EVALUATION OF CASSAVA COMMERCIALIZATION AMONG SMALLHOLDER FARMERS AND ITS EFFECT ON HOUSEHOLD INCOME: A CASE OF SIAYA AND KILIFI COUNTIES

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Thesis submitted to Graduate School in fulfillment of the requirements for the Degree of Doctor of Philosophy in Agribusiness Management of Egerton University

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DECLARATION AND RECOMMENDATION

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This thesis is my original work and it has not been presented for a degree course in any other University.

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DEDICATION

I dedicate this work to my adored daughters, Charlotte and Precious and my family members for their continuous support, words of encouragement and love.

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ABSTRACT

Improving household income as a poverty eradication strategy has been a matter of great concern in Kenya. This problem has been more rampant in Arid and Semi-arid (ASAL) regions especially in Kilifi and Siaya Counties, where the poverty levels are higher than the national average. These counties have high potential for cassava commercialization as a result of favourable climate. Intervention measures have been undertaken by both the government and non-governmental organizations to promote cassava commercialization in both counties as a strategy of transforming livelihoods of smallholder farmers. Despite these endeavours, empirical evidence reveals little information on the effect of cassava commercialization on household income. The main objective of the study was therefore to establish the role of cassava commercialization on household income in Siaya and Kilifi Counties. A cross-sectional data was collected by use of well-structured questionnaires from farmers, traders and extension officers. A multi-stage random sample of 384 farmers, purposive sample of 100 traders and a census of 20 extension officers were obtained. In the descriptive statistics analysis, a value addition index was developed. In the inferential statistics, multinomial logistic and endogenous switching regression models were used. The study found that commercialization had a positive and significant effect on household income. In addition, factors that influenced commercialization included; distance to the market and farm size which were found to have significant effect in both counties. The study found that Kilifi County households had more income as a result of commercialization than Siaya County. The study revealed that factors influencing cassava commercialization in Siaya County were years of schooling ($p<0.05$), farm size ($p<0.05$), group membership ($p<0.10$) and distance to market ($p<0.01$). Significant factors influencing cassava commercialization for Kilifi County were farm size ($p<0.05$), off-farm income ($p<0.10$), age ($p<0.05$) and distance to market ($p<0.01$). Similarly, off-farm income and remittances had significant impact on household income ($p<0.01$). Generally, farmers who undertook cassava commercialization enjoyed more income relative to those who did not in both counties. To improve commercialization, the study recommends that membership to farm based groups should be promoted, trainings should be conducted on processing of high quality value added products and a good balance off-farm and cassava commercialization activities be promoted.

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LIST OF ABBREVIATION / ACRONYMS

AGRA	Alliance for a Green Revolution in Africa
ANOVA	Analysis of Variance
CAST	Contro Per un Appropriato Sviluppo Tecnologico (Appropriate Technology Development Centre)
CI	Commercialization Index
CREPP	Community Rehabilitation and Environment Protection Program
FAO	Food and Agricultural Organization
FAOSTAT	Food and Agricultural Organization Online Statistical Database
FIML	Full Information Maximum Likelihood Estimation
GDP	Gross Domestic Product
GOK	Government of Kenya
HCI	Household Commercialization Index
IFPRI	International Food Policy Research Institute
KENAFF	Kenya National Farmers Federation
KENFAP	Kenya National Federation of Agricultural Producers
KNBS	Kenya National Bureau of Statistics
MOA	Ministry of Agriculture
MOALF	Ministry of Agriculture, Livestock and Fisheries
MMF	Marginal Mixed Farming
SPSS	Statistical Package for the Social Sciences
PSM	Propensity Score Marching
VAI	Value Addition Index
VIF	Variance Inflation Factor

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Agriculture is an important sector in Kenya's economic development. The sector directly contributes 26 per cent to Kenya's Gross Domestic Product and another 25 per cent indirectly to the economy. It is the main source of food and employment. The sector employs over 40 per cent of the total labour force of the total Kenyan labour force and over 70 per cent of the rural labour force. In addition, the sector supports the manufacturing sector with raw materials and generates tax revenue and foreign exchange that support other economic activities (MOALF, 2015). Moreover, three quarters of the population in Kenya live in rural areas and depend on this sector for a living (GOK, 2015). Majority of the urban poor eke out a living in agricultural-related activities. Since the sector plays an important role, the government and development partners have in the past come up with different initiatives geared towards improving the sector. These initiatives include promotion of various agricultural activities such as, dairy farming, cash and cereal crops, commercialization of underutilized crops such as cassava, sweet potatoes among others. Over the years, these agricultural enterprises have performed relatively well. However, in the recent past the performance of over-reliant crops like maize has deteriorated due to climatic change. Consequently, there has been adverse effect on livelihood of farmers since majority of Kenyans rely on maize as their main staple food (Onono *et al*., 2013). This has resulted into serious food insecurity and high poverty levels especially in the arid and semi-arid (ASAL) regions, which form a large proportion of Kenyan inhabitant.

Following the developments aforementioned, the government has embarked on the promotion of neglected or underutilized crops in order to enhance the food base of the poor, increase their income and mitigate poverty. It has been noted that these crops perform well not only under poor rainfall conditions but also on poor soils which characterize ASAL areas. Among the crops being promoted is cassava (*Manihot esculenta Crantz*) which is one of the most important tuber food crops in Africa (Forsythe *et al*.,2016). Cassava is the third most important food crop after maize and a main source of income for the rural communities in some parts of Kenya (Mwang'ombe *et al*., 2013). The root crop is popular throughout the developing world and feeds both the rural and growing urban population. It is also a staple food for 67 percent of the low income farmers as well as 8 per cent of the able farmers

(FAOSTAT, 2013). Cassava is rich in carbohydrates and it has high content of dietary fibre. It is also rich in essential minerals such as calcium, amongst others, which play a vital role in the diet of the people in the developing countries. According to Saediman *et al*. (2016), its consumption contributes greatly to per capita income in the world. Moreover, the crop provides a stable base in areas prone to drought and famine because it has higher efficiency of water use and can therefore tolerate more water stress than many other crops.

Production of cassava in Kenya is mostly concentrated in a few agricultural ecological zones. These include; Western Kenya, Coast and Eastern zones of the country. In these regions, cassava accounts for a greater percentage of the total cassava production in the country (Karuri *et al*., 2001). A study by FAOSTAT (2013) indicated that the world cassava production quantity stood at 276,721,585 tonnes. It further revealed that Kenya's cassava production was at 1,112,420 tonnes which accounted for 0.4 percent of the world share and reflected an increase from the previous year's production of 893,122 tonnes (MOA, 2013). In addition, the area under cassava during 2013 was 70,000 hectares compared to 69,169 tonnes in 2012 (FAOSTAT, 2013). Similarly, the area under cassava production in Siaya County during 2013 was about 5,000 hectares (MOA, 2013). The bulk of this production was mainly for human consumption. In Kilifi County, cassava is grown on approximately 5,779 ha. Production of cassava in the county has increased in the past few years. In 2012, production stood at 137,938 tonnes while was witnessed in 2014 with the total production being 207,060 tonnes (GOK, 2015). This was an increment from 16.4 percent realized in 2012 to 35.8 percent in 2014.

The above statistics confirm that Kenya can produce more than 2 million metric tonnes of cassava per year even though the production of this crop is predominantly on smallholder basis by farmers who focus on producing enough to feed their households. Notably, these farmers are marginalized and the potential of the marginal areas in cassava production still remain untapped. Furthermore, participation in marketing of cassava is confined to local villages and nearby markets with virtually no value addition. It is observed that subsistence farming is a key economic activity in both Siaya and Kilifi Counties. In Siaya County, maize, sorghum, beans, millet and cassava are the main crops produced. Farming is mostly done under intercropping since the average farm size for a household in the region lies in the range 0.5-0.9 hectares (Kenya Integrated Household Budget Survey, 2005/2006). Besides cultivation of crops, livestock and poultry farming are other forms of economic activities undertaken with cattle, sheep, goat and indigenous chicken being kept (Obiero, 2013). However, these farmers are not traditional livestock keepers because they keep very few

livestock, one or two cattle which is still inadequate in meeting the household demand. These activities are supported by bimodal type of rainfall with the long rainfall season experienced between March and June, and short rains from August to November every year. The rainfall ranges from 600-2000 mm per annum with an average of 1572 mm per annum. The average temperature in Siaya County is 21.7^0C.

At the Kenyan coast, specifically in Kilifi County, cassava is grown as a staple food and cultivated on small farms in mixed-cropping systems together with cereal crops like maize or grain legumes such as cowpeas, beans or green-grams. The county is characterized by warm temperatures of over 25^0C throughout the year and experiences two seasons of moderate rainfall of between 800-1000mm. Maize has over the years been the most popular crop followed by cowpeas and cassava. However, over-reliance on maize has been known to affect local food security and increased poverty yet crops such as cassava, if well adopted, can boost income and improve household livelihood. Though cassava is currently under-produced with a high level of subsistence farming, its importance to the livelihoods of millions of poor farm households and the overriding need for poverty reduction has made the crop a target for many interventions.

According to MOA (2007), a National Policy on cassava industry was developed in order to address issues related to production, marketing and regulation of the cassava industry at large in Kenya. In addition, efforts were made toward the development of cassava industry in the country to enhance cassava commercialization so as to match the dynamic changes in cassava industry and the world at large. The government believed that with appropriate policies, cassava could be easily transformed from "a poor man's food" mainly grown for consumption into a commercial commodity for sustainable food security, income generation and poverty mitigation through enhanced production, utilization, marketing and trading of cassava and its value added products. According to FAO (2004), expanding markets for cassava products may turn the crop into a cash crop for smallholder farmers, while maintaining food security, and thus become a driver for rural change in Africa. In support of this view, Akorede (2004) opined that enhanced cassava production can attain its potential of increasing farmer's income and improving their standards of living, since it has an export opportunity and import substitution possibility for cassava flour and industrial starch as observed in Nigeria. Additionally, Martey *et al*. (2012) noted that there are marketing opportunities for cassava products in Ghana and recommended the adoption of strategies such as cassava commercialization which can enhance competitiveness and integrate farmers into markets. Development and trading of high quality cassava products has gained support from

different agencies as a way of transforming livelihoods of smallholder households. Odunaya (2013) demonstrated the significance of value addition towards economic development. He noted that there is low level of engagement in cassava value addition due to inadequate processing equipment.

Despite the effort to increase production of cassava in Kenya through usage of resources under various interventions, the tuber crop has not evolved from subsistence to a commercial crop (FAO, 2011). A study by Munga *et al*. (2012) found that in Kenya, cassava crop is marketed mainly as a fresh root in the proximity of the production areas with few processed cassava products sold at the market centres. Also, most of the cassava produced in Kenya is currently used in its fresh form for human consumption or as traditional processed products. In Kilifi County, cassava is mostly consumed in two main ways; a main dish (boiled tubers) or as snacks (*Kachiri*). In Siaya County, however, cassava *ugali* and porridge are mostly preferred because of their softness and sweet taste. The cassava usage in both counties reveals low value addition and lack of marketing, which are two essential elements of commercialization. Value addition of cassava is quite minimal in Siaya County yet there is a functional processing plant established in Jera. In addition, Red Cross has established three other processing plants in the county at Akala, Uranga and Boro.These plants are yet to start operations. Coastal region equally has an established cassava processing plant (Tapioca Limited) located at Mazeras in Kilifi County, with an installed capacity of 30 tonnes per day.

Since most of the cassava is grown for subsistence, its production and supply does not meet the increasing urban market demand. Siaya and Kilifi Counties are still facing many bottlenecks to meet this rising demand. These include; lack of organized markets for cassava produce, low demand and utilization of cassava products locally, low uptake of technologies that can enhance productivity and inadequate certified planting materials due to very few providers (MOA, 2013). Nonetheless there exists a number of opportunities that can enhance cassava production for commercialization purposes. These include the high demand for cassava and other underutilized traditional crops, favourable climate, establishment of cassava processing factories for value addition, high yielding cassava varieties and well-trained extension officers. Another advantage is that cassava has great potential for a wide range of industrial uses that can be explored to support a number of industrial raw material requirements for domestic industries. These diverse uses have not been fully explored in Kenya.

Apart from human consumption, there are other important uses of cassava as a raw material in the industry. In Asia, for instance, cassava has more recently gained momentum

as an industrial crop in the form of starch and ethanol for biofuel production (Charoenrath, 2008). In other countries, cassava chips and pellets are also used as animal feed and for alcohol production. According to Karuri *et al*. (2001), 246,000 metric tonnes of animal feeds are produced in Kenya using 10 percent of maize products. Cassava, however, could substitute maize by up to 20 percent. This implies that over 4900 metric tonnes of cassava could be utilized for animal feed per year instead of maize.

In Cameroon, researchers have estimated that poultry farmers can cut production costs by 49 percent if they use cassava as an ingredient in chicken feed (New Vision, 2006). This can also be possible in Kenya since the roots and leaves of the tuber are available all year round making it one of the most important ingredients for chicken feed. Therefore it can generate income for many smallholder farmers who may engage in chicken rearing (Kawano, 2003). With the high growth rate of urban population and the need for fast food, poultry farming presents an opportunity for smallholder farmers to generate extra income. They can supply cassava to poultry farmers. Besides food demand, urbanization has also created domestic markets, especially in the confectionery industry which provides a great opportunity to farmers for value added products (GOK, 2015).

Despite the prevailing opportunities for cassava crop, the number of players actively engaged in the sector is still very low. This is made worse with low participation of farmers in the markets. Currently, Siaya County's market for cassava is dominated by small-scale traders who sell their products directly to the local market at reduced prices. Moreover, informal markets which lack proper structures also exist. Besides that, there has been cross-border trade in cassava especially on the Kenyan market through Busia which borders Siaya County to meet the demand of cassava in the Kenyan border town. Similarly in Kilifi County, cassava is sold either at farm gate (informally) or at the local markets. Market participation is an important element of cassava commercialization that entails accessing markets with an aim of selling cassava products. It is measured by the proportion of the value of cassava sold. A basic measure of market participation is the Household Commercialization Index. The other important element of commercialization is value addition. So far, value addition has been measured as a discrete variable since no index has been developed to measure it.

Value addition of cassava through various techniques may result in diversified products which is ultimately important in enhancing market participation (Onya *et al*., 2016). Marketing opportunities exist for value added cassava products that has not been tapped especially by smallholder farmers. It has been realized that value addition is a strategy that has the capability of changing an enterprise which is unprofitable into a profitable venture

(Fleming, 2005). Besides, it is explicitly pointed out that value addition is capable of integrating smallholder farmers into the markets as well as strengthening the linkages between farmers and other actors along the chain. However, no index exists for measuring value addition which takes into consideration the different forms of value added cassava products. This has contributed to the current limited study of commercialization which is concentrated on market participation only. It is also evident that commercialization is a multidimensional concept with varied meaning and theories. Most studies have addressed commercialization from a market participation aspect without clearly indicating the role of value addition in commercialization (Hailua *et al.,* 2015; Kabiti *et al*., 2016; Kotchikpa and Wendkouni, 2016). This study therefore sought to develop an index for measuring commercialization. In this study, commercialization has been addressed from the perspective of value addition and market participation. These two aspects of commercialization are very important in understanding household income.

1.2 Statement of the Problem

Improving household income as a poverty eradication strategy has been a matter of great concern in Kenya. This problem has been more rampant in arid and semi-arid counties, especially in Kilifi and Siaya Counties, where the poverty levels are higher than the national average. These counties are high potential regions in cassava production. However, cereal crop like maize which farmers rely upon do not perform well due to unfavourable climatic conditions. As a result of poor production, low household income and high poverty rates in these regions still remain a challenge. In order to address these problems, underutilized crops like cassava that have been known to be a source of traditional diet for quite a long time have been widely promoted. Though the crop is considered important for its food security role, its commercialization level in these areas has not been established. These counties have set up cassava processing plants which have not been fully exploited by farmers for commercialization purposes. This notwithstanding, there has been concerted effort by both the government of Kenya and non-governmental organizations through various interventions. Reviewed literature shows that many studies in relation to cassava commercialization have been done in West African Countries but little in Kenya. These studies, however, have looked at commercialization from the perspective of market participation without considering the other important aspects of value addition. Past studies on agricultural commercialization in these counties have mainly concentrated on maize with little attention on cassava. This is

despite the high potential of cassava commercialization in these two counties. Hence, the extent to which cassava commercialization contributes towards household income is not known. This study therefore evaluated cassava commercialization and its effect on household income in the two counties.

1.3 Objectives of the Study

The broad aim of the study was to contribute to enhanced cassava commercialization for improved household income in Siaya and Kilifi Counties. To achieve this objective, the study was guided by the following specific objectives.

i. To determine the levels of cassava commercialization within Siaya and Kilifi Counties.
ii. To compare the proportion of cassava income with the income of other selected crops in Siaya and Kilifi Counties.
iii. To evaluate marketing margins of cassava among the actors along cassava marketing chain in Siaya and Kilifi Counties.
iv. To determine the effect of cassava commercialization on household income of smallholder farmers in Siaya and Kilifi Counties.

1.4 Research Hypotheses

Hypotheses which were tested in view of the objectives stated above are:

H_{01} There is no statistical significant difference between the levels of cassava commercialization in Siaya and Kilifi Counties.

H_{02} There is no statistical significant difference between income earned from cassava sales with other selected crops in Siaya and Kilifi Counties.

H_{03} Marketing margins among the actors along the marketing chain do not vary in Siaya and Kilifi Counties.

H_{04} Cassava commercialization does not statistically and significantly influence income of smallholder farmers in both Siaya and Kilifi Counties.

1.5 Justification of the Study

Poverty levels in Kenya, especially in rural areas, has been on the rise as a result of the diminishing cultivable land which has been worsened by the increasing population both in rural and urban areas. This has led to high demand for food and raw materials since the farming system is under considerable pressure while crop yields and economic returns from farming are declining considerably. The drought situation in Kenya has in fact been so severe that a number of households have been hit by the crisis which has been predicted to intensify in the coming years due to climatic change. Cassava has been acknowledged as one of the most popular staple crops in Africa that can withstand harsh conditions (Nweke *et al*., 2003). The crop grows well in semi-arid areas as compared to other crops such as maize which requires sufficient rainfall and fertile soil. The dependence on cassava both for food security and poverty reduction especially in maize deficit areas has intensified. Furthermore, cassava has relatively lower production cost than maize which is currently receiving much attention despite its low yield yet it is Africa's most important model food crop (Blackie, 1990).

The second fold is in relation to the existing literature on the subject matter. In Kenya, a number of research works have concentrated on the agronomic practices of cassava with very little research on commercialization and its contribution towards the welfare of farm households in the two regions. These two factors play a key role in commercialization and therefore understanding them may be an important policy decision factor. Cassava is one of the crops that was acknowledged to contribute to the realization of millennium development goal of poverty eradication which was a solution to enhancing socio-economic development. However, this was not the case since commercialization of cassava was at its lowest and most farmers still struggled with maize production. Moreover, a number of studies have been widely done in countries especially in West Africa but not in East Africa. This study has therefore contributed to literature in commercialization of cassava especially in Kenya. It was also noted that there is unreliable documented information on cassava commercialization in Siaya and Kilifi Counties. Hence, the motivation and emphasis on the two counties was centred on the predominant large population that exists as well as the potential growth of cassava in the areas. In addition, there is a great potential of commercialization in the regions with the existent of processing plants which are underutilized. This study has provided an in-depth analysis of cassava sub-sector in the regions and captured sufficient information that can be useful in other researches within the regions. The research has provided recommendations on the essential cassava practices and policies that farmers, government

and other stakeholders should embrace in order to enhance cassava commercialization in different regions. The information provided will also guide non-governmental organizations, extension officers and other practitioners in stimulating favourable policies towards enhancing cassava commercialization.

