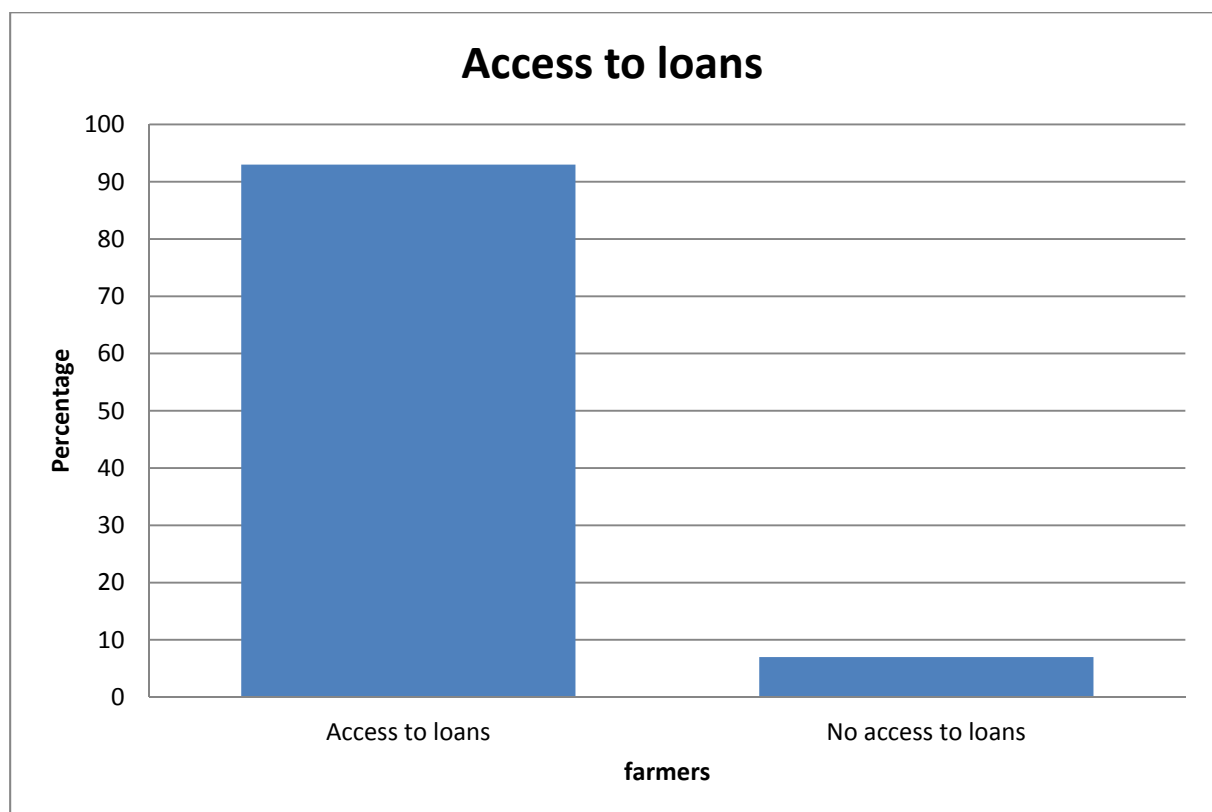
Farmers were also asked about how much do they receive from their produce sales and the response was 83.3% said they get between R5000 and R10 000, 6.7% said they get between R11 000 and R20 000, and 10% said they get R21 000 and above. Daniels (2000) stated that any sustainable future for agriculture must include economic sustainability, if incomes do not meet the needs of labour force, production declines, quality of life diminishes and communities suffer. Mellor (1986) stated three conditions of agriculture to serve as a primary source of economic growth. First, the size of agriculture sector in the domestic economy must be large enough to induce aggregate effects. Secondly, agricultural growth must be based on cost reducing technological change. Thirdly, the rate of growth of demand for labour largely in agribusiness must accelerate through agricultural investment.



Graph 4.

