Local economic sustainability under smallholder subsistence farming

by

Simphiwe Hlatshwayo

A dissertation submitted in fulfilment of the requirements for the degree of

Master of Agriculture (Food Security)

School of Agricultural, Earth and Environmental Sciences

College of Agriculture, Engineering and Science

University of KwaZulu-Natal

Pietermaritzburg

South Africa

November 2018

PREFACE

The research contained in this dissertation was completed by the candidate while based in the School of Agricultural, Earth and Environmental Sciences, in the College of Agriculture, Engineering and Science, University of KwaZulu-Natal, Pietermaritzburg Campus, South Africa. The research was financially supported by the Sustainable and Healthy Food Systems (SHEFS) and National Research Foundation (NRF).

The contents of this work have not been submitted in any form to another university and, except where the work of others is acknowledged in the text, the results reported are due to investigations by the candidate.

_____

Signed: Supervisor Prof AT Modi

Date: November 2018

DECLARATION

I, Simphiwe Hlatshwayo, declare that:

(i) the research reported in this dissertation, except where otherwise indicated or acknowledged, is my original work;

(ii) this dissertation has not been submitted in full or in part for any degree or examination to any other university;

(iii) this dissertation does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons;

(iv) this dissertation does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then: a) their words have been re-written but the general information attributed to them has been referenced; b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced;

(v) where I have used material for which publications followed, I have indicated in detail my role in the work;

(vi) this dissertation is primarily a collection of material, prepared by myself, published as journal articles or presented as a poster and oral presentations at conferences. In some cases, additional material has been included;

(vii) this dissertation does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the dissertation and in the References sections.

_____

Signed: Simphiwe Hlatshwayo

Date: November 2018

ABSTRACT

Food insecurity an issue for many rural households in South Africa. Many South African rural households mainly depend on subsistence agriculture for their livelihoods, income, and food security. However, subsistence farming is not developed enough to provide smallholder farmers with their needs. Smallholder farmers still are faced with many obstacles during and after their production. The aims of study was to understand how smallholder subsistence production systems work, and to access crop production, and economic systems of smallholder farmers. Eight rural areas of KwaZulu-Natal (Deepdale, Swayimane, Nhlazuka, Vulindlela, Ogagwini, Mvuzane and Emaswazini) were considered to gather information on homestead crop and seed production systems. The results are based on data collected from a sample of 162 households using semi-structured questionnaires. Out of the eight rural areas, three rural areas were used to compare how much smallholder farmers consume and sell from what they have harvested for selected crops (maize, beans and cabbage). A total of 59 questionnaires were successfully completed from households. Chi-square, ANOVA, descriptive statistics and paired t-test were used to analyse data at a 5% level of significant association. Results showed that there were significance differences ($P < 0.05$) in most of the exploratory variables among locations. Findings showed that major crops produced by smallholder farmers were maize, beans and potatoes and the minor crops were vegetables. Most of the smallholder farmers obtained their seeds from saved seeds, neighbours, donations and local shops. The study also revealed that most used storage devices were floor, underground, sealed grain and roof. Farmers assessed seed quality by looking at seed sizes, colour and germination capacity. The study also found that smallholder farmers consume more than they can sell for grain crops (maize and beans). The nature of cabbage made farmers to sell more of it at a cheaper price. The findings showed that there is still more interventions needed under subsistence farming. It can be concluded that there is a need for policy makers, government and researchers to develop new and innovative strategies that will improve subsistence agricultural productivity.

ACKNOWLEDGEMENTS

- First of all, I would like to thank the Almighty God for giving me good health, wisdom and strength for doing my work and for his protection and guidance of my life.
- The sustainable and Healthy Food Systems (SHEFS) and the National Research Fund (NRF) are acknowledged for providing funding throughout the study.
- My supervisor Prof Modi, thank you so much for allowing me to further my studies. Thank you for your support, guidance and advices throughout the research project. You are more like a father to us.
- Dr Mabhaudhi, thank you for the support, guidance and motivation throughout the study.
- My mentors, Dr Tendai Chibarabada and Hillary thank you for offering assistance during the course of the study.
- All the participants (rural households) from the selected rural areas were appreciated for their time and valuable information they have provided.
- I would like to thank my friends Nokwe, Mbali and Thobile for assisting in conducting surveys.
- I would like to thank green team for their assistance, motivation and encouragement during the study.
- Last but not least, I would like to thank my family (my grandparents and uncle) for their unconditional support. They did not understand what I was doing but every time when I leave home they would talk to the ancestors and ask for their guidance in my journey.

DEDICATIONS

This piece of work is dedicated to my late parents, especially to my late mom who was with me in this journey until 2016 when God called her home.

Ulalekahle Zikhali Zomkhonto Msinda KaSenge

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

GENERAL INTRODUCTION

1.1 Background

The agricultural sector is the largest contributor to the economies and rural livelihoods of the developing countries in Africa (Mwadalu and Mwangi, 2013). It accounts for 35% of the continent's GDP (Gross Domestic Product), 40% of export earnings and 70% of employment (Nyange *et al.*, 2011). Over 70% of people in the rural areas depend on agriculture. Agriculture plays a crucial role in terms of job creation, food security and poverty alleviation (Cervantes-Godoy and Dewbre, 2010; Hazell *et al.*, 2007). Interventions such as provision of improved production technology and inputs are important for ensuring sustained agricultural production and food security (Nyange *et al.*, 2011).

Most of the rural households, which are largely women – dominated, depend on agriculture for their livelihood and well-being and are involved in subsistence agriculture which is characterised by mixture of animal and crop production (Gautam and Andersen, 2016; Shackleton *et al.*, 2001) .Smallholder farming is characterised by outdated technology and this makes it labour intensive. It is also characterised by use of indigenous knowledge in agronomic practices (Hove and Gweme, 2018).Subsistence farmers produce crops and raise animals for their families and sometimes sell the surplus. In South Africa, traditional crop and seed (including vegetative propagules) production play a vital role in livelihood of smallholder farmers. Production of traditional seeds and crops by small-scale farmers can be classified as informal production system (Almekinders, 2000; McGuire and Sperling, 2016). An understanding of crop and seed production systems of smallholder farmers can allow the development of technologies and strategies that are in farmers' production capabilities and that also suit their cultural values and beliefs.

1.2 Motivation

Smallholder farmers grow seeds and save them for the next production season. Seed quality is not guaranteed as seeds are not produced under proper seed production practices. Smallholder farmers grow crops to feed their families and sell the surplus to their local communities to earn income. Building sustainable food production systems in developing countries requires an increase in agricultural productivity of smallholder famers (Asenso-Okyere, 2009). The fact that informal seed and cropping systems are neglected by researchers, plant breeders and policy makers has led to underutilization of many crop species (Idowu,

2008). The agricultural sector needs to recognize the importance of smallholder subsistence farming and to protect and conserve the traditional knowledge linked to it for future generations (Padulosi *et al.*, 2013). There is a need to study and understand smallholder subsistence production, factors affecting it, contribution of smallholder subsistence farming to household food security and how the challenges facing smallholder subsistence farming can be addressed.

1.3 Problem statement

Smallholder subsistence farming improves agricultural production, which has an implication for farm income. Improvement of farm incomes can increase purchasing power and improve food access and livelihoods. An understanding of production, consumption, food security, marketability and profitability of smallholder subsistence farming can be accomplished by means of proper and purposeful research (Mashamaite, 2014). Seed quality is one of the major constraints that limit smallholder subsistence farm production. Smallholder farmers are faced with challenges which prevent them from selling their produce in the market. These challenges include meeting quality and quantity requirements, postharvest management, transportation, etc. The option is to sell in local communities at cheaper prices and receive less income, greater home consumption, crop losses and poor food security due to limited access to a variety of nutritional food.

1.4 Aim and objectives

It was hypothesised that smallholder farmers practicing subsistence agriculture in KwaZulu-Natal are characterised by inadequate seed and crop systems for successful production and food security. It is important to know how subsistence production systems work so that new ways and strategies can be developed to help farmers produce crops and seeds in a sustainable and economically feasible way. Therefore, the aim of the study was to understand how smallholder subsistence production systems function in selected communities of KwaZulu-Natal, South Africa.

The specific objectives were to:

- To identify and map out the key set of constraints facing smallholder farmers in relation to local seed systems, agricultural production and farming practices.
- Provide implications on socio-economic factors among food security
- Determine major and minor crops produced by rural smallholder farmers,

- Determine how postharvest management and crop production contribute to food security.

1.5 Chapter Overview

In Chapter 1, the research background, problems, motivation, objectives and the hypothesis were presented. In Chapter 2, literature on household food security, seed production systems, farming practices and marketing of the produce, were reviewed. Chapter 3, presents research findings from the initial survey of 162 households in eight selected rural areas in KwaZulu-Natal's two regions; the study was about understanding homestead crop production and seed systems in the selected rural communities. Chapter 4 was about giving in-depth and focussed analysis on consumption and marketing of produce by examining a sub-sample of 56 farmers from the three rural areas out of the initial eight. The conclusions, summary and policy recommendations from the findings of the study were presented in Chapter 5, which was concluded by recommending areas for further study.

REFERENCES

Almekinders, C. 2000. The importance of informal seed sector and its relation with the legislative framework. *GTZ-Eschborn*.

Asenso-Okyere, K. 2009. Building capacity to increase agricultural productivity and incomes of poor small-scale farmersIntl. *Food Policy Res Inst*.

Cervantes-Godoy, D. and Dewbre, J. 2010. Economic importance of agriculture for poverty reduction.

Gautam, Y. and Andersen, P. 2016. Rural livelihood diversification and household well-being: Insights from Humla, Nepal. *Journal of Rural Studies* 44: 239-249.

Hazell, P.B., Poulton, C., Wiggins, S. and Dorward, A. 2007. The future of small farms for poverty reduction and growthIntl Food Policy Res Inst.

Hove, M. and Gweme, T. 2018. Women's food security and conservation farming in Zaka District-Zimbabwe. *Journal of Arid Environments* 149: 18-29.

Idowu, O. O. 2008. Contribution of neglected and underutilized crops to household food security and health among rural dwellers in Oyo State, Nigeria. International Symposium on Underutilized Plants for Food Security, Nutrition, Income and Sustainable Development 806.

Mashamaite, K.A. 2014. The contributions of smallholder subsistence agriculture towards rural household food security in Maroteng Village, Limpopo Province. University of Limpopo, Turfloop Campus.

Mcguire, S. and Sperling, L. 2016. Seed systems smallholder farmers use. *Food Security* 8: 179-195.

Mwadalu, R. and Mwangi, M. 2013. The potential role of sorghum in enhancing food security in semi-arid eastern Kenya: A review. *Journal of Applied Biosciences* 71: 5786-5799.

Nyange, N., Kingamkono, R., Kullaya, A. and Mneney, E. 2011. Biotechnology for sustainable agriculture, food security and poverty reduction in Africa. *Access Not Excess ed Charles Pasternak*: 19-30.

Padulosi, S., Thompson, J. and Rudebjer, P. 2013. Fighting poverty, hunger and malnutrition with neglected and underutilized species: Needs, challenges and the way forward. *Bioversity International*.

Shackleton, C.M., Shackleton, S.E. and Cousins, B. 2001. The role of land-based strategies in rural livelihoods: the contribution of arable production, animal husbandry and natural

resource harvesting in communal areas in South Africa. *Development Southern Africa* 18: 581-604.

CHAPTER 2

LITERATURE REVIEW

2.1 State of food security in rural areas of South Africa

The United Nation's definition of food security is that everyone must always have adequate access to food in order to be healthy and thus actively involved in a sustainable livelihood (FAO, 2010). Although South Africa is regarded as being food secure at a national level, food insecurity is still a major challenge for many households and individual persons (Labadarios *et al.*, 2011). The country is experiencing nutritional and epidemiological transition (25% of children under the age of 3 years are stunted and 40% women are obese) (Popkin *et al.*, 2001). Since rural communities are more vulnerable to food insecurity, it is necessary to understand the food production – economy – security nexus of their livelihoods.

Food security in rural areas of South Africa households largely depends on cash incomes and government grants, which are not adequate to address all the needs for a healthy sustainable livelihood (Altman *et al.*, 2009). Many studies discovered that people in the rural areas grow crops that are mainly for their survival. Maize, beans and potatoes are the dominant food crops that are easy to cultivate, whereas leafy vegetables (cabbage and Swiss chad) are grown in very limited quantities because of crop failure due to inadequate irrigation water, diseases and pests (Govender, 2016; Mugisha-Kamatenesi *et al.*, 2008).

Production of diverse crops can help to alleviate problems of affordability and availability. Rural households can respond to their production challenges using crop diversification (Makate *et al.*, 2016). Crop diversification is viewed as an essential feature of resilience of farming systems that are faced with economic and environmental challenges. Kisaka-Lwayo and Obi (2012) reported that crop diversification helps farmers to respond to risks they are faced with such as volatile food prices, climate change, low bargaining power and insufficient market information. There are many ways in which farmers can increase production of diverse crops. These can be done by using smallholder farmers' traditional methods and taking into consideration the challenges they are faced with. Households can have gardens in their backyards where organic crops are grown (Kortright and Wakefield, 2011) . Farmers can also form groups to produce crops.

A study conducted by Garikai (2014) to assess production constraints and choice of farming practices, revealed that 82.5% of sub-Saharan farmers practice farming as the main occupation

and for income generation. The study also revealed that in South Africa these farmers did not view farming as their main source of income, but they rely on other sources of income such as pension, social grants, remittances, salaries and wages. If farmers can produce more to sell, they can be able to get income and buy other foods that they cannot produce. Smallholder farmers depend on traditional social networks and mechanisms for marketing crops (Kortright and Wakefield, 2011). This is due to challenges such as lack of information, knowledge and technologies which prevent them from marketing their crops through agricultural market chains. This may lead to smallholder farmers not making much profit, as they sell to their neighbours or local communities at lower prices. It can be concluded that subsistence farming remains an important source of income to rural households and needs to be developed to make it more profitable for farmers.

2.2 Seed production systems

A seed is the first determinant of the future plant development. It is an important and crucial input for crop production (ISTA, 2009). Seed supply occurs in both 'formal 'and 'informal' agricultural systems, where the former are fully commercial and the latter is largely for subsistence purposes (Sperling and Cooper, 2004; Spielman and Kennedy, 2016) . The formal seed system combines nationally produced and imported commercial seed whereas subsistence farming is largely used to provide and maintain local (indigenous and traditional) varieties, leading to crop genetic diversity on the farm (Ndjeunga, Kumar and Ntare, 2006; Meles, 2009). The process of formal seed production (Figure 2.1) starts with plant breeding where desired characteristics of a certain variety are used to produce quality seeds. Maintenance of variety purity and identity as well as the assurance of physiological, physical and hygienic quality occur under regulations (Van Mele and Guéi, 2011).

