SOCIO-ECONOMIC AND INSTITUTIONAL FACTORS INFLUENCING SMALLHOLDER FARMERS' PARTICIPATION IN CASSAVA PRODUCTION IN MSAMBWENI SUB-COUNTY, KWALE COUNTY, KENYA

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A Thesis Submitted to the Graduate School in Partial Fulfilment of the Requirements for the Master of Science Degree in Agricultural Economics of Egerton University

EGERTON UNIVERSITY

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DECLARATION AND APPROVAL

Declaration

This Thesis is my original work and has not been presented in this or any other university for the award of any degree.

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Approval

This Thesis has been presented to the Graduate School for examination with our approval as University supervisors.

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DEDICATION

To Virginia, Emily and Changsha for their sacrifice to this cause.

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Glory and honor go to Almighty God for his mercy, care, strength and guidance during the period of study.

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ABSTRACT

Agriculture continues to be the key driver of the Kenyan economy. However, the sector faces challenges in production due to frequent and prolonged droughts. This calls for farmers to adopt more drought-tolerant crops like cassava. Cassava farmers face a number of socio-economic and institutional factors that influence their production decisions. This study sought to contribute to improved food security of smallholder farmers in rural areas by improving production policies through determining the socio-economic and institutional factors influencing smallholder farmers' participation in cassava production in Msambweni Sub-County of Kwale County. The specific objectives included: to characterize the production systems and farmers in Msambweni Sub-County; to determine the socio-economic and institutional factors influencing cassava production decisions in Msambweni Sub-County and to determine the area under cassava production in relation to other food crop enterprises in Msambweni Sub-County. In this regard, data was collected from 186 farmers selected proportionately from Vanga, Kikoneni/Pongwe and Dzombo Wards in Msambweni using face-to-face interviews. Descriptive statistics were used to analyze data for objective 1. The data for objective 2 and 3 were analyzed using Heckman model while data for objective 4 were analyzed using analysis of variance (ANOVA). The Statistical Package for Social Scientists (SPSS), Excel and STATA programs were used to process and summarize the data. Among the Socio-Economic factors, farm size positively influenced participation in cassava production whereas education level and age negatively influence participation in cassava production. Among the institutional factors, production and market information, storage facility and access to cuttings positively influence participation in cassava production whereas group membership and means of transport negatively influence participation in cassava production. Access to information and group membership had a positive influence while Gender of household head had a negative influence on extent of cassava production. The study recommends that the policy makers consider policies that encourage the following aspects: improved education and training among farmers to increase their capacity to engage in cassava production profitably. As land seemed to be a limiting factor, intercropping cassava with other food crops should be encouraged so as to fully and intensively utilize the land resource. Farmer Group empowerment and development should be encouraged as they are easy conduits for seed/cuttings distribution and training.

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ACRONYMS AND ABBREVIATIONS

FAO	-	Food and Agriculture Organization of United Nations
EAAPP	-	Eastern Africa Agricultural Productivity Project
GDP	-	Gross Domestic Product
CIDP	-	County Integrated Development Plan
KNBS	-	Kenya National Bureau of Statistics
KALRO	-	Kenya Agricultural and Livestock Research Organization
FaaB	-	Farming as a Business
MOA	-	Ministry of Agriculture
UN	-	United Nations
COMESA	-	Common Market for Eastern and Southern Africa
CL	-	Coastal Lowlands
SCAO	-	Sub-County Agricultural Officer

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Kenya's economic growth has for a long time depended on agriculture. As such, the country's long-term development blueprint, Vision 2030 singles out agriculture as one of the key sectors to deliver sustainable economic growth and improved livelihoods for the poor in the rural areas. However, the sector faces several endemic and emerging constraints at the global, regional and national levels that require special attention. During the first two decades after independence, Kenya's economy grew at an average rate of 6 percent per year substantially driven by a robust agricultural sector (Ministry of Agriculture, 2009). However, until about six years ago, the overall economy barely grew, partly as a result of a decline in agricultural activities. Despite experiencing mixed results over the years, agriculture still remains the mainstay of the Kenyan economy, its share of the Gross Domestic Product (GDP) declining from 23 percent in 2007 to 22 per cent of real GDP in 2010 (KNBS, 2010). The current share is 26 percent (KNBS, 2012). The agricultural sector however continues to face challenges in production due to frequent and prolonged droughts both regionally and globally. Drought is perhaps the most prevalent abiotic stress affecting plant growth, survival and productivity in the world. The effect of drought is more pronounced in the Semi-Arid Tropics, where rainfall is generally low and erratic in distribution over time and space. The current situation in Kenya where many areas are receiving below-average rainfall attests to this. The drastic effects of drought and the resultant food insecurity can be overcome by growing crops that are drought tolerant like cassava.

Cassava (*Manihot esculenta*) is one of the most popular root crops grown in Africa. It is relatively easy to cultivate, needing very little cultural attention. Many soils are used for growing cassava but high tuber yield can only be obtained in friable and light soils. The soils should be deep, not stony nor water-logged. Cassava is exhaustive of potassium (Ministry of Agriculture, 2012). Cassava value chain is promising with many business opportunities; the main challenge is the mass supply of tuber roots that can satisfy human, animal and industrial needs. Cassava, as well as the rest of agriculture faces production and marketing limitations that significantly impede the country's overall economic growth and development (Elise, 2012). Cassava has

many uses but largely, it is used for three main purposes – human food, animal feed and starch making (FAO, 1995). Some of its products are; boiled cassava, cassava crisps, cassava *chapati*, *Kimanga*, cassava porridge, cassava *ugali*, cassava *mandazi* and cassava cake (Ministry of Agriculture, 2012). Cassava stalks are used as seed, wood fuel and as fencing materials while the leaves may be used as vegetables and hay. Industrial uses of cassava include use in animal feed making and making of industrial starch. Its consumption closely follows the global pattern of output, since most of it is consumed in the countries where it is grown. Furthermore, FAO (1995) indicates that although in the early 1990's a very large part of the cassava output was used directly as human food, its share has continuously declined since then. On the other hand, cassava consumption as animal feed and starch-making has continued to increase since the early 1990's. While total food consumption of all crops has risen considerably during the past 40 years, world consumption of cassava as food has remained stagnant, mainly because it is regarded in many countries as a poor man's food, though it can go a long way in relieving the consumption pressure on cereal crops like maize and rice.

Cassava is the most important root and tuber crop in Coast (30%), Eastern (10%), Western/Nyanza (60%) and some parts of Rift Valley and Central Counties. Kenya is currently ranked 50th in cassava production in the world. Production trends in Msambweni against national production between 2008 and 2013 are given below – showing marginal increase for Msambweni in that period:

Table 1: Msambweni and National Cassava Production Trends Between 2008 and 2013.

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Production in Msambweni (tons)	13,000	12,600	9,053	14,960	14,277	15,992
National production (tons)	750,964	819,967	323,389	679,167	893,122	1,112,420

Source: Msambweni District Annual reports and FAOSTAT

In Kwale County, there is poorly organized formal production and marketing structures in place for cassava. A large proportion of the farm households aim basically to produce enough tubers to meet household requirements and many often fail to meet this basic goal. A growing proportion of farmers are beginning to adopt new varieties because of increased yield. However, they are less willing to allocate more resources to increase production because of the perception of higher

returns from alternative farm and non-farm enterprises whereas cassava could do much better in the prevailing circumstances. Moreover, there has been increased interest by the Government and private investors in animal feed making and starch manufacturers to promote cassava production (Ministry of Agriculture, 2012). The Ministry of Agriculture through Eastern Africa Agricultural Productivity Project (EAAPP) has been working to increase cassava production which is currently a small proportion of food needs. The common improved varieties grown in Kwale County include Karembo, Shibe, Tajirika, Karibuni, Nzalauka, Siri and local types like Kibandameno and Guzo (Ministry of Agriculture, 2012).

The improved varieties were developed by KARI (now Kenya Agricultural and Livestock Research Organization, KALRO), Mtwapa. Following the challenges facing maize and cassava which are the principle food crops for the coastal lowlands KARI has made some advances in its research interventions in the seed systems for a number of "favored" crops in the region but with key emphasis on maize and cassava. Hence, in addressing the problem of low crop yields, which affects approximately 3.32 million people (KNBS, 2009) across all the five mandate area counties the Institute rolled out a strategic formal and informal seed system aimed at availing maize, cassava and cowpea seed that withstand the local climatic and soil conditions so that farmers can increase the respective enterprises' yields, money incomes and profitability which can be transformed for farm households' wealth creation. In establishing the seed unit, KARI had the objectives of providing a mechanism for KARI-developed technologies validation and commercialization, providing a means of disseminating agricultural technologies to catalyze adoption process, increase yields and incomes and finally, to develop direct research and technology user link for feedback and shaping future research agenda (KARI, 2009).

1.2 Statement of the Problem

In the recent past the demand for cassava has gradually increased following increase in population and its industrial use particularly in feed and industrial starch-making. There has also been increased interest by the Government and private investors in animal feed making and starch manufacturing to promote cassava production. The Ministry of Agriculture through KARI (now KALRO) and Eastern Africa Agricultural Productivity Project (EAAPP) has been working to increase cassava production. However, as much as cassava is an important table and income

generating crop, farm households in the study area have been faced with critical challenges which include poor access to quality seed, serious pests and disease challenges of the local varieties and low yields. This makes Msambweni an overall food deficient area despite huge cassava production potential. In response to these challenges, KARI under its regional research mandate developed the six cassava varieties (mentioned earlier) to mitigate the afore-mentioned challenges (including aspects of early maturity) along with incorporation of eating/consumption and other market preferences that respond to industrial needs that cassava also has potential in. In spite of these concerted efforts, the main challenge remains the mass supply of tuber roots that can satisfy human, animal and industrial needs. Cassava still faces production limitations that significantly impede the country's overall economic growth and development.

Kwale County is among the high potential areas for cassava production but indications are that only a few farmers engage in production that spares some cassava for sale. This is probably due to socio-economic and institutional barriers to production. The current status of cassava cultivation in the County is not clear. Furthermore, much of the previous research work laid emphasis on varietal improvement, seed systems and Information and Communication Tools (ICTs) used in the diffusion of agricultural innovations. Underlying factors associated with lack of response to emerging trends in cassava production therefore need to be determined and analyzed for effective promotion of the crop. There could be a range of socio-economic and institutional factors influencing participation in cassava production. These factors could affect farmers' incentives to participate in cassava production and may lead to low acreage under cassava production. A reduction in participation in cassava production, in turn, makes it difficult for farmers to increase yield and shift into commercial cassava production which in turn leads to a reduction in economic development. As aforementioned, there has been scarcity of research with regard to the socio-economic and institutional factors and characteristics of cassava producers in Kwale County and how these factors affect production decisions. These factors include age, gender, education level, household size, farm size, land tenure, household income, storage facilities, mode of transport of produce and road infrastructure. Others are access to cuttings, extension services, access to information and group membership. The question then arises; how have these factors influenced participation in cassava production in the County and in Msambweni Sub-County in particular?

1.3 Objectives of the Study

1.3.1 General Objective

The broad objective of this study was to contribute to improved food security of smallholder farmers in rural areas by improving production policies through analyzing the socio-economic and institutional factors influencing smallholder farmers' participation in cassava production in Msambweni Sub-County.

1.3.2 Specific Objectives

The specific objectives of the study were:

i. To characterize the crop production systems and farmers in Msambweni Sub-County.
ii. To determine the socio-economic factors influencing cassava production decisions in Msambweni Sub-County.
iii. To determine the institutional factors influencing cassava production decisions in Msambweni Sub-County.
iv. To determine the area under cassava production in relation to other food crop enterprises in Msambweni Sub-County.

1.4 Research Questions

i. What were the crop production systems and characteristics of farmers in Msambweni Sub-County?
ii. What socio-economic factors influenced cassava production decisions in Msambweni Sub-County?
iii. What institutional factors influenced cassava production decisions in Msambweni Sub-County?
iv. What was the area under cassava production in relation to other food crop enterprises in Msambweni Sub-County?

1.5 Justification of the Research

All over the world food insecurity is associated with instability and loss of lives. Therefore, food security is a key issue everywhere, including Kwale County. Ways to improve food security, farmers' incomes and employment opportunities through generating information

on production participation in crops that majority of the farmers grow are necessary with special interest in cassava.

Erratic weather, cultural believes, population pressure on land and prohibitive production costs have had a negative effect on the production of the staple foods like maize and rice in this area which is also a regular recipient of relief food. The need to shift focus to the production of drought tolerant crops such as cassava, grown by majority of the smallholder farmers as a food security crop arises. This is because it is high yielding, adaptable to harsh weather conditions, requires low input and cultural attention and has a rising demand. It was therefore envisioned that the results of this study would serve as reference material for policy making and further research on cassava economics.

1.6 Scope and Limitations of the Study

The study considered all cassava varieties grown by smallholder farmers in Msambweni Sub-county. Moreover, the study covered Kwale County and targeted all smallholder farmers in Vanga, Dzombo and Kikoneni/Pongwe wards of Msambweni Sub-county. The study evaluated socio-economic and institutional factors influencing participation in cassava production, crop production systems, proportion of cassava in relation to other food crops and challenges facing cassava farmers. It also determined how and to what extent these socio-economic and institutional factors influence cassava production and reasons as to why farmers produced or did not produce cassava. There were other factors that may influence cassava production that were outside the scope of this study.

Limitations to this study included low literacy levels which may have lead to less exact answers to questions, lack of proper record keeping by farmers and lack of standardized measurement systems at farm level. To mitigate these, face to face interviews using local dialect and observations were employed. Because Kwale County is a small geographical area of the country, the results may not be applied to others areas.

1.7 Definition of Key Terms

Drought- This is a period of dry weather, especially a long one that is injurious to crops.

Food Insecurity – In this study, food insecurity meant the situation when most people lack access to sufficient and safe food of any type to relieve them of the pangs of hunger for a prolonged period of time.

Household-A household is a domestic unit which consists of one or more people who live in the same dwelling and also share at meals or living accommodation, and may consist of a single family or some other grouping of people. The household was the basic unit of analysis in this study.

Institutional Factors- In this study, institutional factors referred to factors of an institutional or structural nature that together with associated activities and resources affect decision making in production activities for instance, road infrastructure, land tenure system and group membership.

Production Participation - The degree of adoption in a long-run equilibrium when a farmer has full information about the crop and its potential. The extent of participation will be captured by the area under cassava rather than the cassava output.

Smallholder- This is a single household on a small farm (not exceeding 12 acres) with a mixture of cash crops and/or subsistence farming.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Cassava is a major component of the diet and livelihood of 500 million people in more than 80 countries mainly in Africa, Asia, Latin America and Oceania. It is grown in over 39 countries and it accounts for a large proportion of the total food produced in sub-Saharan Africa (Draft National Policy on Cassava Industry, 2007). Cassava production has been declining due to shift to other crops that seem to give more returns than cassava, use of poor quality seed, endemic spread of pests and diseases and low understanding of socio-economic/institutional factors affecting farmer's participation in cassava production. It is high time the Government initiated appropriate measures that will make cassava a commercial crop so as to match the dynamic changes in the industry and the world at large (ibid).

2.1 History and Role of Cassava

Cassava was introduced in Kenya around 15th century, by European explorers and by the end of 19th century, it was well adopted and adapted in the country as an important traditional food crop that could grow in many areas of the country across various agro-ecological zones. Currently, it is regarded as a marginal crop with limited production and utilization, despite its great potential in the food, feed, pharmaceutical and paper industries. However, it is a major staple food in western and coastal regions of Kenya (Draft National Policy on Cassava Industry, 2007). Moreover, it is evident that Kenya has for a long time neglected most of the traditional staples such as cassava despite the aforementioned potential. The Common Market for Eastern and Southern Africa (COMESA) presents an opportunity for increased production, utilization and trade in cassava and cassava products in the region (ibid). World production of cassava root was estimated to be 184 million tons in 2002, rising to 230 million tons in 2008. Africa had the majority of production in 2002, where 99.1 million tons were grown. Asia followed with 51.5 million tons while Latin America and the Caribbean had 33.2 million tons. The world's largest producer of cassava is Nigeria. However, based on the statistics from the FAO of the UN, the largest exporting country of dried cassava is Thailand with a total of 77% of world export in 2005. Vietnam, Indonesia and Costa Rica follow with 13.6%, 5.8% and 2.1% respectively. Cassava production worldwide increased by 12.5% between 1988 and 1990 and in 2010, the

average yield of cassava crops was 12.5 tons per hectare (FAO, 2011). It is a crop of the lowland tropics and it does best in a warm, moist climate, where the mean temperature ranges from 25^{o}C to 29^{o}C. The root crop grows poorly under cold climates. Cassava does well with rainfall of between 1000-1500 mm per year; however, the crop is well adapted to cultivation under conditions of drought. The crop can profitably be grown in areas where the annual rainfall is as low as 500mm. On average, yields are approximately 7-10 MT/Ha. However, trials have shown that cassava could yield 50MT per hectare of fresh cassava with dry matter of over 32% (ibid).