4.5. Access to loans

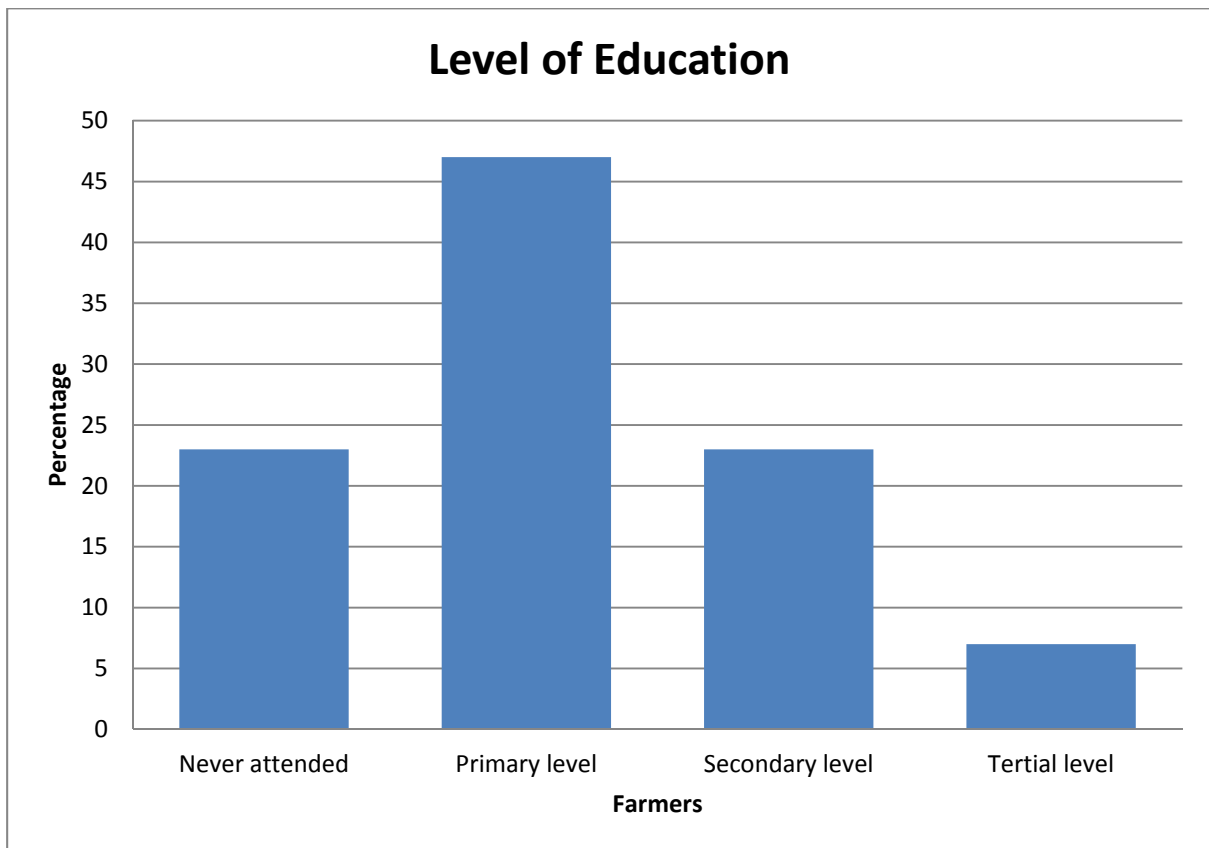
About 93% of farmers said they don't have access to loans when asked about the use of the credit facilities and just only 7% said they have access to finance. According to Ogang (2013) small scale farmers in the emerging economies are faced with a problem of not accessing finance to fund their activities, for example to replace ageing tree crops or buy disease resistant, high yield seeds. They cannot even afford to buy inputs for pests and weed control and this will limit their production potential. The financial institutions have not helped farmers because the terms and conditions for accessing loans are not conducive for small scale farmers: there are collateral-related challenges, interest rates and the mistrust between banks and farmers. According to Olujenjo, small scale agriculture has suffered from limited access to credit facilities, modern technology inputs and inefficient use of resources.



Graph 5.