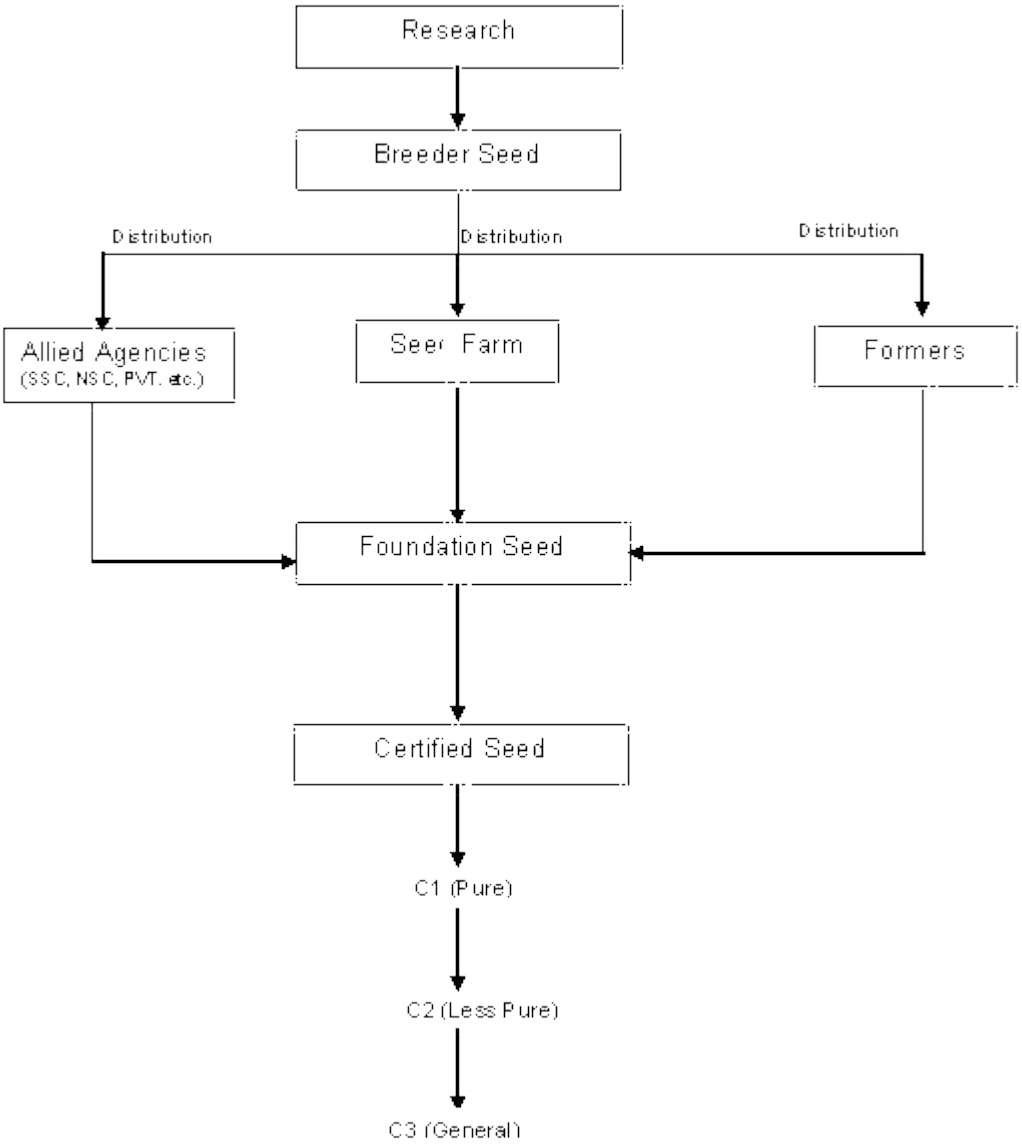

Figure 2.1: A generalised commercial seed certification process (Adapted from SANSOR, 2015).

In South Africa, several smallholder farmers practice informal seed systems. Informal seed systems are categorized by many components, which include (i) farmer self-saved seed of native crops, (ii) informal seed storage, (iii) informal seed markets, and (iv) maintenance of indigenous knowledge base regarding the local system(Gill *et al.*, 2016). It is a dynamic (indigenous, traditional, cultural and flexible) local, national and regional set of communities. This system is more concerned with the production of a diversity of food crops to improve dietary variety in rural areas (Gill *et al.*, 2016). Informal seed systems are noticed as a major source of neglected and underutilized species (NUS), which are important in providing nutrition to rural households (Dansi *et al.*, 2012).

Most of smallholder subsistence farmers live in drought-prone areas and they continue to rely on drought relief and farmer-to-farmer exchange to obtain seed of improved varieties. (Setimela *et al.*, 2004) stated that more than 90% of farmers' necessities are met through these informal channels. It is therefore essential to recognise informal sector as a low-cost source of seed to farmers.

Farmers operating under informal seed systems are faced with a number of challenges which include lack of access to formal institutions and they do not function under effective laws and policies (Khapayi and Celliers, 2016). They do not have enough financial resources to buy production inputs and improved seeds. As a result, they end up depending on seeds that are produced and stored on-farm. Seed management has a decentralised and local character. Seed storing, selection and basic breeding is done on-farm or at community level most often by women. The storage facilities used in informal seed systems are poorly developed and seed production practices are simple. They lack information, knowledge and technologies for quality control and formal certification.

Farmers' needs can be classified according to the crops grown by them, their resource endowments and risk-tolerance capacities (Qi *et al.*, 2018; Venkatesan, 1994). A flexible and effective seed system is needed that will help strategies to respond to farmers' challenges. The value of informal seed sector can be improved in various ways. Setimela *et al*. (2004) outlined three main strategies which are (i) upgrading traditional varieties, (ii) creating a bridge linking the informal and formal systems, and (iii) seeking help from government agencies. Upgrading traditional varieties includes training of farmers for better storage, selection and treatments. The training can assist them to increase crop production through effective use of their own saved seeds (Monyo *et al.*, 2004). Famers involved in some experimentation, need to be encouraged to select, multiply and store quality traditional varieties. Morden varieties at research stations, could be used to make quality seeds through either informal or formal systems (Ochs *et al.*, 2017). This strategy allows farmers that use traditional seeds to obtain them at affordable prices locally in their communities. Government agencies can help informal sector in various ways. They can provide them access to extension guidance on seed production, storage and treatment, processing, certification of seeds and legal framework that allows marketing of quality approved seeds (Almekinders *et al.*, 1994; SANSOR, 2015).

2.3 Seed quality

It is crucial to determine seed quality as seed serves as a prerequisite in attaining good a crop stand (Milošević *et al.*, 2010). However, seed quality assessment or control by research is more pronounced under the formal seed sector than informal seed sector. As discussed, farmers use their traditional methods and knowledge to select and store seeds. Seed quality includes health, physiological and physical attributes (CRS, 2014). A good quality seed can be determined by many characters which are strong germination capacity, seed size uniformity, genetic purity (including absence of other seed type, weed or other foreign objects) and freedom from seed borne diseases (Hartmann and Kester, 1975; Joshi *et al.*, 2015). Important aspects of seed quality include viability and vigour (ISTA, 2012; SANSOR, 2015).

Seed viability is a measure of how many seeds are alive and are capable of germinating, given the appropriate favourable conditions (ISTA, 2012). Breaking dormancy is essential as it differentiates viable, non-viable and physically or physiologically dormant seeds. A dormant seed is that which cannot germinate given suitable environments. A non-viable seed is a dead seed that fails to sprout even under treatment of dormancy. A farmer in informal seed sector, does not measure seed viability under laboratory methods, but defines viability by the ability of a seed lot to produce a healthy crop. Plant breeders and researchers use certain methods to determine viability, which include conductometric measurements, Tetrazolium test (TZ), respiration and enzyme activity. The most commonly used method is the tetrazolium test (TZ), which is done before germination test in the laboratory. Figure 2.2 shows viable and non-viable seeds.

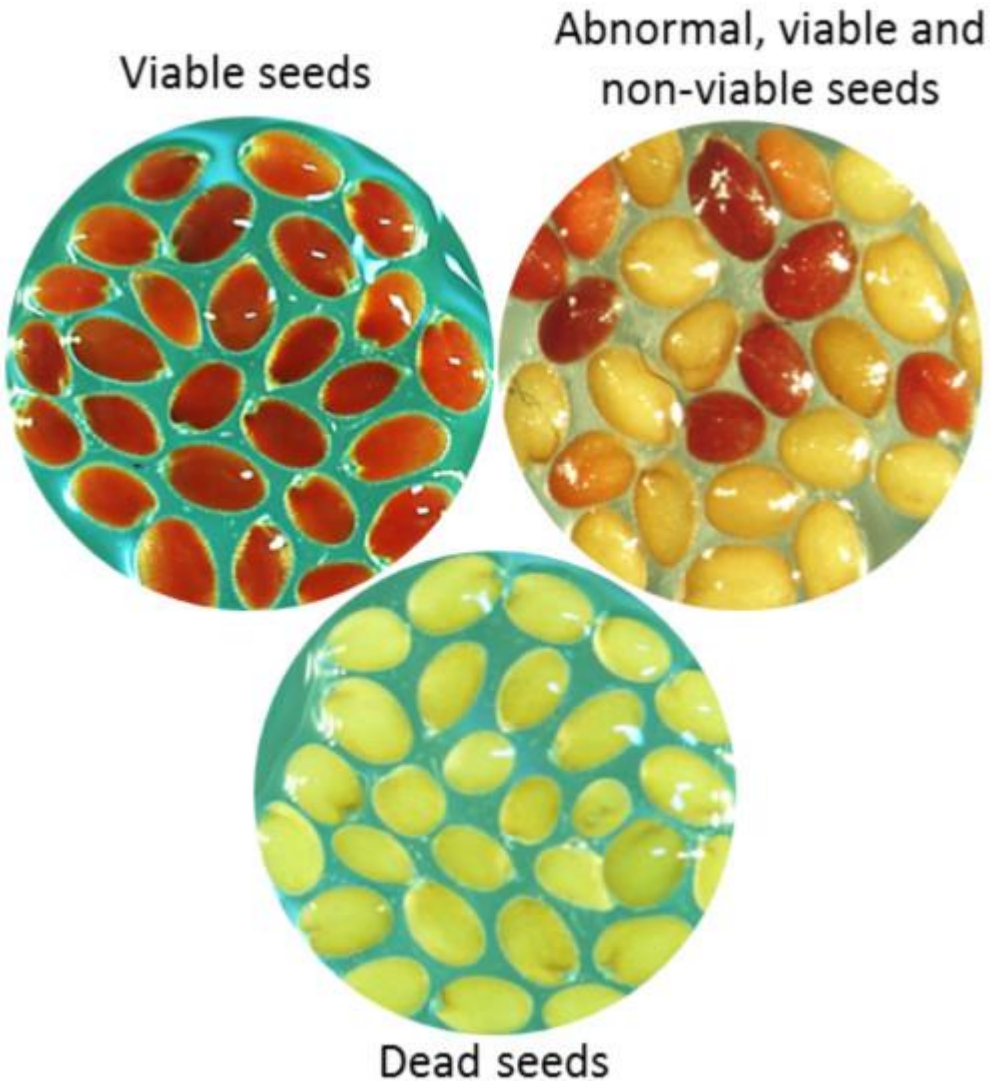

Figure 2. 2: Illustration of a TZ seed viability test (ISTA, 2012)

Seed vigour is the sum of those seed properties that measure the level of activity of seeds or seed lots during the germination process (ISTA, 1976). Seed vigour is the seed quality component that influences crop plant establishment and yield. Vigorous seedlings are characterized by their ability to germinate and grow well. When the seed is vigorous, it is whereby it can germinate under a wide range of environmental conditions (temperature and soil moisture). It is often difficult to determine the potential vigour of the seed as it is affected by many external factors such as soil type, weather conditions, planting depth and pest and diseases. According to ISTA (2012), seed vigour tests must meet certain criteria to have accuracy. The method that is used must be repeatable (it must show adequate uniformity) and, the result obtained during seed vigour test must be highly correlated to seedling tests. To

determine seed vigour various tests can be used which include physical (e.g. seedling size) and physiological (e.g. enzyme activity) seed quality.

The physiological test is usually done before doing other tests; it is fast and does not require expensive equipment. The physical tests include the germination and growth factors. Both tests can be done under controlled environments (test of growth intensity and standard laboratory germination) and it can be done under adverse environmental conditions (accelerated aging test, cold test and Hiltner test).

2.4 Factors that affect seed quality

The quality of seeds is measured as an essential factor for increasing yield. Seeds of high quality have a reliable ability to utilize other inputs such as irrigation and fertilizers (Jönsson and Rådman, 2012) . Seed quality can be affected by crop management and abiotic factors during storage, crop production and post-harvest (Mathew Kwadwo, 2010). The factors can include genetic, environmental or physical factors.

2.4.1 Production factors

Environmental or production factors have been considered to have influence on quality and development of the seed. The environmental factors include soil fertility, moisture supply and climate change. Climate change is one of the environmental factors that have the major effect on seed quality (Campbell *et al.*, 2016; Das, 2005). Climate change is also the factor that is relevant under informal seed production as most of the farmers live and produce their seeds in drought prone areas (Stringer *et al.*, 2009). Severe shortages of water supply can lead to temporal damages, but drought can have disastrous effects. When there is drought, water deficit becomes the major stress in crop production (Hlavinka *et al.*, 2009). Water deficit during seed development period disturbs seed growth resulting in wrinkled, light seeds. Climate change during seed development and maturation can influence the degree of dormancy of the mature seeds (Delouche, 1980; MacGregor *et al.*, 2015). Late maturation and harvest periods during seed production are favoured by arid, dry season, and irrigated areas.

Physiological maturity of grain seeds is normally achieved at moisture contents ranging from 32-35% (e.g., sorghum, rice, maize) to 50-55% (e.g., common bean, soybeans, and groundnuts). This is followed by the drying of the seed (maturity). Just before and during physiological maturity, drought or water stress can have adverse effect on seed quality. According to Bewley *et al.* (2006) water stress caused changes in metabolic reactions, which

influenced reserve deposition to the developing embryo and lead to reduced seed quality. Studies on peas and soybean stated that water deficit on seed quality during seed filling stage decreased seed quality determined by conductivity and germination results (Leisner *et al.*, 2017; Vieira *et al.*, 1992). There are other crops which can withstand water stress. (Pervez *et al.*, 2009) reported that water limitations did not affect seed quality and vigour of tomato seed, but it had impact on growth of tomato. Studies on Bambara groundnut found different and contradicting results on how water stress affected seed quality (Chibarabada *et al.*, 2015; Zondi, 2013). Zondi (2013)found that water stress had positive effect on subsequent seed quality, while, Chibarabada *et al.* (2015) found that water stress had negative effect on seed quality.