1.6 Scope and Limitations of the Study

The respondents that formed the study population were farmers producing cassava, registered traders (retailers) and extension officers who were believed to possess additional information that could enhance understanding on cassava commercialization. The study period was confined to the last production period of 2015. Other agricultural crops that were compared with cassava include; maize, sorghum, sweet potatoes, beans, groundnuts, and other legumes. Commercialization was operationalized as value addition and market participation. Relevant factors related to household characteristics, marketing institutional as well as technical factors were empirically identified. This study was conducted in two counties, which were spatially separate. Because of the distance, data collection was a challenge. However, adequate enumerators were trained and dispatched to the two regions. There were several sub-counties in the regions. It was also of interest to note that some respondents were not willing to disclose vital information. This was addressed by reassuring respondents that the research was meant for academic purposes and that it would not be used for other purposes. Lastly, the study found that respondents were using different measuring units hence the study adopted one standard unit of measurement which was kilogram.

1.7 Operational Definition of Key Terms

Commercialization: According to this study, it is the use of various technologies on farms inorder to achieve marketable surpluses and enhace market participation of cassava products with an aim of making profit.

Household: This is a group of farmers who are related and share a particular place of residence, in this case, a homestead. They also eat together and manage their resources together.

Household Head: This is the key decision maker in a household with respect to cassava commercialization activities. When the female is the head of the house then we have female headed household, and when the head is male, then the house is male headed.

Value Addition: This refers to the transformation of cassava products or upgrading of raw cassava into other usable products which can be sold at a higher price than the raw cassava.

Smallholder: This is a small scale farmer who produces cassava on a land of between 0.1ha to 7 ha.

Market Participation: In this study it means accessing a market with an aim of selling cassava products. Market participation is measured by the proportion of the quantities of cassava sold

Per Capita Income: This is the average income earned per person in a household calculated by dividing the household's total income by its total population.

Price: This is the value or the amount of money in exchange for cassava added products.

Remittances: It refers to money sent to households by relatives who live within the country but in urban areas or those who live in foreign land.

Market Information: This refers to any relevant material concerning cassava that can be useful especially in enhancing market participation.

Market Orientation: It is the allocation of resources to cassava production meant for sale.

Market Access: This refers to conditions that have been set which defines the entry of specific goods into the market. It also refers to market infrastructure.

Marketing Chain: This is the flow of cassava products from the farmers to the final consumers.

Market Margin: It is the difference between the amount of money customers pay for cassava value added products and the costs incurred by the retailers.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The first section of this chapter presents the overall review of the study, beginning with the empirical review of relevant literature on cassava production mostly in Africa as well as the underlying forces and characteristics that determine cassava commercialization and its effect on household income. It is then followed by the theoretical framework that the study is built on and lastly a summary of the conceptual framework is presented.

2.2 Cassava Production and Commercialization by Smallholder Famers

In sub-Saharan Africa, agriculture is the main source of food and employment, with smallholder farmers being the major participants in the sector. In Kenya, for instance, the agricultural sector has been dominated over the years by smallholder farmers who are known for low productivity that is predominantly reserved for household consumption. The term smallholder farming has been extensively used by different researchers with different meanings. For example, Dixon *et al*. (2003), FAO (2004) and Wigging (2009) summarized the concept as production based on small volumes, application of few resources and predominated by family labor. These features were found to describe most Kenyan smallholder farmers who form 75 percent of the rural population (World Bank, 2015). This could be explained by the fact that three quarters of the population in Kenya live in rural areas and depend on agriculture for a living (World Bank, 2008). This also describes Siaya and Kilifi Counties which have a wide geographical area covered by the rural settings dominated by subsistence farming as the major economic activity.

The performance of smallholder farmers especially in cassava commercialization has been observed to be unsatisfactory with many opportunities still remaining untapped (Karuri *et al*., 2001). Smallholder farmers have been known to produce mainly food crops such as cereal, tubers and root crops largely associated with low level technology, inefficient use of resources and low level of commercialization (Ochieng' *et al*., 2015). However, it has been noted that smallholder farmers can produce extra output for commercial purposes by enhancing productivity as well as increasing access and participation in markets. Following this view, Pingali (2010) contend that the transformation of subsistence farming to commercial agriculture is very fundamental in enhancing economic growth in developing

countries. In this case, commercialization of cassava entails producing enough quantities for consumption as well as surplus that can be transformed into other useful products and participating in markets thereby resulting in welfare gain for the households.

The importance of cassava in Africa therefore cannot be overstated. In Nigeria, for instance, cassava production is a major employer of rural labour and has upgraded the financial well-being of rural communities through stabilized farm incomes and industrial mobilization (Oluwasola, 2009; Yakasai, 2010; Onya *et al*., 2016). These studies further noted that production of cassava in many cases was oriented towards commercialization with majority of the farmers actively participating in the markets and trading in both processed and unprocessed cassava. In Kenya, cassava production has performed below the expected production levels despite the increasing population growth and great demand for healthy food (Karuri *et al*., 2001). Considering the crops slow rate of growth, the sector has failed to keep pace with the demand of households and industries for cassava produce either for food or raw materials. Conversely, in the recent past, the government and other interested bodies have made remarkable progress by combining efforts in sensitizing farmers on agronomical aspects of cassava production, harvesting and post harvesting techniques, encouraging farmers to develop entrepreneurial competencies and promotion of cassava commercialization as noted by Mutuku *et al*. (2013). These interventions allude to the fact that cassava commercialization has the potential to spur growth and drive economic development of rural farm households.

2.3 Concept and Approaches of Agricultural Commercialization.

The concept and approaches of agricultural commercialization has been greatly applied in understanding the linkages between farm households and markets. However, understanding of the concept of commercialization differ in focus and breath as evidenced by Zhou *et al*. (2013). Jaleta *et al*. (2009) and Martey (2012). They acknowledged that there is no standard way of gauging the degree of household commercialization. Researchers have come up with several arguments and opinions about the concept of commercialization. Tipraqsa and Schreinemachers (2009) defined agricultural commercialization as the process by which farm households increasingly integrate with both agricultural input and output markets. Jaleta *et al*. (2009), on the other hand, remarked that commercialization is a combination of decision making behaviour ranging from both productions to marketing activities. Their study identified three different indices of cassava commercialization developed from output and input approach, rural economy and cash economy. Dutta *et al*. (2014) as well as Kotchikpa

and Wendkouni (2016) on the other hand, argued that agricultural commercialization occurs when farm households produce marketed supply of output.

The main approach that has been widely used to measure commercialization is household commercialization index. The index used lies in the range of 0 to 1. Based on this index, Dutta *et al*. (2014) identified three levels of commercialization. These are non-commercial, semi-commercial and commercial levels. An index closer to one signified high level of commercialization while non-commercialization was represented by zero. A different approach wich is also anchored on the index was used by Lawal (2014) to categorize commercialization into different levels. The study identified two levels of commercialization; the first one is the full level commercialization, whereby farmers produce primarily for markets. The other one is the moderate level, which involves production for both sale and consumption. Other studies that which were based on similar arguments include; Kabiti et al. (2016), who measured the extent of market orientation using household commercialization index. The study interpreted the index slightly different as; 0 represented (complete subsistence farming) and 1 (full commercialization). Mujeyi (2009) conceptualized commercialization of Jatropha tree species as derivation of financial benefits from selling trees or processing them into other usable products. Ochieng' et al. (2015) likewise used household commercialization index to measure the extent to which bananas and legumes are oriented towards market. This study concluded that an index with a value of zero signifies total subsistence orientation while a larger value indicates higher orientation towards market. The above studies concluded that commercialization entails both orientation towards market and market participation. They can be either buyers of farm inputs or sellers of farm output.

Market orientation is about creating a superior customer value for agricultural products by use of information and knowledge. This is because production decisions are influenced by both production conditions and market signals (Fleming, 2005). Market participation on the other hand is production for output markets and purchase of inputs. Based on these opinions, it is evident that the concept of value addition as a marketing oriented strategy has not been strongly discussed in many studies as a concept that can enhance commercialization. It is in this vein that this study has adopted a mixed approach which integrates value addition and market participation as a way of classifying the different levels of cassava commercialization.

2.4 Enabling and Constraining Factors of Cassava Commercialization

Cassava commercialization has been conceptualized to be an important strategy that positively impact on the livelihoods of farmers in the developing countries (Muriithi and Matz, 2015). Therefore, to attract investment into the business, it is vital that those constraints impeding performance of the sector are recognized with a view to unlocking them and creating a favourable investment climate in the sector. This can be made possible by understanding various factors that influence commercialization. Jaleta et al. (2009) observed that various institutional factors influence the level of household commercialization. These include social capital, which is a network of social connections that exist between people and their shared value, their norms and behaviour that enable and encourage mutually advantageous social cooperation (Falkowski, 2012). One of the ways of enhancing social capital is by being a member of a farm based organizations. Studies have found that farm based associations influence the level of commercialization since there is sharing of information. Pigatto (2012) confirms this in his study on social networks of cassava farmers in Brazil which showed that farmers rely on social support institutions to gather information regarding production techniques and other commercialization activities.

Lack of credit facilities has also been noted as one of the major constraints affecting agricultural productivity among farmers, specifically smallholder farmers. Availability of credit improves farmer skills and link them with modern technology through the purchase of various inputs, equipment and labour payments. This increases agricultural productivity, induces market orientation and participation which results to greater commercialization. Lerman (2004); Martey *et al.* (2012); Agwu and Ibeabuchi (2011) noted that increasing income of farm households increases the probability of undertaking agricultural commercialization. Apart from credit facilities, remittances are important pathways to improving household income. Some farm households receive remittances and transfers from relatives and friends who stay in urban centres or outside the country. According to Gonzalez (2011), remittances and transfers increase the degree of specialization, production of high value commercial crops and adoption of mechanized farming. Notably, disparities in household remittances across the counties can influence farmers' participation in value addition and market participation.

Though participation in market exchange is a core element in agricultural commercialization, it involves various market transactions which are not frictionless and without cost. These comprise physical marketing costs such as transport and storage costs as

well as transaction costs which are related to information search, monitoring, screening and processing information, negotiating contracts, monitoring agents, and enforcing contracts (Jabbar *et al.*, 2008; Gabre-Madhin, 2001). High transaction costs reduce market participation hence smallholder farmers sometimes resort to other informal means of marketing such as spot markets or farm gate transactions.

Distance to market is another determinant of cassava commercialization. This is the physical distance estimated in kilometres from the smallholder farmers' home to the nearest market centre. Generally, the greater the distance to the market, the less likely a farmer's orientation towards commercialization. This is because long distance reduce access to markets. Many studies have established that households farther away from market places have reduced market participation (Barrett 2007; Rios *et al*., 2008; Omiti *et al*., 2009). In addition, when production is market-related, there are certain risks involved which have direct impact on farm household decision-making behaviour (Mendola, 2007). These arise from market and policy failures which to a greater extent, are beyond the control of farm households.

Various statistical methods have been applied in understanding how the above factors influence commercialization. Agbola *et al*. (2010) used logit and multiple regression models to determine factors influencing farmers' access to output markets and their effect on household income. The finding of the study indicated that cost of transportation, distance to the nearest market, access to market information and social networks are important in determining farmers' access to output markets. Similarly, Ochieng'*et al*. (2015) analyzed factors that influence banana and legumes and their impact on household food security using propensity score matching model. The study revealed that gender, farm size, distance to the market, education of the household-head and ownership of transport equipment significantly influenced commercialization. Adenegan *et al*. (2012) investigated the influence of gender on agricultural commercialization in Nigeria. The study applied a multiple regression model to determine factors related to gender on commercialization. The study concluded that farm size, income, land tenure and level of education, in relation to gender of the household head, had an effect on commercialization and that gender impacts on the allocation of household resources among smallholder farmers. The study further revealed that gender of the household head is a key determinant of agricultural commercialization. Kotchikpa and Wendkouni (2016) similarly analyzed factors influencing smallholder crop commercialization. The study employed Heckman selection model because of the existence of sample selection problem which was evidenced in the study. In relation to gender, the

study revealed that female headed households had lower market participation and hence commercialized less compared to male headed households. Another study by Forsythe *et al*. (2016) on women's experience of cassava commercialization in Nigeria and Malawi revealed that gender plays a crucial role in cassava commercialization since the influencers of commercialization range from household to structure, bargaining power and gender customs. The results showed that in Nigeria, men specialize in fresh cassava roots while women engage more in processing and value addition of cassava. However, in Malawi agriculture is a family based activity and male make key commercialization decisions.

Other factors which are deemed important and are capable of influencing commercialization include market forces and extension services. Farmers have been facing increasing market competition both locally and internationally which has hindered their ability to engage in commercialization. According to a study by Meyer *et al*. (2002), smallholder farmers are currently being disengaged from agricultural marketing chain as a result of competition from various agricultural products which has intensively increased in the past few years. Extension services have been acknowledged to greatly promote commercialization. Farmers who receive extension services are able to access current information and utilize improved technology (Jaleta *et al*., 2009; Martey *et al*., 2012). In addition, extension services link up farmers with potential markets hence lowering transaction costs such as information search and transport costs. Therefore, understanding these challenges is vital in identifying those areas that need focus and improvement. One way of unlocking market challenges is through diversification of products in terms of value addition which is envisaged to increase product innovativeness and speed to market.

There are other important policies that influence agricultural commercialization. Gebremedhin and Jaleta (2010) noted that smallholder commercialization cannot be left to market forces alone. This is confirmed by Pingali (2010) who emphasized on the importance of appropriate government policies to facilitate the smooth transition of smallholder farmers from subsistence to commercialized agriculture. According to their arguments, governments should create an enabling policy environment for agricultural commercialization by controlling importation of food and supporting production of local food crops, investing in rural infrastructure and undertaking institutional reforms that could encourage the private sector to participate in the development of the rural economy. Moreover, the role of government is crucial in promoting underutilized crops by prioritizing the production of the crops. This can be achieved by providing high quality planting materials and offering

subsidies to farmers. In addition, specification of property rights and enforcement of contracts is vital in promoting specialization and reducing costs of market exchange (North, 2000).

2.5 Integration of Value Addition and Market Participation Approaches of Commercialization

Virtually all households in both rural and urban areas for one reason or another interact with the market. Improving farm households' access to market and hence market participation is a critical part of any strategy that increases income and reduces poverty. Value addition which involves creating economic value of products is a strategy which links smallholder farmers to markets hence enabling them to gain extensive market participation (Parveen *et al*., 2014). This further explains why entrepreneurial orientation is a function of value addition and market participation. The intention to look at a wider spectrum of cassava commercialization in areas well known for its performance is therefore important. Value addition, is a concept that can drive agricultural performance. It is sometimes referred to as upgrading which includes all those activities performed by farmers in order to deliver more valuable products and services through improved processes as well as identify potential markets. These conceptions can either be combined or performed independently. In this study, the emphasis is on product trajectory since cassava crop has got a number of alternative uses which need to be exploited.

Urbanization has created demand for food crops hence stimulating diversified value-added cassava products, such as bread, biscuits, noodles, cakes, baby foods and sweeteners (Falola *et al*., 2016). In order for these markets as well as other industrial markets to expand, cassava ought to be heavily promoted. This view concurs with that of Collinson (2001) whose study was based on urban market opportunities for high quality cassava products in Ghana. The researcher established that there is potential for production of high quality cassava products for urban markets where the crop is used as both food and industrial raw material. Sanni *et al.* (2005) similarly observed that opportunities exist for cassava utilization in different areas such as paper, textile starch and livestock industries in Africa. Farmers should therefore take advantage of the abundant market opportunities which have not been tapped since the area has remained dormant for many years. This would depend on cultural acceptance of cassava, availability of the products and price competitiveness of the various forms of products as well as other alternative products such as maize.

Punjabi (2007) observed that there has been fast growth in agriculture especially on the post harvest activities driven by growth of middle and low income consumers. However, the absence of active agribusiness oriented firms has contributed to the low levels of value addition of agricultural products. This has been one of the main causes of stagnation in rural incomes especially in exploiting market opportunities of value added cassava. He further echoed that agricultural growth enables a substantial agribusiness sector to generate high outflow of value added commodities which is majorly correlated with high incomes. The revelation is similar to that of Lawal *et al*. (2014) which disclosed that development of market opportunities for cassava, for instance, in the form of value addition is imperative in ensuring increased income. These revelations have been witnessed in Kenya mainly with regards to other crops (Nganga *et al*., 2010). However, there are limited studies which have explored cassava sector thus attracting less attention. Gebremedhin and Jaleta (2010) analyzed the determinants of market orientation and market participation in Ethiopia and found that these two aspects of commercialization are often used synonymously despite the fact that they both differ in context and even in their determinants. However, an orientation towards market has a strong relationship with market participation hence both concepts must be clearly addressed when considering commercialization so as to avoid confusion. Micheels (2008) echoed that market orientation is an important aspect of commercialization which creates competitiveness. The concepts must therefore be embedded in understanding commercialization. The arguments thus provoked further understanding on the relevance of value addition in cassava commercialization. Based on the above arguments, this study integrated the concept of value addition and market participation as opposed to the other studies.

2.6 Economic Performance of Farmers and Traders in Marketing Cassava Products

There are numerous ways of assessing performance of various actors along the marketing chain ranging from profits to margins. Marketing margin refers to the difference between the price paid by consumers and the price obtained from producers, factoring in the costs of middlemen services (Adeniji *et al.*, 2013). According to Wohlgenant (2001), margins arise due to the demand for marketing services and it is represented by the minimum cost of services offered by the actors over the normal profits gained. Therefore, marketing margin is important because it provides a measure of the actors well-being as well as their marketing performance. In addition, it is used to examine the performance of supply chain in order to point out opportunities which can enhance cassava commercialization. By analyzing levels of

marketing margins and their cost components, it is possible to evaluate the impact of the structure and conduct analysis of the various characteristics on market performance. It is generally acknowledged that a distribution system displaying acceptable performance is one that allows technological progress, utilizes resources efficiently and transmits prices that reflect costs common indicators of performance. These may include retail prices, level of stability of farm prices and income spread of marketing margins, marginal propensity to consume, farmers' share of the consumers shilling spent on agricultural product, middlemen profit and parity farm prices (Nduka and Udah, 2015). Marketing margins also result from the forces of supply and demand as well as the transactional costs incurred along the market levels (Mogaji *et al.,* 2013). In addition, it reflects an aggregate processing and retailing firm behaviour as well as the benefits that are derived by participants along the value chain.

Margin analysis for smallholder farmers has been a challenge for many researchers since in most cases, smallholder farmers rarely have proper records for the activities they undertake on the farm. Furthermore, it is difficult to delineate certain costs, especially the fixed costs, which in most cases are shared amongst many other productions. This makes it difficult to collect relevant information that can necessitate the computation of costs and margins as evidenced by Lokshin (2004). Toluwase and Abdu-raheem (2013) also encountered similar challenge in their study on costs and returns analysis of cassava production in Ekiti state, Nigeria. They found that farmers use indigenous ways of record keeping and various costs are shared across the units making it difficult to apportion costs. According to Wohlgenant (2001), there are a number of factors that influence the marketing margins of different market participants. The major factors include; prices, tradable quantity, the location of the market, marketing and transportation costs, the forms of products and the frequency of purchase. Analyzing these economic variables therefore enhance understanding on the dynamics of marketing margins among traders and farmers in the two different counties.