4.6. Level of Education

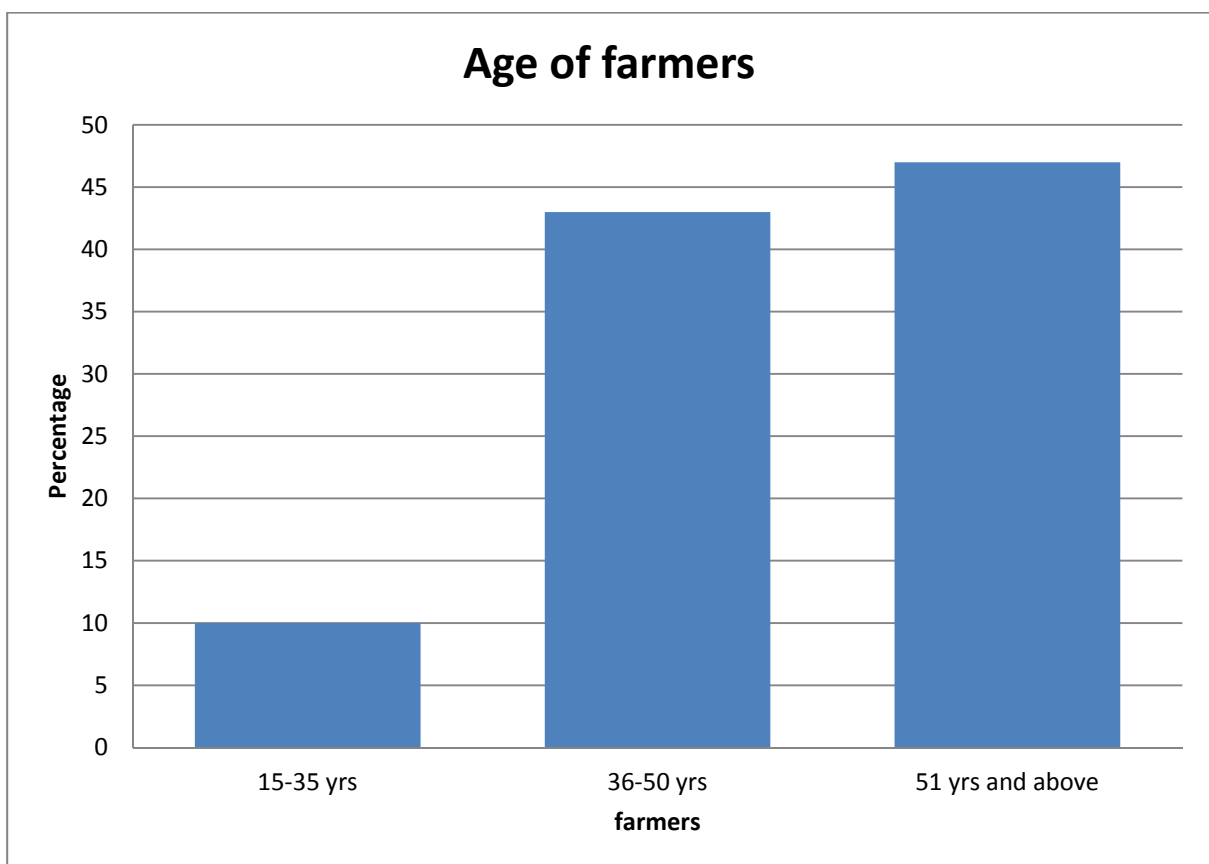
This study also questioned about the level of education of the farmers. Farmers responded as follows: 23.3% never attended school, 46.7% have primary education, 23.3% have secondary education and 6.7% have tertiary education. Ogang stated that lack of education and training in farming techniques contributes to a pattern of low yields and poor crop quality. Furthermore, as the literacy and numeracy skills are not commonly found, understanding the business aspects of agricultural production remains a challenge for many.



Graph 6.