2.4.2 Harvesting factors

The major objective during seed harvest and subsequent storage is to produce enough seeds that can able to develop fast and uniformly from seedbeds after planting, in order to produce a uniform crop stand of rapidly-growing and healthy seedlings(Finch-Savage and Bassel, 2015). Harvesting factors that affect seed quality can include time of harvest, methods of harvest and stages of maturity. Delouche (1980) conducted a study on how harvest time affects seed quality on faba bean, lentil, pea and chickpea. The study focused on physiological and age testa quality, as these two components were used to determine seed quality of these crops, and both are influenced by time of harvest. The results revealed that excessive delay in harvest can reduce seed quality. The testa lost moisture and became impermeable. Delays in harvest caused loss of seeds from pod dehiscence. According to Sibhatu and Qaim (2017) one week delay of harvest in pea and lentil seeds can reduce germination by 30% and 20%, respectively. Harvest maturity is reached by the seed when moisture content is between 10% and 15%.

2.4.3 Post-harvest factors

Postharvest quality of seeds usually starts from the field or under pre-harvest factors until it reaches the final user. The quality of seeds after harvest cannot be easily improved using postharvest treatment techniques or handling practices but can be maintained. It is important to understand and manage the different roles of production or pre-harvest factors (e.g., cultivar selection, irrigation, and maturity stage and fertilizer application) as they can play important roles in seed quality. The postharvest factors that affect seed quality include harvesting, transportation, storage, grading, packaging and labelling (Arah *et al.*, 2015; Kiaya, 2014).

Most of the studies conducted found that storage is an important post-harvest factor in seed quality for small scale farmers. “Storage is the art of keeping the quality of agricultural materials and preventing them from deterioration for a specific period of time, beyond their normal shelf life” stated Kaiya (2014). Different kinds of crops are harvested and stored for variously depending on the end use aim. For the long and effective storage hygiene, facilities and monitoring must be adequate. In closed storages (silos, warehouses, and hermetic bins) it is important to control cleanliness, temperature and humidity. It is also crucial to manage pests and diseases since their damage can lead to corrosion of facilities which could result to losses in quality and food value. Proper temperature management between the period of harvesting and consumption has been found to be the most effective way to maintain quality.

In developing countries, the circumstances that smallholder farmers live under made them to select storage systems which are cheap and easy to construct, irrespective of their inadequacy in maintain high quality seed (Obetta and Daniel, 2007). There are many factors that affect farmers’ choice of the storage methods which include availability of the materials, cost and expertise of building the storage facilities as well as the type of pest problems in the area and climatic conditions of the areas (Ayers and Westcot, 1985). The most commonly used storage methods by smallholder farmers include sacks, cribs, baskets, silos, underground pits and roof storage. Mboya (2011) conducted a study to assess the effect of storage method on the quality of maize in rural areas of Tanzania. The study revealed that roof and sack storage were commonly used by farmers and the quality of maize was affected by pests and insects. It was recommended that before storage rapid drying must be done, to avoid moisture content problems.

Seed transportation also plays a crucial role in quality of the seed. Seed potatoes seeds are often transported for a long distance, according to Potatoes South Africa (2015) there are three basic requirement that need to be taken into consideration when transporting seeds. The temperature in the transport must be adequate, the seed must be retained dry and there must be enough ventilation. To avoid damage and hurting of the seeds and workers should not walk or stand on top of the seeds. After harvest, fresh produce can be transported from the farm to either the market or packing house (Kiaya, 2014). Most of the fresh produce are sold in an unpacked form, which could reduce its shelf life if not sold quickly.

2.5 Farm produce marketing

Farm produce marketing is a formalised system that can be directed from seed producer to farmer, or via a chain of actors including distributors, merchants and agro-dealers (Shepherd, 2007). The aim of marketing is to identify, anticipate and satisfy the need of seed users and achieve objectives of suppliers (Teklewold *et al.*, 2012). To farmers, marketing means selling or exchanging what they produce on the farm to other farmers, neighbours or local community. To a retailer, marketing means promoting goods and services to their consumers. Farm produce marketing can be done internationally, nationally, regionally and locally.

International marketing is aimed at increasing farm produce supply across the world. For international farm produce sector to be reinforced, it is important that agricultural players such as enterprises and seed and crop growers obey the rules and regulation that assure quality standards and suitable regulatory features (OECD, 2012). The Organisation for Economic Co-operation and Development (OECD) is an organisation that helps to promote competitive farm produce markets and lessens barriers to trade. International farm produce marketing has major procedures that need to be followed before produced are imported or exported such as seed certification, seed testing and phytosanitary measures (FAO, 2011).

Smallholder farmers are faced with numerous constraints that prevent their participation and benefit from agricultural market chains. Therefore, international farm produce marketing is more pronounced under commercial production systems than subsistence system. The study conducted by Wiggins and Keats (2013) by assessed farmers market chain and revealed that smallholder farmers lack skills, information and knowledge in marketing and production to compete in international markets. They also have restricted financial capital for investments and do not have much strength to benefit from opportunities in domestic and international market chains(Mwesigye, 2006).

FAO (2008) and MPEDA (2008) compiled findings on experiences with smallholder farmers. The results revealed many reasons that limit farmers from participating in modern market chains and seed certification. Farmers operate in small or large groups. It is difficult to be organized into groups and to be formally licensed or registered. They produce low volume of products which has a negative effect on their market incentives. FAO (2008) reported that other reasons for farmers not to participate in complex marketing may include risk aversion, fear of cost and business structures poorly organised to meet market standards.

Smallholder farmers operating under informal production systems depend on traditional social networks and mechanisms for marketing their produce. Most smallholder farmers use barter, traditional labour payment or gifts to exchange or obtain seeds and crops (Almekinders, 2000). Most seed exchange takes place within the community, between members within the same social class and ethnic group. Monyo *et al.* (2004) conducted a study to assess farmer-to-farmer seed movements in Zimbabwe. The results revealed that the village market trades were dominated by free gifts. Almost 80% of the sorghum and pearl millet were exchanged free of charge. Most of smallholder farmers are price takers and do not have much power to influence market decisions.

The chances of smallholder farmers to participate in the market and increase their earnings mainly depends on their ability to compete in the market. However, there are limiting constrains in rural markets of developing countries (Barham and Chitemi, 2009) . Barham & Chitemi (2009)conducted a study to assess how collective action by farmers can fill the gap of market imperfection. Findings showed that collective action can bring up new opportunities for smallholder farmers. It can help by creating entry ways into new markets or introducing improvements to prevailing value chains. New demand for traditional products can be developed through value-adding strategies and processing; this has been proven to be an innovative strategy to obtain better prices (Gruère *et al.*, 2015).

2.6 Conclusion

Food insecurity remains a major issue in South Africa especially in rural areas. Seed supply occurs in both formal and informal systems. This review showed that seed quality assessment is more pronounced under formal seed systems compared with the informal sector. Seed quality under smallholder farming is negatively affected by crop management and abiotic factors during production and post-harvest. The review showed that farmers under informal system market their produce through traditional networks. This is due to challenges such as lack of information, knowledge and technologies which prevent them from marketing their seeds and crops through formal systems. This may lead to smallholder farmers not making much profit, as they sell to their neighbours or local communities at lower prices. They sometimes exchange seeds with other farmers to get other inputs. It can be concluded that informal seed system remains an important seed system and needs to be developed to make it more profitable for farmers. The existing policies and interventions need to be revised and monitored to ensure their implementation. Therefore, a combination of production and economic analysis of smallholder/subsistence farming system is needed.

REFERENCES

Almekinders, C. 2000. The importance of informal seed sector and its relation with the legislative framework. *GTZ-Eschborn.*

Almekinders, C.J., Louwaars, N.P. and De Bruijn, G. 1994. Local seed systems and their importance for an improved seed supply in developing countries. *Euphytica* 78: 207-216.

Altman, M., Hart, T.G. and Jacobs, P.T. 2009. Household food security status in South Africa. *Agrekon* 48: 345-361.

Arah, I.K., Amaglo, H., Kumah, E.K. and Ofori, H. 2015. Preharvest and postharvest factors affecting the quality and shelf life of harvested tomatoes: a mini review. *International Journal of Agronomy* 2015.

Ayers, R.S. and Westcot, D.W. 1985. Water quality for agricultureFood and Agriculture Organization of the United Nations Rome.

Barham, J. and Chitemi, C. 2009. Collective action initiatives to improve marketing performance: Lessons from farmer groups in Tanzania. *Food policy* 34: 53-59.

Bewley, J.D., Black, M. and Halmer, P. 2006. The encyclopedia of seeds: science, technology and usesCabi.

Campbell, B.M., Vermeulen, S.J., Aggarwal, P.K., Corner-Dolloff, C., Girvetz, E., Loboguerrero, A.M., Ramirez-Villegas, J., Rosenstock, T., Sebastian, L. and Thornton, P.K. 2016. Reducing risks to food security from climate change. *Global Food Security* 11: 34-43.

Chibarabada, T., Modi, A. and Mabhaudhi, T. 2015. Bambara groundnut (Vigna subterranea) seed quality in response to water stress on maternal plants. Acta Agriculturae Scandinavica, *Section B—Soil & Plant Science* 65: 364-373.

Catholic Relief Services (CRS), C. 2014. Catholic Relief Services, Testing Maize Seed Quality. .

Dansi, A., Vodouhè, R., Azokpota, P., Yedomonhan, H., Assogba, P., Adjatin, A., Loko, Y., Dossou-Aminon, I. and Akpagana, K. 2012. Diversity of the neglected and underutilized crop species of importance in Benin. *The scientific world journal* 2012.

Das, H.P. 2005. Agricultural drought mitigation and management of sustained agricultural development in India. *Natural Disasters and Extreme Events in Agriculture. Springer*. p. 277-303.

Delouche, J.C. 1980. Environmental effects on seed development and seed quality.

Food and Agriculture Organization (FAO). 2008. Asia Pacific Regional Aquaculture Review – A Regional Synthesis. *FAO, Rome, Italy*.

Food and Agriculture Organization (**FAO). 2011**. The state of food and agriculture. www.fao.org

Finch-Savage, W.E. and Bassel, G.W. 2015. Seed vigour and crop establishment: extending performance beyond adaptation. *Journal of Experimental Botany* 67: 567-591.

Garikai, M. 2014. Assessment of vegetable postharvest losses among smallholder farmers in Umbumbulu area of Kwazulu-Natal province, South Africa. Citeseer.

Gill, T.B., Bates, R., Bicksler, A., Burnette, R., Ricciardi, V. and Yoder, L. 2016. Strengthening informal seed systems to enhance food security in Southeast Asia. *Journal of Agriculture, Food Systems, and Community Development* 3: 139-153.

Govender, L., Pillay, K., Siwela, M., Modi, A., & Mabhaudhi, T. 2016. Food and Nutrition Insecurity in Selected Rural Communities of KwaZulu-Natal, South Africa—Linking Human Nutrition and Agriculture. *International journal of environmental research and public health*, 14(1), 17.

Gruère, G.P., Nagarajan, L. and King, E. 2015. Collective action and marketing of underutilized plant species.

Hartmann, H.T. and Kester, D.E. 1975. Plant propagation: principles and practicesPrentice-Hall.

Hlavinka, P., Trnka, M., Semeradova, D., Dubrovský, M., Žalud, Z. and Možný, M. 2009. Effect of drought on yield variability of key crops in Czech Republic. *Agricultural and forest meteorology* 149: 431-442.

International Seed Testing Association (ISTA). 1976. Handbook for Vigour Tests, International Seed Testing Association, Switzerland. .

International Seed Testing Association (ISTA). 2009. International Rules for Seed Testing. International Seed Testing Association, Switzerland.

International Seed Testing Association (ISTA). 2012. International Seed Testing Association, Bassersdorf, Switzerland.

Jönsson, T. and Rådman, M. 2012. Economic impact of fertilizers and improved seeds among smallholder farming systems in Central and Western Kenya.

Joshi, M.A., Arun Kumar, M., Kumar, A. and Lal, S.K. 2015. Training Manual: Seed Standards and Legal Aspects, 05-06thMay 2015. Division of Seed Science and Technology, ICAR-Indian Agricultural Research institute, New Delhi. India. *TB-ICN* 149.

Khapayi, M. and Celliers, P. 2016. Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. *South African Journal of Agricultural Extension* 44: 25-41.

Kiaya, V. 2014. Post-harvest losses and strategies to reduce them. Technical Paper on Postharvest Losses, Action Contre la Faim (ACF).

Kisaka-Lwayo, M. and Obi, A. 2012. Risk perceptions and management strategies by smallholder farmers in KwaZulu-Natal Province, South Africa. I*nternational Journal of Agricultural Management* 1: 28-39.

Kortright, R. and Wakefield, S. 2011. Edible backyards: a qualitative study of household food growing and its contributions to food security. *Agriculture and Human Values* 28: 39-53.

Labadarios, D., Mchiza, Z.J.-R., Steyn, N.P., Gericke, G., Maunder, E.M.W., Davids, Y.D. and Parker, W.-A. 2011. Food security in South Africa: a review of national surveys. *Bulletin of the World Health Organization* 89: 891-899.

Leisner, C.P., Yendrek, C.R. and Ainsworth, E.A. 2017. Physiological and transcriptomic responses in the seed coat of field-grown soybean (Glycine max L. Merr.) to abiotic stress. *BMC plant biology* 17: 242.

Macgregor, D.R., Kendall, S.L., Florance, H., Fedi, F., Moore, K., Paszkiewicz, K., Smirnoff, N. and Penfield, S. 2015. Seed production temperature regulation of primary dormancy occurs through control of seed coat phenylpropanoid metabolism. *New Phytologist* 205: 642-652.

Makate, C., Wang, R., Makate, M. and Mango, N. 2016. Crop diversification and livelihoods of smallholder farmers in Zimbabwe: adaptive management for environmental change. *SpringerPlus* 5: 1135.

Mathew Kwadwo, O. 2010. Response Of Bambara Groundnut Landraces To Heat And Drought Stress In The Guinea Savanna And Transition Zones Of Ghana.

Mboya, R. 2011. A Study of the Effects of Storage Methods on the Quality of Maize and Household Food Security in Rungwe District, Tanzania. Citeseer.

Milošević, M., Vujaković, M. and Karagić, Đ. 2010. Vigour tests as indicators of seed viability. *Genetika* 42: 103-118.

Monyo, E., Mgonja, M. and Rohrbach, D. 2004. An analysis of seed systems development, with special reference to smallholder farmers in southern Africa: Issues and challenges.

Correct citation: Setimela, PS, E. Monyo, and M. Bänziger (eds). 2004. Successful Community-Based Seed Production Strategies. Mexico, DF: *CIMMYT*.: 3.

Monyo, E., Rohrbach, D. and Mgonja, M. 2004. New Partnerships to Strengthen Seed Systems in Southern Africa: Innovative Community/commercial Seed Supply Models 4. Correct citation: Setimela, PS, E. Monyo, and M. Bänziger (eds). 2004. Successful Community-Based Seed Production Strategies. Mexico, DF: *CIMMYT*.: 11.