No continent depends as much on root and tuber crops in feeding its population as does Africa. In the humid and sub-humid areas of tropical Africa, it is either a primary staple food or a secondary co-staple. In Ghana, for example, cassava and yams occupy an important position in the agricultural economy and contribute about 46% of the agricultural gross domestic product. Cassava accounts for a daily caloric intake of 30% in Ghana and is grown by nearly every farming family. The importance of cassava to many Africans is epitomized in the Ewe (a language spoken in Ghana, Togo and Benin) name for the plant, *agbeli*, meaning "there is life" (Adebayo, 2009). In Tamil Nadu, India the National Highway 68 between Thalaivasal and Attur has many cassava processing factories alongside it—indicating a local abundance. Cassava is widely cultivated and eaten as a staple food in Andhra Pradesh and in Kerala (FAO, 2000).

In Kenya cassava is one of the major root crop coming only second to Irish potatoes. In the year 2006, Kenya produced approximately 800,000 MT of cassava valued at 3.8 billion Kenya shillings and has the potential to produce more than 2 million metric tons per year (MOA, 2009). Cassava is produced mainly in western, Coast and eastern Kenya while production in the other regions is relatively low. One of the reasons for the decline in cassava production in the recent years has been the emergence of the Cassava Mosaic Disease (CMD) in Eastern Africa. This disease has adversely affected cassava production in many areas especially in Western Kenya (Danda *et al*, 2014). However, there is high potential for increased cassava production especially in the arid and semi-arid lands (ASAL), since about 80% of the Kenyan land mass falls within ASAL. Cassava can grow better in this region (ASAL) than many of the alternative crops (Draft National Policy on Cassava Industry, 2007).

As mentioned earlier cassava, yams and sweet potatoes are important sources of food in the tropics (Adebayo, 2009). The cassava plant gives the third highest yield of carbohydrates per cultivated area among crop plants, after sugarcane and sugar beets. Cassava plays a particularly important role in agriculture in developing countries, especially in sub-Saharan Africa, because it does well on poor soils and with low rainfall, and because it is a perennial that can be harvested as required. Its wide harvesting window allows it to act as a famine reserve and is invaluable in managing labor schedules. It offers flexibility to resource-poor farmers because it serves as either subsistence or a cash crop (FAO, 1990). Cassava is used as food (*fufu, gari, tapioca, kimanga* etc), for making alcoholic beverages (tequila, *kasiri*, etc), for making biofuel, animal feed and laundry starch, and pharmaceutical use. In Kenya, cassava leaves are consumed as vegetables and consumers like them due to their nutritive value (ibid). However the consumption of cassava leaves is higher in Coastal than in Central and Western regions with respective percentage of 89.3%, 40.9% and 22.4% (Kariuki, 2004). Fresh cassava roots are consumed as a snack. Both urban and rural consumers of fresh cassava roots prefer sweet, medium sized cassava roots that deteriorate slowly and are easy to peel. Cassava flour is usually obtained by milling both fermented and unfermented dry chips. The flour in form of composite with maize, sorghum and millet is then used in making "*ugali*" and porridge. The potential of cassava flour in baking and confectionery industry in Kenya is yet to be exploited. A composite of wheat flour and cassava flour can be used to produce high quality bread, cakes, scones and buns depending on the ratio of wheat to cassava used (Draft National Policy on Cassava Industry, 2007).

Starch can be produced from grain, root and tuber crops. In Kenya Cornproduct Limited and Tapioca are the only starch-producing industries. However, there are over 100 cassava starch derivatives, or chemically modified starch products that have been developed to provide specific applications (Kadere, 2004). Among the starch derivatives produced from native (sweet) starch, include glucose syrups and maltose (Henry and Westby, 2000). Thailand and Malaysia have produced good quality cassava starch for specific industrial applications for both local and export market. Although, world over, cassava is widely used in feeding pigs, cattle, sheep and poultry, utilization of cassava in animal feeds is still low in Kenya. With the advanced dairy and poultry industry in the country, cassava chips have the potential to replace 10-30 % of maize grains in animal feed rations. In Cameroon, researchers estimate that poultry farmers can cut production costs by 49 % if they used cassava as an

ingredient in chicken feed (New Vision, 2006). In addition, dehydrated cassava leaves are equivalent in feed value to alfalfa. Far East and Japan import 240,000 tons of dried cassava leaves per annum. There is therefore a great potential for export of dried cassava chips and dried cassava leaves to similar industries in the neighboring countries and overseas, such as China and Japan(FAO, 2000).

2.2 Socio-Economic Factors Influencing Cassava Production

Socio-economic factors are the social and economic experiences that help mold ones personality, attitude and lifestyle. These factors can also define region and neighborhood. They include education, gender, age, household size, farm size and household income.

It is believed that higher level of education is associated with access to information on improved/suitable technologies and higher productivity (Norris and Batie, 1987). Evidence from various sources indicates that there is a positive relationship between the education level of the household head and improved technologies (Igoden, 1990). Education increases managerial competence and therefore enhances ability to diagnose, assess, comprehend, and respond to financial and production problems. High level of education enhances the understanding of instructions and also improves the farmer's level of participation in agricultural activities. There is also a greater tendency of the more educated to invest in risky securities in old age (Bellante and Green, 2004). Education therefore enhances the skill and ability to better utilize production information, which may reduce production costs and make it more profitable to participate in cassava production. The role of education on adoption of lowly perceived crops like cassava has not been addressed sufficiently. The study therefore envisaged that a farmer with higher levels of education is only likely to take up cassava production if it is the best alternative crop in his situation (marginal areas).

Male headed households are more likely to get information about new technologies and undertake risky businesses than female headed households (Asfaw and Admassie, 2004). However, a study by Nhemachena and Hassan (2007) finds contrary results, arguing that female-headed households are more likely to adopt because they are responsible for much of the agricultural work in the region and therefore have greater experience and access to information on various management and farming practices. Therefore, the adoption of crops appears to be rather context specific. Furthermore, female-headed households being poor, a sizeable proportion

are in subsistence agriculture in which most rural poor are found and is the only way of life known to them. The fact that most of the women may not generally be involved in production decision-making has a consequence of low returns to farming which in turn aggravates poverty (Atieno, 2006). Gender of household head was therefore expected to capture differences in production decision orientation between males and females with females expected to have a higher propensity to participate in cassava production than males.

Age of the head of household can be used to capture farming experience. Studies have shown a positive relationship between number of years of experience in agriculture and the adoption of improved agricultural technologies (Kebede, Kunjal and Coffin, 1990). There is clear support for the postulate of decreasing relative risk aversion among the elderly. However, there is equally clear evidence that relative risk aversion increases modestly as the elderly grow older (Bellante and Green, 2004). It was expected that higher age, and therefore, more experience in farming and risk averse will improve orientation to participation in cassava production.

Household size may influence participation in cassava production from two angles. The first is that households with large families may be forced to divert part of the labor force to off-farm activities in an attempt to earn off-farm income in order to ease the consumption pressure imposed by a large family (Yirga, 2007). The other is that large family size is normally associated with higher labor endowment, which will enable a household to accomplish various agricultural tasks. For instance, Croppernsted, Demeke and Meschi, (2003), argue that households with a larger pool of labor are more likely to adopt agricultural technologies and use it more intensively because they have fewer labor shortages at peak times. Cassava is however easy to cultivate and requires little cultural attention. It can be considered as labour saving. While more cassava may be required to feed a large family, less labour may be required to cultivate it. Here it was expected that households with larger families were more likely to participate in cassava production because they have higher consumption demands and not because they have higher labor supply.

Adoption of agricultural technologies studies show that farm size has both negative and positive effect on adoption, showing that the effect of farm size on technology adoption is inconclusive (Bradshaw, 2004). However, since farm size is associated with wealth and ability

for farm enterprise diversification, it is highly likely to be positively related with cassava production.

Meanwhile, it is common knowledge that adoption of agricultural technologies requires sufficient financial wellbeing (Knowler and Bradshaw, 2007). Studies that investigate the impact of income on adoption found a positive correlation (Franzel, 1999). Higher income farmers may be less risk averse and have more access to information, a lower discount rate, and a longer-term planning horizon (CIMMYT, 1993). However, the perception of cassava as poor man's food may hinder households with higher incomes from cassava cultivation. Thus in this study, household income was hypothesized to have either a positive or negative influence on adoption and production of cassava.

2.3 Institutional Factors Influencing Cassava Production

These are defined as factors of an institutional or structural nature that together with associated activities and resources influence decision making in production activities. They are composed of cultural, cognitive, normative and regulative elements that together with associated activities and resources provide stability and meaning to social life (Scots, 2001). They include extension contact, group membership and access to information, access to seeds, communication infrastructure, land tenure system, storage facility and means of transport.

Extension and training on crop production and information on markets represent access to information required to make the decision to produce cassava. Various studies in developing countries, including Kenya, report a strong positive relationship between access to information to adoption behavior of farmers (Yirga, 2007), and that access to information through extension services increases the likelihood of adopting crop technologies. However, smallholder farmers in Kenya are trapped in the "good season-bad market" dilemma that discourages the adoption of production technologies that lead to greater food surpluses. Immediately following good harvest, commodity prices are extremely low and few facilities are available to smallholders to store their crops for several months required for more favorable (and equitable) returns. Opportunistic middlemen complicate this situation by offering "bulking services" to smallholder communities, while actually paying extremely low farm-gate prices to farmers who lack access to market information, capital and transportation (Mukhwana, 2003). Therefore, this study also

hypothesized that access to extension, training and information increases probability of a farmer to produce cassava.

Price taking at the farm gate, which usually results in low prices, is a manifestation of existing poor market structure and conduct. Collective action especially through contract farming among farmers is, therefore, seen as a means by which they can obtain a strategic posture in price setting and in general, for a more active performance of some production and marketing functions (Librero and Alkuino, 1996). Informal institutions and private social networks like group membership play two distinct roles in adoption of agricultural technologies. First, they act as conduit for information about new technologies. Second, they can facilitate cooperation to overcome collective action dilemmas, where the adoption of technology involves externalities. Thus in this study, group membership was seen to have a positive influence on adoption and production of cassava.

Availability of good quality seeds of high yielding varieties, adapted to the growing area, and preferred by the farmers is the most important prerequisite for good crop production (Ajeigbe, Abdoulaye and Chikoye, 2008). However much other productive inputs (land, fertilizer, labor etc) a farmer puts to use, seed still determines whether an output will be realized or not. While both the formal and informal seed systems exist in Kenya, evidence shows that vast majority of farmers rely on the informal seed system for seed for most agricultural commodities, and often continue to recycle seed that has been exhausted through generations of cultivation. The result has been persistently low yields (Ayieko and Tschirley, 2006). Improved seed thus plays pivotal role in increasing agricultural productivity and thereby reduces production costs inherent in production systems. The quality of seeds alone is known to account for an increase in productivity of at least 10–15% (Ajeigbe *et al.*, 2008). Therefore, access to seed in this study was expected to have a positive influence on adoption and production of cassava.

Land tenure is the relationship, whether legally or customarily defined, among people, as individuals or groups, with respect to land. Land tenure systems determine who can use what (land) resources for how long, and under what conditions. Societies with better "institutions", more secure land rights, and less distortionary policies will invest more in physical and human capital, and will use these factors more efficiently to achieve a greater level of income (Acemoglu, Simon, James and Robinson, 2001). Land tenure relationships may be well-defined

and enforceable in a formal court of law or through customary structures in a community. Alternatively, they may be relatively poorly defined with ambiguities open to exploitation. Security of tenure is the certainty that a person's rights to land will be recognized by others and protected in cases of specific challenges. People with insecure tenure face the risk that their rights to land will be threatened by competing claims, and even lost as a result of eviction. Without security of tenure, households are significantly impaired in their ability to secure sufficient food and to enjoy sustainable rural livelihoods. Land issues at the Kenyan Coast are very emotive and people generally feel deprived of their land rights. Research is scant on the effect of such feelings on cassava production. It was prudent to explore effects of land tenure on cassava production as farmers with more secure land tenure were expected to have better farm investment portfolio than those without. Consequently, this study hypothesized that secure land tenure would influence cassava production positively.

Poor roads and poor telecommunication networks result in high transaction cost. These costs are sometimes too high for farmers and traders to get any meaningful benefits from their trading activities, thus discouraging farmers from marketing activities. Institutional development therefore has to be accompanied by technological changes, in order to sustain production and market participation among smallholder farmers (Fraser and Jari, 2009). Thus, good communication infrastructure would have a positive influence on production of cassava.

Meanwhile, in Kenya fresh cassava roots are consumed as a snack. Both urban and rural consumers of fresh cassava roots prefer sweet, medium sized cassava roots that deteriorate slowly and easy to peel. However, cassava roots and leaves are highly perishable once harvested and must be processed into storable forms within 24 to 48 hours. The perishability of cassava roots limits the extent to which the cassava is marketed and dictates swift movement from the farm to consumer. In addition, it is costly to transport bulky cassava to urban centres where most feed millers and food processors are located (Draft National policy on Cassava Industry, 2007) . While this study hypothesized that availability of means of transport to market would have a positive influence on cassava production, availability of storage facilities may not have similar effect because cassava has a large harvesting window and therefore can be harvested as required.

Scientists from Kenya Agricultural Research Institute, KARI have also carried out studies on cassava in the Coastal Lowlands of Kenya. In their study titled Group Approach in Technology Adoption among Smallholder Cassava Farmers, Danda and Gichinga (2004) studied the impact of group approach on farmer perceptions and empowerment. They used two clusters, one with good exposure or connection to research and extension service providers and the other without. Using an empowerment pyramid they concluded that group approach has a positive effect on attitudes and perceptions which in turn are directly and positively linked to value attachment, thereby influencing likes and dislikes (Danda and Gichinga, 2014). In another study, Improving Productivity of Maize, Cassava and Sweet Potato in the Coastal Lowlands of Kenya through Provision of High Quality Seed, Shuma and Weru concluded that generally, increase in food production where the seed was distributed was evident, ranging between 33% to 43% of the food produced, thereby improving the livelihoods and food security for the local people (Shuma and Weru, 2009). A baseline survey to identify specific constraints facing cassava farmers in Kilifi County so as to identify areas of intervention pointed at lack of disease-free planting materials as one of the major constraints (Munga, 2013). A model for income and welfare value chain upgrading strategy of cassava in the coastal lowlands of Kenya was currently in the pipeline.

2.4 Heckman Sample Selection Model

Incidental truncation arises where sample selection is non random. The distribution as well as the mean and variance of the incidental random variable from such data are distorted as previously discussed. If a simple regression was used such that Y is regressed on X, the estimates of the coefficients will be inconsistent if they were to be used to infer to the full sample. This is due to the specification error of omitted variable committed (Greene, 2007). Though the parameters of a sample selection model can be estimated using the Maximum Likelihood, a commonly used approach is the Heckman's (1979) two-step approach.

The first step in this approach entails the use of a Probit Model to estimate the probability that the individual may be selected from the larger sample. In the second step, the probability value (Inverse Mills Ratio i.e. the IMR) obtained from the first step is used as a regressor in the equation of interest that can now employ the OLS technique and thus an unbiased estimator is obtained. The advantage of this technique over the Tobit model is that the two step sequential process allows the analyst to distinguish between the factors that determine whether or not

households adopt a technology and the factors that influence the household's decision on the extent of production, conditional on adoption. This approach addresses the issue of sample selection bias as a specification error since a simple regression would result in biased estimators in the case of the household's self selection as a producer or a non-producer that necessitates incidental truncation in a model. The bias in this case emanates from using a non-randomly selected sample (given that they decide to produce) thus resulting to omitted variable bias where the results infer to the full sample.

The major point of departure between the Cragg's double Hurdle Model and the Heckman's Sample selection model is that the former is a corner solution model and all data observed including the non-participants are taken into consideration. In incidental truncation, the respondents below the truncation point or threshold are not considered in the analysis. Reyes *et al.,* (2010) uses a double hurdle approach to estimate the factors influencing market participation among smallholder potato farmers in the central highlands of Angola. The double hurdle approach controls for self-selection bias and provides unconditional effects (of participation).
Based on the above discussion, this study inclined towards the use the Heckman model by Heckman, (1979) to model cassava production participation decisions.

2.5 Theoretical and Conceptual Frameworks

2.5.1 Theoretical Framework

In this study, cassava farmers were considered as being producers and consumers of cassava. They produced it to consume and whatever amount they sell is not planned for though it increased their purchasing power and utility. Therefore, they want to maximize utility by producing, consuming and selling cassava. It was for these reasons that this study was modeled on the theory of utility maximization as proposed by von Neuman and Morgenstern, (1953). In Victorian days, philosophers and economists talked casually of utility as an indicator of a person's overall well-being. Utility was thought of as a numeric measure of a person's happiness. It was natural to think of a consumer making choices so as to maximize their utility, that is, to make themselves as happy as possible, given their endowment. This view had a limitation in that these classical economists never really described how utility was to be measured. Because of this limitation economists have abandoned the old-fashioned view of utility as being a measure of happiness. The theory of consumer behavior has been reformulated in terms of consumer preferences, and utility is seen only as a way to describe preferences (Varian, H. R, *et al*, 2005).

It is assumed that farmers will maximize expected utility according to a von Neuman Morgenstern utility function defined over wealth (*W*). When confronted with a choice between two alternative practices, the ith farmer compares the expected utility with the technology, $EU_{ti}(W)$ to the expected utility without the technology, $EU_{oi}(W)$. While direct measurement of farmers' perceptions and risk attitudes on farming technology are not available, inferences can be made for variables that influence the distribution and expected utility evaluation of the technology. These variables are used as a vector *'X'* of attributes of the choices made by farmer *'i'* and ε_i is a random disturbance that arises from unobserved variation in preferences, attributes of the alternatives, and errors in optimization (von Neuman and Morgenstern, 1953). Given the usual discrete choice analysis and limiting the amount of non-linearity in the likelihood function, $EU_{ti}(W)$ and $EU_{oi}(W)$ may be written respectively as:

$EU_{ti}(W) = \alpha_t X_i + \varepsilon_{ti}$ and

$EU_{oi}(W) = \alpha_o X_i + \varepsilon_{oi}$.