4.7. Age of farmers

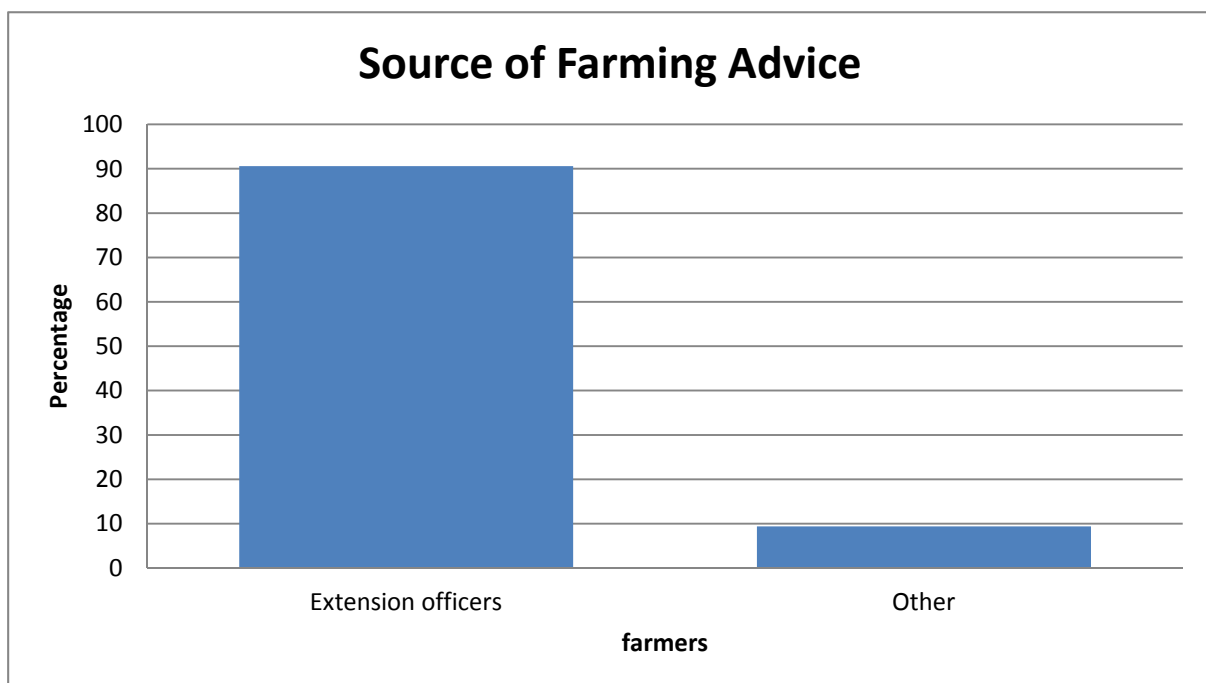
Farmers were also questioned about their age and they responded with the following Answers: 10% are between 15 and 35 years, 43% are between 36 and 50 years, and 47% are 51 years and above. Burton et al. (1999) found that in UK the probability of adoption of organic horticulture is reduced if the farmer is older. According to Harath (1998) younger farmers are more likely to adopt farm conservation practices than older farmers in Central Highlands of Sri Lanka. Nell (1998) also found that age is significantly determining the adoption of livestock medication technologies in Qwaqwa, South Africa.



Graph 7.

4.8. Source of Information

About 90.6% of the farmers interviewed said they are getting their farming advices from the local extension officers. And 9.4% of other farmers said they get their advices from other sources. According to the FAO (1993) extension officer is responsible for providing the knowledge and information that will enable a farmer to understand and make a decision about a particular innovation, and then for communicating that knowledge to the farmer. Extension officer is seen as a vehicle of knowledge, usually of a technical nature, and as a teacher who instructs farmers in the use of this knowledge. Extension officer is formally trained for this position and is provided with the technical knowledge and information which he must then communicate to the farmers.



Graph 8.

It has been found that farmers who have access to finance are planting very successfully resulting in higher income. According to Aliero & Ibrahim (2012) enhancing access to formal financial services especially credit to the small-scale farmers has been identified as a means to reduce poverty in developing countries. They also found that promoting access to formal financial services increases the level of income of the small-scale farmers.

CHAPTER 5

5. CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The main objective of the study was to check the sustainability of the soil fertilization on small scale farmers in the Estcourt area. From this study it has been found that farmers do take soil samples and apply fertilizer. It has been noticed that the age and level of education influence the farmer's adoption behavior. Young and educated farmers adopt new innovations easily and faster as compared to older and less educated farmers.