Research studies on market margins, market efficiencies and price spreads in Kenya are scarce, especially for cassava marketers. However, there exist a number of studies in other nations which have exhaustively addressed the performance of actors along various value chains. Ojogho and Alufohai (2009) investigated the effect of price and income changes on cassava marketed surplus. The study revealed that farmers are price and income responsive especially when the demand for the products increases and this increases the quantities being marketed. A different study on price variation and decomposition of yam markets in Nigeria used a time series model to decompose the prices of yam. The study found that seasonal fluctuation exists and that factors such as marketing infrastructure should be put in place to

reduce the fluctuation. However, Asogwa and Okwoche (2012) observed a significant difference between consumers and farm prices of sorghum which implied that sorghum marketing was a profitable venture in Nigeria. Abassian *et al.* (2012) in their study on economic analysis of marketing margin of Mazafati date used a combination of models including price increase model, relative price and marketing margin to estimate factors that affect the date marketing margin. The study revealed that farm gate prices and harvest margin of dates are some of the influential factors of marketing margin. The study however looked at the margins between farmers and customers without considering other intermediaries along the chain especially traders who are believed to be very instrumental in marketing process.

Enete (2009) conducted a study on middlemen and smallholder farmers in cassava marketing in Africa. The study revealed that farmers had high volumes of cassava products for sale compared to middlemen. However, there were few intermediaries along the marketing chain and the differences in the margins were small. The study further found that marketing margins for different cassava products differed because of the differences in marketing costs. Also, the margins were high but they declined with favourable market access conditions.

Yakasai (2010) applied farm budgeting and regression analysis to explore the economic contribution of cassava production in Abuja, Nigeria. The study found that cassava production is a profitable venture. However, it is labour intensive since most of the work is done manually. This was also supported by Nandi *et al*. (2011) in their study on economic analysis of cassava production in Nigeria. Similarly, they analyzed the costs and returns using a budget analysis. The study concluded that cassava production can increase farmers' margin and profitability. Both studies recommended that farmers should utilize their resources efficiently if they were to maximize on revenues. Conversely, Ibekwe *et al*. (2012) analyzed the socio-economic characteristics that influence the marketing margin of garri processing actors in Nigeria where both budgetary and profit function methods were used. The study established that age, education, marital status, household size and experience positively influenced the profitability of cassava.

Oluwasola (2009) analyzed the economics of cassava processing by rural farm households to establish the socio-economic and policy strategies required to stimulate rural enterprise in Oyo State. He recommended that policy efforts should be geared towards accessibility of locally fabricated machines, research and extension. Food processing at the rural farm-gate should be tailored to meet the needs and constraints of women. According to Kambewa (2010), the role of women in cassava value chain is very important and cannot be

assumed. However, concerning policy interventions, the researcher focused on a single actor along the value chain yet he had identified more than one. On the contrary, Adepoju and Oyewole (2013) found that consumers' willingness to pay a premium varied with the degrees of cassava flour inclusion in bread. Okwuokenye and Onemolease (2011) investigated the socio-economic characteristics that influence marketing margins of yam traders in Nigeria. The study employed regression analysis and identified marital status, years of experience and marketing costs specifically loading and off-loading costs as some of the influencers of marketing margin. The conflicting arguments and results therefore triggered further research to establish the factors that influence marketing margins among farmers and retailers.

2.7 Linkage between Cassava Commercialization and Household Income

With agriculture being the mainstay of many economies in Africa, it is conceivable to expect food security and poverty reduction to be accomplished through innovations in the agricultural sector much more faster than through innovations in other sectors of the economy. According to Diao *et al*. (2010), commercial transformation of subsistence agriculture is an essential path towards economic growth and development for many developing nations Many studies have confirmed that crop commercialization positively influences the livelihoods of smallholder farmers by improving their household income and asset holdings (Hailua *et al*., 2015; Zhou *et al*., 2013). Increasing per capita food production and raising rural household incomes are debatably the greatest challenges facing sub-Saharan African countries and the developing world generally. If low income households generate surplus production, add value and participate in markets, it is expected that their well-being would improve. This is sensibly supported by history of economic development in other regions of the world which indicates that agricultural productivity growth has been the major source of sustained improvements in rural welfare. For instance in Nigeria, cassava generates the largest income for household farmers (Dipeolo *et al*., 2001). The argument that productivity growth and improved household income in smallholder agriculture requires a more commercialized alignment implies that policies must be aimed at transforming the semi-subsistence, low-productivity agriculture that exemplifies much of rural Kenya. A research done in Indonesia by Kawagoe (1994) found that there is high contribution of marketing and processing of agricultural products to rural household income. The study further noted that processing and marketing of commercial products contributes up to 70 percent of total household labour income and employment. However, this is expected to

increase when smallholder farmers come up with various forms of products and participate in markets.

Saediman *et al*. (2015) conducted a study on profitability and marketing of value added cassava products. The study revealed that *kaopi,* which is a by-product of cassava, is profitable and is capable of improving household income. The study was conducted in Indonesia and employed cost and returns analysis, revenue cost ratio, break-even point and production structure. However, the study failed to establish the effect of the realized earnings on household income. On the other hand Chibuzor *et al*. (2014) examined the influence of commercialization on food security status of cassava producing households in Abia State, Nigeria with specific focus on the levels of commercialization among cassava producing households and the food security status of the households operating at different levels of commercialization. Their study revealed that most commercialized cassava producing households sell 90 percent of the gross value of their total cassava production. Overall, the proportion of households that were food insecure was more than those that are food secure as indicated by the food security index. However, the study failed to establish the net value of the sales and their exact contribution to household welfare. According to Chukwuji *et al*. (2007), cassava income contributes greatly to cash income of households in Nigeria compared to other agricultural products. In support of their study, Mapfumo and Mushunje (2012) found that cassava directly increases farmers' incomes and in turn reduces rural poverty.

In Kenya, studies have been conducted touching on the aspects of crops value addition. Mutuku *et al*. (2013) analyzed the proportion of rural smallholder households that had incorporated entrepreneurial activities into cassava production as a means to achieving food security. The study was conducted in Ngata Division of Nakuru District within the Rift Valley province of Kenya. It concluded that few households had adopted cassava growing as an entrepreneurial venture with only 1.9 percent growing cassava for business purposes. Households growing cassava for business purposes utilized a bigger portion of land compared to those who grew it solely for food purposes. This was consistent with a discussion paper presented at the International Food Policy Research Institute - IFPRI (2007) conference, where the experts argued that increased smallholder access to land is significant in improving small holder production and commercialization of crops. In general, the study established that smallholder farmers are in one way or another exposed to value adding technologies. However, majority of them do not utilize these techniques. Karuri *et al*. (2001) investigated the importance of cassava products in industrial markets and how the products could be used

as substitutes for various industrial raw materials. For instance, cassava starch can be used in the food industrial sub-sector and the flour can be used in plywood manufacturing. The study concluded that farm households should not only focus on the food sector but they can as well generate more income from cassava if the industrial uses are explored.

Waswa *et al*. (2009) conducted a research on enhancing household food and income security through crop diversification in the Nzoia and Mumias sugar-belts in Kenya. The study concluded that sugarcane and maize has minimal contribution to increased household income unlike crops such as cassava, sweet potatoes and indigenous vegetables which have high potential to generate income. They recommended that farmers should highly invest in underutilized crops and institutionalize value addition practices. The study therefore adds to this literature by comparing cassava with other crops such as sorghum, maize, sweet potatoes, beans, cowpeas and groundnuts. KENFAP (2013) study on re-introduction and commercialization of cassava as a strategy of improving the livelihoods of farmers in Ganze, Kilifi County confirmed that markets for value added cassava products exist even though they have not been fully exploited. For example, cassava composite flours can be made by combining maize, wheat and cowpeas flour with cassava flour. This is a highly demanded product especially in hospitals and schools because of the nutritional content and its preference for both children and old people. From literature, it emerges clearly that earning behaviour is analyzed by households representing different characteristics including the type of crop grown.

Literature reviewed on the relationship between cassava commercialization and household income revealed that not much has been done on cassava commercialization generally in East Africa, specifically Kenya. In addition, there are variations in terms of the concept of cassava commercialization in various regions. Literature on whether value added cassava yields more household income through market participation is mixed. Evidences have shown that in some cases, there is little contribution of commercialization on income while others have indicated that there is significant contribution of cassava commercialization on household welfare. The mixed outcomes therefore triggered the need to undertake a comprehensive study to ascertain the overall proposition that cassava commercialization improves household income.

2.8 Theoretical Framework

There exist a number of theories that explain the behaviour of farmers with regard to cassava commercialization and its occurrence. The main theories that have been adopted by the study are based on the farm household model which assimilates both the production as well as the consumption behaviour of the households. Utility maximization as well as profit maximization theories are both anchored on the agricultural household model.

2.8.1 Theory of the Farm Household

The theory of the farm household has been widely used in agriculture to understand the integration of household behaviour and the prediction of the responses to various changes in production and consumption. The theory is within the agricultural household model. It treats households as farm business and predicts that all households act as an economic entity whose main aim of production is to allocate resources with a view of maximizing profit (Taylor and Adelman, 2003). This theory further states that decision in both farm households' utility and profit maximization depend on each other thus they are inseparable. In relation to commercialization of crops, Khondoker *et al*. (2014) applied the concept in understanding how marketable surplus can be enhanced through increased production. Similarly, the model was found suitable to this study because enhancing the amount of cassava products marketed, improves the cash flow thereby improving the livelihood of farm households. A study by Mendola (2007) on farm household decision making, theory and evidence from a rural economy found that farm households are responsive to factors such as income, prices and technological changes that affect both production and consumption. This theory therefore facilitates the study of decision making along agricultural value chains, since value addition and market participation strategies are influenced by increased production as well as consumption decisions. Furthermore modeling market participation and value addition must consider behavioural priorities which enable production and consumption decisions by small holder farmers to be linked. The assumption made is that household resources are pooled; preferences and incomes are shared by all household members (Umar, 2013). Even though some studies question this assumption in household decision making, the number of the members matters since household utility is derived from the household membership, efficient allocations within the household as well as production. Household decision-making of production and consumption is seen as non-separable in subsistence farming because the decisions regarding commercialization are affected by various factors such as household

characteristics, technical factors, institutional and market dynamics coupled with external influences from the government and market forces. Therefore, the objective of most farm households that engage in commercialization is to maximize utility while it is separable in market-oriented farming which in this case is profit maximization (Mottaleb *et al*., 2014).

The agricultural household model further illustrates that households can solve their problems by maximizing farm profits and choosing a consumption-leisure allocation to maximize utility. This is possible if all cassava markets are well functioning and all products of cassava are tradable, prices are exogenous and marketing decisions are taken independently of consumption decisions. In addition, the utility of farm and labour is directly linked to the market determined wage rate, and income is singled out as the only link between production, marketing and consumption. In this case, households can either be net buyers when $c_c > q_c$ or autarky when $c_c = q_c$ or net sellers of agricultural goods when $c_c < q_c$, where, c_c and q_c denotes consumption and quantity produced respectively. In addition, when labour demanded is less than labour supplied, households sell labour. Mathematically, it can be presented as $l_d < l_s$ and $l_d > l_s$ respectively. Household income can be generated from its marketable surplus $P_c(Q-C)$ and from its surplus income boosted by commercialization. A household can also increase its ability to pay out hired labour, $w(H-L)$, where H= labour supplied while L = labour demanded and material used is represented by $P_v V$ as well as paying for purchased marketed consumed goods, $P_c\,(Q-C)$. Therefore, these can be summarized in the equations that follow.

$$P_m M + P_c C + wl = (Pcf(L,V,A,K) - P_v V - wL)\,wT \quad (1)$$

$$(Pcf(L,V,A,K) - P_v V - wL) = \Pi \quad (2)$$

When all the relevant markets function perfectly, household decisions can then be made separately from marketing including value addition and consumption decisions. The household then maximizes net farm earnings subject to technology, existing policies and expenditure constraints as well as allocating the earnings, together with other income, among consumption goods. When labour markets and markets for other inputs are imperfect, output (profit) can be influenced by factors such as household specific characteristics represented by vector $\Omega\, hh$, farm specific characteristics represented by vector $\Omega\, f$ and market characteristics such as commercialization of cassava represented by vector $\Omega\, mck$. This explanation is stated in the below equation.

$$Ø = f(\Omega hh, \Omega f, \Omega m Ck,) \quad (3)$$

The above equation implies that factors which influence output affect both the value which is reflected as profit or income and hence household welfare. This model has widely been used in many studies; for instance, Huffman (2001) used it to examine off farm-labour supply, production and consumption decisions made by US farmers. Mendola (2007) reviewed the institutional and behavioral responses of farm households in the developing countries using farm household model. Mottaleb *et al*. (2014) on the other hand modeled market linkages of farm households in Bangladesh based on the theory of farm household.

2.8.2 Profit Maximization Theory

Farm households engage in agricultural activities because of various reasons. The profit objective in most cases is always the lynchpin of them all. Agricultural commercialization can be attained when households' product choice and decisions are made based on the principle of profit maximization. This entails the extent of participation in the output markets with a focus on monetary gains hence extending beyond marketing of the products. This theory has a two-fold approach, namely, motivation of the farm household and the economic performance of the farm as a business enterprise. Huffman (2010) theorized that when market failures exist, households optimize their decisions based on a two-step separable process, which involves maximizing profit as a producer and then utilizing the generated profits to maximize consumer utility. However, the theory has evolved with some criticisms such as the existence of trade-offs between profit maximization and other household goals and the role of uncertainty and risk in farm household production decisions. Because of uncertainty, some farmers shy away from investing in various activities such as production of underutilized crops, adopting value addition technologies and diversification of cassava products. A farmer therefore chooses to maximize profits by choosing various actions $(a_1,.....a_n)$ such as value addition and market participation.

The theory of profit maximization can be expressed as follows:

$$\text{Max} \quad R(a_i.....a_{n[} - C(a_i.....a_n) \tag{4}$$

Where R represents revenue earned from various actions such as value addition and market participation. C denotes the transactional costs incurred from various actions, and $a_1.....a_n$ represents the various actions such as value addition and market participation that smallholder farm households may choose to undertake which can enhance their welfare. It is also noted that other marketers such as traders' decisions revolve around the theory since their engagement in marketing activities is premised on profit maximization.

2.8.3 Utility Maximization Theory

The study extended its focus to household decisions on utility being that trade-offs exist between profit maximization and other goals. The decision on whether or not to participate in commercialization is considered under the framework of utility maximization (Pryanishnikov and Katarina, 2003). Within this framework, farm households' commercialization decisions are measured by the net benefit derived from the choices they make rather than the tangible benefits. Sometimes farmers do not only aim at maximizing profits, but they have other considerations such as minimizing risks when undertaking farming activities. They may decide to carry out value addition activities and participate in markets or do not add any value at all but still participate in markets especially when trying to avoid some risks. Umar (2013) in his study applied utility maximization and profit maximization theories. He argued that farm households do not only aim at making profit but sometimes take great cognizance of the utility maximized based on their decisions. Therefore, the benefits derived from the two choices (value addition and market participation) are presumed to influence their decision. Suppose that U_j and U_k represent a household's utility for two choices, which are correspondingly denoted by Y_j and Y_k, the random utility model could then be specified as below:

$$u_{ij}\left(B_j X_i + e_j\right) > u_{ik}\left(B_j X_i + e_j\right),\ k \neq \forall_i \tag{5}$$

From the equation above, the perceived utilities of cassava commercialization and non-commercialization choices are j and k respectively, while x_1 is the vector of explanatory variables that influence the perceived desirability of each choice. In case smallholder farmers decide to commercialize which is option j, then it follows that the outcome will be greater than the utility from other options k. The probability that a household will choose to commercialize; that is to choose option j instead of k could then be defined as follows:

$$P\left(Y = 1/X\right) = P\left(u_{ij} > u_{ik}\right)\ k \neq \forall_i \tag{6}$$

$$P\left(B_j X_i + e_j - B_k X_i - e_k > 0/X\right) \tag{7}$$

$$P\left(B_j X_i - B_k X_i + e_j - e_k > 0/X\right) \tag{8}$$

P is the probability function of $U_{ij} U_{ik}$ and X_i as shown above and the vector of $U_{ij}, \forall_i$ is assumed to be continuously distributed with the prevailing covariance matrix.

2.9 Conceptual Framework

The variance of the independent variable (household income) is explained by a number of factors which are both exogenous and endogenous variables. Three sets of independent variables, namely; household characteristics, institutional and market factors and technical factors were therefore empirically identified. These factors interact to influence commercialization which consequently has a bearing on household income. In this case, household size explains family labour supply for production and household consumption as well as expenditure levels. Larger households are likely to provide labour that might be required to transport cassava from production to the market; this is expected to lower transaction costs. On the contrary, large families may reduce the probability of commercialization since they demand for more of food and non-food needs. This is expected to reduce the available surplus for market interaction. Moreover, household income is expected to have a positive relationship with the probability of participation and the intensity of participation. Farm households with more income are likely to engage in value addition techniques and market participation. Small scale farmers at times devise ways of coping with financial problems. They may consider engaging in other off-farm activities or receiving remittances from relatives to supplement their household income. Off-farm income and remittances are perceived to play a prominent role in enhancing agricultural growth as well as facilitating commercialization since they reduce financial constraints and enable farmers to purchase the necessary resources.

Commercialization decisions are also influenced by technical factors such as techniques and forms of value addition and production methods which include the use of improved cassava cuttings. This best explains why some smallholder farmers may not engage in extensive value addition activities as well as participate in established organized formal markets. Also, marketing factors such as market costs, market information, and distance to the market have a direct influence on cassava commercialization. Improved access to market information increases formal market participation. Similarly institutional factors like improved credit access, group membership and extension services are hypothesized to enhance commercialization. Contact with extension officers enhances farmers' knowledge on improved production methods and technology, which could lead to increased production hence increasing marketable surplus for commercialization. In addition, social networks are expected to reduce transaction costs such as information search , bargaining costs amongst others. Membership of a farmer to a farm based organization or group increases access to

information which is important to marketing decisions (Olwande and Mathenge, 2012). Conversely, the amount of credit devoted to commercialization may translate to increased cassava productivity and income. Access to reliable means of transport as well as distance to the market equally influences cassava commercialization while unreliable means of transportation and long distances increase transport cost which in turn increases transaction costs. This can further discourage farm households from market participation. The interplay between the theorized factors is illustrated in Figure 1.