The difference in expected utility may then be written as:

$$EU_{ti}(W) - EU_{oi}(W) = (\alpha_t X_i + \varepsilon_{ti}) - (\alpha_o X_i + \varepsilon_{oi}) = (\alpha_t - \alpha_o)X_i + (\varepsilon_{ti} - \varepsilon_{oi}) = \alpha X_i + \varepsilon_i \ .$$

A preference for the technology (cassava production) would result if $EU_{ti}(W) - EU_{oi}(W) > 0$; whereas, a non-preference for the technology will be revealed if $EU_{ti}(W) - EU_{oi}(W) < 0$ (ibid). This will hold for the intensity of production where a farmer decides to produce cassava. Farmers will produce more cassava to consume and sell if they get higher utility than if they are producing, consuming and selling less. Adoption of cassava is therefore linked to cassava production and consumption preferences, the socio-economic/institutional characteristics of the household and characteristics of the farm, where the proportion of the area under cassava relative to other food crops captures production and consumption competitiveness/preferences of the farmers.

2.5.2 Conceptual Framework

Farmers are assumed to be rational, acting in self-interest to increase their utility from their farm enterprises. Therefore, the theory of utility maximization was directly applied to the conceptual framework in this study. They will choose an enterprise that will increase their ability to satisfy their want of food security. As they pursue maximum satisfaction, farmers are faced with both endogenous and exogenous variables that influence their decisions positively and

negatively and develop coping mechanisms as a survival strategy in farming as time passes. The dependent variable in the empirical estimation, conditional on participation in cassava production, was the area under cassava. The explanatory variables for this study included family size, access to information, access to extension contact, membership of farmer group/organization, state of road infrastructure, means of transport, storage facilities, household income, household head's age, educational level attained by the farmer, gender of the household head, farm size, access to seed/cuttings and land tenure. Moderating variables included prices of cassava and other foods, government policy, cost of production and weather. The relationship between dependent variable, explanatory variables and moderating variables as envisioned is shown on Figure 1.

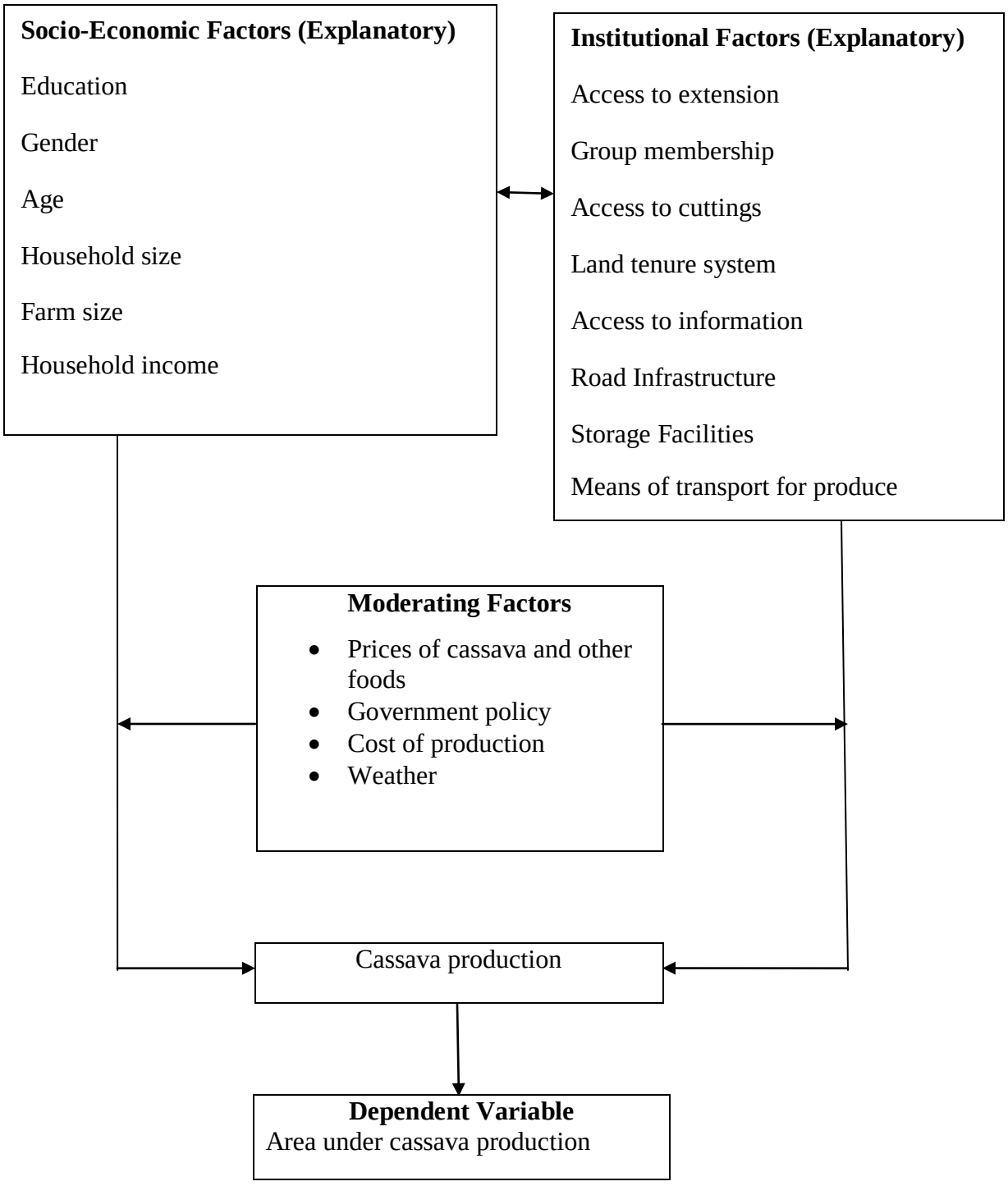

Figure 1: Interaction between Dependent and Explanatory Factors.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter covers the study area, population, sampling procedure, data collection methods, analytical techniques and expected outputs of the study.

3.1 The Study Area

The study was carried out in Msambweni Sub-county of Kwale County, Kenya. This is because despite Msambweni having a huge potential for cassava production it lags behind in cassava production and remains perpetually food insecure. Kwale County is located in the South-eastern corner of Kenya and borders Mombasa County to the North, Kilifi County to the North-west, Taita-Taveta County to the West and the Republic of Tanzania to the South. The County hugs the Indian Ocean on its eastern side forming a stretch of coastline covering approximately 250 km. The County covers an area of 8,270.2 Km^2 (of which 62 Km^2 is under water), lying between Latitudes 3^o 3‘and 4^o 45‘south and Longitudes 38^o 31‘and 39^o 31‘East with a population of 649,931 people (Kwale CIDP, 2013). It has an altitude ranging from 0 m and 462 m above sea level. Kwale County is divided into three administrative Sub-counties namely Matuga, Kinango and Msambweni. The region was chosen because of its potentiality in cassava investment.

Kwale County has four major topographic features namely the Coastal Plain, the Foot Plateau, the Coastal Uplands and the Nyika Plateau. The coastline in Kwale County is about 250 kilometers. This strip of land consists of corals, sands and alluvial deposits. The Foot Plateau, which is behind the Coastal Plain, lies at an altitude of between 60 and 135 meters above sea level. The plateau has a flat plain surface with high potential permeable sand hills and loamy soils. This zone is composed of Jurassic rocks and sandy hills consisting of Magarini sands, ideal for sugar cane growing (ibid). The Coastal Uplands is an area of medium to high agricultural potential while in the Nyika Plateau the main activity is livestock rearing.

Msambweni Sub-County is located to the south of the County and its geographical coordinates are 4° 28’ 0” South and 39° 29’ 0” East (ibid). The land surface is characterized by a number of undulating flatlands and hills as part of the Coastal Lowlands. Msambweni Sub-county also lies between the Shimba Hills and the Indian Ocean, providing diverse climatic and

agro-ecological conditions due to its range of altitudes (from 0 to 462 Meters above Sea Level). Main types of soils are clay, clay-loam, sand and sandy-loam. In the lower flat lands, closer to the shores, alkaline/saline soils predominate.

More than 80% of the population of Msambweni Sub-county live in the rural areas and depend on agriculture, fisheries and livestock for their livelihood. Mixed crop-livestock, mostly maize-based systems are widely found in the Sub-county that are intercropped with varying species, such as common beans, cowpeas and green grams, according to altitude and rainfall availability. Cassava is also widely grown. In the lowlands, paddy rice is cultivated where irrigation is available. Cash crops grown include mangoes, Oranges, coconut, sugarcane, cashew nuts and bixa to a lesser extent.

It is important to note that not many areas of Kwale County are of high agricultural potential and that Kwale is a regular food deficient County. Rains are erratic, soils are light and of low fertility hence conducive for production of cassava in much of these marginal areas. Msambweni Sub-county has five Agro-Ecological zones as follows: Coastal Lowlands (CL) 2 – this is the lowland sugarcane zone. It is ideal for production of grain, pulses, tubers, oil crops and vegetables. Tropical fruits, coconuts, bixa, rice, sugarcane, cashew nuts, pasture and forage for animals are available in this zone. Generally, it is a high potential zone. Coastal Lowlands (CL) 3 – this is the Coconut-cassava zone. This zone is also suitable for grain, tubers, pulses, tropical fruits, oil crops, vegetables and Coconuts. The Coastal Lowlands (CL) 4 is the Cashew nut-cassava zone. The zone is marked by high potential for production of cashew nuts, cassava and sisal; medium potential for grain, pulses, oil crops, pasture and forage. Coastal Lowlands (CL) 5 – this is the Livestock-millet zone: It is suitable for sorghum, millet, green grams, and cassava. Livestock rearing is the predominant activity. Finally, Coastal Lowlands (CL) 6, the Ranching zone is good for livestock rearing (cattle, sheep and goats). Msambweni Sub-county particulars are as follows:

3.1.1 Profile of the Study Area.

Table 2: Msambweni Sub-county Profile.

CATEGORY	DESCRIPTION
Wards	8
Divisions	3 (Diani, Lungalunga and Msambweni)
Locations	11
Sub-locations	29
Altitude	0-462m ASL
Temperature	22^{o}C-30^{o}C
Annual Rainfall (bimodal)	800-1,400mm (Vanga and Lungalunga rainfall stations (Met. Stations Nos.39046 and 39013)
Population	288,393 (2009 Census)
Area of Sub-County	3,236 km²
Population Density	89 per Km^2
Households (rural and urban)	48,065 (average household size is 6 persons)
Farm families	40,000 (83% of the population)
Percentage population below poverty line	74.9%
Literacy level	57%
Major Crops	Maize, rice, Cassava, Coconut, cashew nut, oranges, millet, cow peas, beans, green grams, sweet Potatoes, mangoes and sugarcane.
Major Livestock	Indigenous cows, goats and poultry. Fisheries are also a major enterprise.
Average farm size	3 Ha

Sources: Kwale CIDP and Msambweni Sub-county Agricultural office, 2014.

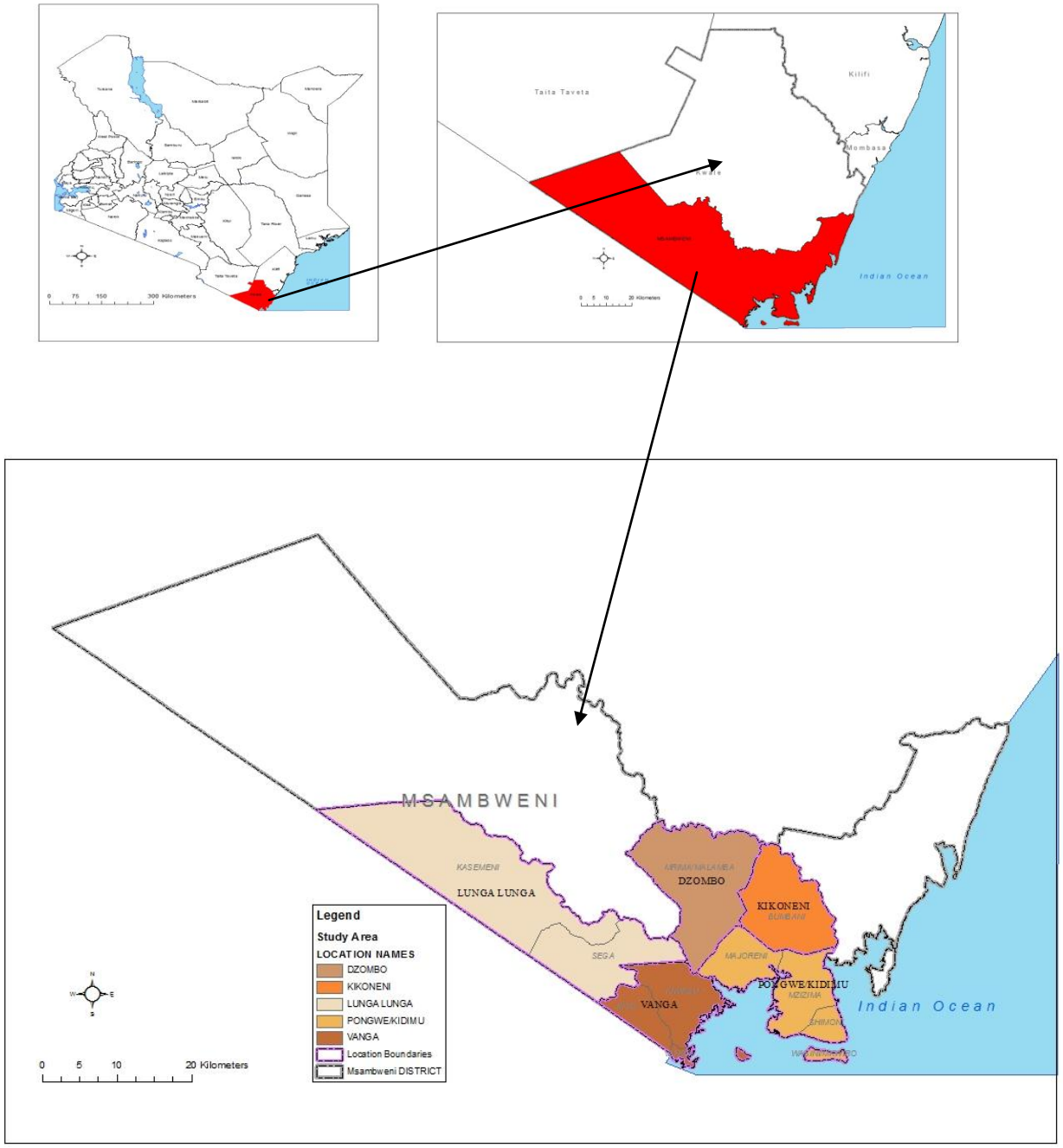

Figure 2: Maps showing location of the Study Area: Kwale County, Msambweni Sub-county, and Vanga, Dzombo and Kikoneni/Pongwe Wards *(Source: Kwale CIDP, 2013).*

3.2 Target Population

Main inhabitants in Msambweni are the Digos. There is minor presence of other Mijikenda groups such as Durumas, as well as Akamba and people of Arabic descent. The Population in Msambweni is 288,393 (the sex ratio is 95 males per 100 females), with a density of 89 people per km^2. Age distribution is 0-14 years (47.23%), 15-60 years (47.82 %), 60+ years (4.95%), and the number of households is 48,065 (2009 Census). The population for this study consisted of all farmers in 3 wards in Kwale County – Vanga, Kikoneni/Pongwe, and Dzombo in Msambweni Sub-county. The farm families are 40,000. This gave the proportion of farmers as: $\frac{40{,}000}{288{,}393} \times 100 = 14\%$.

3.3 Sampling Procedure and Sample Size

The study targeted both cassava and non-cassava farmers. The samples were drawn from Vanga, Kikoneni/Pongwe, and Dzombo wards in Msambweni Sub-county. The three wards have population of 36,119, 51,842 and 41,509 people respectively. They were purposively selected because of the large number of cassava farmers. The population of farmers in the three wards was stratified into cassava producers and non-cassava producers. Systematic sampling was applied in order to choose a sample for cassava producers from sample frames that were provided by the Sub-county Agricultural Office. Simple random sampling was used to select the sample of non-cassava producers by the use of the table of random numbers. The required sample size was determined proportionately from the two strata comprising of cassava producers and non-cassava producers, as stipulated in Kothari, (1990):

$$n = \frac{pqZ^2}{E^2} \quad \text{.........} (1)$$

Where *n* is the sample size, *Z* is the desired *Z*-value yielding the desired degrees of confidence, *p* is an estimate of the proportion of the population containing the major interest, and *E* is the absolute size of the error in estimating the value of *p* that the researcher is willing to permit, *q* = 1-*p*. In this study therefore, the p-value was 0.14. The study also used 95 percent level of confidence (*Z*= 1.96), with an allowable error of 0.05.

p= 0.14, *q*= 1-0.14=0.86, *Z*= 1.96 and *E* = 0.05. This is $\frac{0.14 \times 0.86 \times 1.96^2}{0.05^2} = 186$

Therefore, this resulted to a sample of at least 186 respondents who were divided proportionally to the ratio of farmers in the Wards to total number of farmers as: 52 farmers in Vanga Ward (27.91% of sample), 59 farmers in Dzombo Ward (31.78% of sample) and 75 in Kikoneni/Pongwe Ward (40.31% of sample). In each Ward about 60% of the farmers produce cassava. Therefore, the total sample consisted of 32 cassava producers and 20 non-cassava producers from Vanga, 36 cassava producers and 23 non-cassava producers from Dzombo and 45 cassava producers and 30 non-cassava producers from Pongwe/Kikoneni

3.4 Data Collection and Data Sources

to save on time, get direct answers and to ease the work of analyzing, primary data were collected using interview schedules, collecting information on farm and farmer characteristics, institutional, production and market related factors. Face-to-face interviews with the household heads were done. In the absence of the head, the spouse or any family member who was directly involved in the farming activities and management was interviewed.