Another thing that has been found in the study is that most of the farmers interviewed get less than R10 000 per annum from their produce. This amount is very little to sustain their farming activities. This is the reason why most farmers put less fertilizer on their fields.

About 90% of the farmers don't have access to loans which means that they have to buy every farming inputs using their cash. These farming don't have security or collateral which the banks need in order to give out loans. These farmers are using communal lands to do their farming and banks don't accept these lands as collateral.

Almost all farmers are using Zulu language as their communication medium. And because of age they can't learn new language now. This means that extension officer must be sure that he uses the language understood by the farmers so that the information can be transferred easily.

These farmers get all their farming information from local extension officers. The extension officers must be trained and given all necessary material to do their job. If extension officers have got incorrect and insufficient information, the farmers will get wrong information.

5.2. Recommendation

Farmers must be given big lands where they can have title deeds, so that they can use that land as collateral. Banks must loosen their conditions in order to allow the small scale farmers to access loans. Without loans these farmers can't survive.

Extension officers must focus on younger farmers as these will be the future farmers and adopt new technology easily and fast. And there must be some formal education that is given to farmers who are not literate. It has been found that young and educated farmers learn and adopt easily as compare to older and less educated farmers.

Farmers must be trained on how to take soil samples and how to apply fertilizer. Farmers do take soil samples and apply fertilizer but their yields remain unchanged, based on the income these farmers receive from their produce. Maybe they are not applying correct fertilizer, not applying recommended quantities or their soil samples are not correctly taken.

6. References

Abdu-Raheem, K.A., & Worth, S.H., 2011. Household food security in South Africa. Evaluating extension's paradigms relative to the current food security and development goals. South African Journal of Agricultural Extension.

Adjei-Nsiah, S., 2012. Role of Pigeonpea Cultivation on soil fertility and farming system sustainability in Ghana.

African National Congress., 2009. Election manifesto 2009.

Aliber, M., & Hart, T.G.B., 2009. Should Subsistence Agriculture be supported as a strategy to address rural food security? South African ePublications.

Altman, M., Hart, T., & Jacobs, P., 2009. Household food security status in South Africa.

Associacao Nacional para Difusao de adubos. 2008. ANPDDA.

Ayisi, K. K. & Mpangane, P. N. Z. (2004). Growth and symbiotic activities of cowpea cultivars in sole and binary cultures with maize.

Badgley, C., Moghtader, J., Quintero, E., Zakem, E., Chappell, M., Aviles-Vazquez, K., Samulon, A., & Pectecto, I., 2007. Organic Agriculture and the global food supply. Renewable Agriculture and food systems.

Burton, M., Rigby, D., & Young, T., 1999. Analysis of the determinants of adoption of organic horticulture technologies in the UK.

Daniels, C.H., 2000. Department of entomology, Washington State University, 2710 University Drive, WA99352-1671.

Department of Agriculture and Land Reform (2007). Situation analysis, market indicators and outlook for 2008 season.

Drimie, S. & Ruysenaar, S., 2010. The Intergrated Food Security Strategy of South Africa. An Institutional Analysis.

FAO., 1993. Guide to Extension training. FAO training series.

Food And Agriculture Organization, 2008. FAOSTAT. <http://faostat.fao.org>

Food and Agriculture Organization, 2010. The state of foof Insecurity in the world. Addressing food insecurity in protracted crises. Rome.

Franco, H.C.J., Otto, R., Faroni, C.E., Vitti, A.C., de Oliveira, E.C.A., & Trivelin, P.C.O., 2010. Nitrogen in Sugarcane derived from Fertilizer under Brazilian Field Conditions. Field crops Research.

Franzen, D.W.&Cihacek, L.J., 1998. Soil Sampling as a basis for fertilizer application.

Giller, K.E., Witter, E., Corbeels, M., & Tittonell, P., 2009. Conservation Agriculture and Smallholder Farming in Africa: The heretics' view.

Giurca, D., 2008. Semi-Subsistence Farming-Prospects for the small farmer to choose between a way of living or efficiency.