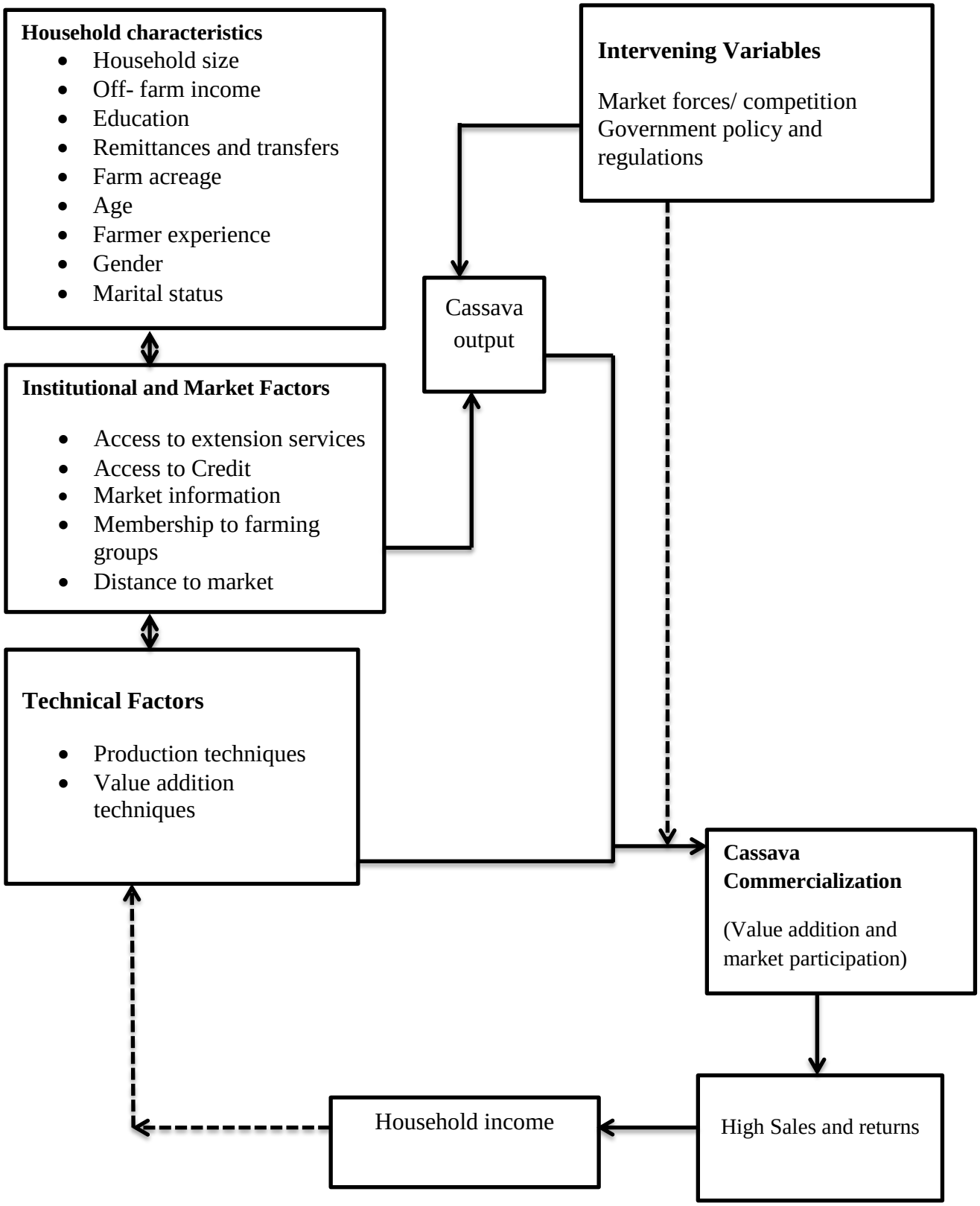

Figure 1: Determinants of Cassava Commercialization and its Effect on Household Income.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the study design and areas, techniques that were used in data collection and analysis. First, a brief description of the study areas is presented followed by detailed sampling procedure and sample size determination for farmers, traders and extension officers. Thereafter, analytical tools are presented including model specifications which addressed the specific objectives.

3.2 Research Design

Research design helps in gathering data and analyzing it to arrive at a solution. This study used a cross-sectional survey design to study the variables at a aparticular period. Surveys may be used for descriptive, explanatory and exploratory research. Therefore survey research design was the most suitable design to meet the objectives of the study which were exploratory in nature.

3.3 Study Areas

The study was conducted in Siaya and Kilifi Counties. Siaya County has six sub-counties namely Alego-Usonga, Ugunja, Gem, Bondo, Ugenya and Rarieda. The County has a population of 842,304 and total land areas of approximately 2530.4 square km. Out of the total population, 754,789 are from the rural area. The annual rainfall in the region ranges between 1170-1450 mm with the main rainy season being from March to June and short rains between August and December. Kilifi County on the other hand is in the coastal region of Kenya and lies between 2º 20' and 40' South, and 39º 5' and 40º 14' East, covering an area of 15,500 square kilometres. It borders Tana River County to the North, Taita Taveta County to the West, Kwale to the South West, Mombasa County to the South and the Indian Ocean to the East. The County has a population of 1,134,856 according to Kenya National Population Census, (2009). This comprises 821,645 rural and 313,211 urban dwellers. Administratively, Kilifi County has seven sub-counties namely; Kilifi North, Kilifi South, Magarini, Ganze, Rabai, Kaloleni and Malindi. The mean annual temperature is 27^0C and annual rainfall ranges between 300-1300mm per annum. Poverty levels in the regions are also high with 68 percent (Kilifi) and 47.5 percent (Siaya) of the population living below the poverty line. The study

areas were chosen mainly because agriculture is the dominant occupation of the people in these regions. Furthermore, these regions are part of the arid and semi-arid areas with high potential for cassava production. In addition, poverty levels in these regions are on the rise and intervention measures need to be implemented in order to address the problem. The two counties were considered for the study in order to identify unique aspects and factors of cassava commercialization in each of these counties that can be used as benchmarks in the regions as well as other regions in Kenya.

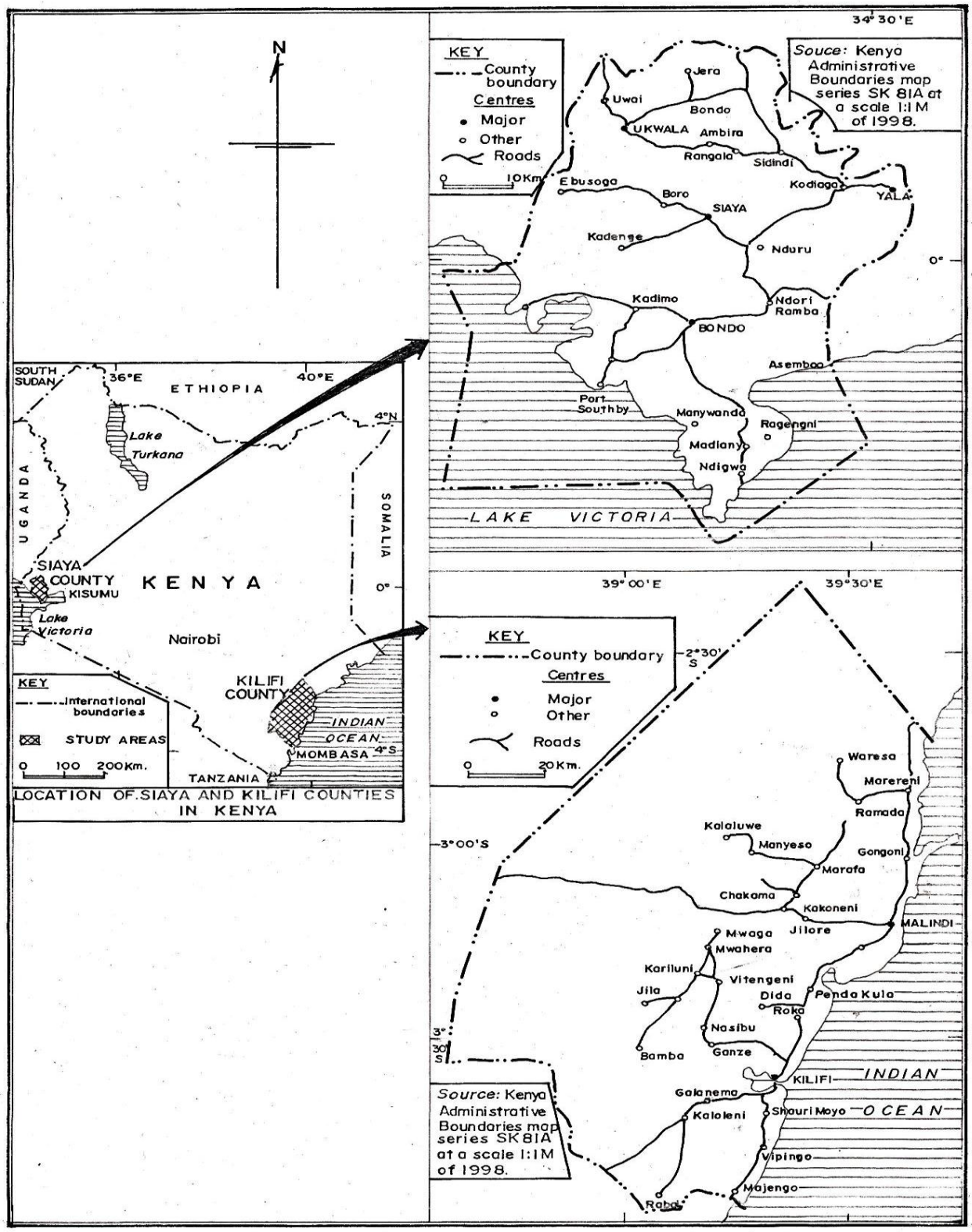

Figure 2: Map of Siaya and Kilifi Counties

3.4 Respondents

In this study, both qualitative and quantitative data were collected from primary sources which included farmers, traders and extension officers. Farmers and traders, who were involved in cassava production and trading for more than a year and six months respectively, were interviewed. Extension officers were also interviewed for additional information in relation to cassava commercialization. Their views broadened the qualitative data that was collected.

3.5 Sampling Procedure and Sample Size

3.5.1 Sampling of Farmers

A four stage sampling technique was employed to sample farmers from Kilifi and Siaya Counties. In the first stage, Alego-Usonga and Ugenya constituencies were purposively selected from Siaya County. As of Kilifi County, Magarini and Ganze constituencies were likewise purposely selected. The second stage involved random sampling of two locations from each sub-county and the third stage involved selecting a random sample of six and five villages from Siaya and Kilifi Counties respectively. Finally, a systematic sample of eight (Siaya) and ten (Kilifi) households which grow cassava were selected. A systematic random sample was used because of lack of a sampling frame of farmers who grow cassava in each village. Alego-Usonga and Ugenya constituencies were chosen because of the extensive production of cassava as well as the existence of cassava processing factories which were instituted by various development organizations. Magarini and Ganze constituencies on the other hand have very high poverty indices and are ranked as among the poorest constituencies in Kenya. In addition, the regions are characterized by high population growth rate of about 3.5 percent against the national index of about 2.46 percent (Gujarati, 2005).

3.5.2 Sampling of Traders

Kilifi and Siaya Counties have different categories of registered traders who are involved in retail and wholesale of cassava (KNBS office, Kilifi County, 2012). The population of traders consisted of a mixture of both raders who were trading in both livestock and other agricultural products. Cluster sampling technique was used, where each market centre formed a cluster. For Siaya County, clusters were chosen in Ugenya and Alego-Usonga sub-counties. For Ugenya sub-county, the clusters were randomly selected. These included;

Luhano, Sega, Aboke, and Uhuru markets. Boro, Uranga, Karemo and Siaya town markets were chosen from Alego-Usonga Sub-County. Six respondents from each market were randomly selected totaling to 48 respondents. In Kilifi County, five markets were selected from each Sub-County. These included Kibarani, Kaloneni, Ramada, Baricho and Wakalla markets from Magarini; and Ganze, Shangweni, Bamba, Kikambala and Ngorneni from Ganze Sub-County. From each market, five traders were sampled. The sampled traders from the two regions were 98. The markets were identified based on the level of cassava trade.

3.5.3 Sampling of Extension Officers

A census of all the extension officers in the sub-counties was done. There existed 30 wards in Siaya County, out of which 6 extension officers were stationed at Alego-Usonga sub-County while Ugenya sub-County had 4 officers. Therefore a total of 10 extension officers from Siaya County were interviewed. Kilifi County on the other hand had 35 wards of which 4 extension officers were from Ganze and 6 extension officers from Magarini. Similarly a total of 10 officers represented the County. Views of the extension officers aided further understanding, validating and strengthening of the data collected from farmers.

3.5.4 Sample Size

The sample sizes for farmers and traders were determined by use of the formula given by Groebner and Shannon (2005), indicated as follows:

$$n = \frac{Z^2 PQ}{d^2} \tag{9}$$

Where; n= required sample size

Z value at 95% confidence level (standard value of 1.96)

P represents the proportion of smallholder cassava farmers in the population which is 0.50. This is an assumption that 50% of farm households are engaged in cassava commercialization.

Q is the weighting variable given by 1- P (proportion of non-cassava smallholder farmers)

d^2= margin of error at 5% (standard value of 0.05). The calculated sample size is thus

$$n = \frac{Z^2 PQ}{d^2} = \frac{1.96^2 \times 0.50 \times 0.50}{0.05^2} = 384$$

Siaya County has a rural population of 754,789 while Kilifi County has 821,645.Therefore the sample sizes were computed based on the proportion of the population which is indicated below:

$$\text{Sample size for Siaya } \frac{384\times 754{,}789}{1{,}576{,}434} = 184$$

$$\text{Sample size for Kilifi } \frac{384\times 821{,}645}{1{,}576{,}434} = 200$$

A total of 384 farmers were therefore selected from the counties with 184 and 200 farmers sampled from Siaya and Kilifi respectively. However, a total of 381 were interviewed, 200 from Kilifi and 181 from Siaya. The target respondents were the heads of the households aged 18 years and above. The study emphasized on farm households who grew cassava either in sole or intercropped plots. A cluster and random sampling was applied in sampling traders and based on the formula indicated in equation (3.1) the following sample sizes for traders were computed.

$$\text{Sample size for Traders} = \frac{1.96^2 \times 0.50\times 0.50}{0.1^2} = 96$$

$$\text{Sample size for Siaya traders} = \frac{96\times 754{,}789}{1{,}576{,}434} = 46$$

$$\text{Sample size for Kilifi traders} = \frac{96\times 821{,}645}{1{,}576{,}434} = 50$$

3.6 Data Collection

Data was collected from three categories of respondents which included; farmers, traders as well as extension officers. A well-structured questionnaire was developed for each category and used to obtain data from the respondents. The data collection instruments were pretested in a few selected cassava growing locations that were not sampled in the main study. Pretesting was necessary since it aided in clarifying and improving the questions in the instrument. The questionnaires were filled through personal interviews which were conducted by well-trained enumerators. Data was collected between May and June, 2015. The questionnaire for farmers was divided into two sections; the first section contained demographic information. The second section had a collection of questions on; farmers household characteristics, land ownership and use, asset ownership, labour distribution, production and value addition aspects of cassava, institutional and marketing factors as well

as household income. Similarly, the questionnaire for traders had two sections. The first part addressed their socio-economic characteristics while the second section dwelt on cassava marketing aspects. Lastly, the questionnaire for extension officers comprised general information about the study areas.

3.7 Study Analysis

This section presents the empirical models that were used in the analysis of each objective. Both descriptive and inferential analysis were performed. First, the study presents a computation of commercialization index which was later fitted in the multinomial logistic regression model where the various logit functions have been specified. To address the second objective concerning income comparisons, ANOVA test was specified. The third objective on margin analysis was computed and then linear and double log regression models for both famers and traders were fitted. Finally, commercialization decision was modeled using an endogenous switching regression model which is a two stage model. A simultaneous equation model of cassava commercialization and incomes have been estimated by full maximum likelihood estimation.

3.7.1 Modelling Levels of Cassava Commercialization and their Determinants

The first objective on determining the levels of commercialization in Siaya and Kilifi was analyzed by use of both descriptive and inferential statistics. To assess the levels of cassava commercialization, the study developed an enhanced commercialization index which encompassed value addition and market participation. The commercialization index was necessary for grouping of the dependent variable (cassava commercialization) into four categories. The levels were then fitted into a multinomial regression model to further identify factors that influence the various levels.

3.7.1.1 Commercialization Index Measure

Market participation aspect of commercialization has been measured using von Braun *et al*. (1994) Household Commercialization Index (HCI). This index has been applied in most studies (Martey, 2012; Muricho, 2015; Kabiti *et al*., 2016). The index measures the degree to which cassava production is market oriented. The index was estimated as follows:

$$HCI_i = \frac{Gross \quad value\, of\, cassava\, sales \quad for\, i^{th} \; household}{Gross\, value\, of\, all \; cassava\, production\, for\, i^{th} \; household} \qquad (10)$$

Where HCI_i is the ith household commercialization index for cassava, the numerator is the total amount of cassava sold by the ith household in the 2015 farming season and the denominator is the total value of output of cassava by the ith household in the same season. A value of zero signifies total subsistence, while a HCI value approaching 1 indicates a larger degree of cassava market participation. The HCI was combined with VAI (value addition index) to obtain a single index for commercialization. The composite index on value addition which is an inclusive approach was mathematically computed guided by studies of Group and Mogee(2004) as well as Sharpe and Andrews (2012). Since there were various forms of value added products, constructing a single index was necessary. Therefore, in order to combine the different dimensions, composite indices can be considered (Salzman, 2003). Hence, the weighted index was based on an argument that value addition is a strategy that can be embraced by farmers in order to move away from being price takers to price setters. Hence, changes in the prices of value added products further increases opportunities for market participation (Osmani and Hossain, 2015). The value addition index was mathematically computed as shown below.

$$\text{Composite Weighted Value Addition Index} = \frac{\sum p_i q_i}{\sum p_h q_i} \qquad (11)$$

Where; p_i = price of value added cassava in kg, q_i= quantity sold and p_h= highest price of the value added cassava in kg in a value addition category.

Commercialization index was thereafter computed as an average of the two indices (equation 3.2 and 3.3). The study assumed that value addition and market participation were equally important and therefore the indices have equal weightings. The commercialization index value ranged from 0 to 1 which was used to categorize the levels of commercialization into none, low, medium and high levels. ANOVA was used to compare commercialization levels in the two counties. In addition, a multinomial logistic model was used to analyze factors that influence farm households' decision to participate at the different levels of commercialization.

3.7.1.2 Multinomial Logistic Regression Model

The multinomial logit model allows for the estimation of the effect of independent variables on the response variables as well as the overall significance of the variables across all logit

models. The model is an extension of binary logistic model and it is one of the most important methods for analyzing categorical data. According to Reddington *et al*. (2000) the model uses logit link and allows for more than two categories of the dependent outcome variable. Similar to binary logistic regression model.It uses maximum likelihood estimation to evaluate the probability of the response variable. The impact of the predictor variable is usually explained in terms of the odds ratio. In assessing the variations in the levels of cassava commercialization, the study assumed that smallholder farmers' decisions are grounded on utility maximization (as explained in chapter 2). The model is convenient to use because it does not assume homoscedasticity, normality, and linearity. Furthermore, it is easily interpretable (Madhu *et al*., 2014). This model was also regarded appropriate because it supports the theoretical framework and suitably addresses the outcome variable which has more than two response. Using this model, one category of the unordered categories of the

$$Log\left(\frac{P_{ij}}{P_{il}}\right) = \chi_i \beta_j \tag{12}$$

dependent variables, in this case the none-commercialization, was nominated as a reference or base category. Calculation for the other logits was done with reference to the base category. The probability for each category was estimated using the following equations:

where j=1,…, n and i= 1,…, n and P_j which is the probability of outcome category. Therefore if the error terms are identical and independently distributed then the probability that a household will choose an alternative j can be modeled as shown below:

$$P_{ij} = \frac{\exp\left(\chi_i \beta_j\right)}{\sum_{j=1}^{J} \exp\left(\chi_i \beta_j\right)} \tag{13}$$

The above equation can be further expanded using the maximum likelihood method as follows:

$$Logit\left[P(Y=1)\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k \tag{14}$$

$$P_{ij} = \frac{\exp\left(\alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k\right)}{1 + \exp\left(\alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k\right)} \tag{15}$$

$$In\left[\frac{\Pr(Low\ \ Commer)}{\Pr(None\ \ Commer)}\right]=\beta_0+\beta_1(Gender)+\beta_2(Ext\_Serv)+\beta_3(DistanceM)+\beta_4(Schoolyrs)$$
$$+\beta_5(Total\_hhsize)+\beta_6(Yrs\_cassava)+\beta_7(MarketCost)+\beta_8(Acre \quad (16)$$

$$In\left[\frac{\Pr(Medium\ \ Commer)}{\Pr(None\ \ Commer)}\right]=\beta_0+\beta_1(Gender)+\beta_2(Ext\_Serv)+\beta_3(DistanceM)+\beta_4(Schoolyrs)$$
$$+\beta_5(Total\_hhsize)+\beta_6(Yrs\_cassava)+\beta_7(MarketCost)+\beta_8(Acre) \quad (17)$$

$$In\left[\frac{\Pr(High\ \ Commer)}{\Pr(None\ \ Commer)}\right]=\beta_0+\beta_1(Gender)+\beta_2(Ext\_Serv)+\beta_3(DistanceM)+\beta_4(Schoolyrs)$$
$$+\beta_5(Total\_hhsize)+\beta_6(Yrs\_cassava)+\beta_7(MarketCost)+\beta_8(Acre) \quad (18)$$

The coefficient β_i, refers to the effect of x_i on the log odds when other explanatory variables are held constant. Y is the observed dependent variable which farm households belong to. It was was categorized into four responses. The categories were; 0= none- level 1 =low level commercialization, 2= medium level and 3 = high level commercialization. These categories which are mutually exclusive. In categorizing the four levels, value addition and market participation of cassava were the main factors under consideration. Based on the previous studies, the index which is a continuous variable was collapsed into a categorical variable since multinomial regression model deals with categorical variables. There were eight observed independent variables.The explanatory variables had been theoretically identified and they are related to market, technological, institutional and household factors. In construction of the logits, the none-level category was considered as the reference variable and all the other three logits were constructed relative to the category as indicated in equation 15.