Secondary data were collected from the Sub-County Agricultural office, Government publications, district statistical (DDO's) office and other data bases. Observation method was also used.

Interviews were conducted to collect information on access to information, access to extension contact and proximity to the extension office, membership to farmer organization, state of road infrastructure, means of transport, storage facilities, availability of extensive household income, farm family head's age, educational level attained by the farmer, gender of the farm family head, farm size and access to cassava seed/cuttings. Other data included Information on reasons as to why farmers produce or do not produce cassava, acreage under cassava and that under other common food crops, and non socio-economic and non institutional constraints facing cassava production.

3.5 Analytical Techniques

The main econometric specification used for exploring the factors that influence household participation and level of participation in cassava production was the Heckman model. The decision to either participate in cassava production or not and level of participation were dependent variables and therefore were estimated independently. Heckman two-step procedure is

an appropriate model for such independent estimation. Heckman two-step model involves estimation of two equations: Selection equation in the first step and outcome equation in the second step (Heckman, 1979). First is if a household participates in cassava production or not then second is the level of participation (area under cassava). The area under cassava is conditional on the decision to participate in cassava production. Studies show that estimation of such relationships is normally problematic due to sample selection bias.

Therefore, Descriptive statistics were used to analyze data collected for objective 1. Descriptive methods of analysis were used to generate frequencies, standard deviation, tables, proportions and means to describe the proportion of farmers involved in cassava production, and those who were not, non socio-economic and non institutional opportunities and constraints limiting cassava production, the systems of production and reasons as to why the farmers grow or do not grow cassava.

Analyzing collected data on objective 2 and 3 used the Heckman model. The Heckman type models deal with sample selection problems by computing a selection term from the first equation (selection model) and including it as a regressor to correct for self selection in the second stage regression involving observations from the selected sample (Heckman, 1979). It models non-participation, participation and potential for participation. In that case it is a 2-step decision model. The two-steps include; first a Probit model for participation or selection equation is estimated. This step estimates the probability of farmer participation as shown in the equation (1) below:

Step 1: Participation decision to produce or decision not to produce

$$P_i = \gamma_1 + \gamma_i Q_i + \mu_i,\ E\left(\mu_i / Q\right) = 0 \quad \text{.....(2)}$$

Where, P_i is a dummy for participation in cassava production while Q_i is a vector of variables that affect participation decision.

Step 2: Level of participation in cassava production:

Step 2 applies if $P>0$. Here, conditional on participation, the level of participation function is given as;

$$Y_i = \beta_1 + \beta_i X_i + e_i,\ E\left(e_i / X\right) = 0 \quad \text{.....(3)}$$

Where Y_i indicates the level of participation measured in terms of area under cassava by a farmer, X_i is a vector of variables that explain the levels of participation, μ_i and e_i are the error terms.

The model assumes that *Q* and *X* are observable exogenous variables and *X* is a subset of *Q*. Correlation between μ_i and e_i if not zero will bring about the selection bias problem. Upon estimation of the selection equation a non selection bias is computed using equation (3) below,

$$E\left(\mu_i / P_i, Q_i\right) \quad \text{.....(4)}$$

This is called the Inverse Mills Ratio (IMR), $\lambda(\delta Q_i)$ when P_i=1.

Then the lambda is used in the outcome equation (2) as an explanatory variable. The new equation for the second stage regression therefore becomes:

$$E(Y_i = Q_i, P_i = 1) = \beta_1 + \beta_i X_i + \rho\lambda(\delta Q_i) \quad \text{.....(5)}$$

This equation gives the expected area under cassava, Y_i given vectors of observable factors Q_i and given that the household has already made the decision to participate in cassava production. This is explained by a vector of observable characteristics X_i and the Inverse Mills Ratio evaluated as, $\lambda(\delta Q_i)$. There is no evidence of the selection bias if P_i=0 and therefore the regression reverts to Ordinary Least Square (OLS). However, if $Pi \neq 0$ then there were omitted variables in the initial model correlated with X_i which is corrected by including IMR in the second regression. The major limitation to this model is the assumption that a variable affecting the decision to participate in cassava production can sequentially lead to reduced level of participation to zero acreage under cassava. The Heckman two stage model is specified as follows:

Step 1. (Selection equation)

The Probit model giving the probability of farmer participation and consequently identifying the factors which influence participation is specified as,

$$P_i(0,1) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_n X_n + \varepsilon$$

$$P_i(0,1) = \beta_0 + \beta_1 genr + \beta_2 lante + \beta_3 age + \beta_4 accinfo + \beta_5 extco + \beta_6 orgmem + \beta_7 hhsze + \beta_8 hhin + \beta_9 educ + \beta_{10} seedacc + \varepsilon \quad \text{..... (5)}$$

Step 2. (Outcome equation)

$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots + \beta_n X_n + \beta_n \lambda_n + \varepsilon$

$Area\ under\ cassava, (Y_i) = \beta_0 + \beta_1 genr + \beta_2 lante + \beta_3 age + \beta_4 accinfo + \beta_5 extco + \beta_6 orgmem + \beta_7 rodinfr + \beta_8 transmn + \beta_9 storgf + \beta_{10} hhsze + \beta_{11} hhin + \beta_{12} educ + \beta_{13} farsze + \beta_{14} seedacc + \beta_{15} IMR + \varepsilon \ldots\ldots\ldots \quad (6)$

In this study, the socio-economic and institutional variables under consideration were; age of household head, gender of household head, access to information, access to extension contact, membership to farmer organization, condition of road infrastructure, means of transport, storage facilities, household income, educational level attained by the farmer, farm size, land tenure system, access to cassava seed/cuttings and household size. *Table 3* below summarizes these characteristics.

Objective 4: Analysis of Variance (ANOVA) and descriptive statistics were used to analyze data collected for objective 4. The mean acreage under cassava and other food crops was compared across the three wards to determine whether they were significantly different. The variability in score between the different groups was compared with the variability within each group. This was important so as to capture specific crop production preferences and gaps, and provide Ward-specific interventions to production and consumption gaps.

Table 3: Nature of Variables used in the Models.

Variable Label	Variable name	Coding of variable / Unit of Measurement	Expected relationship
Dependent Variables			
P	Dummy for decision to produce or not to produce cassava	1=producing, 0= otherwise	
Y_i	Intensity of cassava production	Area under cassava	
Explanatory Variables			
genr	Gender of the farm family head	1= male, 0= female	+/-
lante	Land tenure system	1=individual, 0 otherwise	+/-
age	Age of Farm family head	Years	+/-
accinfo	Access to information	1 if access, 0 otherwise	+
extco	Access to extension contact	1 if yes, 0 otherwise	+
orgmem	Member of farmer organization	1 if member, 0 otherwise	+
rodinfr	Condition of road infrastructure	1 if good (all-weather) 0 otherwise	+
transmn	Means of transport	1 if have own transport, 0 otherwise	+
storgf	Storage facilities	1 if good, 0 otherwise	+/-
hhsze	Household size	Number of persons in household	+/-
hhin	Household income	1 if sufficient, 0 otherwise	+/-
educ	Educational level attained by the Farmer (highest level completed)	Years	+/-
farsze	The size of farm in acres	Number of acres owned by household	+
seedacc	Access to cassava seed/cuttings	1 if yes, 0 otherwise	+

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Characteristics of the Smallholder Farmers and Farming Systems

In this section, socioeconomic and institutional characteristics of the sampled farmers are discussed. These aspects are important because they influence cassava production decisions in different ways. Further, cassava production systems, reasons for growing and for not growing cassava are presented. The empirical results of the Heckman two-stage model are also presented in addition to comparison between area under cassava and other food crops in the study area.

a) Socio-Economic Characteristics

4.1.1 Gender of Farmers

The results on demographic characteristics showed that there were a larger proportion of males (63.4%) as opposed to females (36.6%) as shown in Table 4. This was as expected given that farming in the region is dominated by men who are involved in such enterprises as cassava which is grown in the region both for subsistence and incidental commercial purposes. However, it is the women who perform farm chores, in agreement with findings of Doss, (1999) which indicate that women were more involved in subsistence crop production unlike men. The chi-square statistic of 1.0663 is not significant meaning there is no relationship between gender and cassava production in the study area.

Table 4: Gender of Household Head

Variable	Description	Percent	Cassava farmers	Non-cassava farmers	Chi-square
Gender	Male	63.4	66.37	58.9	1.0663
	Female	36. 6	33.63	41.1	

The results further indicate that more male (66.37%) were producing cassava as compared to only 33.63% of the women who were producing cassava as shown in Figure 3. This is also in disagreement with Ogunley, (2008) who found out that women are more involved in

cassava production and processing than men and women are likely to gain proportionally more if the investment and development efforts are shifted in their favor.

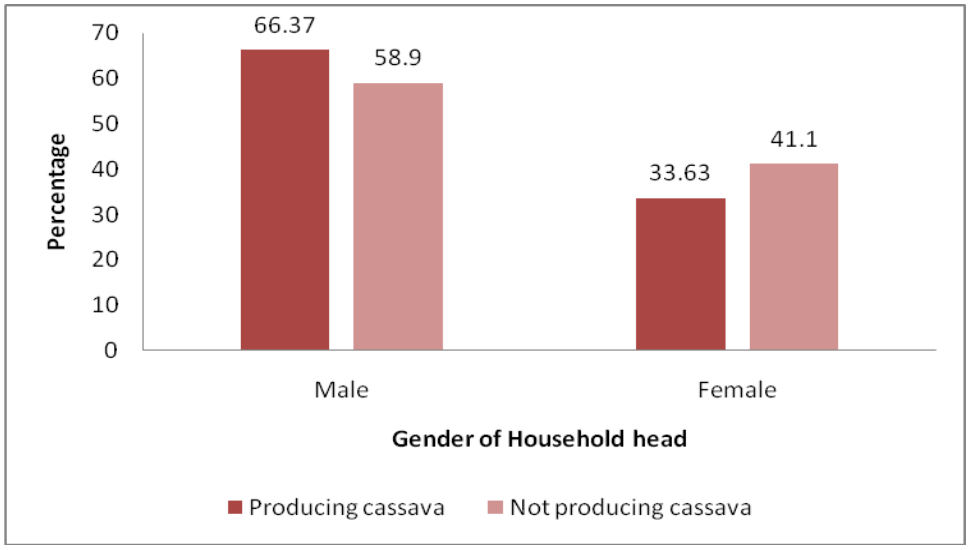

Figure 3: Participation in Cassava Production by Gender

4.1.2 Age Distribution of Farmers

Age of the household head is an important aspect in agriculture because it determines experience one has in a certain type of farming. Household head's experience further influences household members' farming activities since they usually provide guidance (Ngqangweni and Delgado, 2003). The results showed that the mean age of those growing cassava was 49.13 years while the mean age of those not producing cassava was 48.06 years. The results therefore imply that the mean age of the respondents was above the youth age bracket as shown in Table 5 below. The t-statistic was -0.696, implying a negative relationship between age and cassava production. However, the relationship is not statistically significant.

Table 5: Cassava Production by Age of Farmers

Group	Observations	Mean	Std. Err.	t-statistic
Producing cassava	113	49.133	1.050217	-0.6960
Not producing cassava	73	48.055	1.033475	

The results of the study further revealed that only 5.4% of the respondents were less than 30 years whereas 20.4%, 23.7% and 37.7% were in the age brackets of 30-39, 40-49 and 50-59 years respectively. 0nly 12.9% of the respondents were above 60 years of age. Figure 4 below shows cassava production by age category of farmers in the study area. The results show that participation in cassava production increased with increase in the age of farmers to a certain extent. This is in agreement with Itam *el al* 2014, which found a positive relationship between age and cassava production where chances of producing cassava increased as farmers grew older.

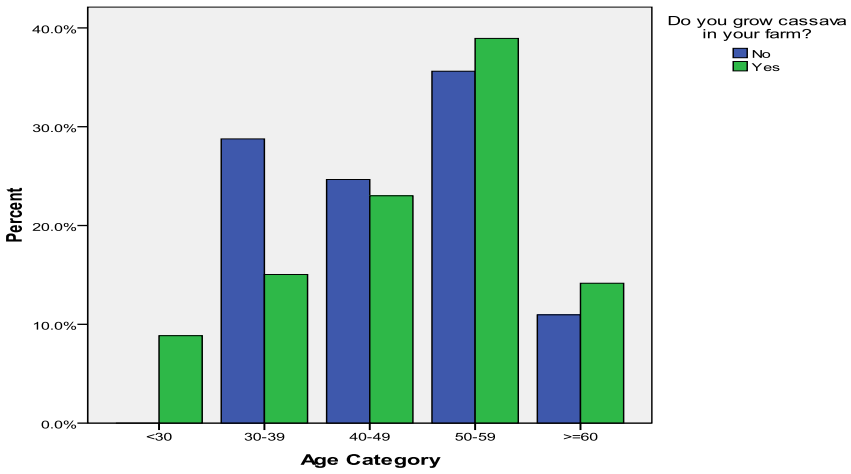

Figure 4: Age of farmer and cassava production

4.1.3 Education Level of Farmers

The results showed that 38.2%, 51.1% and 3.8% of the respondents had primary, secondary and tertiary level of education respectively. Only 7.0% of the respondents reported to have no formal education. Majority of the farmers in the study area had primary and secondary education as shown in table 6 below. This generally means that most of the respondents were literate.

Table 6: Cassava Production by Education Level of Farmers

Group	Education level	None	Primary	Secondary	Tertiary	Chi square
Producing cassava		6.45	24.73	28.49	1.08	9.9357**
Not producing cassava		0.54	13.44	22.58	2.69	
Total		6.99	38.17	51.08	3.76	

It was also noted that majority of the farmers with little or no education participated in cassava production than those more educated. From Table 6 above, 6.45% of farmers without education were producing cassava unlike those with tertiary education where out of those farmers only 1.08% were producing cassava. The chi-square was 9.9357 and significant at 5%. This means a strong positive relationship between age and cassava production. Also, majority of those with middle level education were producing cassava as shown in Figure 5 below. This indicates that as farmers' education levels increased, cassava production increased. This could be because farmers with higher education tend to look for off-farm employment and income which they use to increase and diversify farm enterprises. Therefore, they would usually have diverse income and food sources. These results agree with Itam *et al* (2014), who found a positive relationship between education and farmer participation in cassava production implying that as the level of education increased, chances of increasing cassava production also increased.

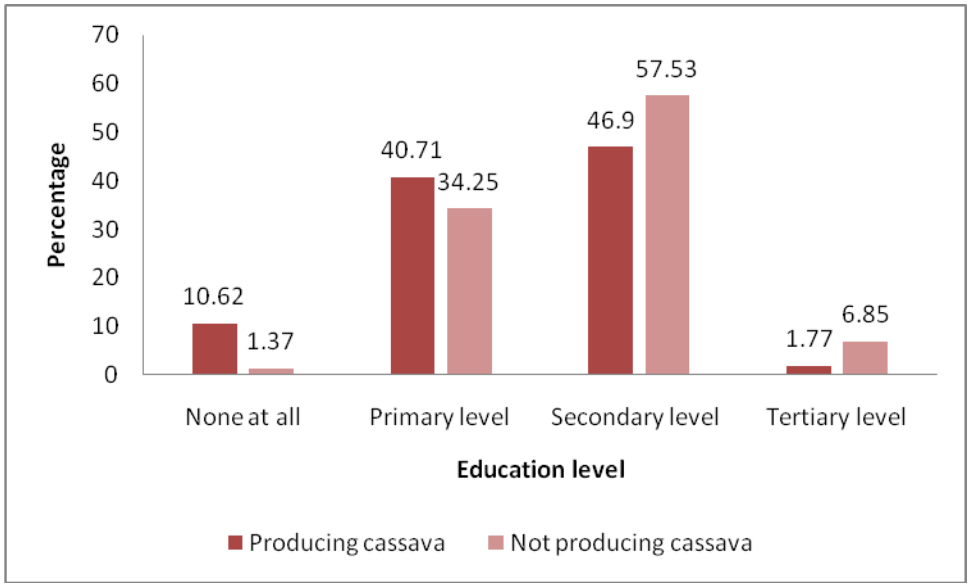

Figure 5: Education Level of Farmer and Cassava Production

4.1.4 Household Size

The household is the major source of farm labour in small-scale agriculture. Ng'ang'a (2009) attributes large household sizes to the desire to have enough family labour and hence farmers keen on using family labour instead of hired labour will in most cases have more children. In his study, the use of free child labour was also positively associated with family size implying that families that rely on child labour tend to have more children. This is especially true

for women who use older children as baby-sitters as they perform other chores both inside and outside the household.