Golam Farouque, & Hiroyuku Takaya, 2007. Farmer's Perception of Integrated soil fertility and Nutrient Management for Sustainable Crop Production: A case study in Rural Areas in Bangladesh.

Grace Communication Foundation, 2013. Sustainable Agriculture-The Basics.

Haefele, S.M., & Konboon, Y., 2009. Nutrient Management for Rainfed lowland rice in northeast Thailand.

Hall, R., & Aliber, M., 2010. The Case for Re-strategising spending priorities to support small scale farmers in South Africa.

Harath, A., 1998. Socio-economic factors influencing soil conservation in Cash crop farming systems in the central highlands in Sri Lanka.

Hedden-Bunkhorst, B., & Mollel, N.M., 1999. Small Scale farming and Extension in South Africa's Northern Province. South African Journal of Agricultural Extension. [http://www.saexplorer.co.za/South -Africa/Estcourt Climate](http://www.saexplorer.co.za/South-Africa/Estcourt%20Climate) (2013)

Huang, J., Wang, X., & Qiu, H., 2012. Small-Scale farmers in China in the face of Modernization and globalisation.

IBDGE, 2010. Instituto Brasileiro de Geografia e Estatística.

International Assessment of Agricultural Science and Technology for Development, 2009. Island press. www.agassessment.org

International Fertilizer Association, 1991. World fertilizer Use Manual.

International Fertilizer Society, 2013. What is soil fertility?. www.fertilizer.org

Kashem, M.A., 1988. The Rejection of Innovation. South African Journal of Agricultural Extension.

Kgonyane, M.C., Marika, I.K., & Dimes, J.P., 2013. Low rates of Nitrogen and Phosphorus as fertilizer options for Maize production by smallholding farmers in drier regions of South Africa.

Kirsten, J.F., & van Zyl, J., 1998. Defining small scale farmers in the South African Context.

Li, H., Li, L., Wegenast, T., Longin, C.F., Xu, X., Melchinger, A.E., & Chen, S., 2010. Effect of Nitrogen supply on stalk quality in maize hybrids. Field Crops Research.

Li, Y., Chen, D., Walker, C.N., & Angus, J.F., 2010. Estimating the Nitrogen status of crops using a digital camera. *Field Crops Research*.

Magingxa, L.L., Alemu, Z.G., & van Schalkwyk, H. D., 2009. Factors Influencing Access to Produce Markets for Small Scaleholder Irrigators in South Africa.

Mkhabela, T.S., 2002. Determinants of Manure Use by Small Scale crop farmers in KwaZulu-Natal Province. A logit analysis. *Agrekon*.

Nell, W.T., 1998. Transfer and adoption of technology: the case of sheep and goat farmers in Qwaqwa, South Africa.

Ogang, C., 2013. Challenges of Agricultural financing: Case of Uganda. World Farmers Organization (WFO).

Olujenjo, F.O., 2013. The determinants of agricultural production and profitability in Akoko Land, Ondo-State, Nigeria.

Pinard, J., 2012. Improving small-scale farmer incomes and livelihoods. OLAM

Radhakrishna, R. B., & Jackson, D.G., 2008. Approaches for linking Markets and farmers to Foster India's Rural Development.

Ramanjaneyulu, G.V., Chari, M.S., Raghunath, T.A.V.S., Hussain, Z., & Kuruganti, K., 2008. Non-pesticidal management: Learning from experiences. www.csa-india.org

Sarker, K.K., Xiaoyan, W., Chunlin Xu., Li Wenying, . He Jin, Rasaily, R.G., & Qiao Xiaodong., 2012. Development Strategies of Small Scale Conservation farming practices on two wheeled tractor in Bangladesh.

Setiyono, T.D., Walters, D.T., Cassman, K.G., Witt, C., & Dobermann, A., 2010. Estimating maize Nutrient Uptake requirement. *Field Crops Research*.

Sparks, G.D., Ortmann, G.F., & Lyne, M.C., 2011. A Normative economic analysis of Co-operative biodiesel production using Soybeans produced by Smallholders in KwaZulu-Natal, South Africa. *Agrekon*.