For the model to be adequate, there are several tests that must be conducted: These include testing that all the coefficients of the independent variables are equal to zero; the explanatory variables are between two outcomes and the assumption of independence of irrelevant alternatives (IIA) should hold. The assumption requires that the probability of being in one category must be independent from the probability of being in another category. In this case, the probability of being in low level category of value addition must be independent of the probability of being in high level, medium or none level category. However, McFadden (1974) and Long and Freese (2014) illustrated why the assumption is

unrealistic and in most cases may not work. From the tests that were conducted, it became evident that the various tests that detect the violation of IIA assumption gave contradicting outcomes hence limiting their use. They further argued that the model operates well if the various choices are divergent and not alternates for each other. This deduction was also reinforced by Cheng and Long (2007) who concluded that multinomial logit should be applied in cases where the outcome categories can be noticeably distinguished in the eyes of each decision maker.

Grounded on the above information, the model was carefully specified and the responses clearly identified and distinguished from each other. To explain the various choices, eight independent variables were used. These included gender and extension services which are dummy variables while distance to the market, years in school, household size, years of experience, cassava output and acres of cassava were continuous.

3.7.2 ANOVA (Analysis of Variance) F-Test Analysis

A two way Analysis of Variance (ANOVA) technique was used to compare the population means of the incomes earned from the various crops. This model is appropriate because it can test the differences among several means without increasing the Type 1 error. In addition, the model is robust to moderate violation of its assumptions hence the results can be interpreted with accuracy even if the assumptions are violated. One of the assumptions of the model was that data was normally distributed. Normalization was therefore done by taking the log of incomes. First net returns from each crop were computed using a budgetary tool represented as:

$$NI = TR - TVC \quad (19)$$

Where:

NI= Net income from the various crops

TR= PxiQ=Total revenue earned from the crops

Pxi= Price of the crops per kg

Q=Quantity of the crops sold

TVC= Total variable cost of the crops

A log-linear regression analysis was. performed. In the model, log of house household income was regressed on the incomes from various crops as shown below:

$$Y = f(\chi_1, \chi_2, \chi_3, \chi_4, \chi_5, \chi_6) \quad (20)$$

Where Y= Household income

χ_1- χ_6 = Net incomes of the various crops

The functional form of the model can be explicitly expressed as:

$$\ln Y = a + b_i l_n \chi_1 + b_2 l_n \chi_2 + b_3 l_n \chi_3 + b_4 l_n \chi_4 + b_5 l_n \chi_5 + \mu_i \quad (21)$$

a= Constant term, b_1 - b_6 = coefficients of independent variables and μ_1 is the error term.

To compare the mean net returns of the crops and that of cassava, hypotheses were formulated. The null hypothesis tested if the means of the crop returns were equal specified as:

$$H_0 = \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 \quad (22)$$

While the alternative hypothesis tested if at least one population mean of the net returns differed from each other.

$$H_A \neq \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5 \neq \mu_6 \quad (23)$$

3.7.3 Marketing Margin Analysis

Different approaches and techniques have been used in the analysis of price spread. Carambas (2005) suggested that a complete set of equations should be used to perform a comprehensive analysis of the marketing margin. However, this demands for availability of sufficient data. In this study, the marketing margin analysis was done by comparing the differences between value added cassava selling prices per Kg and buying prices per Kg charged by different actors along the value chain since margin analysis aims at checking price information flow from one actor to another. The retailer margin was a function of the difference between the prices that the retailers pay to the producer and prices paid by the customers. The study used the relative price margin which is expressed as a percentage of the consumer price while marketing margin for farmers was computed as the difference between the selling price and the product price. It was therefore paramount to analyze the factors that affect the margins at the different points since most studies have not focused on cassava margin behaviour at the farm and retail levels. Studies by Ojogho *et al*. (2012); Marsh and Brester (2004) found that there is no perfect way of transmitting prices from one actor to

another along the marketing chain. Therefore, estimating the margins helped in understanding the structural and dynamic factors that influence the market structure for cassava. Furthermore, one of the ways of determing the profitability of cassava products as well as the efficiency of the activities is by analyzing the marketing margin. The changes in marketing margin also influences household income. The following formula was thus used to compute the marketing margin for traders and farmers:

$$(MM)\,Marketing\,M\,\text{arg}in = \frac{Buying\ \text{Pr}ice - Selling\ \text{Pr}ice}{Buying\ \text{Pr}ice} \times 100 \qquad (24)$$

Empirically, marketing margin has been related to a number of factors which include; transaction costs such as transport cost, market costs, labour costs and storage costs; and quantity of products sold and experience (Nandi, 2011; Emokaro, 2010; Asogwa *et al*., 2013). In addition, other factors that also play key role are related to socio-economic factors such as gender, household size and years of schooling. Institutional factor such as extension service is also hypothesized to significantly influence marketing margin. A multiple regression analysis was used to estimate the marketing margin function and analyze factors that influence the differences in the degree of price changes or price differences from one market level to another or buying point and selling point.. A logarithmic transformation of the variables was necessary in order to address the non-linearity challenge as well as skewness of the variables into approximately normality. According to Keen (1995), large sets of data sometimes lead to departures from the OLS assumptions which can cause unbiased estimates. Therefore, log transformation may be considered in case of severity to address the challenge. Two models, namely; linear and double-log were fitted and a comparison of the results made. The general linear regression function for traders is expressed as follows:

$$MM = \beta_0 + \beta_1\chi_1 + \beta_2\chi_2 + \ldots\ldots\ldots + \beta_9\chi_9 + \varepsilon \qquad (25)$$

Where: MM = Market margin of traders

x_1= Age, x_2=Education *(Educ)*, x_3 = Quantity sold (*Qtysold*), x_4=Purchase times (*PurchaseT*), x_5= Years of experience x_6=Transport cost (*Transcost*) , x_7= Labour cost, $x_{8=}$ Market charges, $x_{9=}$ Storage costs

β_0 = Intercept

$\beta_1 - \beta_9$ = Coefficients estimated

ε = Error term or disturbance term (which is assumed to have a zero mean and constant variance).

The reduced form of marketing margin for the linear model is expressed as follows:

$$MM = \beta_0 + \beta_1 Age + \beta_2 Educ + \beta_3 Qtysold + \beta_5 PurchaseT + \beta_6 Experience + \beta_6 Transcost + \beta_7 Laborcost + \beta_8 MarketCharge + \beta_9 Storagecost + \varepsilon \quad (26)$$

While the double log model is expressed as:

$$InMM = \beta_1 InAge + \beta_2 InEduc + \beta_3 InQtysold + \beta_5 InPurchaseT + \beta_6 InExperience + \beta_6 InTranscost + \beta_7 InLaborcost + \beta_8 InMarketCharge + \beta_9 InStoragecost + \varepsilon \quad (27)$$

Comparably, factors influencing marketing margin for farmers were identified by use of multiple regression method which is specified below.

$$MM = \beta_0 + \beta_1 \chi_1 + \beta_2 \chi_2 + \ldots\ldots\ldots + \beta_{10} \chi_{10} + \varepsilon \quad (28)$$

x_1= Gender, x_2=Extension), x_3 = Quantity sold (*Qtysold*), x_4=Market costs x_5= labour cost x_6=Distance , x_7= Years of schooling *(Schoolyrs)*, x_8= Household size (*Hhsize*) , x_9= Value addition experience (*Valueaddexp*), x_{10}= Value addition index (*Valueaddindex*)

The reduced form of the linear model is expressed as follows:

$$MM = \beta_0 + \beta_1 Gender + \beta_2 Extension + \beta_3 Qtysold + \beta_4 Marketcosts + \beta_5 Laborcost + \beta_6 Distance + \beta_7 Schoolyrs + \beta_8 Hhsize + \beta_9 Valueaddexp + \beta_{10} Valueaddindex + \mu \quad (29)$$

Where β_0 = is the constant

$\beta_1 - \beta_{10}$=parameters under estimation

$\chi_1 - \chi_{10}$ = variables fitted into the model

The double log model is expressed as shown below:

$$InMM = \beta_1 InGender + \beta_2 InExtension + \beta_3 InQtysold + \beta_5 InMarketcosts + \beta_6 InLaborcost + \beta_6 InDistance + \beta_7 InSchoolyrs + \beta_8 InHhsize + \beta_9 InValueaddexp + \beta_{10} InValueaddindex + \mu \quad (30)$$

3.7.4 Effect of Cassava Commercialization on Household Income

The study aimed at evaluating the effect of cassava commercialization on household income. Commercialization is based on a non-separable model whereby the choices made by farmers are endogenously influenced by a number of factors. The decision to commercialize or not is assumed to be derived from the maximization of expected utility which in this case is household income. Therefore, a two stage switching regression model was adopted. The first stage involved identification of determinants of cassava commercialization while the second

stage established the effect of commercialization on household income. The empirical models have been discussed in the subsequent sections.

3.7.4.1 Determinants of Cassava Commercialization

Commercialization decision is modeled as self-selection behaviour since it is contingent on the decision of farm households to engage in commercialization. The implication is that the decision to participate in either of the regime (to commercialize or not) is not independent of each other hence handling them separately would lead to selectivity bias (Maddala, 1983). This further means that the decision to undertake cassava commercialization as previously discussed in the theoretical framework is an endogenous choice hence there exists unobservable variables that might affect the probability of engaging in commercialization as well as household income. To correct the problem of endogeneity which arises from the selection bias, the two stage endogenous switching regression model was found appropriate as it accounts for the unobserved characteristics (Maddala, 1983; Elwert and Winship, 2014).

Endogenous model was found relevant because it supports the theoretical framework which states that decision to commercialize is influenced by farm households' participation in the market as a result of marketed surplus. A simultaneous equation model was estimated combined with endogenous switching model using full information maximum likelihood. In the first stage, a probit model was applied to determine the probability of commercialization and identify factors that influence commercialization. The endogenous switching regression model was then fitted in the second stage by maximum likelihood estimation to adjust the estimation of the selection and outcome equations as suggested by Lokshin and Sajaia (2004). Variables that were fitted into the model had been empirically identified and they were grouped into three broad categories, namely; socio-economic, institutional and marketing as well as technological factors. In identifying factors that influence commercialization decision among farmers, a probit model which constrains the estimated choices to 0 and 1 was specified as:

$$A^*_i = Z_i\alpha + \mu_i \qquad (31)$$

Where

$A_i = 1$ if $A^*_i > 0$ commercialize

$A_i =$ 0 if $A^*_i < 0$ otherwise , do not commercialize

A^*_i Represents the unobservable or latent variable for commercialization, while A_i is its observable counterpart which indicates whether a farmer was involved in cassava commercialization or not. Conversely, Z represents the vectors of observed characteristics that affect commercialization while i represents cassava farm households and μ_i denote the stochastic disturbances. Furthermore, A^* represents the net utility derived from cassava commercialization, which is unobservable. This is because, it is not possible to measure the amount of net utility realized from cassava commercialization. However, one is capable of making an observation on the actual outcome of decision making, which is commercializing or not commercializing. Even though the probit model is used to analyze the determinants of commercialization, the model may however not handle the heterogeneity effects that are caused when the observed characteristics influences both the decision to commercialize as well as the household income (potential correlations among the unobserved disturbances). This might lead to inconsistent unbiased estimates. To correct the heterogeneity problem and yield dependable standard errors of the estimates, the second stage of endogenous switching model is introduced.

3.7.4.2 Effect of Cassava Commercialization on Household Income

Different methods have been used to measure household welfare since it is a multidimensional theory. World Bank (1998) singled out three methods that can be used to analyze the welfare of households. The first approach takes into consideration the household consumption and employment; secondly the total expenditure of a household; and finally, the computation of full income for households. Greely (1994) also explored the different approaches used to measure poverty and he concluded that income can be justifiably used as a unit of measure. Brewer and O'Dea (2012); Tambo and Wunscher (2014), and World bank (2000) also supported the use of income as a measure of household welfare and recommended per capita income as the most appropriate measurement. Hence, this study used household income, which is a continuous variable to measure cassava farm households' welfare. Three different measures of income were used in order to gain a clear understanding on the dynamics of certain parameters. In this case, a comparison was made between per capita income, average income per household per year; and average income per acre. Estimates of per capita household income for farm households were obtained by the summation of all the possible incomes brought into the household considering the household size. Per acre income on the other hand was computed as production value of farm products

less paid out costs, while annual household income was calculated by totaling the amount of income brought in by persons who are 15 years and above within a calendar year. Consequently, the logs of the incomes were fitted into the model.

The predicted probability obtained from the probit equation in the first stage was then used in the second stage to obtain estimates of cassava commercialization. Two instrumental variables which included group membership and distance to the market were identified. The variables were correlated with commercialization but not directly with the household income. These variables were related to market access since it is argued that farmers can comfortably market their value added products if they have access to the markets. Distance to the market is assumed to have an indirect impact on income because it influences trading behaviour of farm households. Group membership on the other hand is related to pooled resources such as transport as well as access to information. Therefore, the income functions for the two regimes whereby farm households are confronted with decisions: (1) to commercialize (2) not to commercialize are shown in equations 32a and 32b:

Regime 1: $y_{1i} = \beta_1 \chi_{1i} + e_{1_i}$ if $G_i = 1$ (For commercialization) (32a)

Regime2: $y_{2i} = \beta_2 \chi_{2i} + e_{2i}$ if $G_i = 0$ (For non-commercialization) (32b)

Where y_{1i} and y_{2i} represents the household income in regimes 1 and 2 while χ_{1i} and χ_{2i} represents vectors of exogenous variables whereas β_1 and β_2 represent vectors of the parameters which are perceived to influence household income. e_{1i} and e_{2i} are the error terms. An assumption is made that the terror term μ_1 is correlated with the errors e_{1i} and e_{2i}, the three disturbance terms are assumed to have a jointly normal distribution with the zero mean vector. This explanation can be expressed as follows;

$$COV(e_{1i}, e_{2i}, u_i) = \begin{pmatrix} \sigma^2_{e2} & \bullet & \sigma e2u \\ \bullet & \sigma^2_{e1} & \sigma^1 u \\ \bullet & \bullet & \sigma^2_u \end{pmatrix} \quad (33)$$

Where σ^2_{e2} is a variance of the error term in the selection equation (31) and it is assumed to be 1 while σ^2_{e1} and σ^2_{μ} are the variances of the error terms in the income equations (32a and 32b). Also σ^1_{μ} is a covariance of μ_i and $e1_i$ while σ^2_{μ} is the covariance of μ_i and

$e2_i$ It is assumed that if the error term of the selection equation (3.23) is correlated with the error terms of commercialization outcome functions (32a) and (32b), then the expected values of co-variances condition on the sample selection are non-zero. Therefore, if the estimated co-variances are found to be statistically significant then the decision to commercialize and the household income are assumed to be correlated. This forms the basis of using endogenous switching model. Furthermore, the null hypothesis of sample selectivity bias will be rejected. The two step estimation corrects the bias caused by the sample selection using the control function approach referred to as inverse mill's ratio. Derived correction terms are then merged to obtain consistent estimates. The above explanations are as indicated below.

$$E\left[e_{1i}/G_i=1\right]=\sigma e1u\frac{\phi\left(\beta X_1\right)}{\Phi\left(\beta X_1\right)}=\sigma e1u\,\lambda_{1i}\ and\ E\left[e_{2i}/G_1=0\right]=-\sigma e2u\frac{\phi\left(\beta X_1\right)}{1-\Phi\left(\beta X_1\right)}=\sigma e2u\,\lambda_{2i} \quad (34)$$

Where ϕ (.) is the standard normal probability density function, Φ (.) is the normal cumulative density function, and $\lambda_{1i}=\frac{\phi\left(\beta X_1\right)}{\Phi\left(\beta X_1\right)}$, and $\lambda_{2i}=-\frac{\phi\left(\beta X_1\right)}{1-\Phi\left(\beta X_1\right)}$

The adequacy of the model fitted was investigated using various tests. Wu-Hausman and Sargan statistical tests were performed to determine whether endogeneity and over identification of variables existed. The approaches have similarly been used by Vance and Geoghegan (2004), to verify the appropriateness of the identified instrumental variables. This model has been used widely by many researchers, for instance, Kim (2000) assessed the effects of consumer label used on nutrient intake. Vance and Geoghegan (2004) modeled the determinants of semi-subsistence and commercial land uses in agricultural frontier. Other researches that have equally used the model include (Seng, 2016; Abdullai and Huffman, 2013; Di falco *et al*., 2011).

CHAPTER FOUR
RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the findings from analyzed data which was collected from the three categories of respondents. They included farmers, traders and extension officers. Among these respondents, 200 and 181 farmers were from Kilifi and Siaya Counties respectively. There were 48 traders from Siaya and 54 from Kilifi. Extension officers interviewed from Siaya and Kilifi Counties were 8 and 10 respectively. The total number of respondents represented 99 percent of the targeted total sample. Farmers who participated in the study were those who had produced cassava in 2015 season. Summaries of descriptive statistics of key variables used to address the four objectives are presented. Inferential statistics based on the analysis of multinomial logistic model, ANOVA F-test analysis, margin analysis and endogenous switching model are also included.

4.2 Characterization of Cassava Farming Households

Different sets of variables, precisely socio-economic, market and institutional as well as technical characteristics of cassava commercialization in Siaya and Kilifi were analyzed. In particular, the socio-economic variables analyzed included age, gender, marital status, household-size, off-farm income, farm size, level of education, remittances and cassava farming experience. Market and institutional variables discussed comprise household head membership to groups, access to extension services, access to credit, access to market information and distance to the market. Under technical variables, value addition and production techniques are discussed. These results are presented and discussed in the next sections.