The findings of this study showed that 59.7% of the farmers had between 4 and 6 members in their household, while 38.7% of the farmers had between 7 to 9 persons in their households. Only 1.6% had less than 4 persons in their household. The average household size was 6.08 (approximately 7) persons and this was higher than Kenya's mean household size of 5.1 persons (GOK, 2006). This means that majority of the farmers in the study area generally have large household sizes which means higher demand for food and household income. The chi-statistic was -0.8282. However it was not significant, meaning household size has no influence on cassava production.

Table 7: Cassava Production as per Mean household Sizes

Group	Observations	Mean	Std. Err.	t-statistic
Producing cassava	113	6.141593	0.121793	-0.8283
Not producing cassava	73	5.972603	0.170026	
Combined	186	6.075269	0.099541	

4.1.5 Farm Size

Farm size plays an important role for farmers in deciding what enterprises farmers undertake and the area to be put under each of those enterprises. The results show that majority (54.8%) of the respondents owned between 2 and 4 acres of land. Only 24.2%, 12.4%, 8.1% and 0.5% of the respondents owned between 4.1-6acres, 6.1-8 acres, 8.1-10 acres and more than 10 acres respectively as shown in Table 8. The results generally indicate that land size is a limiting factor in the study area.

Table 8: Ranges of Farm Size

Farm size (acres)	Frequency	Percent	Cumulative Percent
2-4	102	54.8	54.8
4.1-6	45	24.2	79.0
6.1-8	23	12.4	91.4
8.1-10	15	8.1	99.5
>10	1	.5	100.0
Total	**186**	**100.0**	

The findings further indicated that the mean acreage of those producing cassava was 5.19 acres as compared to the mean acreage of 4.31 for those not producing cassava as shown in Table 9. The results also indicated that farmers with more acres of land were participating more in cassava production as compared with those with few acres (as the chi-square statistic suggests). This could be occasioned by the fact that as land size increases, it gives room for expansion of the enterprises.

Table 9: Farm Size and Cassava Production

Group	Observations	Mean	Std. Err.	t-statistic
Producing cassava	113	5.185841	0.197086	2.8797***
Not producing cassava	73	4.308219	0.225097	
Combined	186	4.841398	0.151719	

4.1.6 Household Income

From the study findings there were two main sources of income namely farm income and off-farm income. Out of the 186 respondents who gave a response, 18.3% dependent on on-farm income while 11.3% depended on off-farm income. However, 70.4% of the respondents depended on both on-farm and off-farm sources of income.

The study further revealed that out of the 186 respondents, 18.8% had incomes ranging from Kshs 20,000 to Kshs 39,999 per month while 36%, 39.2%and 5.9% of the respondents had incomes ranging from Kshs. 40,000- 59,999, 60,000-79,999 and over Kshs 80,000 per month respectively. This implies that majority of the farmers in the study area have access to fairly adequate disposable income for farm investment About 31.4% of the farmers with income of between Kshs 20,000-39,999 were producing cassava whereas in the income category of between Kshs 40,000 and Kshs 59,999, 82.1% of the farmers were producing cassava. There were 56.2% of the farmers with income of between Kshs 60,000 and Kshs 79,999 who were producing cassava while 54.5% of farmers with income over Kshs 80,000 were producing cassava. The results imply that fewer farmers with low incomes participate in cassava production as compared to those with high incomes. However, the results show that a very high number of

those in middle income groups were participating in cassava production than those at both low and very high income groups as shown in Figure 6 below.

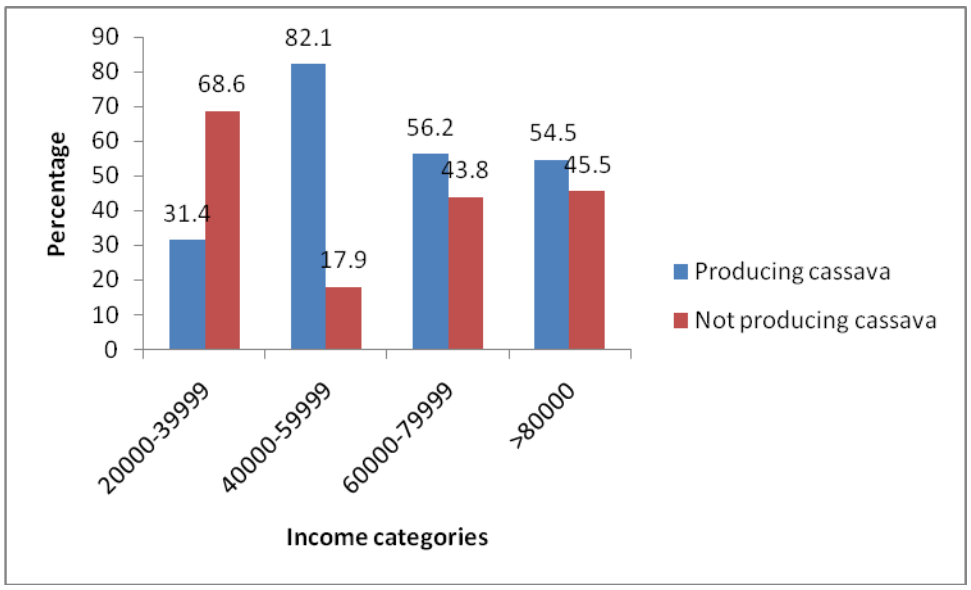

Figure 6: Participation in Cassava Production as Per Category of Household Income

b) Institutional Characteristics

4.1.7 Land Tenure

Land tenure provides the legal and normative framework within which all agricultural as well as other economic activities are conducted. When tenure rights are certain, they provide incentives to use land in a sustainable manner or invest in resource conservation whether for the individual or group of individuals (Ogolla and Mugabe, 1996). Land tenure types and policies also tend to determine the nature of agriculture and influence other land use practices (Waiganjo and Ngugi, 2001).

The Results of this study showed that 90.3% of the farmers had individual land ownership while 8.6% were using family land and 1.1% of the respondents were squatters. This implies that a majority of the farmers in the study area own land on individual basis as is often the case in Kenya (Kameri-Mbote, 2005). This is important because it gives farmers a free hand in decision making. The chi-square statistic was 6.733 and significant at 5%, indicating a strong positive relationship between land tenure and cassava production in the study area as shown in Table 10.

Table 10: Cassava Production as Influenced by Land Tenure

Group	Individual ownership	Family ownership	Squatter	Chi-square
Producing cassava	52.15	7.53	1.08	6.733**
Not producing cassava	38.17	1.08	0	
Total	90.32	8.6	1.08	

The results of the study further indicated that 85.8% of the farmers with individual ownership of land were cultivating cassava (Figure 7). On the other hand, 12.4% of the farmers using family land were cultivating cassava and all the squatters were producing cassava. However, the latter two were a minority. This implies that secure land tenure is important for cassava promotion.

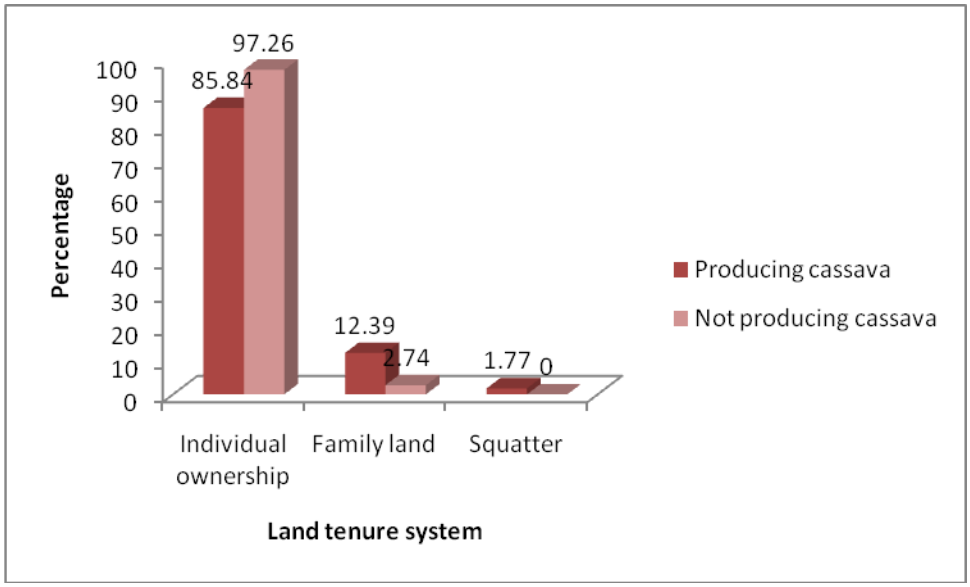

Figure 7: Participation in Cassava Production as Per land tenure type

4.1.8 Access to Adequate Storage Facilities

The results of the study showed that 32.8% of the farmers in the study area have access to adequate storage facilities while 67.2% were not having adequate storage space. This implies that less than half of the farmers in the study area have got access to adequate storage facilities for their produce. The chi-square statistic is 4.9286 and significant at 5%, indicating positive relationship between adequate storage and cassava production in the study area (Table 11).

Table 11: Cassava Production as Influenced by Adequate Storage

	Do you have adequate storage?		
Do you produce cassava?	No	Yes	Chi-statistic
Producing cassava	37.1	23.66	4.9286**
Not producing cassava	30.11	9.14	
Total	67.2	32.8	

The results in Figure 8 show that 61.06% of the farmers without adequate storage were participating in cassava production. On the other hand 38.94% of farmers with adequate access to storage were participating in cassava production. The results indicate that more farmers with access to adequate storage were producing cassava than those with access to adequate storage and not producing. For those without adequate storage fewer farmers were producing cassava compared to those not producing. This means that storage plays major consideration in cassava production in the study area.

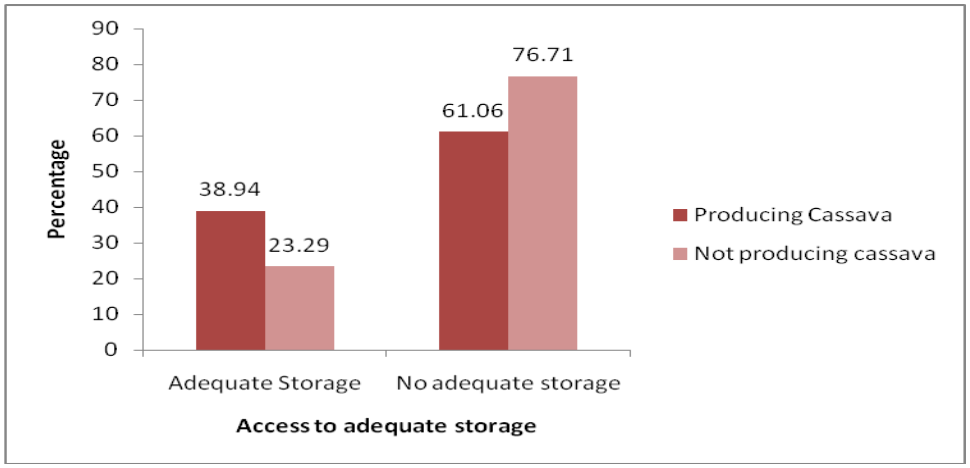

Figure 8: Cassava Production on The Basis of Access to adequate Storage

4.1.9 Mode of Transport Used by Farmers to Transport Produce to Markets

The mode of transport determines the level of transport costs incurred, the time the produce takes before reaching the market and the condition or quality of the produce to the final consumer. The study revealed that the most common mode of transport used by the households was motorcycles at 72.6% followed by vehicles at 22.6%, human and/or wheelbarrows at 2.7% and carts at 2.2%. This implies that majority of the farmers in the study area transport their produce to the markets in good time due to adequate and fast means of transport especially

during the dry seasons. The means of transport used is positively and significantly influencing cassava production at 1% as shown below.

Table 12: Means of Transport Influence on Cassava Production

	Means of transport used				
Group	Vehicles	Motorcycle	Carts	Human/Wheelbarrow	Chi-statistic
Producing cassava	10.75	50	0	0	20.7179***
Not producing cassava	11.83	22.58	2.15	2.69	
Total	22.58	72.58	2.15	2.69	

There are major challenges that farmers in the study area face while transporting their produce to the market. They include: impassable roads in wet seasons at 35.5%, long distances to markets at 9.1%, high transport costs at 25.1%, bulky produce which is difficult to handle at 9.1%, loses and damages during transport at 16.7% as shown in Table 13.

Table 13: Transport Challenges Facing Farmers

Transport challenges	Frequency	Percent	Cumulative Percent
Impassable roads in wet seasons	66	35.5	35.5
Long distances to markets	17	9.1	44.6
High transport costs	47	25.3	69.9
Produce is bulky and difficult to handle	17	9.1	79.0
Losses and damages during transport	31	16.7	95.7
Blockage of foot paths by farmers	6	3.2	98.9
None	2	1.1	100.0
Total	**186**	**100.0**	

4.1.10 Road Infrastructure Used by Farmers Producing Cassava

Road infrastructure has a bearing on the cost of transport, damages on produce and time taken for the produce to reach the market. The findings of the study indicate that 12.4% of the respondents were using all weather roads to transport their produce to the market while 79% of

the respondents were using earth roads and 8.6% were using foot paths. The chi-square indicates that road infrastructure was not having an influence on cassava production (Table 14).

Table 14: Cassava Production as per Road Infrastructure

	Road infrastructure type used			
Group	All weather roads	Dry weather roads	Foot paths	Chi-square
Producing cassava	8.06	46.24	6.45	1.8663
Not producing cassava	4.3	32.8	2.15	
Total	12.37	79.03	8.6	

The results further indicated that 13.27% of all farmers were using all-weather roads and producing cassava while 76.11% were using earth roads and producing cassava as shown in Figure 9. On the other hand, 10.62% were using foot paths and producing cassava.

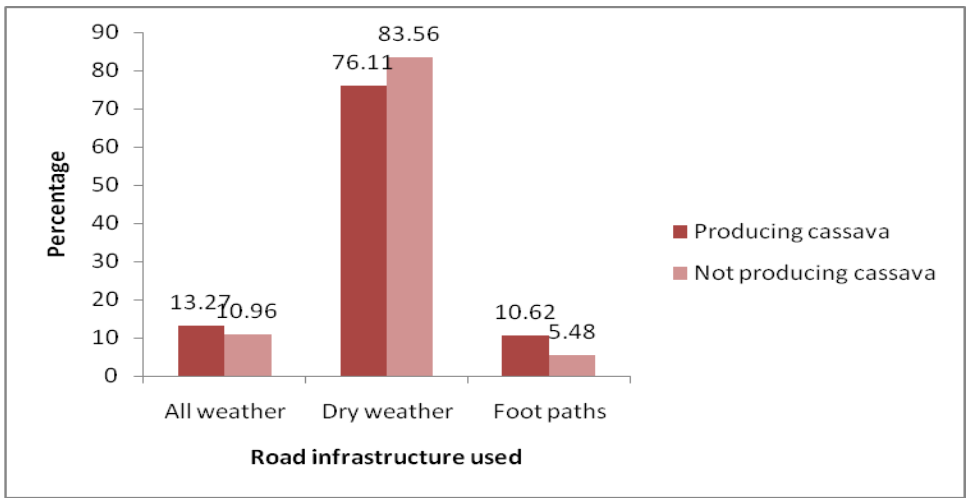

Figure 9: Cassava Production as Influenced by Road Infrastructure used

4.1.11: Farmer Participation in Cassava Production on the Basis of Access to Cuttings

The results of the study showed that 84.4% of the respondents had easy access to cassava cuttings for planting while 15.6% had not. The ease of access to cassava cuttings did not have significant influence to cassava cuttings (see table 15 below).

Table 15: Cassava Production as per Access to Cuttings

	Do you easily access cassava cuttings?		
Group	No	Yes	Chi-square
Producing cassava	7.53	53.23	2.2431
Not producing cassava	8.06	31.18	
Total	15.59	84.41	

The results showed that 20.55% of the farmers were without easy access to cassava cuttings and were not producing cassava while 12.39% were producing. On the other hand, 87.61% of the respondents had easy access to cassava cuttings and were producing cassava as shown in Figure 10. The results indicate that farmers who had easy access to cassava cuttings had a higher but insignificant chance of producing cassava than those who didn't.