Marine Product Export Development Authority (MPEDA). 2008. Action plan for development of export oriented aquaculture in maritime states of India. *MPEDA, Cochin*, pp. 72.

Mugisha-Kamatenesi, M., Deng, A., Ogendo, J., Omolo, E., Mihale, M., Otim, M., Buyungo, J. and Bett, P. 2008. Indigenous knowledge of field insect pests and their management around Lake Victoria basin in Uganda. *African Journal of Environmental Science and Technology* 2: 342-348.

Mwesigye, F. E. 2006. The roles of government in supporting small rural producers reach new markets and supply chains: the experience of Uganda. United Nations Conference on Trade and Development (UNCTAD) conference "Enabling small commodity producers in developing countries to reach global markets", December.

Obetta, S. and Daniel, C. 2007. Preliminary investigation into some quality control indices for selected stored grains in Makurdi, Nigeria.

Ochs, M., Andrews, C., Downs, A., Morris-Knower, J. and Young, S. 2017. Research Practices and Support Needs of Scholars in the Field of Agriculture at Cornell University. *Journal of Agricultural & Food Information* 18: 200-219.

Organisation for Economic Co-operation and Development (OECD). 2012. Seed Scheme, OECG.org.

Pervez, M., Ayub, C., Khan, H., Shahid, M. and Ashraf, I. 2009. Effect of drought stress on growth, yield and seed quality of tomato (*Lycopersicon esculentum L*.). *Pak. J. Agri. Sci* 46: 174-178.

Popkin, B.M., Horton, S., Kim, S., Mahal, A. and Shuigao, J. 2001. Trends in diet, nutritional status, and diet-related noncommunicable diseases in China and India: the economic costs of the nutrition transition. *Nutrition reviews* 59: 379-390.

Qi, X., Wang, R.Y., Li, J., Zhang, T., Liu, L. and He, Y. 2018. Ensuring food security with lower environmental costs under intensive agricultural land use patterns: A case study from China. *Journal of environmental management* 213: 329-340.

South African National Seed Organization (SANSOR). 2015. Seed Certification. http://sansor.org/seed-certification/ (Accessed on 3o November 2017).

Setimela, P.S., Monyo, E. and Bänziger, M. 2004. Successful community-based seed production strategies*CIMMYT*.

Shepherd, A. 2007. Approaches to linking producers to marketsFood & Agriculture Org.

Sibhatu, K.T. and Qaim, M. 2017. Rural food security, subsistence agriculture, and seasonality. *PloS one* 12: e0186406.

Sperling, L. and Cooper, D. 2004. Understanding seed systems and strengthening seed security: A background paper. *Towards effective and sustainable seed relief activities*: 7-33.

Spielman, D.J. and Kennedy, A. 2016. Towards better metrics and policymaking for seed system development: Insights from Asia's seed industry. *Agricultural systems* 147: 111-122.

Stringer, L.C., Dyer, J.C., Reed, M.S., Dougill, A.J., Twyman, C. and Mkwambisi, D. 2009. Adaptations to climate change, drought and desertification: local insights to enhance policy in southern Africa. *Environmental Science & Policy* 12: 748-765.

Teklewold, A., Alemu, D., Kiyoshi, S. and Kirub, A. 2012. Seed Demand Assessment. Practices, Challenges, and Options, FRG II Project Empowering Farmers' Innovation. EIAR/FRG, Addis Ababa.

Van Mele, P. and Guéi, R.G. 2011. African seed enterprises: sowing the seeds of food securityCABI.

Venkatesan, V. 1994. Seed systems in sub-Saharan Africa: issues and optionsThe World Bank.

Vieira, R.D., Tekrony, D. and Egli, D. 1992. Effect of drought and defoliation stress in the field on soybean seed germination and vigor. *Crop Science* 32: 471-475.

Wiggins, S. and Keats, S. 2013. Leaping and Learning: Linking smallholders to markets in Africa.

Zondi, L.Z. 2013. Responses of bambara groundnut (Vigna subterranea L. Verdc) landraces to field and controlled environment conditions of water stress. MSc thesis, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

CHAPTER 3

UNDERSTANDING HOMESTEAD CROP PRODUCTION AND SEED SYSTEMS OF SELECTED RURAL COMMUNITIES IN KWAZULU-NATAL

3.1 Introduction

KwaZulu-Natal is considered as a major agricultural province in South Africa (Nxumalo and Oladele, 2013). KwaZulu-Natal agricultural production is mainly dominated by smallholder farmers. Jacobs *et al*. (2009) reported that 65% of the provincial population is estimated to be involved in agricultural production. Many studies reported that smallholder subsistence farming is highly diverse as it involves many activities such as livestock and crops production(Sibhatu and Qaim, 2017).

KwaZulu-Natal has a wide range of natural resources that permits variety of crops. Crops that are mainly produced in KwaZulu-Natal are maize, potatoes, beans, groundnuts and taro (Govender *et al.*, 2013).Kirsten (1998) reported that 92.5% of rural households produced maize, 57.2% produced dry beans, 32.8% cabbage and 54.9% produced potatoes. It is not well documented on what motivates smallholder farmers to produce these crops and there is less information on seed subsistence.

There are a number of factors that affect crop production by smallholder farmers. Seed quality is one of the major constrains that limit rural production. Farmers use their traditional methods to select, determine and store seeds. These methods influence seed quality. Therefore, the aim of this chapter was to determine crop production and seed systems in rural areas of KwaZulu-Natal. The objectives of this chapter were to determine major crops grown by farmers, major sources of seeds, seed storage devices and to determine smallholder farmers' perception on seeds quality from the selected rural areas of KwaZulu-Natal.

3.2 Materials and Methods

3.2.1 Description of KwaZulu-Natal

The study was conducted in the eight communal rural areas of KwaZulu-Natal (Nungwane, Deepdale, Swayimane, Nhlazuka, Vulindlela, Ogagwini, Mvuzane, Umbumbulu and Emaswazini). The rural areas mentioned above are populated by smallholder subsistence farmers who mainly depend on agricultural and livestock farming for their livelihoods. These

rural areas were selected because they are representative of the socio-economic, bio resources and demographics conditions of the midlands and coastal lands of KwaZulu-Natal. They were grouped into two districts (uMgungundlovu and Ethekwini) (Figure 3.1).

UMgungundlovu District Municipality is in the KwaZulu-Natal Midlands. The district consists of the seven local municipalities which are associated with towns (Mpofana – Mooi River, Impendle – Impendle, Mkhambathini – Camperdown, Msunduzi – Pietermaritzburg, uMngeni – Howick, Richmond – Richmond and uMshwathi – New Hanover/Wartburg. The midlands region of KwaZulu-Natal is an inland area extending between the low-lying coastal strip of the Indian Ocean and the high altitude of the Drakensberg escarpment. Five rural areas from midlands region were selected for the study: Swayimane, Emaswazini, Deepdale and Nhlazuka. These rural areas were selected based on bio resource, socio-economic and demographic groups.

The midlands region has average rainfall of 600 – 1200 mm. Swayimane area rainfall differs between 600 - 1100 mm. Deepdale receives annual rainfall of 650 – 850 mm and Emaswazini receives an average of 929 mm rainfall annually. The areas are located in the bio resource group called humid midlands in the mist belt (Lembede, 2017). Average temperature ranges between 11.8°C and 24.0°C in the midlands. Swayimane have a mean temperature of 17 °C (Lembede, 2017). Climate in midlands is relatively hot, wet and cool in summer and dry in winters. The soil type is clay loam soil which is fertile.

Ethekwini district is in KwaZulu-Natal coastal regions. The district consists of local municipalities including Umbumbulu area. Umbumbulu area is situated in the south-east part of Durban. It has 25 smaller districts. Four selected areas (Ogagwini, Mvuzane, Nugwane and Odidini) are located at Umbumbulu area. This area can accommodate more than a quarter of a million people.

Umbumbulu has the average rainfall of 956 mm per annum. It is a moist and arable fertile area which makes it more productive (Garikai, 2014). Although the rainfall occurs throughout the year, the main rainfall is between November and March. Modi *et al*., (2006) reported that smallholder farming begins in September/October, when rainfall is about to start. Umbumbulu have the maximum temperature of 24.0°C and minimum temperature of 13.4°C (Kisaka-Lwayo & Obi, 2012). Garikai (2014) reported that 15% of the Umbumbulu area had high potential for annual cropping and 9% was fertile but less favourable for annual planting.

However, Umbumbulu climate was reported to be suitable for wide variety of crops and crops can be grown in all seasons. As a result, subsistence agriculture in this area is mostly rain-fed.

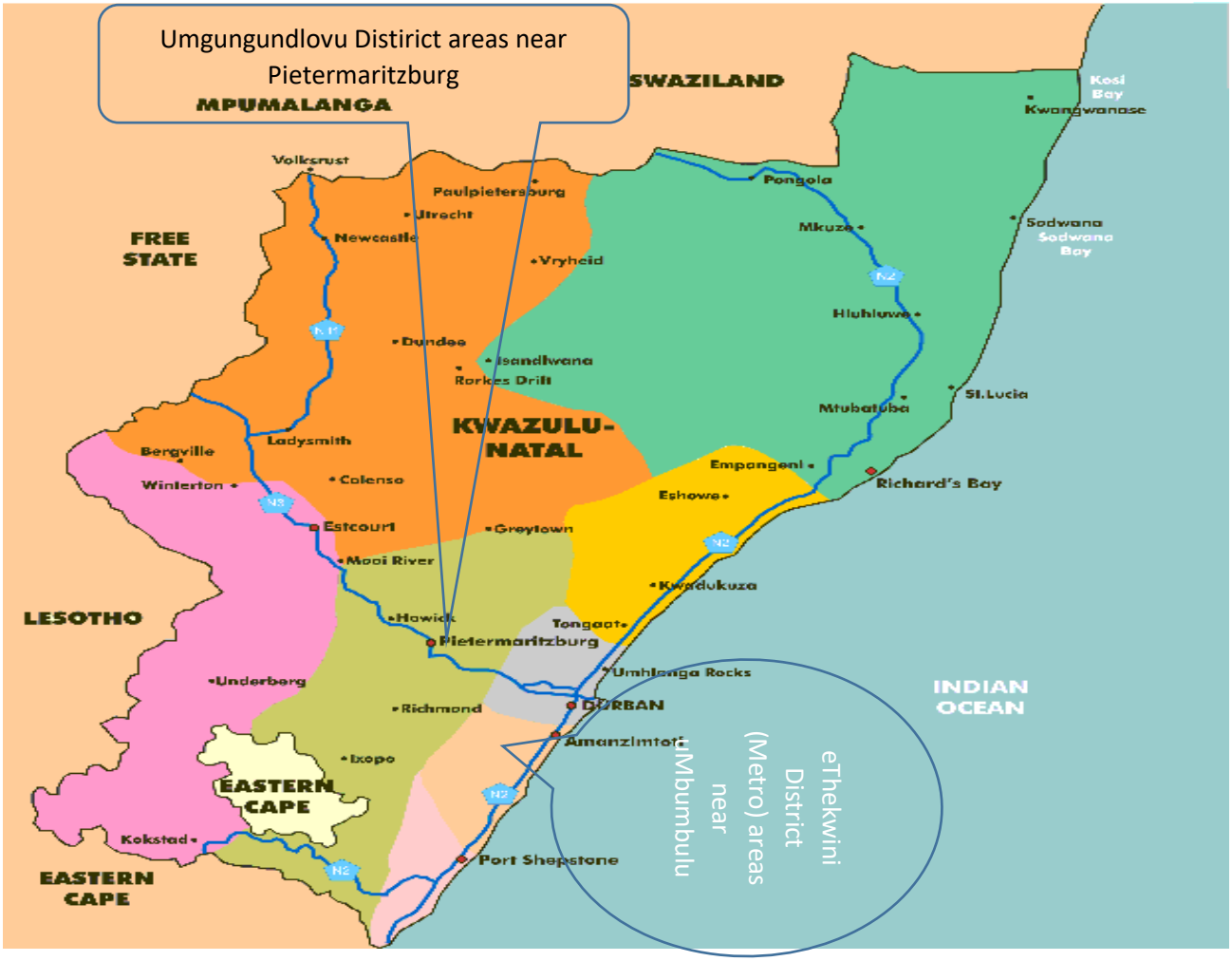

Figure 3.1: A map of KwaZulu-Natal and selected study areas. Source: www.temba.co.za

3.2.2 Data collection methods

A cross-sectional survey was conducted using a semi-structured questionnaire that was directed to the homestead rural subsistence in the study sites. Rural homestead subsistence was the chosen unity of analysis because it is the major objective that is being analyzed in the study. It provides important boundaries for the study particularly in data analysis. Close and open questions were asked to farmers. The reason for this interview style is that it allows questions and follow-up questions to take place, and respondents enjoy freedom to express themselves. There are no restrictions pertaining to how many questions can be asked (Creswell, 2013) . The main aim of questionnaire was to gather information on homestead crop and seed production systems. The study used probability sampling method, where each population member had a

chance of being chosen for the sample. Farmers were randomly selected using stratified sampling design. In each site farmers were divided into groups based on similar characteristics (type of crops they grow and method of cultivation). The interviews were conducted using local language which is IsiZulu. Farmers were grouped together and asked questions, some of the questions were focused group questions and some were for individual. Data collection was implemented from May 2017 to June 2018 a total of 162 questionnaires (n= 162) were successfully completed.

3.2.3 Data analysis

The data was captured in a computerized manner using Statistical Packages for Social Science (SPSS) (IBM, 2009). Chi-Square ($\chi 2$) test was used to test for significant differences between observed distribution of the data among categories and expected distribution (Cooper & Schindler, 2003). ANOVA was applied to test the differences between different groups of data. ANOVA includes splitting the differences for analytical purposes. By using ANOVA, a researcher can easily investigate any number of factors that are hypothesised. Chi-square and ANOVA analysis was performed at 5% level of significant association.

3.3 Results and discussion

3.3.1 Demographics

KwaZulu-Natal has a population of 8,577,000 people (21% of the South African population), of which 5,300,000 (62%) live in rural areas (Adey *et al.*, 2004). There are an estimated 400,000 rural agricultural land user households. However, in this study a total number of 162 smallholder farmers were used in the eight selected rural areas. From the 162 smallholder farmers 30% were the males and 70% were the females (Figures 3.2). This confirmed what other studies reported that women are often an essential resource in agriculture and the rural economy in developing countries (Bhandari, 2013; Hunt and Samman, 2016). Their roles differs within and between areas and are changing rapidly in several parts of the world, where economic and social forces are transforming the agricultural sector. Rural women often manage multifaceted households and pursue multiple livelihood strategies. Smallholder farmers explained that women play a significant role in the agricultural labour force and in agricultural activities, although to a varying degree. Therefore, their contribution to agricultural output is certainly significant, although difficult to quantify with any accuracy. It has often been claimed that women produce 60-80 percent of food (FAO, 2011). They are also responsible for selling, packaging and marketing of the farm produce.