Tang, X., Li, J., Ma, Y., Hao, X., & Li, X., 2008. Phosphorus efficiency in long-term (15years) wheat-maize cropping systems with various soil and climate conditions.

Thamago-Chitja, J., & Hendriks, S.L., 2008. Emerging Issues in Small Scaleholder organic production and marketing in South Africa.

The Local Government handbook., 2012. A Complete Guide to Municipalities in South Africa.

Tolessa, D., Du Preez, C.C., & Ceronio, G.M., 2009. Effect of Tillage system and Nitrogen fertilization on efficacy of applied Nitrogen by maize in Western Ethiopia. *South African Journal of plant and Soil*.

UN COMTRADE, 2007. United Nations Commodity Trade Statistics Database. <http://comtrade.un.org>

Valle, S.R., Pinochet, D., & Calderini, D.F., 2011. Uptake and Use Efficiency of N, P, K, Ca and Al by Al-sensitive and Al-tolerant cultivars of wheat under a wide range of soil Al concentrations. *Field Crops Research*.

Van Biljon, J.J., 2010. Maize fertilizer Research over the last 25 years- an overview. *South African Journal of Plant and soil*.

Zhang, X., Qiu, H., & Huang, Z., 2009. Linking Small Scale farmers in China with the International Markets: A case of Apple Export Chains.

Zingore, S., Murwira, H. K., Delve, R.J., & Giller, K.E., 2008. Variable grain legume yields, responses to phosphorus and rotational effects on maize across soil fertility gradients on African Smallholder farms.

APPENDIX A: QUESTIONNAIRE

INVESTIGATION ON SUSTAINABILITY OF FERTILITIZATION BY SMALL SCALE FARMERS AT ESTCOURT AREA IN KWA-ZULU NATAL SOUTH AFRICA

SECTION A: DEMOGRAPHICS CHARACTERISTICS OF FARMERS

1. Date completed

____/____/____

2. Name of farmer (optional)

3. What is your gender?

(a) Male	1
(b) Female	2

4. What is your home language?

(a) Zulu	1
(b) English	2
(c) Afrikaans	3
(d) Other	4

5. Age of respondent

(a) 15-35 years	1
(b) 36-50 years	2

6. What is your level of education?

(a)	Never attended	1
(b)	Primary level	2
(c)	Secondary level	3
(d)	Tertiary level	4

7. Do you own land?

(a)	Yes	1
(b)	No	2

8. What is the size of your land?

(a)	1-5 ha	1
(b)	5-10 ha	2
(c)	10 ha and above	3

9. Do you have farming skills?

(a)	Yes	1
(b)	No	2

10. If yes, what are those skills?

(a)	Certificate	1
(b)	Diploma	2
(c)	Degree	3

11. Are you a full time farmer?

12. Do you have an experience in farming?

(a) Yes	1
(b) No	2

13. If yes, how long have you been farming?

(a) 1-5 years	1
(b) 6-10 years	2
(c) 11 years and above	3

14. Do you own a tractor?

(a) Yes	1
(b) No	2

15. Which of the following implements do you own?

(a) Mould board plough	1
(b) Chisel plough	2
(c) Planter	3
(d) Disk harrow	4
(e) None	5