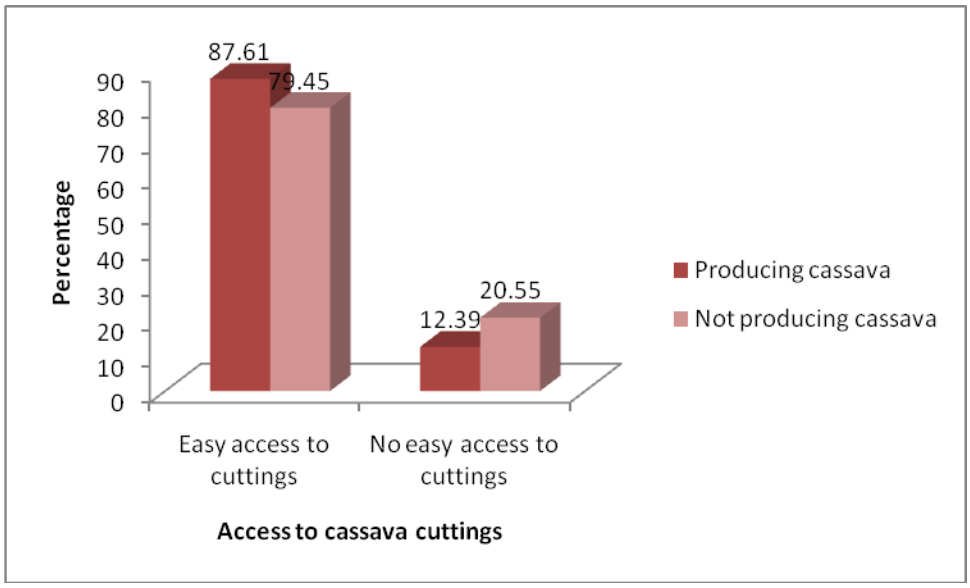

Figure 10: Participation in Cassava Production as Influenced by Access to Cassava Cuttings

4.1.12: Varieties of Cassava Grown by Farmers

The findings of the study indicate that 49% of the cassava farmers were at least growing Kibandameno variety while 20%, 17% and 14% were growing Karembo, Tajirika and Guzo varieties respectively as shown in Figure 11. Even though most of the farmers were at least growing Kibandameno (a low yielding local variety) the uptake of the new varieties (Karembo

and Tajirika) was encouraging and lent credence to the work done in the area by researchers and extension staff from KALRO, Mtwapa.

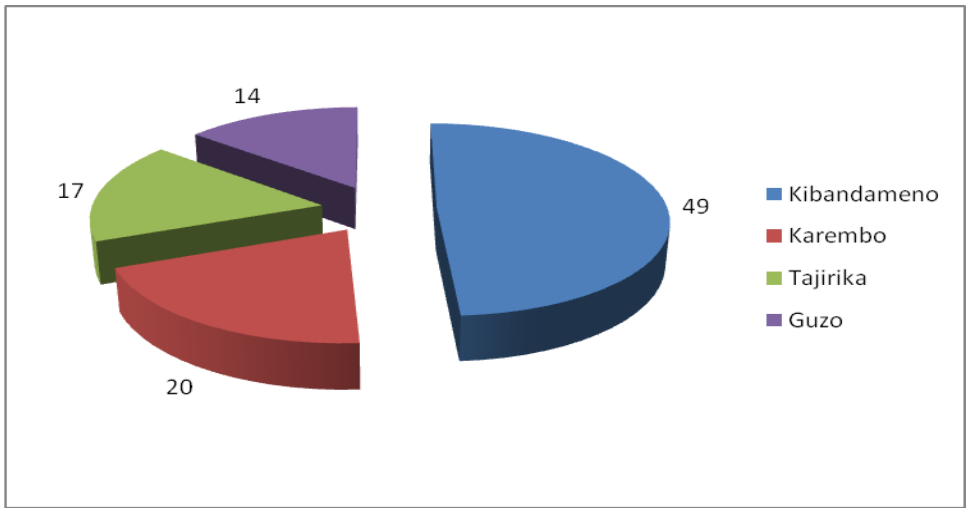

Figure 11: Varieties of Cassava Grown in Percentage

4.1.13 Access to Extension

Access to extension plays a crucial role in decision making and enterprise selection by the farmer due to access to necessary information on production of various crops. In the study area, 76.9% of the farmers had access to extension services as shown in Table 16. This is an indication that majority of the households in the study area have access to extension services. 47.31% of all farmers accessed extension services and produced cassava. On the 0ther hand, 29.57% of all farmers accessed extension services but did not produce cassava. Relationship between cassava production and access to extension services is insignificant with a chi-square statistic of 0.1602 as shown below.

Table 16: Access to Extension Services and Cassava Production

	Do you access extension services?		
Description	No	Yes	Chi-square
Producing cassava	13.44	47.31	0.1602
Not producing cassava	9.68	29.57	
Total	23.12	76.88	

The results in Fig.12 indicated that 75.34% of the farmers with access to extension were not producing cassava while 77.88% were producing. On the other hand, 24.66% of the farmers without access to extension were not growing cassava. The results give an indication that more farmers with access to extension are participating in cassava production as compared to those without access to extension. This gives an indication that extension service providers may have promoted cassava production in the study area. It also means that farmers were making use of the extension information and it was influencing them positively. However, a good number of farmers without access to extension were also producing cassava, an implication that if they had access to extension, then more farmers could produce the crop hence the need for more vigorous extension service in the region, especially on the new high yielding varieties.

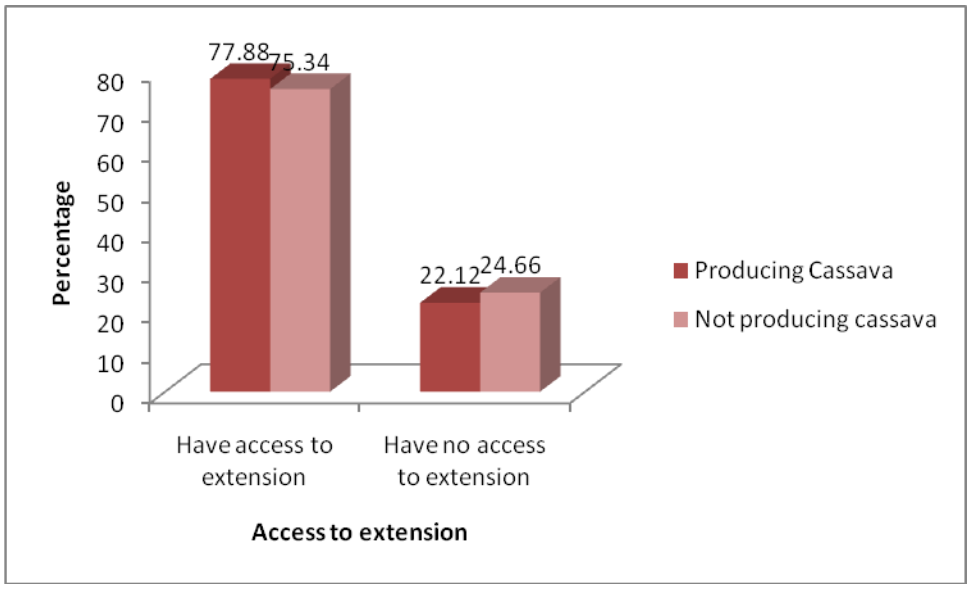

Figure 12: Farmer Participation in Cassava Production as Per Access to Extension

Five main cassava production practices were promoted by extension service providers and these included timely planting, correct spacing, new/improved varieties, field management and post harvest management. The main emphasis by extension workers was on field management of cassava. The response to extension service package was as follows; 3.2% on timely planting, 2.2% on correct spacing, 26.3% on new/improved varieties, 39.2% on field management and 1.1% on post harvest management as show in Table 17. Only 26.9% of the respondents received all the other packages of extension at the same time.

Table 17: Practices Promoted by Extension Staff

Practices promoted by extension staff	% of responses
Timely planting	3.2
Correct spacing	2.2
New/improved varieties	26.3
Field management	39.2
Post harvest management	1.1
All	26.9
No answer	1.1

A number of the practices promoted by extension staff on cassava production had been adopted by the farmers. 3.2% of the cassava farmers have adopted timely planting while 1.1% correct spacing, 12.4% have adopted new/improved varieties of cassava and 26.9% have adopted field management practices as shown in Table 18. Only 12.4% had adopted all the technologies while 40.9% had not adopted any. But these non adopters included those who had no access to extension service. The results imply that majority of the households were adopting new/improved varieties of cassava and field management practices as promoted by extension service providers.

Table 18: Cassava Production Practices Adopted by Cassava Farmers

Cassava production practices adopted	% of responses
Timely planting	3.2
Correct spacing	1.1
New/improved varieties	12.4
Field management	26.9
All	12.4
None	40.9
No answer	3.2

4.1.14 Access to Production and Market Information

Access to market information plays a crucial role in agricultural production and more so in cassava production. Farmers use market information to plan future production and also in decision making on when and where to sell their produce. In the study area, the results of the study indicated that out of the 186 farmers, 78.5% of the farmers had access to cassava production and market information as shown in Table 19. This was an indication that majority of the households in the study area have access to market information for cassava. This could be playing a crucial role in informing farmers on cassava production decisions in the study area. There is also a very strong positive relationship (significant at 1%) between access to information and cassava production as shown below.

Table 19: Access to Cassava Production and Market Information

	Do you access information?		
Description	No	Yes	Chi-square
Producing cassava	4.84	55.91	31.2729***
Not producing cassava	16.67	22.58	
Total	21.51	78.49	

The results in Figure 13 further show that, 92% of the farmers with access to market information participated in cassava production whereas 42.47% of the farmers without access to market information were not participating in cassava production. This means that access to market information is influencing farmers in the study area to produce cassava.

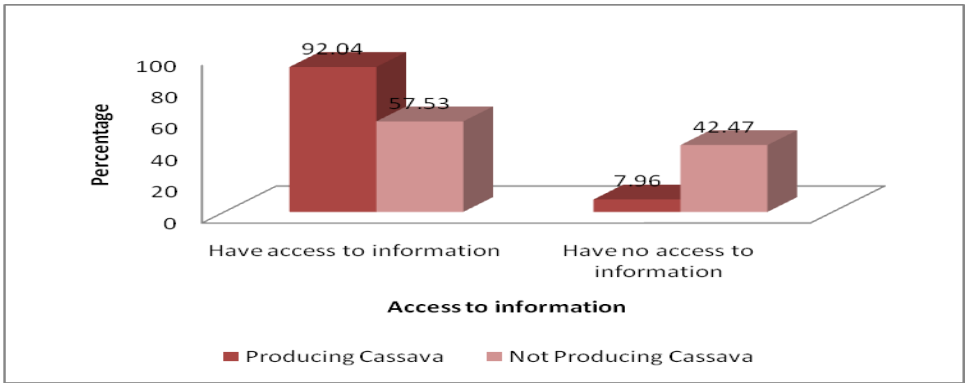

Figure 13: Farmer Participation in Cassava Production as Per Access to Market Information

The farmers with access to market information identified two major sources of market information namely through television and radio and through fellow farmers. From the results 14.5% of the respondents accessed market information through television and radio while 64.5% of the farmers accessed market information through fellow farmers. The results imply that majority of the farmers in the study area accessed market information mainly through fellow farmers. The disadvantage with this method is that in case wrong or distorted extension messages are given they spread very fast among farmers.

Table 20: Major Sources of Production and Market Information

Major sources of production and market information	Percent of responses
TV and radio	14.5
Fellow farmers	64.5
None	21

There were four major benefits of accessing cassava production and marketing information among the farmers in the study area namely improved skills in cassava production and marketing, awareness of cassava importance in their ecological zone, understanding markets and market requirements and information and sources of new varieties. Regarding benefits, 18.3% of the respondents indicated that they benefited through improved skills in cassava production and marketing, 17.2% through awareness of cassava importance in their ecological zone, 37.1% through understanding markets and market requirements and 5.9% through information and sources of new varieties (Table 21).

Table 21: Nature of Benefits of Accessing Production and Market Information by Farmers

Information benefits	Frequency	Percent	Cumulative Percent
Improved skills in cassava production and markets	34	18.3	18.3
Awareness of cassava importance in my ecological zone	32	17.2	35.5
Understanding markets and market requirements	69	37.1	72.6
information and sources of new varieties	11	5.9	78.5
N/A	40	21.5	100.0
Total	**186**	**100.0**	

4.1.15 Access to Group Membership

According to Kherallah and Kirsten (2001), collective action is important in agricultural production and marketing because it contributes towards reduced transaction costs and it strengthens farmers' production and bargaining power. In the study area, the results of the study showed that 51.1% of the farmers were members of a production or market association. This means that majority of the farmers in the study area are members of producer and marketing groups. There is a very strong positive and significant relationship between group membership and cassava production as shown on Table 22. The results agree with Danda *et al* 2014, who found a positive relationship between group membership and cassava production.

Table 22: Cassava Production as per Group Membership

	Are you a member of farmers' group?		
Description	No	Yes	Chi-square
Producing cassava	36.56	24.19	14.5884***
Not producing cassava	12.37	26.88	
Total	48.92	51.08	

The results in Figure 14 showed that majority of the farmers who were not members of farmers' groups were producing cassava. The results show that 60.18% of the farmers without membership in farmer groups were producing cassava (Fig.14) as compared to 39.82% of farmers who were members of farmer association and were producing cassava. This implies that majority of farmers in the study area who are not members of farmer groups are producing cassava.

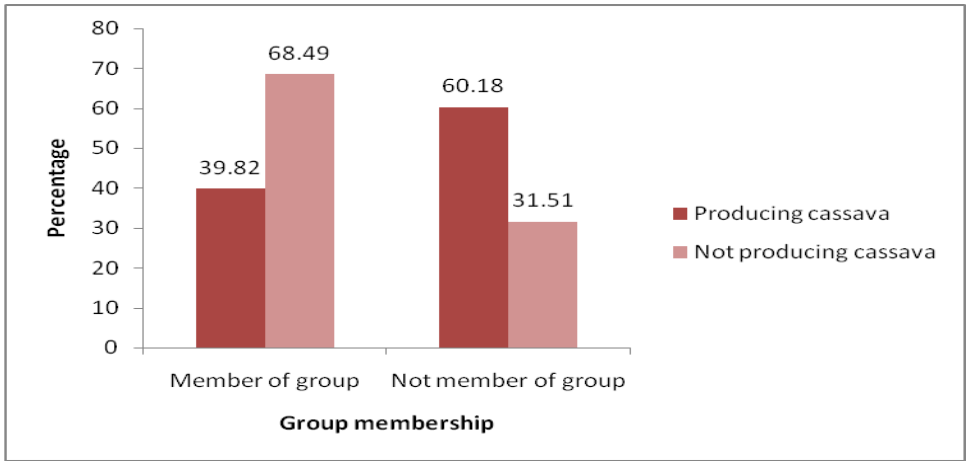

Figure 14: Farmer Participation in Cassava Production by Membership in Farmer Groups

4.1.16: Cassava Production Systems

The cassava production systems are summarized in table 23 below. From the table 25.7% of all respondents grow cassava under mono-cropping system. This means they grow cassava on pure stands. On the other hand, 35.5% of the farmers grow cassava under intercropping system, an indication that they grow cassava with another crop on the same piece of land. In this regard, to increase farmers' food and income diversity, and to enhance their resilience it is important to promote intercropping of cassava among those who practice mono-cropping.

Table 23: Systems of Cassava Production

What is the cassava production system	Frequency	Percent	Cumulative Percent
Mono-cropping	48	25.8	25.8
Intercropping	66	35.5	61.3
N/A	72	38.7	100.0
Total	**186**	**100.0**	

The common intercrop systems revealed by the study are cassava-maize and cassava-pulses as shown in Table 24. From the Table, 10.7% of all farmers grow cassava under maize intercrop while 25.7% grow cassava under pulses (beans or cowpeas or green grams) intercrop. This promotes sustainable land use and spreads production risks for farmers.

Table 24: Cassava intercropping systems

What is the intercrop?	Frequency	Percent	Cumulative Percent
Cassava-maize	20	10.8	10.8
Cassava-pulses	48	25.8	36.6
N/A	118	63.4	100.0
Total	186	100.0	

4.1.17: Reasons for Growing Cassava

The study revealed various reasons for producing cassava. The percentage of farmers who grow cassava for tuber sale and boiling to eat was 33.3% and 24.2% respectively. This means that most farmers preferred to deal with raw cassava as opposed to processing. On the other hand, 1.1% of farmers grew cassava for processing before selling while 2.2% grew cassava as a traditional crop or to sell cuttings. This means that there is massive potential for cassava value addition and processing in the study area. Table 25 below summarizes reasons for growing cassava.

Table 25: Reasons for Growing Cassava

What is the reason for growing cassava?	Frequency	Percent	Cumulative Percent
Boiling to eat	45	24.2	24.2
Processing and selling	2	1.1	25.3
Tuber sale	62	33.3	58.6
Sale of cuttings/seed	2	1.1	59.7
Cultural/traditional crop	2	1.1	60.8
N/A	73	39.2	100.0
Total	**186**	**100.0**	

4.1.18: Reasons for Not Producing Cassava

Form the study the reasons for not producing cassava were given as follows: Low prices for cassava and cassava products, limited farmland and unstable demand for cassava had 16%, 10.7% and 9.1% respectively. Farmers who said they had limited resources to spare for cassava production were only 1.1%, probably because cassava requires very little cultural attention to

grow. Farmers who reported flooding of farmland in wet seasons as reason for not producing cassava were 2.1%. These were probably those in low lying areas or with water logging soil types. Therefore, there is need to stimulate demand for cassava and to improve prices so as to mitigate these reasons. Table 26 below summarizes the reasons for not producing cassava.