In South Africa, there is a common perception that youth is not considering agriculture as a career or as a key component of a livelihood strategy. The current study found that more of the smallholder farmers were adult between the age of 51-65 and less smallholder farmers were youth between the ages of 18-35 (Figure 3.3). Non-interested rural youth in agriculture worsened number of challenges including unemployment and poverty. Aging agricultural labour force have negative effect on agricultural production. Older farmers tend to give up easily, they are risk adverse, illiteracy and reluctant to change to new technology. These adversely affect their production, investments and sustainability.

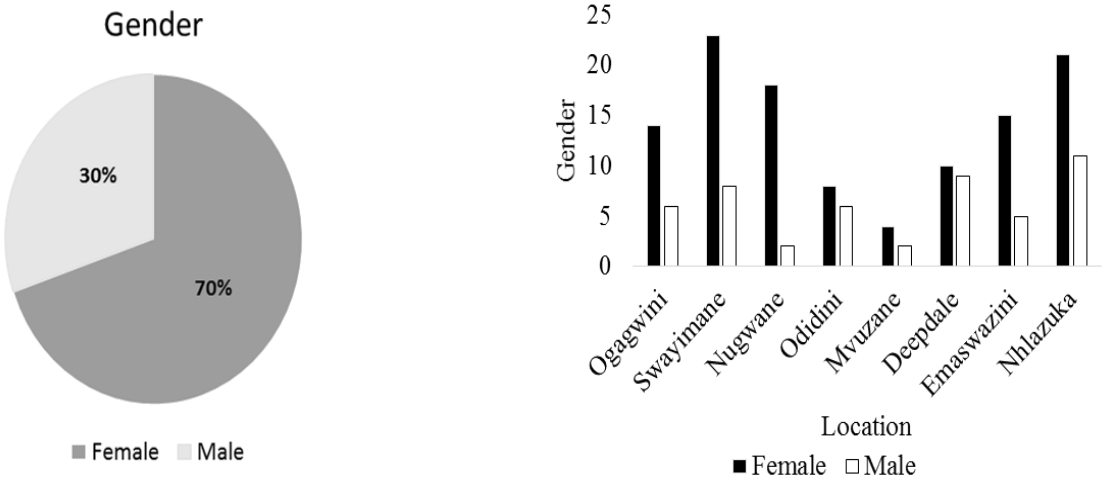

Figure 3. 2: Gender distribution (left) of smallholder farmers by location (right)

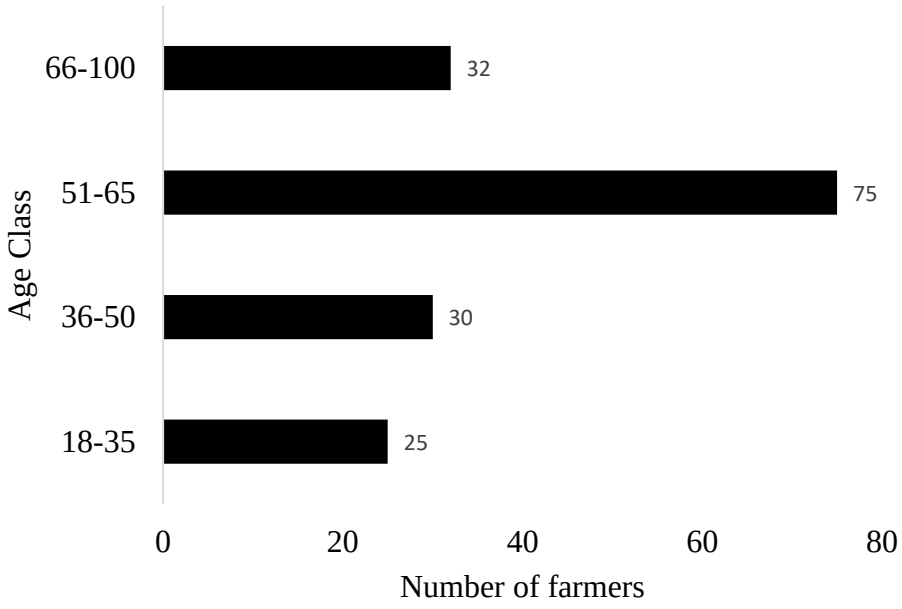

Figure 3. 3: Age distribution of smallholder farmers in selected rural areas.

3.3.2 Crops grown by farmers from selected rural areas of KZN

Results showed that for most of the crops, there were significant differences ($P < 0.05$) among the eight selected rural areas (Appendix 1). There were significance differences ($P < 0.05$) among locations with respect to the production of the beans, maize and potatoes. These were the most grown crops by farmers in all locations (Table 3.1). This confirms reports by Govender *et al.* (2013) that maize, beans and potatoes are one of the most important food crops grown in KwaZulu-Natal. Maize is the source of carbohydrates and can be grown in a diverse environment and it is easy to grow, harvest and store (McKevith, 2004). Beans are the cheap source of proteins. People in rural areas get more of their proteins from legumes since animal protein is expensive to them (Food and Agriculture Organisation (FAO), undated). Apart from proteins, beans are rich in antioxidants, and vitamins and minerals, such as iron, magnesium, manganese, phosphorous, potassium, folate and zinc(Halim and Russo, 2011). Beans was also popular because it can grow in adverse conditions (Stoyanov, 2005).

Vegetables were the least grown crops in the selected areas of KwaZulu-Natal. Vegetables are the least grown crops in rural areas of KwaZulu-Natal. People in rural areas end up depending on wild vegetables that are abundance when other vegetables are scarce (Govender *et al*., 2016). Most of the vegetables are easily perishable, need suitable storage devices and close market. Most of the farmers explained that because of the distance to market, they plant less of vegetables for consumption and or to sell to local communities. Kistern *et al.* (1998) found that 38.2% of the rural households grew cabbage for consumption. Emaswazin, Nhlazuka, Mvuzane and Deepdale had high number of farmers who grew spinach and cabbage (Table 3.1). Most of the farmers explained that they sell to local communities and sometimes sell to the nearest town.

Deepdale farmers also explained that their growing conditions are suitable for cabbage productions. As a result, most of them end up growing cabbage, of which there is no market for it, hence it ends up getting spoilt. Farmers explained that other vegetables like butternut, carrot or pumpkin are luxury goods. They do not need them for survival, so they buy them when there are special occasions. The issue of water scarcity is also the major constrain in farmer's production. Results showed that less than 50% of farmers grew sugarcane (Appendix

1). Sugarcane requires water and they do not have irrigation systems. Sugarcane is also an industrial crop which need mono-cropping and it takes time to grow.

Table 3.1: Crops grown by farmers in the selected rural areas (n=162)

	Maize		Beans		sweet potato		Sweet potatoes		Butternut		Cabbage		spinach		Cowpea		Taro		Lettuce		Umfino		pumpkin		Ppepper		Onion		Carrot	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Ogagwini	1	19	1	19	5	15	6	14	20	0	16	4	14	6	20	0	2	18	19	1	15	5	18	2	19	1	17	3	18	2
Swayimane	0	31	6	25	21	10	8	23	30	1	21	10	22	9	31	0	21	10	31	0	30	1	27	4	25	6	28	3	28	3
Nugwane	3	17	3	17	3	17	2	18	20	0	17	3	16	4	20	0	2	18	20	0	15	5	12	8	19	1	20	0	19	1
Odidini	1	13	2	12	3	11	0	14	13	1	10	4	9	5	14	0	2	12	14	0	11	3	9	5	14	0	12	2	9	5
Mvuzane	4	2	1	5	1	5	1	5	6	0	3	3	1	5	6	0	0	6	5	1	5	1	6	0	3	3	4	2	3	3
Deepdale	0	14	1	13	7	7	1	13	13	0	4	9	4	9	8	5	9	4	11	2	11	2	7	6	13	0	11	2	9	4
Emaswazini	5	15	3	17	13	7	1	19	12	8	3	17	1	19	20	0	19	1	20	0	20	0	19	1	12	8	15	5	7	13
Nhlazuka	0	32	2	30	13	19	5	27	31	1	8	24	7	25	32	0	6	26	28	4	27	5	30	2	23	8	20	12	16	16
Total	14	143	19	138	66	91	24	133	145	11	82	74	74	82	151	5	61	95	148	8	134	22	128	28	128	27	127	29	109	47

3.3.3 Production seasons for selected rural areas of KwaZulu-Natal

Results from chi-square showed that there were significant differences ($P < 0.05$) among locations with respect to sources of seeds from eight selected locations (Figure 3.4). Results of this study showed that most of the farmers from the selected rural areas grow their crops in winter and summer (Figure 3.4). Since most of the smallholder farmers do not use genetically modified crops or improved seeds, climate conditions are very important for them to consider before planting. However, there are crops that can be planted throughout the seasons for instance potatoes. In summer there is high rainfall and it is hot which is favourable for most of the crops. Farmers said that crops like spinach and cabbage are cool weather crops that grow better when daytime temperature is low. Most of famers said that use spring and autumn for harvesting.

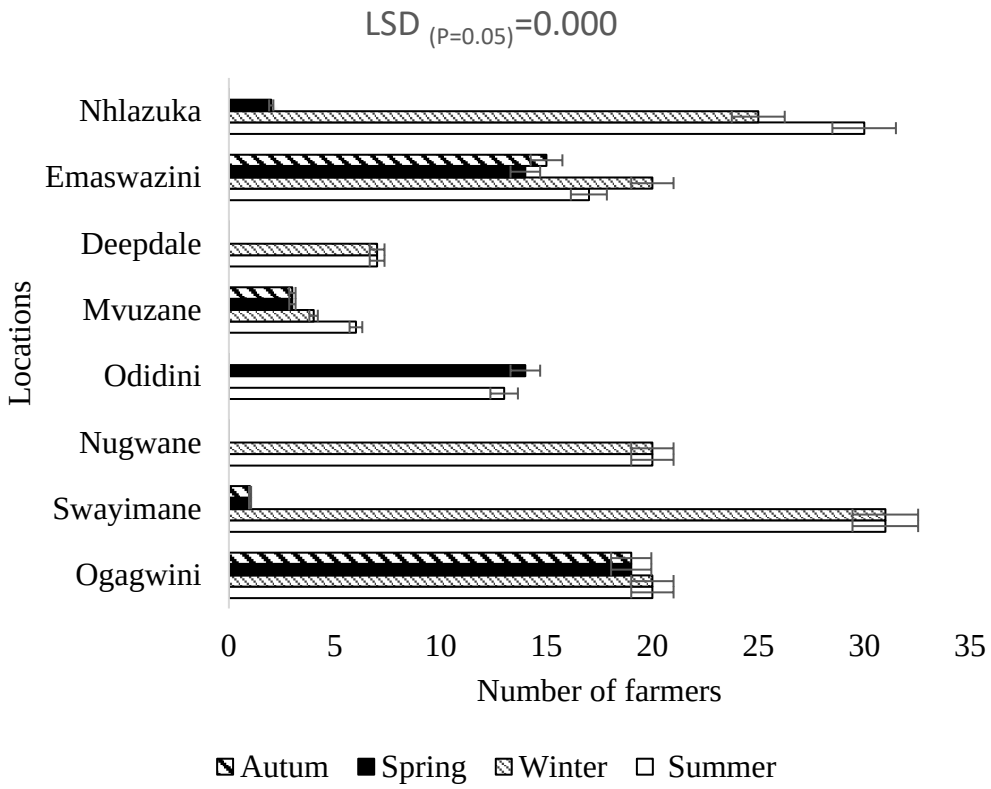

Figure 3.4: Production seasons used by farmers at the selected study sites of KwaZulu-Natal.

3.3.4 Factors used by farmers to select seeds and seed sources

Seed quality remains one of the main issues that affect production of smallholder farmers. Results from ANOVA showed that there were significant differences ($P < 0.05$) in mean scores among locations with respect to factors used by farmers to select quality seeds and sources of seeds from eight selected locations (Table 3.2 and 3.3). This means that all farmers from the selected areas were significantly affected by the storage devices and sources of seeds. With respect to source of seeds the study observed that most farmers obtained their seeds from saved seeds, local shops and neighbours. The study also found that smallholder farmers use traditional methods to select for quality of seeds. Smallholder farmers are faced with financial constraints that prevent them from buying to formal seed markets. They do not have access to laboratory measures to determine seed quality. Saved seeds by farmers can decrease quality of seeds since farmers do not have proper storage devices. These have impact to crop production and yield of smallholder farmers. Seeds are the foundation of farming (McDonald, 1998). Seed quality describes the potential performance of a seed lot (McDonald, 1998). Many studies confirmed that assessment of seed quality should be done using International Seed Testing Association (ISTA) standard procedures in both field and laboratory. These allows for good germination, establishment, crop standing and high yield.

The present study showed that smallholder farmers used seed size, colour and germination to determine quality of seeds (Table 3.3). These characteristics must be assessed together with other characteristics to ensure that the seed is of high quality and it is healthy. It might happen that seed is of bigger size because it contains high moisture content which is not required for production. There are also chemical compositions of the seed that need to be assessed as it is where seeds store food. Assessment of seed vigour and viability assures quality of seeds that can respond well to other inputs such as fertilizer. The traditional methods impact seed quality, crop quality and yields of smallholder farmers. Ferguson *et al* (1991) reported that without a stable supply of quality seeds, yield and crop quality would significantly decrease. Informal seed systems that farmers operate on influence them to sell to their local communities since they cannot sell unimproved varieties under formal seed channels. Formal seeds channels require certified seeds that are of high and known quality (South African National Seed Organisation (SANSOR, 2015).

Table 3. 2: Major sources of seeds from eight selected locations in rural areas of KwaZulu-Natal

Sources of seeds		Sum of Squares	df	Mean Square	F	Sig.
Purchase	Between Groups	2.036	7	.291	5.695	.000
	Within Groups	7.302	143	.051		
	Total	9.338	150			
Saved seeds	Between Groups	2.667	7	.381	5.912	.000
	Within Groups	9.214	143	.064		
	Total	11.881	150			
Neighbour	Between Groups	19.315	7	2.759	29.387	.000
	Within Groups	13.427	143	.094		
	Total	32.742	150			
Donated	Between Groups	23.520	7	3.360	35.246	.000
	Within Groups	13.632	143	.095		
	Total	37.152	150			

Table 3. 3: Selection of stored seeds by smallholder farmers in the selected rural areas of KwaZulu-Natal.