4.2.1 Frequency Distribution of the Categorical Variables

The frequency distribution of the categorical variables for Siaya and Kilifi are presented in the Table1 and 2 respectively. The first column of these tables contains results for all the farmers in the county considered. The second column present summary statistics results for the commercialized group while results for non-commercialized one is presented in the third column. In the last column, a chi-square statistics for measuring association between categorical variables and commercialization is presented.

Table 1 indicate that with respect to cassava commercialization, female headed households in Siaya County constituted 77 percent of the sample households while 23 percent were male. The results further show that majority of the respondents who engaged in cassava commercialization from Siaya County were female (74%) while the male headed households were 26 percent. Among those who did not commercialize, 85 percent are female while 15 percent are male. A chi-square test shows an insignificant relationship between gender and commercialization in Siaya County.

Concerning education of the household heads, the proportion of household heads who had not received formal education were 21 percent while majority of the household heads had received primary education (62%). The proportion of household heads with primary level education and had commercialized was 61 percent. Notably, 17 percent of the household heads from Siaya County had received secondary level education and above. Also, a small proportion of the household heads with secondary level education and above had commercialized. This is represented by 22% (Siaya). Moreover, education was found to have a statistical significant relationship with cassava commercialization in Siaya County ($p<0.05$). Education is believed to endow farm household heads with both production and managerial skills which are necessary especially in making rational farming decisions as demonstrated by Enete (2009) as well as Muricho (2015).

The results for Siaya County (Table1) also indicate that with regards to age, most of the respondents were within the age bracket (31-45) as represented by 33 percent. A small proportion of the young people within the age bracket (16-30 years) were involved in cassava production. This is represented by 10 percent. The low involvement in commercialization by the young people could be due to lack of interest in agriculture especially traditional crops like cassava which has been associated with old people. Studies have revealed that youth engagement in agriculture has been considerably declining as most of them do not have ownership to land which is a primary resource of production (Ahaibwe *et al*., 2013). Moreover, most of the young people perceive agriculture as a low income profession and hence they opt for white collar jobs believed to be more income attractive. The study also established that there was no statistical significance relationship between age and cassava commercialization for Siaya County.

In relation to marital status, 65 percent of the household heads from Siaya County were married while a significant number of farmers (33%) were headed by the widowed (Table 1). This could be explained by the fact that HIV and AIDS disease is prevalent in Siaya County

as a result of cultural practices such as wife inheritance leading to many deaths. The relationship between marital status and cassava commercialization was found significant ($p<0.1$).

Table 1: Results of Distribution and Significant Test for Categorical Variables (Siaya County)

Variable	Overall (181)	Commercialization (n=126)	Non-commercialization (n=55)	χ^2 Value
Gender (%)				0.181
Female	77	74	85	
Male	23	26	15	
Education Level (%)				8.603**
None	21	17	31	
Primary Level	62	61	62	
Secondary Level	14	18	5	
Tertiary Level	3	4	2	
Others	0	0	0	
Age category (%)				4.556
16-30	10	11	1	
31-45	33	33	31	
46-60	27	30	48	
61-90	30	26	40	
Marital Status (%)				4.876*
Married	65	69	56	
Single	2	2	0	
Divorced	0	0	0	
Widowed	33	29	44	

Note: ** Significant at 5% level and * Significant at 10% level

Table 2 on the other hand indicates that 71 percent of the respondents from Kilifi County were female and the remaining 29 hand percent were male. Majority of the respondents who engaged in cassava commercialization were female (70%). However, the male respondents who participated in commercialization were 30 percent. This figure indicates that more male headed households from Kilifi County participated in cassava commercialization unlike their counterparts from Siaya. This could be explained by the fact that most men from Kilifi County were not living farther away from their homes whereas majority of men from Siaya County had migrated to urban centres in search of off-farm jobs. The results also show that 73 percent of those who did not commercialize are female and 27 percent are male headed households. A chi-square test shows that a significant relationship existed between gender and cassava commercialization in Kilifi County ($p<0.10$).

The mixed results reveal the uniqueness of gender in Kilifi and Siaya Counties. Therefore, the distribution of gender between the two counties is not quite different since in

both cases cassava farming is dominated by the female headed households. This corresponds to the results of World Bank report (2007) which found that women are generally responsible for food production in sub-Saharan Africa and they account for a greater percentage of the labour force. Other literature reveals that gender issues are very important in understanding the dynamics in agriculture. FAO (2011) investigated the role of women in agriculture and they affirmed that women make essential contributions to agriculture across the developing world. By contrast, a study conducted by Adenegan *et al. (*2013) revealed that men's participation in agriculture is greater than women's, which reflects their autonomy in decision making This is consistent with the findings of Adenegan *et al*. (2012) which found a relationship between gender and agricultural commercialization. Kotchikpa and Wendkouni (2016) similarly found that a relationship exist between gender and output commercialization.

From Table 2, 39 percent of the household heads had not received formal education while majority of the household heads had received primary education (49%). A small proportion of 12 percent had attained secondary level education. Majority of those who engaged in commercialization (51%) had primary level education. Education was found to have an insignificant relationship with cassava commercialization in Kilifi County. Overall, the number of respondents with primary education was lower for Kilifi compared to that of Siaya. This indicates that illiteracy level is high in Kilifi in comparison to Siaya, though in both cases most household heads had attained low level of education. The disparity in the levels of education is as a result of cultural orientation towards education in the two regions. These communities put different premiums on education.

There was a noteworthy disparity in the age groups as indicated in Table 2. It is clear that majority (40%) of the household heads were within the age bracket (31-45 years). In addition, 38 percent of the respondents within the same group undertook cassava commercialization. However, a small proportion (21%) of the elderly farmers who engaged in cassava commercialization was recorded. Probably, the low number of old people involved in cassava farming could be as a result of high mortality rate especially in Kilifi County. According to Kilifi County report (2013), many households belong to the stressed phase in the livelihood zones and are struggling to meet their basic dietary requirements. Also, this category of farmers may not be energetic and productive enough to undertake commercialization activities. Notably, 17 percent of the young respondents of the age group (16-30 years) undertook commercialization. This is not different from the findings of Siaya which found that young people are less involved in cassava commercialization activities. Generally, there was a significant relationship between age and cassava commercialization ($P<0.05$).

Concerning the marital status, 73 percent of the respondents were married while 4 percent were widowed. The rest (23 %), were either single or divorced. The high cases of divorce could be attributed to the fact that Mombasa being a tourist destination centre, there are many tourists who visit the city and are attracted to young men and women, among them married people from the neighbouring counties.

Table 2: Results of Distribution and Significant Test for Categorical Variables (Kilifi County)

Variable	Overall (200)	Commercialization (n=138)	Non-commercialization (n=62)	χ^2 Value
Gender (%)				2.963*
Female	71	70	73	
Male	29	30	27	
Education Level (%)				3.660
None	39	36	47	
Primary Level	49	51	43	
Secondary Level	8	8	8	
Tertiary Level	3	4	2	
Others	1	1	0	
Age category (%)				10.001**
16-30	14	17	8	
31-45	40	38	45	
46-60	29	24	39	
61-90	17	21	8	
Marital Status (%)				1.104
Married	73	75	69	
Single	3	2	3	
Divorced	20	5	3	
Widowed	4	18	25	

Note: ** Significant at 5% level and * Significant at 10% level

Concerning marital status, 73 percent of the household heads from Kilifi County were married while 4 percent were widowed. Cases of divorce in the county were also high as represented by 20 percent. This is because Mombasa being a tourist destination centre, there are many tourists who visit the city and are attracted to young men and women, among them married people from the neighbouring counties.

4.2.2 Off-farm Occupation and Cassava Commercialization

It is evident that households derive income from both agriculture and other activities. Farmers have diversified into other sources of revenue generation to supplement their household income. Figure 3 shows the distribution of income earned from the various sources. Among farm households in Kilifi County who had commercialized, 27 percent engaged in off-farm

activities while 9 percent engaged in salaried activities. However, for the households that did not commercialize, 37 percent engaged in off-farm activities and 5 percent of the households engaged in salaried activities in that order. A different result was obtained for Siaya County. For the commercialized group, the proportion that had engaged in off-farm activities was 42 percent while 2 percent was involved in salaried activities. The proportion engaged in off-farm activities among the non-commercialized households was represented by 24 percent. Similarly, 2 percent of the households engaged in salaried activities.

The results indicate that among the commercialized group Siaya (42%) had a higher proportion of those who engaged in off-farm activities than Kilifi (27%). The off-farm activities carried out differed in both counties. From this study, it was observed that most farmers in Kilifi County were involved in burning and marketing of charcoal as well as tourism activities, while in Siaya, the off-farm activities were mainly small businesses and *bodaboda* business. Income from off-farm activities contribute to farm household's income and this can potentially reduce household dependency on agriculture (Woldeyohanes *et al*., 2015). Furthermore, off-farm income provides an alternative income especially when the farm conditions become unfavorable. Farmers can also use off-farm income to invest in farming and value addition activities.

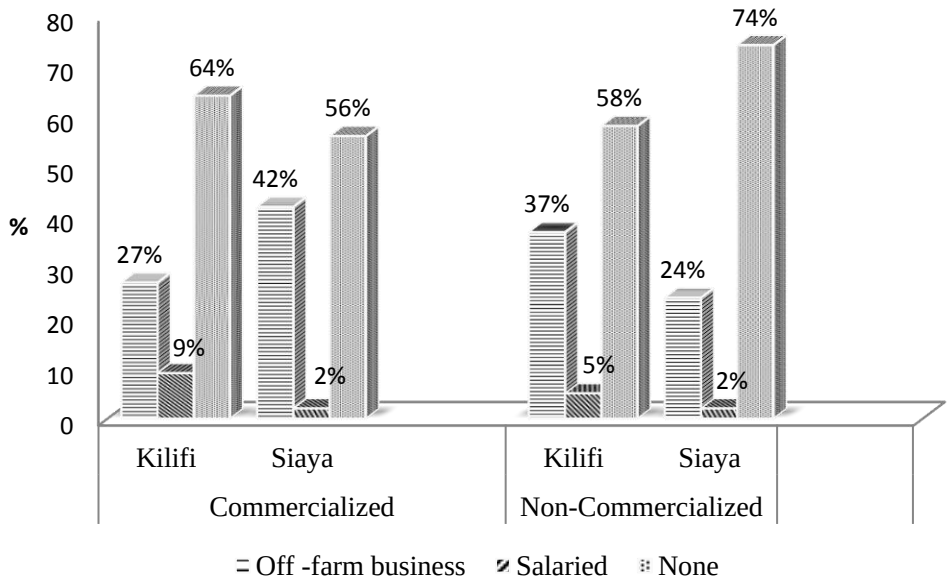

Figure 3: Relationship Between other Occupation and Commercialization in Kilifi County.

Many studies have found that off-farm income can have both positive and negative effect on agricultural commercialization. For instance, off-farm income can be used by farmers to manage risk in agriculture as it boosts the working capital needed for purchasing agricultural

inputs and paying for labour costs. Woldeyohanes *et al*. (2015) investigated the effect of off-farm income on smallholder commercialization. The study revealed that there is no significant relationship between the two variables since most farm households spent income earned from off-farm activities on household purchases with minimal amount spent on improving marketed surplus. Conversely, engaging in other activities limits a farmer from fully concentrating on farm activities. Prior studies have recommended diversification in off-farm activities to farmers as it enhances their profitability and act as other alternative sources of income (Korir *et al*., 2011). A simple correlation analysis performed revealed a weak relationship between off-farm income and cassava commercialization in Siaya County while the result indicates a negative relationship between off-farm income and cassava commercialization in Kilifi County.

4.2.3 Remittances and Household Expenditure

Other than income generated from off-farm and other farming activities, farm households also received remittances from relatives and friends who reside outside their locality, including overseas. The remittances were spent on various activities which included farming amongst others. These are summarized in Table 3.

Table 3: Remittance Expenditures of Farm Households in Kilifi and Siaya Counties

Responses	Kilifi (n=200) %	Siaya (n=181) %	Pooled (n=381) %
Increase farm production	11	25	18
To buy food items	24	29	27
Pay school fees	14	11	12
Other uses	1.5	4	3
None	49.5	31	40
Total	100.0	100.0	100.0

The percentage of farmers who responded that they had received remittances in Kilifi County during the survey period was 50.5 percent while 49.5 percent did not. Out of the households that received remittances, majority (24%) said that they spent the money on buying food items, 11 percent spent the remittances on increasing farm production while 14 percent spent the money on school fees. Likewise, 69 percent of the farmers from Siaya

County received remittances. Among these recipients, 25 percent was spent on increasing farm production, 29 percent on buying food items and 11 percent on paying school fees. The study clearly shows that few farmers from Kilifi received remittances relative to Siaya and that most of the remittances from both counties were spent on food items with minimal amount on agriculture. The decision to utilize remittances also lies within the utility maximization approach. The analysis of the pooled data indicates that out of the 60 percent of farm households who received remmitances, 27 percent spent the remittances on buying food items, and 18 percent spent the remittances in increasing farm production. Therefore, expenditure of remittances were similar for the pooled and single data.

4.2.4 Summary Statistics of Institutional Factors

The institutional factors discussed in this section include membership in groups, access to market information, access to extension services and access to credit facilities. The summary statistics are presented in Tables 4.

4.2.4.1 Membership to Farm based Groups and Associations

The study identified various farm based groups and other related associations that farmers were ascribed to and the opportunities that the groups offered to the members. Table 4 shows the statistics for the different groups.

Table 4: Summary Statistics for Group Membership

Types of groups	Siaya (n=181) %	Kilifi (n=200) %	Pooled (n=381) %
Farmers groups	28.7	38.5	33.6
Savings and credit institution	7.2	15.0	11.1
Women's associations	28.2	16.5	22.4
Others	6.1	8.0	7.0
None	29.8	22.0	25.9
Total	100.0	100.0	100.0

From Table 4, 70.2 percent of farmers from Siaya County belong to either a group or an association. Similarly, Kilifi County was represented by 78 percent. A significant proportion of household heads from Siaya (29.8%) as well as Kilifi (22.0%) were neither in a group nor association. This was expected since majority of the household heads were women. In most

cases, many active and operational groups or associations are formed and managed by women. Mwaura (2014) in his study on the effect of farmer group membership on agricultural technology adoption and crop productivity in Uganda observed that farmers who belonged to farm groups obtained higher cassava yields. Cassava production and processing involves a wide range of activities, some of which are laborious, it is therefore hypothesized that group effort can be useful in accomplishing some of these activities.

There were three main farming related groups which cassava farmers were associated. These included; farmers' cooperative groups, women associations, savings and credit institutions. The farm household heads belonged to either one or a combination of these three groups and associations. The most favoured association in both counties was farmers' groups (Siaya-28.7%, Kilifi-38.5%), followed by women's association (Siaya-28.2%, Kilifi-16.5%), while the least favoured was savings and credit associations. The statsistics obtained for the pooled data is a simple average of the statistics for the two counties. Therefore this shows that there is similarity among the results for pooled and single data.

Also, a significant proportion of household heads in Siaya-(29.8%) and Kilifi-(22.0%) did not belong to any group. Farm based group was the most popular due to the fact that members of the groups were more likely to enjoy benefits such as free planting cassava cuttings, marketing opportunities and trainings. In addition, high rate of participation in the groups could be partly attributed to the fact that there were many governmental and non-governmental organizations (NGOs) that had introduced various interventions for cassava farmers in the two regions. From the interviews with the farmers, it emerged that most NGOs do not reach out to individual farmers but channel their support through farm groups. A report by KENFAP, (2013) confirmed that farmers were being drawn from farm based groups to participate in cassava projects which had been initiated in Kilifi County. Therefore, farmers were being encouraged to join the groups if they were to benefit from new techniques of cassava production and value addition.

There were a number of benefits that farm households derived from participating in farm based groups. Some of the benefits that were identified include; fast delivery of farm inputs, affordable input prices, fair farm gate output price, strong bargaining power, easy access to credit, low cost credit and agricultural information access. Most members benefitted from easy access to credit, low credit cost and access to agricultural information as shown in Table 5. Generally, access to credit and low credit were the main benefits derived from membership and participation in farm based groups. 54 percent and 49.8 percent of the total respondents

benefited from easy access to credit facilities and at an affordable cost respectively. This was attributed to the fact that most individual farmers experienced difficulties in accessing credit facilities either from banks or other lending institutions as a result of the stringent credit requirements or sometimes the interest rates which were unaffordable. Studies have reported that groups provide institutional response to these challenges by enhancing farmers' abilities to access credit facilities with ease and at affordable rates subsequently improving farm households' livelihoods (Kirui and Njiraini, 2013).

Table 5: Benefits Derived from Group Membership

	Kilifi (n=200)		Siaya (n=181)		Pooled (n=381)	
Benefits	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)
Fast Input delivery	42.5	37.0	33.7	39.2	38.1	38.1
Affordable input price	43.5	36.0	35.9	37.0	39.7	36.5
Fair farm gate output price	52.5	27.0	51.9	21.0	52.2	24
Strong bargaining power	54.0	25.5	54.7	18.2	54.3	21.9
Easy access to credit	30.0	49.5	14.4	58.6	22.2	54
Low cost credit	33.5	46.0	19.3	53.6	26.4	49.8
Agricultural information access	37.0	42.5	24.3	48.6	30.7	45.6

Farm groups are moreover good platforms for sharing useful information that enhances cassava commercialization. Ngugi and Kariuki (2009) found that membership to a group is paramount in the uptake of technology amongst smallholder farmers. According to Olwande (2010), membership to farming based groups has the potential to increase access to vital information which is needful in marketing decisions. In addition, it is a proxy to credit access because members who belong to groups or associations are likely to acquire credit from financial institutions smoothly as it is an approach to overcoming the risk of lending to farmers. It also facilitates access to planting materials, fast input delivery and affordable prices for inputs. The entry point of many organizations that support agriculture is through groups.

The respondents in Siaya County cited Red Cross, CREPP and Ministry of Agriculture as some of the organizations which have worked closely with farmers and intensified cassava production and value addition through farmer based groups. These organizations have set up

value addition factories at various points and encouraged farmers to embrace value addition to enhance cassava commercialization. In addition, they have facilitated the distribution of improved cassava varieties and promoted cassava seed bulking and multiplication as well as linked farmers with potential buyers. Similarly, in Kilifi County, development organizations such as CAST, KENFARM, FAO, East African Breweries amongst many others, have supported cassava farmers in various ways which include; distribution of improved cassava cuttings, training members on the best practices of cassava production and value addition amongst others.

4.2.4.2 Extension Services Offered to Cassava Farmers

Agricultural extension services are mainy offered by National Government officers based at the county offices and wards. The main duties of extension officers are to educate and disseminate agricultural information to farmers. Some of the vital information that extension officers offer to farmers range from value addition techniques, identification and control of pests and diseases, marketing, selection of planting materials, group formation, access to credit facilities, compost manure preparation and general crop management practices. The study revealed that the proportion of farm households from Siaya (39%) that had received extension services was lower than that of Kilifi (55%). This could be attributed to the poor interaction of smallholder farmers with extension officers as well as inactive participation in farm based groups. It was observed that farmers from Kilifi County had close interactions with extension officers through the various groups which were quite active. In fact, on a weekly basis, they held a group meeting which was attended by at least one extension officer. According to Ong'ayo *et al*. (2017), groups enhance the interactions between farmers and extension officers. Out of the farm households from Siaya County that received extension services, 85 percent engaged in commercialization while 15 percent did not undertake commercialization activities. For Kilifi County, 68 percent commercialized while 32 percent did not. This indicates that a good proportion of farmers who received extension services commercialized.