Table 26: Reasons for Not Growing Cassava

What is the reason for growing cassava?	Frequency	Percent	Cumulative Percent
Low prices of cassava and cassava products	30	16.1	16.1
Limited farmland	20	10.8	26.9
Limited resources to spare for cassava production	2	1.1	28.0
Unstable demand for cassava and cassava products	17	9.1	37.1
Flooding of farm in wet season	4	2.2	39.2
N/a	113	60.8	100.0
Total	**186**	**100.0**	

4.2: The Heckman Two Stage Model Results

The Heckman two stage model results of participation and the extent of participation in cassava production are presented in Tables 27 and 28. The Wald chi2 (14) was 13.28. The Wald Chi-Square statistic is used to test the hypothesis that at least one of the predictors' regression coefficients is not equal to zero. The number in the parentheses indicates the degrees of freedom of the Chi-Square distribution used to test the Wald Chi-Square statistic and is defined by the number of predictors in the model. From the results in Tables 27 and 28, all coefficients were non zero and therefore the model results were significant. Prob > chi2 is the probability of getting a Wald chi2 test statistic as extreme as, or more so, than the observed under the null hypothesis. The null hypothesis in Wald chi2 is that at least one of the regression coefficients in the model is not equal to zero. In other words, this is the probability of obtaining this Wald chi-square statistic (13.28) if there is in fact no effect of the predictor variables. This p-value is compared to a specified alpha level, our willingness to accept a type I error, which is typically set at 0.05 or 0.01. The high p-value of 0.5048 from the Wald chi2 test was greater than 0.05 and

this makes it difficult to conclude that at least one of the regression coefficients in the model is not equal to zero. But however, the results show that none of the coefficients is equal to zero. These test results are in agreement with Log pseudolikelihood results. This is the log likelihood of the fitted model. It is used in the Wald Chi-Square test of whether all predictors' regression coefficients in the model are simultaneously zero and in tests of nested models. The results in Tables 27 and 28 shows that none of the predictor's coefficients are zero and therefore the null hypothesis that all coefficients are simultaneously zero is rejected. Tables 27 and 28 below show the Heckman's two stage estimates on participation in cassava production and extent of area under cassava.

Table 27: Heckman Two-Step Results for Probability of Producing Cassava

Wald chi2(14) = 13.28, Prob>chi2 = 0.5048

CassProd	Coef.	Std. Err.	P>|z|
AgeHH	-0.0381	0.0179	0.033**
SizeHH	-0.1255	0.1089	0.249
GendHH	0.2877	0.2851	0.313
SchlgYer	-0.2152	0.0473	0.000***
FarmSiz	0.2481	0.0809	0.002***
ExtServ	0.4979	0.4433	0.261
InfoProdMart	2.3345	0.4230	0.000***
GroupMem	-1.5947	0.3042	0.000***
LanTenure	0.8397	0.5426	0.122
StorFaci	1.9003	0.4036	0.000***
TransProd	-0.6352	0.2759	0.021**
RoadInfra	-0.4075	0.2733	0.136
CuttsAcces	1.2609	0.4714	0.007***
IncomTotCat	-0.0153	0.1921	0.937
_cons	1.5546	1.7090	0.363
Mills Lambda	-1.1140	0.5317	0.036**
Sigma	1.1140		

***: significant at 1% level; **: significant at 5% level; *: significant at 10% level.

In stage 1, out of the 14 independent variables, age of household head and means of transport were statistically significant at 5% whereas schooling years, farm size, access to production and marketing information, group membership, storage facilities and access to cassava cuttings were statistically significant at 1%. While age, schooling year and farm size were the significant socio-economic factors, means of transport, access to information, group membership, storage facilities and access to cuttings were of an institutional nature. Age of household head has a negative β coefficient of 0.038 and a significance value of 0.033. The results imply that ceteris paribus, if the age of the household head increases by one unit, chances of participation in cassava production decreases by 0.038 units. This means that as the age of the household head increases the likelihood of participation in cassava production decreases an indication of a negative relationship between participation and age of household head. This could be as a result of shifting from cassava production to other high value crops due to more experience in farming as one grows older. However, this is in disagreement with Itam *et al* (2014), who found a positive relationship between farming experience and cassava production.

The number of schooling years which in this case referred to the educational level of the household head has a negative β coefficient of 0.215 and a significance value of 0.000. The results indicate that ceteris paribus, if the educational levels of the household heads increases by one unit, the chances of participation in cassava production decreases by 0.215 units. This implies that as the educational level of the household head increases the likelihood of producing cassava decreases. More educated farmers have the ability to engage in farming as a business than farmers with low education levels. They are also able to compare between enterprises and carry out enterprise selection based on profitability. This means therefore that, farmers could be opting for more profitable enterprises at the expense of cassava. However, this is in disagreement with Omokore *et al* (2012) and Itam *et al* (2014) who found a positive relationship between cassava production and education.

Farm size has a positive β coefficient of 0.248 and a significance value of 0.002. The results indicate that ceteris paribus, if farm size increases by one unit, chances of participation in cassava production increase by 0.248 units. The positive sign indicates a positive relationship between farm size and participation in cassava production in the study area. Farm size influences a farmer's decision on enterprise selection such as growing cassava. In the study, cassava is not a major cereal or cash crop and farmers will more likely participate in cassava production if the

available arable land is enough for both preferred crops and this alternative crop. This is because as farm size increases, more enterprises can be undertaken simultaneously. Farmers with larger farm sizes are also more likely to adopt modern varieties of cassava for higher returns which is in agreement with Omokore *et al* (2012) who found that cassava production is positively correlated to farm size. The desire to participate in cassava production therefore is thus promoted with ownership of large farm sizes as reflected in the analysis results.

The β coefficient for access to production and market information is 2.334 and has a positive sign and a significance value of 0.000. The results imply that ceteris paribus, if access to production and market information increases by one unit, chances of participation in cassava production increases by 2.334 units. This implies that the increase in the likelihood of participation more than doubles due to a single unit increase in access to information on production and marketing. This indicates a very high positive relationship and is in agreement with Ogunleye *et al* (2008), Omokore *et al* (2012) and Itam *et al* (2014).

The β coefficient for group membership is 1.595 and has a negative sign and a significance value of 0.000. This means that ceteris paribus, if group membership increases by one unit, the likelihood of producing cassava decreases by 1.515 units. The significance level shows that access to group membership is significantly influencing participation in cassava cultivation negatively. This implies that if more and more farmers joined farmer groups, their chances of producing cassava diminished with time. The reason for this could be that farmer groups are promoting other interests at the expense of cassava. However, these results were in disagreement with results of a study carried out by Mwaura (2014) who found out that as more and more farmers joined farmer groups, the chances of producing cassava increased.

Access to storage facilities had a positive β coefficient of 1.900 and a significance value of 0.000. The results imply that other factors held constant, if access to storage facilities increases by one unit, the likelihood of participation in cassava production increases by 1.9 units. This means that as access to storage facilities increases, the likelihood of more farmers participating in cassava cultivation increases, an indication of a positive relationship. This is in disagreement with earlier findings on the relationship between access to storage facilities and acreage under cassava which was found to be negative. This finding is in agreement with Westby

(2002) who indicate a positive relationship between access to storage facilities and cassava production.

Means of transport has a negative β coefficient of 0.635 and a significance value of 0.021. Majority of the households (72%) were using motorcycles and/or bicycles in transporting their cassava to the market. The results therefore indicate that ceteris paribus, if the number of households using motorcycles and/or bicycles increases by one unit, the likelihood of participation in cassava production decreases by 0.635 units. This could be as a result of most likely damages associated with use of motorcycles and/or bicycles and the fact that cassava is bulky, requiring bigger vehicles to transport and is in disagreement with Chalwe (2011) who stated that the availability of on-farm transport increases the probability of transporting goods to the market.

Access to cassava cuttings has a positive β coefficient 1.261 and a significance value of 0.007. The results indicate a strong positive relationship between access to cassava cuttings and the likelihood of producing cassava. This means that other factors held constant, if the number of households with access to cassava cuttings increases by one unit, the likelihood of producing cassava increases by 1.261 units. This indicates a strong positive relationship as the likelihood of producing cassava almost doubles. These findings were in agreement with Akinnagbe (2010) who recommends greater access to planting materials as a way of increasing cassava production.

Table 28: Heckman Two-Step Results for Area Under Cassava Production

CasLanSize	Coef.	Std. Err.	P>|z|
AgeHH	0.0211	0.0130	0.105
SizeHH	-0.0786	0.0880	0.372
GendHH	-0.6513	0.2341	0.005***
SchlgYer	0.0927	0.0516	0.072*
FarmSiz	-0.0364	0.0663	0.583
ExtServ	-0.2700	0.4117	0.512
InfoProdMart	1.0244	0.5883	0.082*
GroupMem	0.7843	0.4657	0.092*
LanTenure	-0.0875	0.1185	0.46
StorFaci	-0.7350	0.4601	0.11
RoadInfra	0.1564	0.2243	0.486
IncomTotCat	0.1546	0.1708	0.365
_cons	1.2419	1.3360	0.353

***: significant at 1% level; **: significant at 5% level; *: significant at 10% level.

In stage 2, out of the 12 independent variables used in the model, only gender of household head was significant at 1%. Education level, access to information and group membership were significant at 10%. Gender of household head had a β coefficient of -0.65 with a significance value of 0.005. All other factors held constant, if the number of male farmers increased by one unit, acreage of land under cassava production would decrease by 0.65 units. The results imply that other factors held constant, there is a very strong negative relationship between being male household head and cassava production in the study area. This is because in the study area, it was found that there were more men heading households than women, though it is the women who are more involved in agricultural activities. Therefore, this study agrees with most studies that have found a positive relationship between gender and cassava production but only when more women were involved in agriculture than men. For example, Itam *et al*, 2014 and Ovwigho and Ifie (no date), found a positive relationship between gender and cassava production. But in their studies, the number of women sampled was more than men. This therefore gives an implication that women produce cassava than men do.

The level of education represented by schooling years had a β coefficient of 0.0927 with a significance value of 0.072. this means that all other factors held constant, if level of education increased by one, acreage under cassava production would increase by 0.093 units. This implies that as the educational level of the household head increases the area under cassava production increases. More educated farmers have the ability to engage in farming as a business than farmers with low education levels. They are also able to compare between enterprises and carry out enterprise selection based on both drought tolerance and profitability. This is in agreement with Omokore *et al* (2012) and Itam *et al* (2014) who found a positive relationship between cassava production and education.

The β coefficient for access to production and market information is 1.0244 and has a positive sign and a significance value of 0.082. The results imply that ceteris paribus, if access to production and market information increases by one unit, chances of increasing area under cassava production increases by 1.0244 units. This implies that the increase in the acreage under cassava is more than one unit due to a single unit increase in access to information on production and marketing. This indicates a high positive relationship and is in agreement with Ogunleye *et al* (2008), Omokore *et al* (2012) and Itam *et al* (2014).

The β coefficient for group membership is 0.7843 and has a positive sign and a significance value of 0.092. This means that ceteris paribus, if group membership increases by one unit, the likelihood of increasing area under cassava increases by 0.7843 units. The significance level shows that access to group membership is significantly influencing participation in cassava cultivation positively. This implies that if more and more farmers joined farmer groups, their chances of increasing area under cassava increases with time. These results were in agreement with results of a study carried out by Mwaura (2014) and Danda *et al* (2014), who found out that as more and more farmers joined farmer groups, the chances of increasing acreage under cassava increased.

4.3 One-Way Between Groups ANOVA with Post-Hoc Tests Results

The third objective of the study was to determine area under cassava production in relation to other food crops and to determine whether there is any significant difference in the mean scores on the area under cassava in the three wards that comprised the area under study. To carry out the analysis, one-way between groups ANOVA with post-hoc tests was used. One-way

ANOVA tells whether there are significant differences in the mean scores on the dependent variable across the groups. Post-hoc tests are then used to find out where these differences lie. The test results are as shown below:

4.3. 1 One-Way ANOVA Results

Table 29: One-way ANOVA Descriptive Results

What portion of land is devoted to cassava

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
Vanga	52	.8750	1.15311	.15991	.5540	1.1960	.00	5.00
Pongwe/Kikoneni	75	.5967	.57780	.06672	.4637	.7296	.00	1.50
Dzombo	59	.7737	.82113	.10690	.5597	.9877	.00	3.00
Total	186	.7306	.85159	.06244	.6075	.8538	.00	5.00

The one-way descriptive results in Table 29 indicate that there were 52, 75 and 59 respondents from Vanga, Pongwe and Dzombo wards respectively. The results are a true reflection of the sampled respondents.

Table 30: Test of Homogeneity of Variances

What portion of land is devoted to cassava			
Levene Statistic	df1	df2	Sig.
4.395	2	183	.014

The results on test of homogeneity of variance give the Levene's test for homogeneity of variance, which tests whether the variance in scores is the same for each of the three groups. If in the Levene's test, the significance value (Sig.) is greater than .05, then the assumption of homogeneity has not been violated. The significance value in Table 30 is .014 and since it is less than .05, the assumption of homogeneity has been violated hence the need to consult results in the table of Robust Tests of Equality of Means in Table 31 where if the Significant value is less than .05, then the assumption has not been violated. In Table 31, the Significant value is .212

which is greater than .05 and this therefore indicates that the assumption of homogeneity of variance has been violated.

Table 31: Robust Tests of Equality of Means

What portion of land is devoted to cassava

	Statistic[a]	df1	df2	Sig.
Brown-Forsythe	1.570	2	117.946	.212

a. Asymptotically F distributed.

The main interest of the ANOVA results is to confirm whether there is a significant difference among the mean scores of the dependent variable (area under cassava) for the three groups (Wards). If the Significant value is less than or equal to .05, then there is a significant difference somewhere among the mean scores on the area under cassava for the three wards. The results in Table 32 show that the Significant value is .174 which is greater than .05 and therefore there is no significant difference among the mean scores of the acreage under cassava in the three wards. However, there is need to confirm this from the table of Multiple Comparisons as shown in Table 34.

Table 32: ANOVA Results

What portion of land is devoted to cassava

Difference:	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.539	2	1.270	1.765	.174
Within Groups	131.625	183	.719		
Total	**134.164**	**185**			

To confirm this in the table of multiple comparisons, the column of Mean Difference is used to check if there are any asterisks (*) next to the values listed. If there are asterisks, this means that the groups being compared are significantly different from one another at the $p<.05$. From the results in Table 33, there are no asterisks in the Mean Difference column for the three groups being compared and therefore it means that the three groups being compared are not significantly different from one another at $p<.05$.

Table 33: Multiple Comparisons Results: Post Hoc Tests

Dependent variable: What portion of land is devoted to cassava
Tukey HSD

(I) Ward	(J) Ward	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Vanga	Pongwe/Kikoneni	.27833	.15304	.166	-.0833	.6400
	Dzombo	.10127	.16132	.805	-.2799	.4825
Pongwe/Kikoneni	Vanga	-.27833	.15304	.166	-.6400	.0833
	Dzombo	-.17706	.14758	.455	-.5258	.1717
Dzombo	Vanga	-.10127	.16132	.805	-.4825	.2799
	Pongwe/Kikoneni	.17706	.14758	.455	-.1717	.5258

To confirm and compare the mean scores of the three groups, a graph of mean plots is used as shown in Figure 15. The mean plots indicate that Vanga had the highest mean score followed by Dzombo and lastly by Pongwe/Kikoneni.

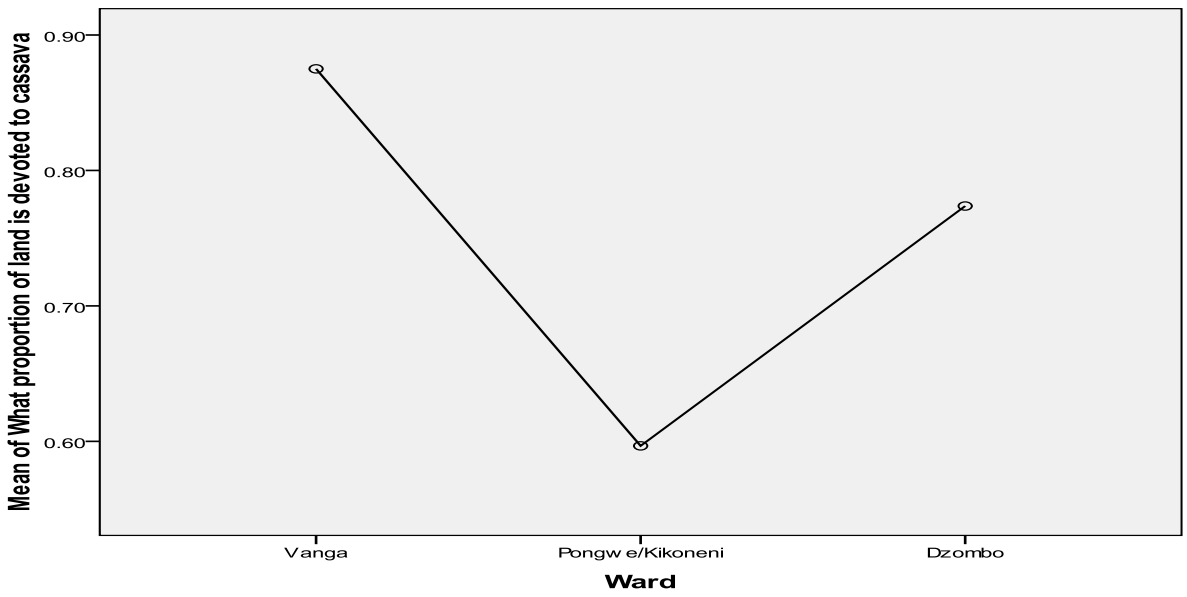

Figure 15: Mean plots of acreage under cassava in Vanga, Pongwe/Kikoneni and Dzombo wards.

The overall One-way results therefore indicate that the mean acreages of land under cassava in the three wards are not significantly different.