Factors		Sum of Squares	df	Mean Square	F	Sig.
Germination	Between Groups	6.715	7	.959	4.823	.000
	Within Groups	27.846	140	.199		
	Total	34.561	147			
Sizes	Between Groups	14.726	7	2.104	54.723	.000
	Within Groups	5.382	140	.038		
	Total	20.108	147			
Colour	Between Groups	6.075	7	.868	18.405	.000
	Within Groups	6.601	140	.047		
	Total	12.676	147			

3.3.5 Storage devices farmers used to store seeds

Significant differences ($P < 0.05$) in mean scores among locations were observed with respect to storage devices farmers used to store seeds from ANOVA (Table 3.4). Storage is one of the post-harvest factors that affect quality of seeds. Selection of storage device to use depends on the moisture content of the grain, prevailing ambient temperature and level of humidity in the surrounding air (FAO, undated). The present study found that most of the farmers in the selected rural areas used underground, sealed grain, floor and roof to store seeds. These storage devices were considered by farmers to be cheap, accessible and easy to use. Obetta and Danial (2007) reported that farmers select storage systems which are cheap and easily to construct because of the challenges they are faced with. Underground storage were used by farmers to avoid external sources of damage such as rain, wind, pest and diseases and theft. Farmers also explained that underground storage can be used for other purposes when seeds are not stored for example storage of animal feed. Underground storage structures that smallholder farmers use include silos and bulk or loose bags.

Table 3.4: Seed storage devices used by smallholder farmers

Storage devices		Sum of Squares	Df	Mean Square	F	Sig.
Underground	Between Groups	25.722	7	3.675	57.100	.000
	Within Groups	8.945	139	.064		
	Total					
Sealed grain	Between Groups	4.749	7	.678	4.929	.000
	Within Groups	19.129	139	.138		
	Total					
Roof	Between Groups	8.815	7	1.259	13.234	.000
	Within Groups	13.226	139	.095		
	Total					
Floor	Between Groups	10.081	7	1.440	10.050	.000
	Within Groups	19.919	139	.143		
	Total	30.000	146			
Cool house	Between Groups	9.397	7	1.342	21.692	.000
	Within Groups	8.603	139	.062		
	Total					

3.3.6 Farmers who sold seeds in the selected rural areas of KwaZulu-Natal

There were significant differences ($P < 0.05$) in mean scores among locations on seeds sold by farmers in the selected areas (Figure 3.5). From the present study almost, all farmers sell seeds except farmers from Emaswazini. Farmers from Emaswazini explained that they do not produce enough seeds to sell. They further explained that this was because of the small farm sizes they operate on. Farmers sell seeds in their local communities, to each other and neighbours. This was because of the challenges they are faced with to participate in agricultural market chains. Farmers explained that the form in which they sell their seeds differs they sometimes use barter and traditional labour payment. These confirm what Almekinders (2000) said that farmers also exchange seeds as a gift.

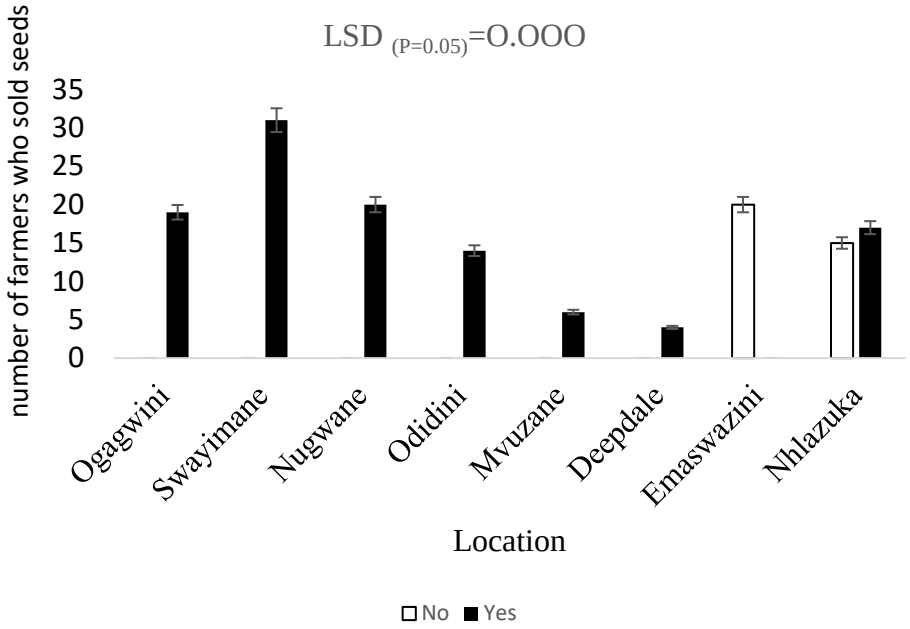

Figure 3.5: Number of smallholder farmers who sold seeds in selected rural areas.

3.3.7 Market values and market strategies used by farmers to market their seeds

Farmers dot not market their seeds under formal seed systems, their seeds are not well advertised. Results from ANOVA showed that there were significant differences ($P < 0.05$) in mean scores among locations with respect to market values and strategies used by farmers from eight selected locations (Table 3.5 and 3.6). Selling quality, informing other people and bringing samples to people were the most used market strategies by farmers. Farmers stated that they first plant a seed and when it shows good germination capacity, good establishment or good crop stand they would then sell the seeds. Marketing was done informally, for example, by word of mouth and asking neighbours to spread the word .When someone come to buy they also tell them to tell others. Some bring samples of quality seeds to show people. They said they normally do that when attending community meetings, churches and pensions.

When farmers package or differentiate their seeds, they use certain market values. Most of the farmers separated seeds into different sizes, colour and germination percentage (Table 3.6). Farmers explained that shelf life was the least used market value. These is because their storage devices are not properly installed. Their seeds do not stay longer since they do not take extra steps in seed production such as seed coating or pelleting. Farmers considered themselves as crop growers not seed growers.

Table 3.5: Market strategies used by farmers to market their seeds

Market values		Sum of Squares	df	Mean Square	F	Sig.
Inform other people	Between Groups	18.754	6	3.126	44.872	.000
	Within Groups	6.966	100	.070		
		25.720	106			
Sell quality	Between Groups	18.482	6	3.080	51.144	.000
	Within Groups	6.023	100	.060		
		24.505	106			
Bring samples	Between Groups	8.644	6	1.441	17.497	.000
	Within Groups	8.234	100	.082		
		16.879	106			

Table 3. 6: Market values used by farmers to market their seeds

Market values		Sum of Squares	df	Mean Square	F	Sig.
Seed size	Between Groups	12.900	6	2.150	16.882	.000
	Within Groups	11.589	91	.127		
	Total	24.490	97			
Germination percentage	Between Groups	15.013	6	2.502	24.029	.000
	Within Groups	9.476	91	.104		
		24.490	97			
Colour	Between Groups	3.999	6	.667	4.852	.000
	Within Groups	12.501	91	.137		
		16.500	97			
Shelf life	Between Groups	3.365	6	.561	5.464	.000
	Within Groups	9.339	91	.103		
		12.704	97			

3.5 Conclusion

The study showed that smallholder farmers focusses on some crops such as maize, beans and potatoes for their survival and to feed their families. There is still need for research on what diverse crops farmers can produce for food security taking consideration challenges they are faced with. The study revealed that storage devices that farmers use are not properly installed can expose seeds to damages which can decrease production. The study also revealed that smallholder farmers do not use laboratory measures to assess quality of seeds. Farmers still sell their seeds to their local communities because of the challenges they are face with and do not get much profit. It can be concluded there is still more interventions required under smallholder subsistence farming.

REFERENCES

Adey, S., Kotze, D.C. and Rijkenberg, F.H. 2004. Small-scale farming in KwaZulu Natal: Experiences from some promising pockets. Seeds of transition: *Essays on novelty production, niches and regimes in agriculture*: 203-225.

Almekinders, C. 2000. The importance of informal seed sector and its relation with the legislative framework. *GTZ-Eschborn*.

Bhandari, P.B. 2013. Rural livelihood change? Household capital, community resources and livelihood transition. *Journal of rural studies* 32: 126-136.

Cooper, D.R., & Schindler, P. S. 2003. Research methods. Boston, MA: Irwin.

Creswell, J.W. 2013. Steps in conducting a scholarly mixed methods study.

Food and Agriculture Organization (FAO). Undated. Staple crops: What do people eat? http://www.fao.org/docrep.

Ferguson, J. 1990. Report of seed vigour subcommittee. *J. Seed Technol* 14: 182-184.

Garikai, M. 2014. Assessment of vegetable postharvest losses among smallholder farmers in Umbumbulu area of Kwazulu-Natal province, South Africa. Citeseer.

Govender, L., Pillay, K., Siwela, M., Modi, A. and Mabhaudhi, T. 2016. Food and Nutrition Insecurity in Selected Rural Communities of KwaZulu-Natal, South Africa—Linking Human Nutrition and Agriculture. I*nternational journal of environmental research and public health* 14: 17.

Halim, G. and Russo, S. 2011. Healing Foods, Healthy Foods: Use superfoods to help fight disease and maintain a healthy bodyHachette UK.

Hunt, A. and Samman, E. 2016. Women's economic empowerment: navigating enablers and constraints. UN High Level Panel on Women‟ s Economic Empowerment background paper. London: Overseas Development Institute.

Kirsten, J., Van Zyl, J., and Vink N 1998. The agricultural democratization of South Africa, 1 st ed. Cape Town: IPA/ Francolin publishers.

Kisaka-Lwayo, M. and Obi, A. 2012. Risk perceptions and management strategies by smallholder farmers in KwaZulu-Natal Province, South Africa. *International Journal of Agricultural Management* 1: 28-39.

Mcdonald, M.F. and Copeland, L.O. 2012. Seed production: principles and practicesSpringer Science & Business Media.

Mckevith, B. 2004. Nutritional aspects of cereals. *Nutrition Bulletin* 29: 111-142.

Modi, M., Modi, A. and Hendriks, S. 2006. Potential role for wild vegetables in household food security: a preliminary case study in Kwazulu-Natal, South Africa. *African Journal of Food, Agriculture, Nutrition and Development* 6: 1-13.

Nxumalo, K. and Oladele, O. 2013. Factors affecting farmers' participation in agricultural programme in Zululand district, Kwazulu Natal Province, South Africa. *Journal of Social Sciences* 34: 83-88.

Obetta, S. and Daniel, C. 2007. Preliminary investigation into some quality control indices for selected stored grains in Makurdi, Nigeria.

South African National Seed Organization (SANSOR). 2015. Seed Certification. http://sansor.org/seed-certification/ (Accessed on 3o November 2017).

CHAPTER FOUR

CONSUMPTION AND SELLING PATTERNS OF SMALLHOLDER FARMERS FOR CERTAIN CROPS IN THE SELECTED RURAL AREAS OF KWAZULU-NATAL

4.1 Introduction

Smallholder farmers in developing countries produce diverse foods, which are often more diverse than commercialised farmers (Sibhatu *et al*., 2015). Farmers produce their main stable food more but also diversify their production to achieve improved diets. However, most of their foods are produced in bulk for consumption. Observed evidence on the link between production, selling and consumption diversity is scarce. Most studies reported that challenges facing smallholder farmers are well known which prevent them from selling their produce to the market.

Maize, beans and potatoes dominates the production of Sub-Sahara Africa rural households followed by fruits and vegetables. Studies observed that most farmers in Sub-Sahara Africa sell less than 50% of their produce and retain most of it for household consumption (FAO, 2015). In Kenya and Ethiopia less than a quarter of smallholder produce was sold, in Bangladesh and South Africa the proportion of 23% was sold and in Nepal 12% was sold (FAO, 2015).

There are number of constraints that limit smallholder farmers from selling their produce to agricultural markets. The challenges include small sizes of land, lack of access and information to the market, lack of technology and innovations, lack of infrastructure and population size. Farmers end up selling small proportion of their produce to local communities and keep the rest for consumption. This has effects on their income, food security and cost of living. It was hypothesised that smallholder farmers in rural areas of KwaZulu-Natal are primarily involved in subsistence production. The aim of this chapter was to compare consumption and selling of two grain crops (beans and maize) and cabbage.

4.2 Materials and Methods

4.2.1 Description of selected sites

The selected rural areas of KwaZulu-Natal were described in detail on chapter three. Out of the eight rural areas used in chapter three only three were used for this study (Swayimane, Deepdale and Umbumbulu). These rural areas were selected to compare what farmers consume and sell. These three rural areas were selected because they are the representative of the socio-economic, bio resources and demographics conditions of the midlands and coastal lands of KwaZulu-Natal. The three rural areas consist of smallholder farmers who produce more of maize and beans. The smallholder farmers also have market for cabbage. From the crops that smallholder farmers grow, the major and minor crops were selected to compare consumption and selling. Maize, beans and cabbage were the selected crops, maize and beans were the major grown grain crops by smallholder farmers in selected areas and cabbage was the least grown crop. Maize and beans were selected because are the traditional crops mostly grown by smallholder farmers in the selected areas. Cabbage was selected because it was the vegetable that farmers had market of and it was the mostly grown vegetable.

4.2.2 Data collection methods

In the previous chapter (Chapter 3) a cross-sectional survey was conducted to gather information on crop and seed production systems using questionnaires, in this study a follow up was made on what farmers produce. From what farmers produce, they were asked to keep records of three crops which are maize, beans and cabbage. The aim of this survey was to gather information on how much smallholder farmers consume and sell from what they have harvested for the selected crops. Smallholder farmers from the three locations were interviewed individually using local language. Farmers were asked to give quantities of beans and maize in kilograms and heads of cabbage. Maize was divided into dry and green maize since farmers use both. Data collection was implemented after farmers harvested in May to June 2018. A total of 59 questionnaires (n=59) were successful completed.

4.2.3 Data analysis

The data was captured in a computerized manner using Statistical Packages for Social Science (SPSS) (IBM, 2009). Descriptive statistics were used to show frequencies originating the data. Descriptive statistics provided a descriptive summary of the sample and variables measured (Jaggi, 2003). Various measures of dispersion such as mean, standard deviation,

minimum and maximum were calculated. Computation of the mean and standard deviation statistics were used to convey information about the average. Paired t-test was performed to determine significant differences between two variables (consumption and selling). Paired t-test analysis was performed at 5% level of significant association.

4.3 Results

4.3.1 Amount of green maize, dry maize and beans harvested, consumed and sold by smallholder farmers in Deepdale.

Results from descriptive statistics showed that there were farmers who did not harvest, sell and consume green maize in Deepdale (Table 4.1) (minimum amounts were zero). Among amounts of green maize harvested, the maximum amount harvested and consumed was 1250 kg's. All green maize harvested was consumed. There were farmers who did not harvest, sell and consume dry maize since minimum amounts were zero. The maximum amount sold for dry maize was 400 kg's and maximum amount sold was 1250 kg's. The mean average for consumption (436.66) was greater than the mean average for amount sold (173.33) for dry maize. There was a great variation between amount consumed (377. 23) compared to amount sold (149.84). Maximum amount consumed was greater (1300 kg's) compared to the maximum sold (400 kg's) for beans. The mean average showed that more beans were consumed (354) compared to what was sold (140.66).

4.3.2 Number of cabbages harvested, consumed and sold by smallholder farmers in Deepdale

The results showed that there were farmers who did not harvest, sell and consume cabbages in Deepdale (minimum amounts were zero) (Table 4.2). The maximum cabbages harvested were 3600. Among harvested cabbages, 3000 maxima were sold and 700 maxima were consumed. The mean average showed that more cabbages were sold (422.66) compared to cabbages consumed (112.66).