As evidenced in Figure 4, the three major extension services received by farmers from Siaya included group formation and access to credit (24.5%); identification and control of pests and diseases (23.6%), and marketing of cassava products (22.6%). Similarly, farmers from Kilifi County mainly benefitted from selection of planting materials (50.5%), identification and control of pests (28%) as well as marketing of cassava products (16%).

This indicates that majority of farmers seek extension services for various purposes. This finding is similar to that of Asogwa and Okwoche (2012) who acknowledged that the principle purpose of extension services is to disseminate information and equip farmers with new techniques which may help them improve on their farming operations and productivity. It was revealed that a relationship existed between extension services and group membership. An explanation could be that most farmers accessed extension services through the different farm based groups.

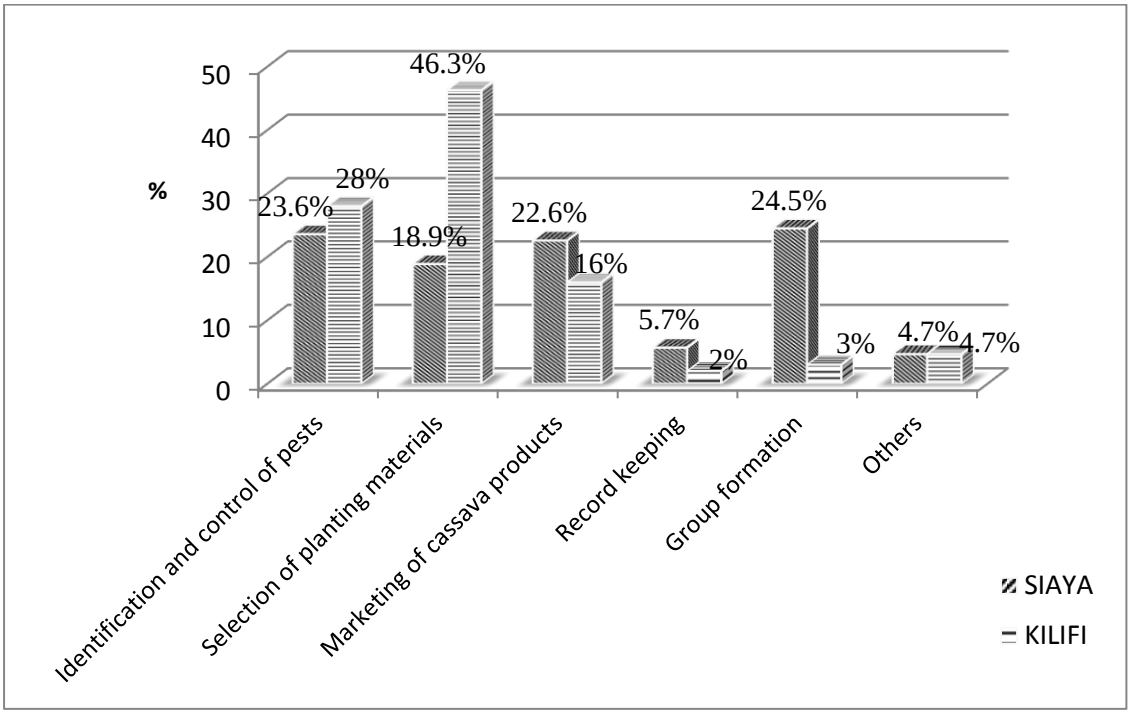

Figure 4: Benefits Derived from Extension Visits

4.3 Levels of Cassava Commercialization

In this section, the first objective of the study is addressed. This was concerned with the identification of the levels of cassava commercialization and the factors that affect them. Levels of cassava commercialization were identified using an index which was developed. These levels were classified as; none, low, medium and high levels. This result was used in both descriptive and inferential statistics. The numerical descriptive statistics obtained from the data included summary measures such as the mean and standard deviation. These summary measures were used for making inferences on cassava commercialization. Hypothesis test was performed to find out if there was significant difference in cassava commercialization between the two counties.

4.3.1 Commercialization Indices

In computing the Commercialization Index, Household Commercialization Index (HCI) and Value Addition Index (VAI) were computed for both Siaya and Kilifi Counties. The indices were then averaged to obtain Commercialization Index (CI). These indices were continuous, and ranged from 0 to 1. Each of these indices were then analyzed and discussed.

HCI was grouped into class sizes of 0.2 as shown in Figure 5. The classes were: very low (0<0.2); low (0.2<0.4); moderate (0.4<0.6); high (0.6<0.8); and very high (0.8<1.0) orientation to market participation. The reported statistics in Figure 5 show that majority of the farmers in both Kilifi (mode =38%) and Siaya Counties (mode =47%) had very low orientation towards market participation. This can be attributed to the fact that most farm households were peasant farmers who mostly produced for household demands. For the very high market participation category, Kilifi County had more respondents (15%) than Siaya (12%). The difference in responses could also be attributed to the fact that in Siaya County, most farmers had low output because of crop destruction by animals and rodents. On the other hand, farmers from Kilifi County enjoyed much higher production which could be attributed to the large parcels of land that also motivated their participation in markets.

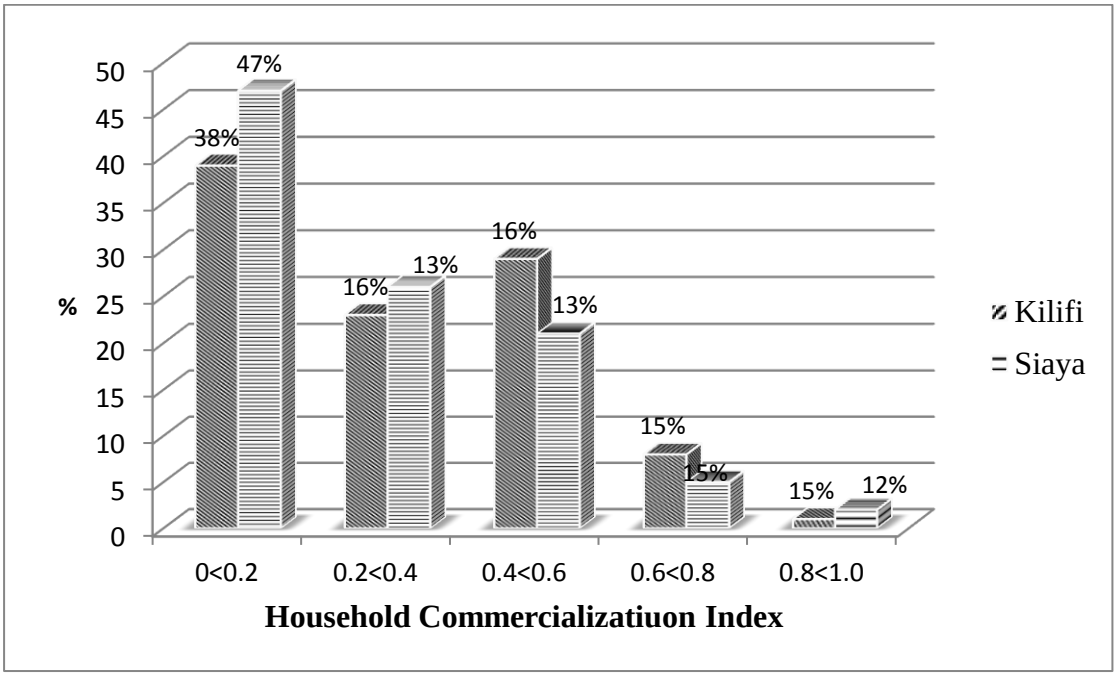

Figure 5: Distribution of Household Commercialization Index

Figure 6 on the other hand shows the distribution of value addition index. It is clear that the very low category value addition (0<0.2) predominates in both regions with a proportion

of 39 percent and 47 percent for Kilifi and Siaya respectively. This indicates that majority of the farmers hardly engage in value addition. This is more noticeable in Siaya County than Kilifi. Farm households that engaged in both low and medium value addition (0.2<0.6) were 52 percent and 47 percent for Kilifi and Siaya correspondingly. The proportion that engaged in high value addition represented by 0.6<0.8 was very small in both counties as indicated by 8 percent in Kilifi and 5 percent in Siaya. An insignificant proportion practised very high value addition in both counties. The results therefore indicate that farmers from both counties generally practise low value addition. This would mean that a good proportion sell raw cassava as it is harvested. Most farmers cited high cost of undertaking value addition and laborious activities involved in processing cassava as some of the hindrances to undertaking high-level value addition.

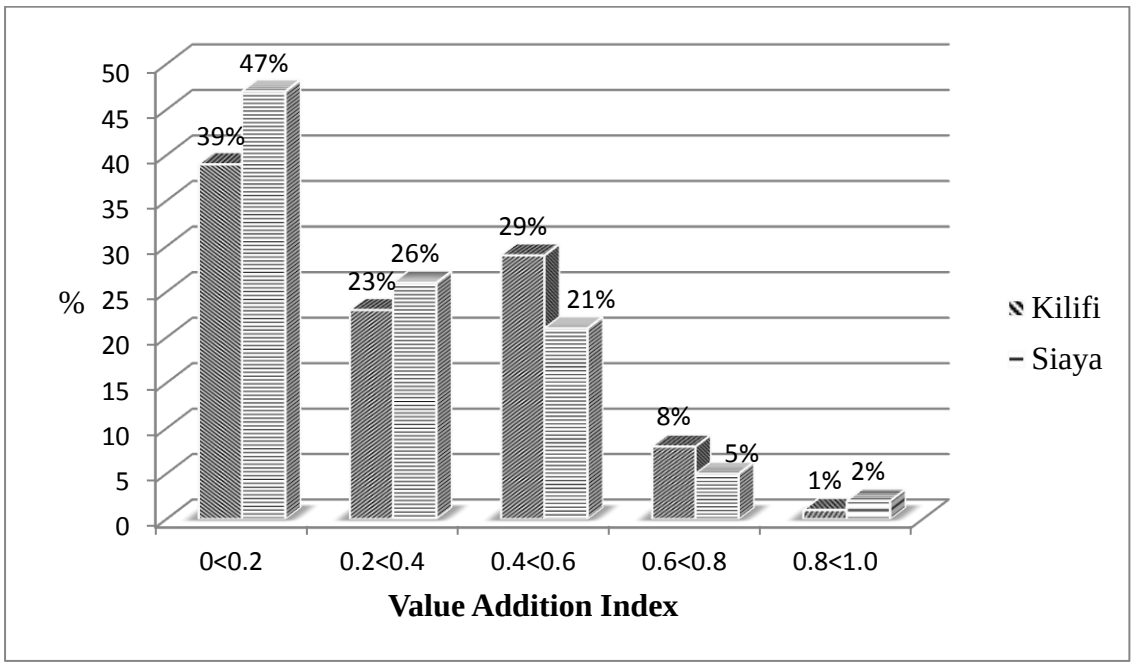

Figure 6: Distribution of Value Addition Index

Finally the study computed the commercialization index of households for each of the two counties as well as for the pooled data. This index was used to profile commercialization of farmers as follows: none (0), low (0.1<0.30), medium (0.3<0.60), and high category (0.60 and above). The summary statistics for commercialization index of each county is presented in Figure 7. The results show that majority of farm household in both counties were in the medium category of commercialization and a small number of farm households engaged in high level commercialization.

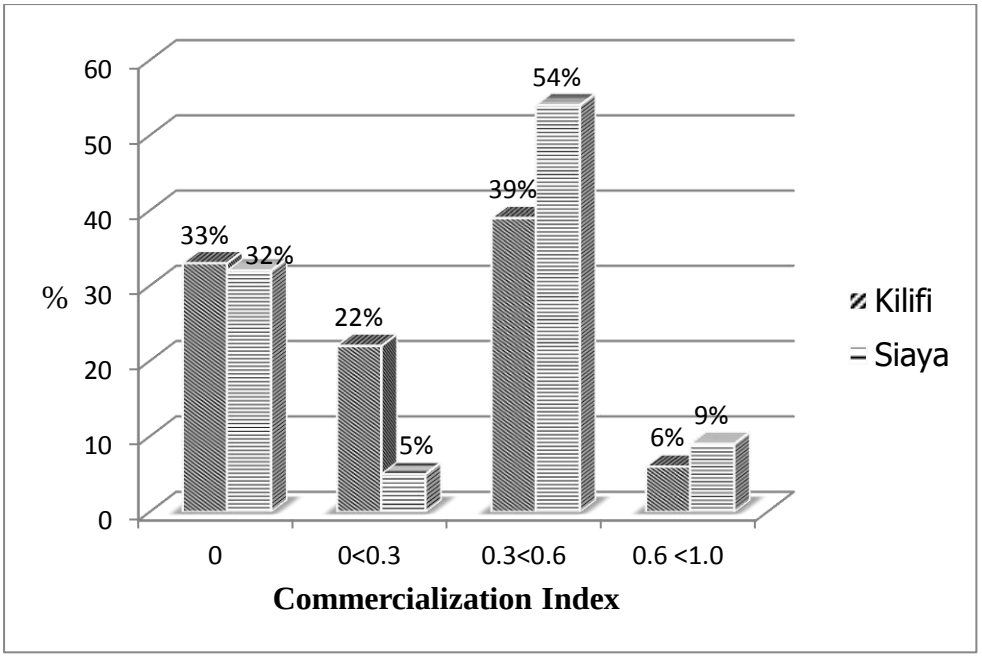

Figure 7: Distribution of Commercialization Index

Figure 8 represents the overall summary of the pooled data analysis. It is clear from the figure that 38 percent of farm households were engaged in the medium level of commercialization with only 8 percent in the high level category. This further confirms the earlier findings which pointed out that most farm households are in the medium category of commercialization.

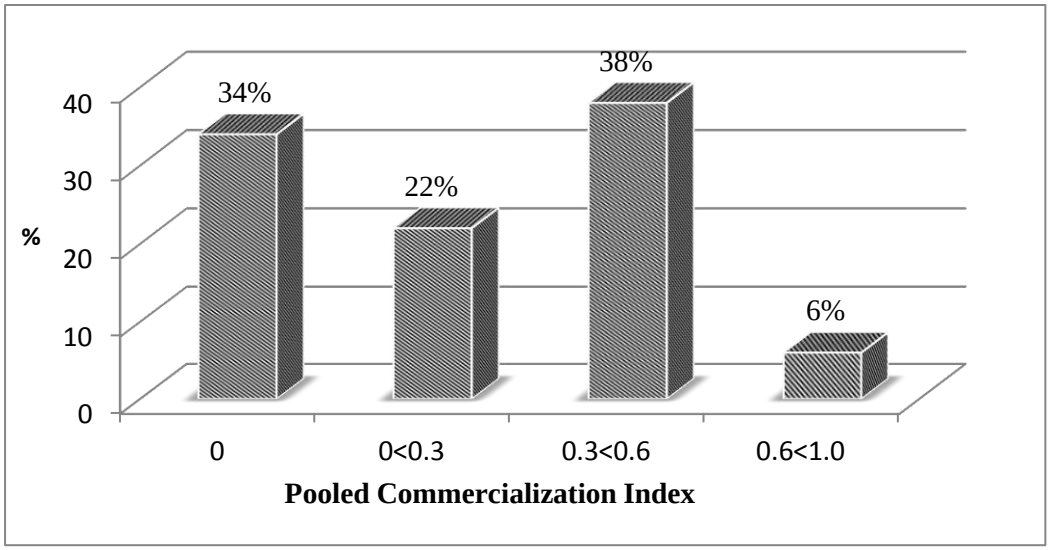

Figure 8: Distribution of Commercialization Index for Pooled Data Analysis

Table 6 shows the mean commercialization indices for the two counties. Kilifi County had a mean index of (0.278) which was slightly lower than that of Siaya (0.271). Comparing the variation of the indices within each county, Siaya had a higher coefficient of variation (0.929) than Kilifi (0.866) indicating that there was greater disparity in the index for Siaya than that of Kilifi.

Table 6: Group Summary Statistics of Commercialization Index

	County	Mean	Std. Deviation	Variance
Commercialization Index	Siaya	0.271	0.252	0.929
	Kilifi	0.278	0.241	0.866

Hypotheses tests were carried out to determine if the differences in the Commercialization Index of households in Siaya were significantly different from that of Kilifi. This was achieved using a two independent sample t-test. The results of the tests are presented in Appendix 5.

Two hypotheses tests were carried out. The null hypothesis for the first test stated that there was equality of variance of cassava commercialization index in both counties. This test was based on Levene's test for equality of variance. The study failed to reject the null hypothesis ($p > 0.05$). This meant that there was equality of variance in the indices. Since this assumption was met, the second test was performed on this assumption. The hypotheses were stated as follows;

$H_0 : \mu_1 = \mu_2$ (The two counties have equal commercialization level).

$H_1 : \mu_1 \neq \mu_2$ (Commercialization level for the two counties are different).

The results indicate that the test statistics for equality of means had a p-value = 0.779 >.05. We therefore failed to reject the null hypothesis. This implies that on the basis of the data collected there was no evidence to indicate that commercialization index for both counties was different. Indeed it is even evident from the mean of CI for Siaya (0.271) and Kilifi (0.278) which were approximately equal.

4.3.2 Summary Statistics of the Variables used in Multinomial Logistic Model

The summaries presented in Table 7 clearly show that the proportion of farm households from Siaya County who participated in the low, medium and high level categories of commercialization were 23 percent, 37 percent and 5 percent respectively while the rest (35%) did not participate at all. Concerning gender, it was observed that 23.5 percent of the men from Siaya County participated in the high level of commercialization. Also, 17.2 percent of the men did not engage in commercialization. This implies that majority of the men were not involved in commercialization. Extension contacts are important as they bridge the gap of information asymmetry, therefore farmers who receive extension services are believed to be more knowledgeable than their counterparts (Rahut *et al.*, 2015). It is evident that a good proportion (58%) of farm households from Siaya County who had engaged in high level commercialization had contacts with extension officers.

Distance to the market was hypothesized to influence market accessibility. Households located far away from market places are less likely to engage in value addition as well as market participation (Barrett 2007; Rios *et al*., 2008; Omiti 2009). In Siaya County, farm households in the medium (0.28km) and high (0.20km) categories were located farther from the markets than those in the low and none levels. The mean for household size also varied across the different levels of commercialization.

Value addition experience was expected to be more for households that undertook high level commercialization than those that did not. This was however not the case in Siaya County as evidenced by the mean value addition experience which for high level commercialization was (4.12 years). Another variable of interest was marketing cost. The costs were minimal in both counties, though the medium category incurred slightly more costs than the high level category. It is acknowledged that marketing costs can be a constraint to output market participation by smallholder farmers (Musumba and Costa, 2015).

Table 7: Summary Statistics of Variables used in Multinomial Logistic Model (Siaya County)

Variables	NONE n=64		LOW n=42		MEDIUM n=66		HIGH n=9	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender (Male)	0.172	0.381	0.262	0.445	0.278	0.451	0.235	0.437
Extension service (Yes)	0.189	0.395	0.444	0.527	0.464	0.501	0.588	0.507
Distance to market (Km)	0.059	0.211	0.056	0.110	0.275	0.369	0.200	0.269
Schooling (Years)	4.810	4.253	5.444	3.087	6.526	3.992	8.176	3.627
Household size (No.)	5.431	2.610	4.889	2.522	5.866	2.714	7.059	2.304
Value addition experience (Years)	12.569	15.189	19.111	22.133	13.845	12.676	4.118	3.371
Marketing Cost (KES)	2.413	13.418	18.889	39.511	178.258	1056.112	30.588	40.693
Cassava acreage (Acres)	0.446	0.501	0.579	0.599	0.620	0.503	0.733	0.699

Conversion rate: 1Euro is equivalent to Kes116.06

Similarly, Table 8 indicates summary statistics for Kilifi County. The proportion of farm households that participated in commercialization were, 23 percent, 38 percent and 6 percent in the low, middle and high level categories whie 33 percent did not commercialize. Concerning gender, interesting results were noted. Kilifi had both the largest proportion of households that participated in the extreme levels of commercialization. It was noted that 45.5 percent of the men from Kilifi County participated in high level commercialization while 27.2 percent did not engage in commercialization activities. Regarding extension services, 36 percent of those who had contacts with extension officers undertook high level commercialization.