4.3.2 Area under Cassava in Comparison with Area under Other Food Crops Results

Apart from comparison of acreage under cassava among the three wards, objective four also aimed to compare acreage under cassava with that under other food crop enterprises. To achieve this, the acreage under cassava was compared with total acreage under other food crop enterprises as shown in Table 34 below. The results in Table 34 show that 62.5% of the farmers who had put between 1 and 1.9 acres under all other food crop enterprises had put cassava production in less than 0.5 acres while 37.5% had cultivated between 1 and 1.9 acres of cassava. On the other hand, out of all the farmers who had put 2 and 4.9 acres under all other food crop enterprises, 48.6%, 14.6%, 23.6%, 11.8% and 1.4% of the farmers had put cassava production in less than 0.5 acres, 0.6-0.9 acres, 1-1.9 acres, 2-4.9 acres and more than 5 acres respectively. Similarly out of all the farmers who had put over 5 acres under all other food crop enterprises, 42.3%, 7.7% and 50% of the farmers had put cassava production in less than 0.5 acres, 0.6-0.9 acres and 1-1.9 acres respectively as shown in Table 34.

Table 34: Area under Cassava in Comparison with Other Enterprises

Other food crops area category	**Other food crops area category * Cassava land size category**					
	Cassava land size category					Total
	≤0.5	0.6-0.9	1-1.9	2-4.9	≥5	
1 -1.9	62.5%	0.0%	37.5%	0.0%	0.0%	100.0%
2 – 4.9	48.6%	14.6%	23.6%	11.8%	1.4%	100.0%
≥5	42.3%	7.7%	50.0%	0.0%	0.0%	100.0%
Total	**48.9%**	**12.4%**	**28.5%**	**9.1%**	**1.1%**	**100.0%**

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

This chapter includes the discussion of implication of the socio-economic and institutional characteristics of small holder cassava farmers in Msambweni Sub-County. It also gives the implications of the empirical results of the Heckman two-stage model and ANOVA analysis. With regard to participation challenges revealed by the empirical results, policy recommendations are suggested to help in enhancing cassava production among small holder farmers.

5.1 Conclusions

This study aimed at characterizing the production systems and farmers in Msambweni. It also aimed at determining socio-economic and institutional factors influencing cassava production decision in addition to determining the area under cassava production in relation to other food crops. The results revealed the importance of education, farm size, land tenure, adequate storage facilities, group membership, access to seed and information in influencing smallholder farmers' decisions in cassava production. It was evident that while some of the farmers practiced mixed/inter-cropping as a way of enterprise diversification others still grow cassava as a mono-crop. The farmers do not produce cassava efficiently due to the fact that they do not reap from economies of scale. This is mainly due to continued production of low-yielding local varieties and producing cassava in uneconomical scale. Given the climatic conditions of the study area, cassava production could possibly outdo most of the other food crops. However, most farmers continue to grow other food crops at the expense of cassava. Most of the farmers also prefer dealing with raw tubers as opposed to processing and value addition which offer excellent opportunities for increasing their farm incomes and food security which could haul them out of poverty in which they currently languish.

5.2 Recommendations

Based on the results of the study, emphasis should be given to the significant variables especially those that have positive influence on cassava production with an aim to maximizing their influence. The government and other policy makers should consider policies that encourage the following socio-economic aspects: improved education and training among farmers to increase their capacity to engage in cassava production profitably. As land seemed to be a limiting factor, intercropping cassava with other food crops should be encouraged so as to fully

and intensively utilize the land resource. On the other hand, the following institutional aspects should be considered: the Government should invest in rural infrastructure, especially road networks to ease conveyance from points of production to points of consumption. Farmer Group empowerment and development should be encouraged as they are easy conduits for seed/cuttings distribution, information sharing and training. They should be encouraged to include cassava production among their activities. In addition to this, extension service delivery needs to be enhanced so as to increase the coverage/access of the new improved cassava varieties because many farmers still grow the local variety (Kibandameno). In this regard, farmer to farmer extension should be discouraged due to the impact it has on adoption of improved technologies in case of wrong/negative messages. There is also need for government and stakeholders to promote and invest in cassava value addition. Policies that spur growth in demand for cassava and cassava products should also be considered. Finally, rigorous promotion of cassava production should be done equally among farmers in the entire study area irrespective of their farm sizes. This is because there is no significant difference in area under cassava in the three wards. structuring the markets and improving market linkages could go a long way in unlocking the potential opportunities in the cassava value chain.

5.3 Areas for Further Research

The main intention of the study was to determine the factors influencing participation and extent of participation in cassava production. It also compared the area under cassava with the area under other food crops in the study area. Nevertheless, the study proposes further research on:

1. The factors that influence the choice of cassava varieties grown by farmers. There is need to determine the constraints and barriers that affect adoption of varieties, especially the new high yielding varieties.
2. The factors that influence the marketing of cassava and cassava products and choice of markets. This study merely determined the factors that influence cassava production but not those that influence marketing.

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APPENDIX

QUESTIONNAIRE FOR FARMERS

My name is Moses Nderitu, a student at Egerton University. This questionnaire has been developed to gather data for the purpose of analyzing the socio-economic and institutional factors influencing cassava production in your area. You are among the farmers who have been selected for the study. The data collected will be used only for the purpose of this study and will be highly appreciated and treated with utmost confidentiality. Indication of your name is optional and should you wish to have the findings of this study, kindly indicate your mobile telephone number and email address for ease in sharing of the findings.

Instructions for the enumerators

1. *Introduce yourself and tell the purpose of the study before starting the interview*
2. *Tick the box on the closed questions as indicted*
3. *Ask interview questions clearly*

SECTION 1: GENERAL INFORMATION

Sub-County…….Ward……..

Location……...Sub-location ……..

Village ……. ……Questionnaire number……

Phone number of respondent…….. E-mail……

Interviewed by ……. Date of interview …….

SECTION 2: SOCIO-ECONOMIC CHARACTERISTICS

2. 1. **Name of respondent_____**

2.1.1. Age in years _____

2.1.2. Household size *(number of people living and eating together)*_____

2.1.3. Gender: 01 = Male [ ] 02 = Female [ ]

2.1.4. Educational level attained_____

2.1.5. Marital Status:

01=Married [ ] 02=Single (never married) **[**] 03=Divorced [ ] 04=Widowed **[**]

2.2. Farm size ……acres

01=0- 2 Acres [ ] 02=2-4 Acres **[**] 03=4-6 Acres [ ] 04=6-8 Acres **[**]

05=8-10 Acres [ ] 06=Others (Specify) [ ] _____

2.2.1. Does farm size influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

2.2.2. If yes, How?

……

……

……

2.3. Income

2.3.1. Source of income?

01=on-farm [ ] 02=off-farm [ ] 03=both [ ] 04= others (specify) …….

2.3.2. What is the total income (on-farm and off-farm) of the head of the farm family per year?

01=Less than 20,000.00 [ ] 02= 20,000.00 – 40,000. 00 [ ] 03= 40,000.00 – 60,000.00 [ ]

04= 60,000.00 – 80,000.00 [ ] 05= More than 80,000.00 [ ]

2.3.3. Is the total income adequate for farm operations? 01 = Yes [ ] 02 = No [ ]

2.3.4. Does your income influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

2.3.5. If yes, How?

……

……

……

2.4. **Physical, natural and financial capital *(Tick as appropriate)*.**

2.4.1. **Material used for walls in the residential main house (majority of the walls)** 01 Brick/cement (finished) 02 Brick/cement (unfinished/rough) 03 Wood (finished eg planks) 04 Wood (unfinished eg poles) 05 Mud/dirt 06 Straw matting/cardboard 07 Other:_____	*2.4.2.* **Material used for flooring in the residential main house** 01 Brick/cement 02 Wooden planks 03 Tiles/carpet/parquet 04 Mud/dirt/dung/sand 05 Other:_____	*2.4.3.* **Material used for roofing in the residential main house** 01 Brick/cement 02 Wooden planks 03 Tin cans 04 Corrugated metal/plastic/ plastic sheets 05 Straw/grass/palm fronds 06 Tiles 07 Other:_____
2.4.4. **State of the dwelling** 01 Completely dilapidated shack 02 Needs major repairs 03 Good condition 04 Under construction/repair	*2.4.5.* **How many rooms are in the house?**_____ [Room is a space with <u>permanent</u> division however frail (eg fabric). But a curtain that is opened and shut does mean separate rooms]	*2.4.6.* **Do you have access to a latrine/toilet**? 01 No 02 Yes, in own house/compound 03 Yes, in neighbor's house
2.4.7. **What type of toilet facilities do you use?** 01 Pit latrine 02 VIP latrine 03 Flush toilet /with or without connection to water) 04 Bucket/newspaper/polythene 05 Open space 06 Other: _____	*2.4.8.* **During the DRY season, what is your primary source of water for HOUSEHOLD use?** 01 Informal piped water supply 02 Open public well 03 Closed public well 04 Open well, house/compound 05 Closed well, house/compound 06 Rainwater in tank 07 River/stream 08 Spring 09 Public tap 11 Other:_____	*2.4.9.* **During the WET season(s), what is your primary source of water for HOUSEHOLD use?** 01 Informal piped water supply 02 Open public well 03 Closed public well 04 Open well, house/compound 05 Closed well, house/compound 06 Rainwater in tank 07 River/stream 08 Spring 09 Public tap 10 Water truck 11 Other:_____
2.4.10. **What is the main source of fuel for cooking in this household?**	*2.4.11.* **What is the main source of lighting in this**	*2.4.12.* **What is the ownership of this house and the land on which located?**

01 Charcoal 02 Firewood 03 Bottled Gas (propane) 04 Kerosene 05 Electricity 06 Biogas 07 Coal 08 Dung 09 Other:_____	**household?** 01 Naked flame (candle, fire etc) 02 Kerosene 03 Mains electricity 04 Solar power 05 Biogas 06 Other_____	01 house owned, land owned with title 02 house owned, land owned without title 03 House owned, land leased 04 House leased land leased 05 House leased land owned 06 House owned, land squatted 07 Other: _____
2.4.13. **Is there allocated space/housing for animals**? 01 Only allocated space 02 Only special housing 03 Both special space and housing 04 Neither allocated space nor housing 05Other _____	*2.4.14.* **What assets do you own**? 01 Tractor 02 Motor vehicle 03 Motorcycle 04 Bicycle 05 others (specify) _____	*2.4.15.* **What animals do you own**? 01 Cows 02 Goats 03 Sheep 04 Poultry 05 others (specify) _____

SECTION 3: INSTITUTIONAL FACTORS

3.1. Extension Service

3.1.1. Have you ever received any form of extension services on cassava production?

01 = Yes [ ] 02 = No [ ]

3.1.1.1. If yes, who provided the extension services?

01=Government/agricultural extension staff [ ] 02=Research institution [ ]

03=NGO [ ] 04=other (specify) ……

3.1.1.2. What is the distance to the nearest extension service provider? .....km

3.1.2. How often do you meet with extension agents?

01=Weekly [ ] 02=Fortnightly [ ] 03=Once a month [ ]

04=Once in three months [ ] 05=Once in six months [ ] 06=Once a year [ ]

07=Others (Specify) ……..

3.1.3. Which technologies in relation to cassava production do extension service providers promote among farmers?

01=Timely planting [ ] 02=Correct spacing [ ] 03=New/improved varieties [ ]

04=Field management [ ] 05=post harvest management [ ] 06=others (specify)……

3.1.4. Which technologies have you adopted?

01=Timely planting [ ] 02=Correct spacing [ ] 03=New/improved varieties [ ]

04= Field management [ ] 05=post harvest management [ ]

06=others (specify)…….

3.1.5. Does contact with the extension service provider influence your decision-making in cassava production? 01 = Yes [ ] 02 = No [ ]

3.1.5.1. If yes, How?

……
……
……

3.2. **Production and Market Information**

3.2.1. Do you have access to cassava production and market information other than from extension contact?

01 = Yes [ ] 02 = No [ ]

3.2.2. Which is your major source of production and market information?

01=TV and Radio [ ] 02=Newspapers and Magazines [ ] 03=Mobile phone [ ]

04=Fellow farmers [ ] 05=Other (Specify) …….

3.2.3. What benefits do you derive by accessing production and market information?

(List them in order of priority)

a) ……
b) ……
c) ……
d) ……

3.2.4. Does access to production and market information influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

3.2.5. If yes, How?

……
……
……

***3.3.* Group/Association Membership**

3.3.1. Are you a member of a farmer group/association?

01 = Yes [ ] 02 = No [ ]

3.3.2. If yes, what is the name of the farmer group/association? ……..

3.3.3. How many years have you been a member? ……

3.3.4. What benefits do you derive from being a member of farmer group?

(List them in order of priority)

a) ……
b) ……
c) ……
d) ……
e) ……

3.3.5. Does group membership influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

3.3.6. If yes, How?

……
……
……
……

3.4. Land tenure system: What is your land tenure system?

01=Individual ☐ 02=Leasehold ☐ 03=Communal ☐ 04=other (specify)☐ ----------

3.4.1. Does land tenure system influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

3.4.2. If yes, How?

……
……
……

***3.5.* Storage facilities**

*3.5.*1. Do you have adequate storage facilities for food crops?

01 = Yes [ ] 02 = No [ ]

3.5.2. Does availability of storage facilities influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

3.5.3. If yes, How?

……
……
……

***3.6.* Transport of Farm Produce**

3.6.1. What mode of transport do you use for your farm produce?

01= vehicles [ ] 02= Motorcycle/bicycle [ ] 03 = carts [ ] 04=others (specify) [ ]……

3.6.2. Ownership of mode of transport: What is the ownership of mode of transport?

01=personal [ ] 02=hired [ ] 03= others (specify) [ ]

3.6.3. Does mode of transport influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

3.6.4. If yes, How?

……
……
……

3.7. Road Infrastructure

3.7.1. Type of road used for farm-related transportation.

01=all-weather (tarmac, murram) [ ] 02= dry-weather (earth road) [ ] 03=others [ ]

3.7.2. What challenges do you face in transporting the produce?

(List them in order of priority)

a) ……
b) ……
c) ……
d) ……

3.7.3. Does type of road used influence your decision-making in cassava production?

3.7.4. If yes, How?

……
……
……
……

3.8. Access to Cassava Cuttings

3. 8.1. Are cassava cuttings for planting easily accessible to you?

01 = Yes [ ] 02 = No [ ]

3.8.2. Does availability of cassava cuttings influence your decision-making in cassava production?

01 = Yes [ ] 02 = No [ ]

3.8.3. If yes, How?

……
……
……
……

SECTION 4: CASSAVA PRODUCTION

4.1. Do you grow cassava in your farm? 01=Yes [ ] 02=No [ ]

4.2. If yes, what are the reasons as to why you grow cassava?

01= Boiling to eat [ ] 02= Bread/chapatti [ ] 03= processing and selling [ ] 04= Tuber sales [ ]

05= Fodder [ ] 06=Sale of cuttings/seed [ ] 07= Porridge [ ]

08= Cultural/traditional crop [ ] 09= Cassava meal/ugali [ ] 10=others (specify) [ ] --------

4.2.1. List two varieties you grow. a)…… b)……..

4.3. If you don't grow cassava, what are the reasons as to why you do not grow cassava?

01= Low yields compared to other crops [ ]

02= Low prices of cassava and cassava products [ ]

03= Considered crop of the poor [ ] 04= Limited farm land [ ]

05= Limited knowledge and skills on cassava production and utilization [ ]

06= Limited or lack of appropriate cassava cultivars/variety [ ]

07=Limited resources to spare for cassava production [ ]

08= Low demand for cassava and cassava products [ ]

09=others (specify): _____

4.4. What other food crops do you grow? *(List four in order of importance)*

1) ……acres……
2) ……acres……
3) ……acres…….
4) ……acres……..

4.5. What proportion of land is devoted to:

a) Cassava? …….

01= <0.5 acre [ ] 02=0.6-1 acre [ ] 03=1.1-2acres [ ] 04=2.1 -5 acres [ ] 05=5.1 – 10 acres [ ] 06=other (specify) [ ]……

b) Other Food crops? ……

01= <0.5 acre [ ] 02=0.6-1 acre [ ] 03=1.1-2acres [ ] 04=2.1 -5 acres [ ] 05=5.1 – 10 acres [ ] 06=other (specify) [ ]……

4.6. If *4.1* above is yes, which varieties do you grow? .....

4. 7. If yes, what is the system of cassava production? 01=Mono-cropping [ ] 02=Intercropping [ ]

4.8. If intercropping, specify the intercrops…….

4.9. List the cash crops that you grow and the acreage they occupy.

a. Cash Crop…….acres…….

b. Cash Crop…….acres…….

c. Cash crop……..acres…….

d. Cash Crop……acres…….

SECTION 5: OTHER CHALLENGES FACING CASSAVA FARMERS.

5.1. How do you rate the following as challenges experienced in cassava production?

Challenge	Very great	Great	Average	Not great
01=Unreliable rainfall and prolonged droughts				
02=Limited technical information on production and use				
03=Poor/low market prices				
04=Unreliable local demand for cassava produce				
05=High cost of inputs (fertilizer, seed, etc)				
06=Limited land for economical farm enterprises				
07=Diseases/pests/Damage by wild animals				
08=Other (specify) ……				

5.2. How have you been dealing with the challenges named above?

a) ……

b) ……

c) ……

d) …….

Your participation in this study is greatly appreciated.

Once again, I assure you that your identity will remain ***STRICTLY CONFIDENTIAL.***

THANK YOU FOR YOUR TIME