4.3.3 Paired t-sample test for Deepdale

The results showed that there were significant differences ($P < 0.05$) among means of consumed and sold green maize, dry maize and beans (Table 4.3). The positive relationships showed that more amount consumed for green maize, dry maize and beans compared to amount

sold. There were no significance differences ($P > 0.05$) between means of consumed and sold cabbage. The negative relationship showed that more cabbages were sold than consumed.

Table 4.1: Amount of green maize, dry maize and beans harvested, consumed and sold by smallholder farmers in Deepdale.

Crop	Amounts (kg)	Minimum	Maximum	Mean	SD
Green maize	harvested	0	1250	68	38.76
	sold	0	0	0	0
	consumed	0	1250	68	38.76
Dry maize	harvested	0	1500	456.99	503.15
	sold	0	400	173.33	149.84
	consumed	0	1250	436.66	377.23
Beans	harvested	5	1400	369.33	469.72
	sold	0	400	140.66	142.25
	consumed	5	1300	354.00	372.62

Table 4.2: Number of cabbages harvested, consumed and sold by smallholder farmers in Deepdale

Crop	Number of cabbages	Minimum	Maximum	Mean	SD
Cabbage	harvested	0	3600	450.66	978.72
	sold	0	3000	422.66	793.35
	consumed	0	700	112.66	221.49

Table 4. 3: Paired t-sample test for Deepdale

	Paired differences							
				95% confidence interval of the difference				
	Mean	SD	SD error mean	Lower	Upper	t	df 14	Sig. (2 tailed)
Pair 1 Amount consumed green maize(kg)- amount sold green maize (kg)	68.000	38.766	10.009	46.531	89.468	6.794		.000
Pair 2 Amount consumed dry maize(kg)- amount sold dry maize (kg)	263.333	276.758	71.458	110.069	416.597	3.685	14	.002
Pair 3 Amount consumed beans (kg)- amount sold beans (kg)	213.333	317.454	81.966	37.532	389.133	2.603	14	.021
Pair 4 Amount consumed cabbage- amount sold cabbage	-310.000	631.404	163.027	-659.660	39.660	-1.902	14	.078

4.3.4 Amount of green maize, dry maize and beans harvested, consumed and sold by smallholder farmers in Umbumbulu

Results from descriptive statistics showed that the minimum sold by farmers was zero and minimum consumed was 20 kg's of green maize in Umbumbulu. The maximum consumed and harvested was 150 kg's. All green maize harvested in Umbumbulu was consumed, the mean average was zero for amount sold and 83.33 for consumption. The minimum amount harvested and consumed was 25 kg's for dry maize. The maximum amount consumed (350 kg's) was greater than the maximum sold (100 kg's) for dry maize in Umbumbulu. The mean average showed that more amount of dry maize consumed (123.666) compared to amount sold (29.333). The minimum amount of beans consumed and harvested was the same (5 kg's). All beans harvested in Umbumbulu were consumed, mean average for amount sold is zero.

4.3.5 Number of cabbages harvested, consumed and sold by smallholder farmers in Umbumbulu

There were farmers who did not harvest, sell and consume cabbages (minimum amounts were zero) (Table 4.5). The maximum amount of cabbage sold (80) were greater than maximum consumed (40). The mean average for amount sold (20.00) was greater than mean average for amount consumed (14.666).

4.3.6 Paired t-sample test for Umbumbulu

The results showed that there were significant differences ($P < 0.05$) among means of consumed and sold green maize, dry maize and beans (Table 4.6). The positive relationships showed that more amount consumed for green maize, dry maize and beans compared to amount sold. There were no significance differences ($P > 0.05$) between means of consumed and sold for cabbage. The negative relationship showed that more cabbages were sold than consumed.

Table 4. 4: Amount of green maize, dry maize and beans harvested, consumed and sold by smallholder farmers in Umbumbulu'

Crop	Amounts (kg)	Minimum	Maximum	Mean	SD
Green maize	harvested	20	150	83.33	33.69
	sold	0	0	0	0
	consumed	20	150	83.33	33.69
Dry maize	harvested	25	400	200.66	109.68
	sold	0	100	29.33	37.69
	consumed	25	350	123.66	85.82
Beans	harvested	5	150	50.66	45.42
	sold	0	0	0	0
	consumed	5	150	50.66	45.42

Table 4. 5: Number of cabbages harvested, consumed and sold by smallholder farmers in Umbumbulu

Crop	Number of cabbages	Minimum	Maximum	Mean	SD
Cabbage	harvested	0	100	34.01	37.12
	sold	0	80	20.00	34.64
	consumed	0	40	14.66	13.55

Table 4. 6: Paired t-sample test for Umbumbulu

	Paired differences							
				95% confidence interval of the difference				
	Mean	SD	SD error mean	Lower	Upper	t	df	Sig. (2 tailed)
Pair 1 Amount consumed green maize(kg)- amount sold green maize (kg)	87.333	33.693	8.699	68.674	105.992	10.039	14	.000
Pair 2 Amount consumed dry maize(kg)- amount sold dry maize (kg)	94.333	73.018	18.853	53.897	134.769	5.004	14	.000
Pair 3 Amount consumed beans (kg)- amount sold beans (kg)	50.666	45.429	11.729	25.508	75.824	4.319	14	.001
Pair 4 Amount consumed cabbage- amount sold cabbage	-5.333	28.999	7.487	-21.392	10.725	-.712	14	.488

4.3.7 Amount of green maize, dry maize and beans harvested, consumed and sold by smallholder farmers in Swayimane

Results from descriptive statistics showed that there were farmers who did not consume green maize (Table 4.7). The maximum amount of sold green maize (5000 kg's) was greater than maximum of amount consumed (1000 kg's). The mean average showed that more green maize was sold (749.814) compared to amount consumed (94.407). The result showed more of deviation in amount sold (1312.615) than amount consumed (185.583). Farmers from Swayimane did not harvest, sell and consume dry maize. The maximum consumed (480 kg's) for beans was greater than the maximum sold (40 kg's). There are famers who did not sell beans (minimum amount consumed is zero). The mean averages showed that more beans were consumed (69.034) compared to beans sold (14.827).

4.3.8 Number of cabbages harvested, consumed and sold by smallholder farmers in Swayimane

There were farmers who did not harvest, sell and consume green maize in Swayimane (Table 4.8). The maximum number of cabbages harvested was 1000. Among number of harvested cabbages, maximum of 900 cabbages were sold and 450 maxima of cabbages were consumed. More mean average cabbage were sold (126) compared to consumed (48).

4.3.9 Paired t-sample test for Swayimane

The results showed that there were significant differences ($P < 0.05$) among all means of consumed and sold amounts of green maize, beans and cabbage (Table 4.6). The positive relationships showed that more amount consumed for green maize, beans and cabbage compared to amount sold.

Table 4. 7: Amount of green maize, dry maize and beans harvested, consumed and sold by smallholder farmers in Swayimane

Crop	Amounts (kg)	Minimum	Maximum	Mean	SD
Green maize	harvested	50	6000	815.67	1434.51
	sold	10	5000	749.81	1312.61
	consumed	0	1000	94.40	185.58
Dry maize	harvested	0	0	0	0
	sold	0	0	0	0
	consumed	0	0	0	0
Beans	harvested	15	5000	158.45	918.50
	sold	0	40	14.82	10.47
	consumed	10	480	69.03	91.49

Table 4. 8: Number of cabbages harvested, consumed and sold by smallholder farmers in Swayimane

Crop	Number of cabbages	Minimum	Maximum	mean	SD
Cabbage	harvested	0	1000	200.33	275.38
	sold	0	900	126	210.80
	consumed	0	450	48	85.62

Table 4. 9: Paired t-sample test for Swayimane

	Paired differences							
				95% confidence interval of the difference				
	Mean	SD	SD error mean	Lower	Upper	t	df	Sig. (2 tailed)
Pair 1 Amount consumed green maize(kg)- amount sold green maize (kg)	-657.407	1206.876	232.263	-1134.83	-179.982	-2.830	26	.009
Pair 2 Amount consumed beans (kg)- amount sold beans (kg)	46.206	90.540	16.812	11.767	80.646	2.748	28	.010
Pair 3 Amount consumed cabbage- amount sold cabbage	-77.655	166.456	30.910	-140.971	-14.338	-2.512	28	.018

4.3.10 Minimum, maximum and mean area planted by smallholder farmers in hectares

The result from the graph (Figure 4.1) showed that the maximum area of land owned by smallholder farmers in the selected areas is 2 hectares and the minimum is 0.5 hectares. The mean average of land for Umbumbulu was greater than Deepdale and Swayimane.

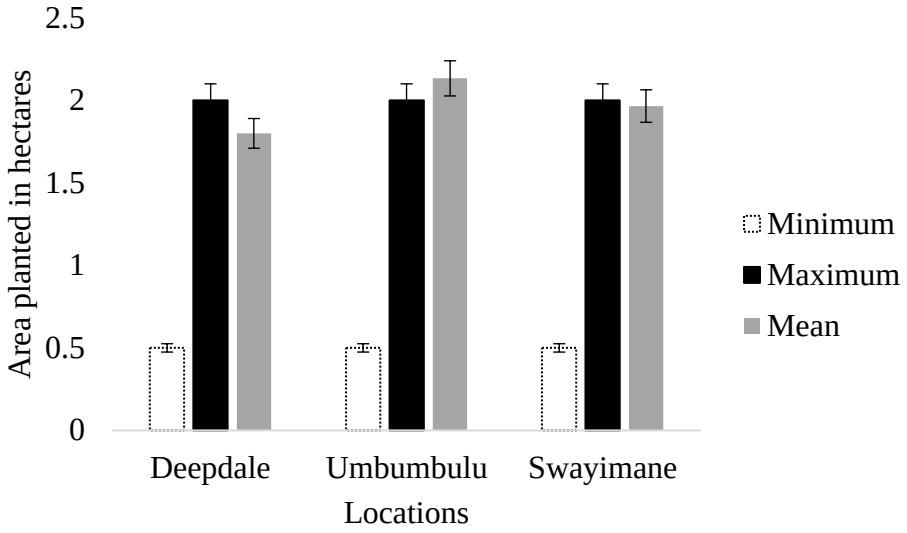

Figure 4. 1: Minimum, maximum and mean area planted by smallholder farmers in hectares.

4.4 Discussion

The objective of this study was to compare whether smallholder farmers consume more than they can sell for two grain crops (maize and beans) and cabbage in the selected rural areas of KwaZulu-Natal. The present study showed that most smallholder farmers in the selected areas consume more than they sell for grain crops. Dry maize, green maize and beans were the most consumed crops compare to cabbage. Farmers stated that they are faced with number of challenges which prevent them from selling their produce to the market. This confirms what other studies reported that smallholder farmers' challenges are known and need to be addressed. The challenges start before and during production until to the end user (market). The land that farmers operate on is small and most of the farmers do not own the land, so they cannot produce enough. The present study found that the minimum area of land farmers have is 0.5 hectares and maximum is 2 hectares (Figure 4.1). FAO (2015) found that most smallholder farmers own less than 2 hectares of land.

Most smallholder farmers live in remote areas, they are faced with difficulties to access the output and input markets. The traditional methods, equipment and inputs used by farmers are

relatively inefficient which in turn result to low yields(Barrett *et al.*, 2002) . The gap between smallholder farmers' yields and technical potential yields is with the use of improved varieties under good conditions and the use of low-yielding inputs and insufficient adoption of productive technologies (Omotilewa *et al.*, 2018). Smallholder farmers' food market remain marginalized which function poorly and is very locally. The cost of participating in the markets is very high for farmers. Farmers have inadequate opportunities to participate in the market due to high transaction cost (Nekhavhambe, 2017). Entering a market require start-up cost and transportation cost. The sales in the formal markets occur in sophisticated channels such as supermarkets. Farmers are required to have logistics and managerial skills and are required to provide continuity of supply and meet food quality and safety requirements (Khapayi and Celliers, 2016).

Most farmers have inadequate collaterals, which makes it difficult for them to access credit from banks. Farmers stated that their households' sizes are big, which require them to produce enough to keep for the future. The nature of the product also has impact on whether to sell or consume more of it. Farmers explained that they sell more of cabbage because it is perishable, have less shelf life and they do not have proper storage facilities. They sell the cabbage in their local communities and exchange it with other farmers for inputs. Farmers also explained that they do not harvest more of green maize, they take some for consumption and leave it to dry. However, farmers from Swayimane harvested and sold green maize not dry maize. Farmers stated that they have market for green maize, there are middlemen in town who normally come with their transport to collect green maize from them. During production farmers incur some losses due to pest, diseases and insects. Farmers mentioned that they do not use more of fertilizers, pesticides and herbicides.

4.5 Conclusion

The study showed that smallholder farmers consume more than they can sell, especially for grain crops. The study also revealed that there are number of challenges that farmers are faced with which prevent them from producing enough to sell and participate in the market. All of these have impact on smallholder farmers' food security, income and cost of living. Smallholder farmers cannot access or afford other source of food which they cannot grow, and they cannot get income to buy inputs or resources to use during production. It can be concluded that there is a need for researchers, policy makers and government to develop strategies that will help farmers to access the market and sell their produce to get income. The existing policies need to be revised.

REFERENCES

Barrett, C.B., Place, F., Aboud, A. and Brown, D.R. 2002. The challenge of stimulating adoption of improved natural resource management practices in African agriculture. *Natural resource management in African agriculture*: 1-21.

Food and Agriculture Organization (FAO). 2015. Smallholder Farmers' Data Portrait. www.fao.org.

Jaggi, S. 2003. Descriptive statistics and exploratory data analysis. *Indian Agricultural Statistics Research Institute* 1: 1-18.

Khapayi, M. and Celliers, P. 2016. Factors limiting and preventing emerging farmers to progress to commercial agricultural farming in the King William's Town area of the Eastern Cape Province, South Africa. *South African Journal of Agricultural Extension* 44: 25-41.

Nekhavhambe, E. 2017. Factors contributing to the transformation of smallholder farming to commercial farming in Mutale Local Municipality of Limpopo Province, South Africa.

Omotilewa, O.J., Ricker-Gilbert, J., Ainembabazi, J.H. and Shively, G.E. 2018. Does improved storage technology promote modern input use and food security? Evidence from a randomized trial in Uganda. *Journal of Development Economics* 135: 176-198.

Sibhatu, K.T., Krishna, V.V. and Qaim, M. 2015. Production diversity and dietary diversity in smallholder farm households. *Proceedings of the National Academy of Sciences* 112: 10657-10662.