SECTION B: BIOLOGICAL PRODUCTION

1. Which crops do you grow?

(a) Maize	1
(b) Soybeans	2
(c) Dry beans	3
(d) Vegetables	4

2. Do you plant your land every year?

(a)	Yes	1
(b)	No	2



3. Which crops have a high market demand?

(a) Maize	1
(b) Soybeans	2
(c) Dry beans	3
(d) Vegetables	4

4. Do you take soil samples?

(a) Yes	1
(b) No	2

5. If yes, how often do you take soil samples?

(a) Seasonal	1
(b) Annual	2
(c) After two years and above	3

6. Do you apply fertilizer?

(a) Yes	1
(b) No	2

7. What type of fertilizer do you use?

(a) Organic	1
(b) Inorganic	2

8. Where do you buy your fertilizer?

(a) Co operative	1
(b) Local shops	2

9. How much fertilizer do you apply?

(a) Recommended	1
(d) Don't know	4

10. Do you rotate your crops?

(a) Yes	1
(b) No	2

11. Do you have irrigation?

(a) Yes	1
(b) No	2

SECTION C: ECONOMIC VIABILITY

1. Do you have market for your produce?

(a) Yes	1
(b) No	2

2. Do you have a contract with the market?

(a) Yes	1
(b) No	2

3. If yes, how often do you supply the market?

(a) Once a week	1
(b) Twice a week	2

4. Do you meet the market demand?

(a) Yes	1
(b) No	2

5. Do you sell your produce?

(a) Yes	1
(b) No	2

6. How much do you receive from produce sales?

(a) R5 000 – R10 000	1
(b) R11 000 – R20 000	2
(c) >R21 000/season	3

7. Where do you sell your produce?

(a) Local	1
(b) Regional	2
(c) Provincial	3
(d) National	4

8. How much of the produce do you use for home consumption?

(a) 0 – 10%	1
(b) 11 – 20%	2
(c) >20%	3

9. What is the distance from the farm to the market?

(a) 50 – 300km	1
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(b)	301 – 600km	2
(c)	601 and above	3

10. What do you use to transport your produce to the market?

(a)	Public transport	1
(b)	Own transport	2
(c)	Hired transport	3
(d)	Other	4

11. Do you own transport?

(a)	LDV	1
(b)	Sedan	2
(c)	Truck	3
(d)	Tractor	4

12. Do you keep farm records?

(a)	Yes	1
(b)	No	2

13. Do you pay cash for inputs?

(a)	Yes	1
(b)	No	2

14. Do you have an access to loan for inputs?

(a)	Yes	1
(b)	No	2

15. Do you have other source of income?

(a) Yes	1
(b) No	2

16. How much do you get from other sources?

(a) R500 – R1 000/month	1
(b) R1 001 – R5 000	2
(c) R6 000 and above	3

SECTION D: PROTECTION OF NATURAL RESOURCES

1. Is your land having drainage for excess water?

(a) Yes	1
(b) No	2

2. Is your land having grass strips or contours?

(a) Yes	1
(b) No	2

3. Do you remove crop residue after harvest?

(a) Yes	1
(b) No	2

4. Do you burn crop residues after harvest?

(a) Yes	1
(b) No	2

5. Do you have wind brakes in your land?

(a) Yes	1
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(b)	No	2
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6. Do you protect the soil against soil erosion?

(a)	Yes	1
(b)	No	2

7. Do you measure chemicals and fertilizers to be used?

(a)	Yes	1
(b)	No	2

SECTION E: SOCIAL ACCEPTABILITY

1. Is the community happy with your farming?

(a)	Yes	1
(b)	No	2

2. Where do you get farming advices?

(a)	Extension officer	1
(b)	Consultants	2
(c)	Media	3
(d)	Other	4

3. Are you a member of the cooperative?

(a) Yes	1
(b) No	2

4. Are you working as a cooperative?

(a) Yes	1
(b) No	2

5. Do you think you can improve the crop production?

(a) Yes	1
(b) No	2

6. If yes, what do you need to improve the production?

(a) Finance	1
(b) Machinery	2
(c) Mentorship	3
(d) Other	4

7. Do you get support from the government?

(a) Yes	1
(b) No	2

SECTION F: RISK REDUCTION

1. Do you experience theft problems?

(a) Yes	1
(b) No	2

2. Do you have insurance for your crops?

(a) Yes	1
(b) No	2

3. Do you experience pest problems?

(a) Yes	1
(b) No	2

4. Do you control pests?

(a) Yes	1
(b) No	2

5. Do you use poisonous insecticides?

(a) Yes	1
(b) No	2

6. Do you wash your produce before selling?

(a) Yes	1
(b) No	2

7. Do you experience drought problems?

(a) Yes	1
(b) No	2

8. Do you experience weed problems?

(a) Yes	1
(b) No	2

9. Which method of weed control do you use?

(a) Herbicides	1
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(b)	Mechanical	2
(c)	Other	3