CHAPTER FIVE

GENERAL DISCUSSION

5.1 Summary

Smallholder subsistence farming is perceived as one of the contributors to economic and livelihoods of rural households, however it still remain underprivileged and undeveloped. The purpose of the study was to understand more on how smallholder subsistence production systems function in the selected rural areas of Kwazulu-Natal, to come up with strategies that will improve subsistence agriculture. The specific objectives were to understand local seed systems, major and minor crops produced by rural smallholder farmers and to determine contribution of post-harvest management and crop production in food security.

Chi- squared, ANOVA, descriptive statistics and paired tests were employed to achieve the objectives. The results from the study and literature showed that smallholder farmers still operate under informal seed systems which are marginalised and unimproved. The study also discovered that throughout the production and value chain smallholder farmers use their traditional methods. This implicate that there is a need to develop new ways to engage farmers into adopting new technology.

The hypothesis was that smallholder farmer's practise subsistence agriculture in KwaZulu-Natal and are characterised by inadequate seed and crop systems for successful production and food security. The hypothesis was accepted, as the study found that smallholder farmers have obstacles during their production which prevent them from producing enough for consumption and to sell. During seed production they do not follow proper seed production procedures which prevent them from producing viable seeds. In overall, the study found that the conditions that farmers operate on prevent them from improving their production and there is a lot that need to be done for smallholder farmers to be able to operate under formal agricultural production systems.

5.2 Conclusions

The findings obtained in this study were more similar to other previous studies, this confirmed that smallholder farmers' production systems are still underdeveloped and need

more improvement. It can be concluded that smallholder farmers still use their traditional methods and knowledge to produce and store their produce. They still do not have resources and technologies that will help them improve their agricultural productivity.

The challenges that smallholder farmers are faced with made them to consume more than they can sell especially for grain crops. This means that farmers cannot be able to generate their own income to buy other crops or food they cannot grow for their healthy. It was then concluded that smallholder farmers do not produce their crops in a sustainable way, since they cannot be able to consume and sell the surplus continuously. It was also concluded that farmers do not understand what food security is and their decision making on type of crops they produce are based on their survival, resources they have and their traditional knowledge.

5.3 Policy and food security improvement recommendations

- Smallholder farmers especially Women should be encouraged and be supported by government, agricultural extension workers and NGO's to produce diverse crops for food security, for instant they can be encouraged to have gardens in the back of their yards.
- Extension officers, NGO's and nutrition educators need to come up with strategies on how to educate and increase awareness of smallholder farmers on food security, healthy and nutritious food. Most of the farmers that were interviewed did know on what to eat for their healthy. The education should be based on nutritional benefit of producing diverse crops, income generations and food security.
- Farmers can be provided with proper storage devices such as communal seed storages where they can store their seeds as a community and be monitored
- Researchers need to take seeds from smallholder farmers for seed quality assessment before they plant and provide them with improved varieties.
- Farmers market need to be developed in such a way that when farmers sell their produce locally or within communities they do generate income for them to be able to buy other things they cannot produce. New and innovative strategies need to be developed to help farmers produce and sell in sustainable way.
- There are policies which are aimed at improving smallholder farmers' participation in the agricultural markets. There are also policies that seek to increase youth participation in agriculture. However the existing policies need to be revised and their

implementation need to be monitored to ensure that they serve people intended to and are in a public interest.

5.4 limitations of the study and directions for further studies

The study wanted to go further and assess Profit/Loss for farmers, to find out whether farmers are making any income from what they are selling. One the limitations were to find enough information from farmers on costs they incur during production. Another limitation was to find information on their sales since they do not keep records and they do not sell regularly they only sell when there is someone in a community who want to buy.

As the study found that the main grown crops are maize, beans and potatoes in the selected rural areas, future studies can now determine household food security by checking their nutritional status. This can helps to know whether the households are healthy, malnutritious, obese or stunted. Knowing nutritional status of rural households can help to recommend diverse crops that farmers can plant to supplement their nutrition such as vegetables.

Most of the smallholder farmers live under certain circumstances such as obstacles, beliefs and values. Further studies can determine factors that influence their dietary diversity, to come up with strategies on how to improve smallholder farmers' food security taking into consideration the conditions they live in.

APPENDICES

Appendix 1: Table for crops grown by farmers for Chapter three

Percentage of crops grown by farmers from eight locations in rural areas of KwaZulu-Natal

Variables	Location	Percentage (%)		Chi-Square value	P-Value
		No	Yes		
Maize	Ogagwini	5	95	39.888	0.000
	Swayimane	0	100		
	Nugwane	15	85		
	Odidini	7.1	92.9		
	Mvuzane	25	75		
	Deepdale	0	100		
	Emaswazini	25	75		
	Nhlazuka	0	100		
Beans	Ogagwini	5	95	4.331	0.741
	Swayimane	19.4	80.6		
	Nugwane	15	85		
	Odidini	14.3	85.7		
	Mvuzane	16.7	83.3		
	Deepdale	7.1	92.9		
	Emaswazini	15	85		
	Nhlazuka	6.3	93.8		
Sweet potatoes	Ogagwini	25	75	25.533	0.001
	Swayimane	67.7	32.3		
	Nugwane	15	85		
	Odidini	21.4	78.6		
	Mvuzane	16.7	83.3		
	Deepdale	50	50		
	Emaswazini	65	35		
	Nhlazuka	40.6	59.4		
Potatoes	Ogagwini	30	70	11.313	0.126
	Swayimane	25.8	74.2		
	Nugwane	10	90		
	Odidini	0	100		
	Mvuzane	16.7	83.3		
	Deepdale	7.1	92.9		
	Emaswazini	5	95		
	Nhlazuka	15.6	84.4		
Butternut	Ogagwini	100	0	39.049	0.000
	Swayimane	96.8	3.2		
	Nugwane	100	0		
	Odidini	92.9	7.1		
	Mvuzane	100	0		
	Deepdale	100	0		

	Emaswazini	60	40		
	Nhlazuka	96.9	3.1		
Cabbage	Ogagwini	80	20	42.900	0.000
	Swayimane	67.7	32.3		
	Nugwane	85	15		
	Odidini	71.4	28.6		
	Mvuzane	50	50		
	Deepdale	30.8	69.2		
	Emaswazini	15	85		
	Nhlazuka	25	75		
Spinach	Ogagwini	70	30	46.624	0.000
	Swayimane	71	30		
	Nugwane	71	29		
	Odidini	64.3	35.7		
	Mvuzane	16.7	83.3		
	Deepdale	30	69.2		
	Emaswazini	5	95		
	Nhlazuka	21.9	78.1		
Amadumbe	Ogagwini	10	90	69.143	0.000
	Swayimane	67.7	32.3		
	Nugwane	10	90		
	Odidini	14.3	85.7		
	Mvuzane	0	100		
	Deepdale	69.2	30.8		
	Emaswazini	95	5		
	Nhlazuka	18.8	81.3		
Umfino	Ogagwini	75	25	10.964	0.140
	Swayimane	96.8	3.2		
	Nugwane	75	25		
	Odidini	78.6	21.4		
	Mvuzane	83.3	16.7		
	Deepdale	84.6	15.4		
	Emaswazini	100	0		
	Nhlazuka	84.4	15.6		
Pumpkin	Ogagwini	90	10	24.583	0.001
	Swayimane	87.1	12.9		
	Nugwane	60	40		
	Odidini	64.3	35.7		
	Mvuzane	100	0		
	Deepdale	53.8	46.2		
	Emaswazini	95	5		
	Nhlazuka	93.8	6.3		
Onion	Ogagwini	85	15	15.590	0.029
	Swayimane	90	9.7		
	Nugwane	100	0		
	Odidini	85.7	14.3		
	Mvuzane	66.7	33.3		
	Deepdale	84.6	15.4		

	Emaswazini	75	25		
	Nhlazuka	62.5	37.5		
Carrot	Ogagwini	90	10	34.899	0.000
	Swayimane	90	9.7		
	Nugwane	95	5		
	Odidini	64.3	35.7		
	Mvuzane	50	50		
	Deepdale	69.2	30.8		
	Emaswazini	35	65		
	Nhlazuka	50	50		
Sugarcane	Ogagwini	55	45	40.695	0.000
	Swayimane	93.5	6.5		
	Nugwane	80	20		
	Odidini	100	0		
	Mvuzane	100	0		
	Deepdale	100	0		
	Emaswazini	100	0		
	Nhlazuka	100	0		

Note: level of significance (P=0.05)

Appendix 2: Chapter 3 questionnaire

- **Survey questionnaire**

TOPIC: The Economic Sustainability of Homestead Seed Production

Background

1. Name (Optional)_____.
2. Gender : ( )Male or ( ) Female
3. Age:
4. Location (e.g. Sweet water)_____.
5. KwaZulu-Natal district (e.g. UMgungundlovu)_____.

Section A

1. Do you grow your own crops? Yes or No
   If you answered yes, please answer the following questions.
2. What crops do you grow?

_____

_____

_____

3. Why do you grow these crops?

_____

_____

_____

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

4. When do you grow these crops?

_____

_____

Section B

1. Where do you get your seed? (*only check one*)
   ( ) I purchase, ( ) I use saved seeds from previous season, ( ) I purchase from local neighbors ( ), I use donated seeds or ( ) All of the above
2. If you purchase your seed, give reasons why

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

3. If you do not purchase your seed give reasons why

Section C

1. Do you produce your own seeds? Yes or No
   If you answered yes, please answer the following questions
2. What are the disadvantages of homestead seed production?

3. What are the advantages of homestead seed production?

4. How do you select seeds that will be stored?

5. How do you store seeds?

6. How do you determine the seed quality of stored seeds?

7. How does storage affect seed quality?

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

8. Do you sell your seeds? Yes or No
   Give a reason why

9. How you market/ promote your seeds?

10. What market values do you use to sell your product? (e.g seed size, germination percentage)

Appendix 3: Chapter 4 questionnaire

Questionnaire

Objective: Determine whether farmers grow diverse crops for consumption and sell surplus to get income.

Background

6. Name (Optional)_____.
7. Location (e.g. Sweetwater)_____.
8. KwaZulu-Natal district (e.g. UMgungundlovu)_____.

Section on farmer's performance

5. How big is your area planted? (to know the amount of land used during production)
   0 = > 0.5 ha
   1 = 0.5 – 1 ha
   2 = 1 – 2 ha
   3 = > 2 ha
   Notes: (1 ha = football field)

6. From the crops given, which ones did you grow?

   _____

   _____

   _____

7. When did you grow the crops? (Winter, summer, autumn or spring)

   _____

   _____

8. When did you harvest?

   _____

   _____

9. What input you used? (E.g. seeds, fertilizer, manure etc.) (To know how much it cost farmers to get inputs)

Inputs type	**Amount**	**Cost (R)**
Seeds		

Inputs type	**Amount**	**Cost (R)**
Fertilizer		

Inputs type	**Amount**	**Cost (R)**
Manure		

Inputs type	**Amount (Lt)**	**Cost (R)**
Pesticides		

Inputs type	**Amount (Lt)**	**Cost (R)**
Herbicide		

Inputs type	**Hours**	**Cost (R)**
Tractor		

Inputs type	**Hours**	**Cost (R)**
Hired labour		

10. Information on crops harvested (To determine if farmers consume more than they can sell **AND** if they get enough income from what they sell for them to buy other things they can't plant)

Crop type	**Amount Harvested**	**How much was for consumption**	**How much was sold**	**Sale price (R)**

11. What is the amount of yield lost after harvest? (maybe through post-harvest) (To determine how much farmers lost during harvest or post-harvest and what caused the loss)

Crop type	Amount lost	Causes

Measurements

1 ha = football field

Tins of known size (small, medium or large)

Sacks (12, 5 kg, 25 kg or 50 kg)

Buckets (10 Lt, 20 Lt or 25 Lt)

Seeds in bags (kg)

Appendix 4: Research output

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	How much was for consumption? green maize	318.8596	57	729.93824	96.68268
	How much was sold? green maize	42.0175	57	134.98631	17.87937

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	How much was for consumption? green maize & How much was sold? green maize	57	.893	.000

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1	How much was for consumption? green maize - How much was sold? green maize							
	276.84211	612.39331	81.11348	114.35229	439.33192	3.413	56	.001

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	How much was for consumption? dry maize	148.5593	59	263.34396	34.28446
	How much was sold? dry maize	45.4237	59	105.83530	13.77858

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	How much was for consumption? dry maize & How much was sold? dry maize	59	.844	.000

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1	How much was for consumption? dry maize - How much was sold? dry maize							
	103.13559	183.07926	23.83489	55.42488	150.84631	4.327	58	.000

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	How much was for consumption? beans (kg)	132.0339	59	234.55960	30.53706
	How much was sold? beans	42.5424	59	88.36334	11.50393

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	How much was for consumption? beans (kg) & How much was sold? beans	59	.697	.000

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	How much was for consumption? cabbage	172.4746	59	438.81004	57.12820
	How much was sold? cabbage	57.1017	59	138.81366	18.07200

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
What amount harvested? green maize (kg) * Locations	57	95.0%	3	5.0%	60	100.0%
How much was for consumption? green maize * Locations	57	95.0%	3	5.0%	60	100.0%
How much was sold? green maize * Locations	57	95.0%	3	5.0%	60	100.0%

Case Summaries

Sum

Locations	What amount harvested? green maize (kg)	How much was for consumption? green maize	How much was sold? green maize
Deepdale	1020.00	1020.00	.00
Umbumbulu	1310.00	1310.00	.00
Swayimane	22750.00	15845.00	2395.00
Total	25080.00	18175.00	2395.00

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1	How much was for consumption? green maize - How much was sold? green maize	-270.52632	902.26386	119.50777	-509.92914	-31.12349	-2.264	56 .027
Pair 2	How much was for consumption? dry maize - How much was sold? dry maize	90.59322	177.72529	23.13786	44.27776	136.90868	3.915	58 .000
Pair 3	How much was for consumption? beans (kg) - How much was sold? beans	89.49153	184.17967	23.97815	41.49404	137.48901	3.732	58 .000
Pair 4	How much was for consumption? cabbage - How much was sold? cabbage	-97.40678	357.81719	46.58383	-190.65445	-4.15911	-2.091	58 .041

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
How do you store seeds? Underground?	Between Groups	25.722	7	3.675	57.100	.000
	Within Groups	8.945	139	.064		
	Total	34.667	146			
How do you store seeds? Sealed grain?	Between Groups	4.749	7	.678	4.929	.000
	Within Groups	19.129	139	.138		
	Total	23.878	146			
How do you store seeds? Roof?	Between Groups	8.815	7	1.259	13.234	.000
	Within Groups	13.226	139	.095		
	Total	22.041	146			

How do you store seeds? Floor?	Between Groups	10.081	7	1.440	10.050	.000
	Within Groups	19.919	139	.143		
	Total	30.000	146			
How do you store seeds? Cool house?	Between Groups	9.397	7	1.342	21.692	.000
	Within Groups	8.603	139	.062		
	Total	18.000	146			
How do you store seeds? Smoke?	Between Groups	3.300	7	.471	9.528	.000
	Within Groups	6.877	139	.049		
	Total	10.177	146			