In Kilifi County, the mean distances of the households to the market centers were higher than for Siaya across all the levels. This indicates that most farm households in Kilifi County had to travel for longer distances to the market centres. Concerning schooling years, the results show that the mean schooling years for household heads who were involved in high level commercialization was (6.46 years). This was lower than for Siaya. Table 8 also indicate that Kilifi County had larger household sizes compared to Siaya. Household size can have mixed effects with regard to commercialization. In the first case, large households can

be a source of labour for cassava activities which are known to be labour intensive hence help in minimizing the cost of labour. Secondly, the large numbers can be an impediment to commercialization as it may reduce cassava marketed surplus as well as increase diversification into other off farm activities (Onya *et al*., 2016; Shapiro, 1990).

The mean value addition experience for farm households in the high level category was (4.09 years) compared to the low level category represented by (7.34 years). Table 8 further shows that with regard to the size of cultivatable land, households in Kilifi County had larger acreage compared to the ones from Siaya County.

Table 8: Summary Statistics of Variables used in Multinomial Logistic Model (Kilifi County)

Variables	NONE n=66		LOW n=45		MEDIUM n=78		HIGH n=11	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender (Male)	0.272	0.448	0.333	0.477	0.269	0.446	0.455	0.522
Extension service (Yes)	0.561	0.500	0.622	0.490	0.526	0.503	0.364	0.505
Distance(Km)	0.238	0.507	0.928	0.755	0.788	0.653	0.568	0.447
Schooling (Years)	3.772	4.213	3.888	3.651	4.807	4.671	6.455	4.906
Household size (No.)	7.469	3.054	7.289	3.409	6.897	3.273	8.273	5.569
Value addition experience (Years)	7.341	8.998	8.844	10.392	5.962	8.919	4.091	3.081
Marketing Cost (KES)	2.413	3.630	70.222	145.293	79.167	172.200	84.545	149.623
Cassava acreage (Acres)	0.446	1.327	1.175	0.749	1.848	1.506	1.704	0.640

Conversion rate: 1Euro is equivalent to Kes116.06

4.3.2.1 Multinomial Logit Estimation for the Levels of Cassava Commercialization

Multinomial logistic regression results captured the likelihood estimates of the dependent variable wich was represented by the different discrete levels of cassava commercialization. The model explains the relative effects of the explanatory variables on the various outcomes. These effects were measured using the odds ratios. The odds ratios reflect a change in the predicted probabilities of being in a given level of commercialization as a result of a change in the independent variable. Table 9 presents the econometric results of the multinomial regression model for Siaya County while for Kilifi County is presented on Table 10. In addition, diagnostic results for testing the adequacy of the model are presented at the lower

end of each table. It can be observed that the chi-square test statistics for Siaya (135.95) and Kilifi (90.25) were significant (p-value<0.05). This confirmed that the model was adequate. Based on the overall goodness of fit test, it is clear that the models are statistically significant as revealed by (p<0.05). A multicollinearity test of the explanatory variables using VIF (Variance Inflation Factor) confirmed that the correlation among the variables was insignificant implying that there was no multicollinearity.

Table 9: Parameter Estimates of the Models for Levels of Cassava Commercialization (Siaya County)

	Low Commercialization (1)			Medium Commercialization(2)			High Commercialization (3)		
Variable	Coef.	*P[|Z|>z]*	RRR	Coef.	*P[|Z|>z]*	RRR	Coef.	*P[|Z|>z]*	RRR
Constant	-3.311	0.097	0.036	-4.256	0.002	0.014	-7.900	0.000	0.000
Gender (Male)	-15.438	0.988	1.97e-07	-0.639	0.371	0.527	-1.146	0.222	0.318
Extension service (Yes)	0.846	0.318	2.330	0.840	0.127	2.318	1.085	0.137	2.959
Distance to market (Km)	-4.075**	0.017	0.017	-4.416***	0.005	0.012	-4.486***	0.006	0.011
Years of schooling	0.601	0.223	1.825	0.632**	0.042	1.880	1.333**	0.016	3.793
Household size (No.)	-0.635	0.306	0.529	0.022	0.957	1.022	0.843	0.255	2.324
Value addition experience (Years)	0.161	0.744	1.174	0.653*	0.052	1.921	0.272	0.541	1.313
Marketing Costs (KES)	0.801***	0.005	2.229	1.154***	0.000	3.172	1.030***	0.000	2.804
Cassava acreage (Acres)	0.869	0.237	2.385	0.911*	0.059	2.487	1.328**	0.027	3.773

Multinomial logistic regression — Number of observations =179
LR chi2 (24) =135.95
Prob>chi2 =0.000
Log likelihood=-123.995 — Pseudo R2 =0.354
Cox and Snell = 0.507
Nagelkerke = 0.574

*** Significant at p<0.01, ** significant at p<0.05 and * significant at p<0.10

Test of independence for the irrelevant alternatives was performed by both Hausman and LR tests. However, the two tests gave differing results. The inconsistency of the results is supported by the works of Long and Freese (2014) and Cheng and Long (2007) who also found differing outcomes of the tests. They argued that the tests offer little guidance to violation of the assumption and may be ignored. In comparing the different levels of commercialization, the none commercialization category was chosen as a base level. Therefore, the logits were interpreted with respect to the none commercialization category.

In relation to the first logit model that compared low commercialization to the none commercialization group, results for Siaya (Table 9) show that only two predictors, distance to market ($p<0.05$) and marketing costs ($p<0.01$) were found to be statistically significant at the given levels of significance. The coefficient of distance to market in the model (-4.075) was negative while for marketing cost (0.801) was positive. The negative coefficient suggests that farm households that were located farther from the market centres had lower probability of engaging in low level category relative to none level category. Furthermore, the higher the level of commercialization, the larger the coefficients became (medium= -4.416 and high -4.486) indicating a greater negative effect. This meant that farmers were less likely to engage in higher level commercialization when they were located farther from markets. This is because of the high costs of transactions associated with participation in distant markets. The results confirm the finding of Gebremedhin and Jaleta (2010) who also established that farm households are less likely to participate in markets when they are located far away. Similar results were also obtained using relative risk ratio (RRR). The relative risk decreased from low (0.017) to high (0.006) levels showing a less likelihood of engaging in higher levels of commercialization.

An unexpected result was obtained on marketing costs since positive coefficients were obtained for all the levels. This implies that farm households were more likely to participate in commercialization when marketing costs increased. However, the size of the coefficient of the marketing cost differed (low, 0.801; medium, 1.154; high, 1.030). Similarly, the RRR for the medium level (3.172) was greater than the low level (2.229). This implies that an increase in marketing cost had greater effect on the medium level of commercialization. Low level category was least affected by increases in marketing costs compared to the none level category. This contradicts the findings of other studies which found an inverse relationship (Hailua *et al*., 2015; Gebremedhin and Jaleta, 2010; Ochieng' *et al*.,2015). In their studies, they identified the main marketing costs as handling, packaging, storage, processing and

market fees. Their results revealed that marketing costs have negative implications on agricultural commercialization as they reduce market revenues which could lower market participation.

Education also had an effect on commercialization. The coefficients for years of schooling for the medium (0.632) and the high (1.333) logits were statistically significant. However, the coefficient of the high category is larger than for the medium category. Similarly, the RRR was greater for the high category (3.793) than the medium category (1.880). This implies that farm household heads who were educated were more equipped and empowered with information that guided their decisions on commercialization. This is supported by Mottaleb *et al*. (2015) who found a positive relationship between education and commercialization. However, the finding is in contrary to that of Lawal *et al*. (2014), which suggested that progress in education decreases the probability of engaging in commercialization. They argued that more educated household heads opt for off-farm activities that are reputed to have steady income as well as generate high returns.

Value addition experience was statistically significant ($0.052<0.1$) for the middle level category but insignificant for the low and high levels categories. The significant value addition experience indicates that an additional year of value addition is likely to increase the probability of being in the medium level compared to the none level category. This result is consistent with the findings of Agwu *et al*. (2013) who found that farmers with more experience on value addition are likely to undertake cassava diversification as well as engage in market participation.

The coefficients of cassava acreage for the different levels of commercialization were positive and increased in sizes, medium (0.911) and high (1.328). These values are larger and significant along the levels of commercialization. This implies that increasing cassava farm acreage enhanced the likelihood of engaging in higher levels of commercialization. This was confirmed by the RRR obtained which indicated that the effect of increasing cassava acreage for high category was 1.286 more than that for medium category. The results for Kilifi are presented in Table 10 and discussed thereafter.

Table 10: Parameter Estimates of the Models for Levels of Cassava Commercialization (Kilifi County)

	Low Commercialization (1)			Medium Commercialization (2)			High Commercialization (3)		
Variable	Coefficient	*P[|Z|>z]*	RRR	Coefficient	*P[|Z|>z]*	RRR	Coefficient	*P[|Z|>z]*	RRR
Constant	0.518	0.600	1.678	0.012	0.991	1.012	-0.874	0.389	0.417
Gender (Male)	-0.212	0.645	0.808	-0.955*	0.092	0.385	-1.034**	0.040	0.387
Extension service (Yes)	-1.372***	0.003	0.253	0.126	0.801	1.134	-0.913	0.839	0.913
Distance to market (Km)	-1.004***	0.004	0.366	-0.533	0.162	0.586	-0.870**	0.011	0.419
Years of schooling	0.479**	0.029	1.615	0.126	0.596	1.134	0.208	-0.209	1.231
Household size (No.)	-0.783*	0.055	0.457	-0.833*	0.065	1.522	-0.422	0.301	0.656
Value addition experience (years)	0.087	0.735	1.091	-0.097	0.724	0.908	0.288	0.237	1.335
Marketing Costs (KES)	4.804	0.001	122.06	5.769	0.000	144.414	4.998	0.983	148.069
Cassava acreage (Acres)	0.122	0.548	1.129	0.682**	0.027	1.251	0.298***	0.003	1.348

Multinomial logistic regression — Number of observations =200
LR chi2 (24) =90.25
Prob>chi2 =0.000
Log likelihood= -123.995 — Pseudo R2 =0.165
Cox and Snell = 0.380 Nagelkerke = 0.406

*** Significant at p<0.01, ** significant at p<0.05 and * significant at p<0.10

From Table 10, it is indicated that the findings for Kilifi County had some varying results from that of Siaya. This was expected since the two regions have different unique characteristics. In the first logit model, which shows the results for low category compared to the none level commercialization category, the coefficient for years of schooling was positive and significant, while extension service, distance to the market and household size were negative. The positive coefficient of education years implies that an additional year of schooling by farm household head increased the probability of the farm households engaging in low commercialization compared to the case for none level commercialization. This variable was however not statistically significant in the medium and high levels of commercialization. This implies that education is not an important factor for commercialization in the high and medium levels. It is possible that farm households can acquire commercialization skills and techniques through experience and trainings by extension officers and other stakeholders. This result is in conformity to the findings of Mathijs (2002) which established that more educated household heads focus more on off-farm activities.

From Table 10, it is also evident that coefficients for acreage under cassava production were positive and significant at 5 percent and 1 percent significant levels for the medium and high levels, though the coefficient for medium (0.682) category was greater than high level (0.298). The positive signs indicate that an increase in acreage under cassava cultivation increases the likelihood of up scaling commercialization. This effect is more pronounced for the medium than for high level. This implies that those who are in higher levels already have larger parcels of land and therefore land is not the main incentive at that level. For the medium, most of them have small land and hence land could have a higher effect on commercialization as noted by Martey *et al*.(2012).

Contrary to Siaya results, household size in Kilifi negatively influenced the probability of being in the low (-0.783) and medium (-0.833) categories. The effect was greater in the medium level than for the low category. However, the variable was insignificant in the high category. This implies that an increase in farm household size reduced the likelihood of engaging in the medium and low levels of commercialization. The effect was more noticeable for the medium than in the low level category. There are mixed opinions concerning the effect of household size on commercialization. One argument has been that a large household size exerts pressure on the limited household resources. This means that all or a greater proportion of production is channeled to meet the household demand with less surplus left for commercialization. This result confirms the findings by Gebremedhin and Jaleta (2010) that

smallholder households can barely meet their daily requirements especially when the household size is large. The other argument is that large household size can be a source of labour at different stages in the cassava commercialization chain.

Table 10 also shows that distance to the market was significant though with a negative coefficient on the low (-1.004) and high (-0.870) levels of commercialization. This implies that farmers who were farther from markets were less likely to undertake commercialization. The RRR for the high category (0.419) similarly indicates higher probability of participating in markets located further a way from the farm households than that of the low category (0.366). The result contradicts the finding of Lawal *et al*. (2014), which found that an increase in transport costs increases the likelihood of farm households' participation in commercialization. This could be possible especially when the returns expected from the transaction outweighs the cost by a greater margin.

The results of Table 10 indicate that extension services had a negative relationship with a low level commercialization relative to none level. However, the variable was not statistically significant in the medium and high logit models. By implication, farm households are less likely to engage in low level commercialization despite making contacts with extension officers. Contacts with extension officers act as networks for disseminating information and this is expected to heighten commercialization (Rahut *et al*., 2015). Probably most farm households do not heed advice given by extension officers. Another possible explanation could be that the extension services focus on other activities which are unrelated to cassava commercialization.

It can be shown that gender of the household head negatively influenced participation in the medium (-0.955) and high (-1.034) categories and the coefficient was increasingly large for the high level. The negative effect of the gender variable implies that male headed households were less likely to engage in higher levels of commercialization. Several studies have shown contradictory results. The study finding is consistent with the argument that a man's social life is less interactive compared to a woman's and this lowers his integration into cassava commercialization activities (Agwu *et al*., 2015). However, it contradicts the finding of Lara *et al*. (2016) which demonstrated that both men and women actively participate in cassava commercialization activities in Nigeria. Forsythe *et al*. (2016) in their study established that men are mostly involved in marketing of cassava while women engage more in processing activities. Therefore, in both counties, factors influencing commercialization at the various levels in the regions differ slightly and this calls for

different measures that identifies with the regions in order to promote cassava commercialization.

4.4 Comparison between Incomes Earned from Cassava and other Selected Crops

In this section the study has addressed the second objective of the study which involved a comparison of the proportion of income earned from cassava commercialization with the income from the other selected crops in Siaya and Kilifi Counties. The study sought to establish the existence of disparities in income earned. This analysis is linked to the overall objective of the study since income differences or returns from various crops are key drivers of household income. The crops which are commonly grown in the two counties include; sorghum, cassava, sweet potato, maize, ground nuts, and legume crops. The returns from the different crops were computed and ANOVA test was performed to compare the net returns from cassava commercialization and returns from the other crops. Table 11 shows a summary of the results obtained for Kilifi County.

Table 11: Comparative Expenses and Returns of Different Crops (Kilifi County)

Crops	Crop %	Mean Acreage	Annual Sales (Kes)	Annual Expenses (Kes)	Net Income (Per year Kes)	Net Income (Per acre Kes)
Sorghum	3%	0.40	625	613	12	30
Cassava	100%	1.52	13,089	6703	6386	4257
Sweet potatoes	9.5%	0.61	103.5	182.5	-79	-129
Maize	97%	2.18	34,696	31425	3271	1500
Groundnuts	1%	0.58	25	8.6	16.4	28
Legumes	29%	0.64	1182	615	567	886

Note: Net returns= Net revenue - Total costs
1 acre = 0.045 hectare
Conversion rate: 1Euro is equivalent to Kes116.06

Table 11 shows that all farm households in Kilifi County grow cassava (100%) followed by maize (97%) and then legumes (29%). Considering the mean acreage under each crop, maize was was the highest with 2.18 acres, followed by cassava at 1.52 acres, while sweet potatoes and legumes had 0.61 acres and 0.64 acres respectively. The remaining crops are also fairly presented in the county as observed acreages are sorghum (0.40 acres) and groundnuts (0.58

acres). The legumes consist of green peas and green grams which were also found to be commonly produced in the county. Moreover, it was observed that intercropping was a common practice in the county because of limited productive land. Concerning the costs of production under each crop, farm households spent more money on maize and cassava relative to the other crops. Maize expenses (Kes 31,425) almost balanced off the sales (Kes 34,696) while expenses for cassava (Kes 6,703) were about half of the sales (Kes 13,089). It is worth noting that households consumed a large proportion of what they produced and only sold the surplus. Table 12 further indicates that net income generated from maize was low (net income per acre Kes 1500) considering the acreage under production, while cassava had a net income per acre of (Kes 4,257).

The results further indicate that maize is the main staple food in Kilifi County. In fact, majority of farm households consume both raw and dried forms of maize hence limiting the quantities available for marketing. This was also evidenced by the proportion of maize output that was consumed. The mean maize output and the amount consumed were 1160 kg and 869 kg respectively, while for cassava, an average of 1370kg was produced and 568 kg consumed. This shows great difference in terms of the amount of sales for the two crops which were also high contributors of income. The finding indicates that in Kilifi County, cassava is more inclined towards marketing while maize farming is majorly used for subsistence purposes.

Siaya County had slightly different findings from Kilifi concerning the proportion of income generated from the various crops. However, we observe significant differences in productions of the crops. Examining the households' production behaviour, cassava was produced by all the sampled households; maize was second at 93.4 percent, followed by sorghum and legumes at 76.2 percent and 63.5 percent respectively. Table 12 shows that the greatest allocation of land acreage was on maize with an average acreage (0.87 acres) and cassava (0.57 acres) with the rest of the crops covering less than half an acre. This was however not surprising since a good proportion of farm households own small parcels of land of less than 3 acres each, which confirms the findings by Obiero (2013). The study found that farmers from Siaya County are mostly peasant farmers who own less than 3 acres of land.

Table 12: Comparative Expenses and Returns of Different Crops (Siaya County)

Crops	Crop %	Mean acreage (acres)	Annual Sales (Kes)	Annual Expenses (Kes	Net income per year (Kes)	Net income (per acre Kes)
Sorghum	76.2%	0.43	1044	655	389	905
Cassava	100%	0.57	4731	826	3905	6851
Sweet potato	34.8%	0.25	174	62	112	448
Maize	93.4%	0.87	3555	1697	1858	2135
Groundnuts	38.7%	0.37	1010	389	621	1678
Other legumes	63.5%	0.46	1282	267	1015	2206

Note: Net returns =Net revenue - Total costs
1 acre = 0.045 hectare
Conversion rate: 1Euro is equivalent to Kes116.06

Typically, most smallholder farmers in the county practise intercropping because of the limited land. Cassava and maize are in most cases intercropped with other crops such as groundnuts, sorghum, millet and beans. This is mainly done during the first year of production as a strategy of maximizing output since cassava is a perennial crop. With these small sizes of land and high poverty levels, crop diversification and commercialization could be a challenge in the county.

With regards to the average expenses incurred for the various crops during the production period, maize (Kes1,697) had higher expenses than the other crops, followed by cassava (Kes 826) and sorghum (Kes 655). The rest of the crops incurred minimal expenses as was the case in Kilifi. In terms of crop diversification, farm households in Siaya County were growing a variety of crops compared to Kilifi County where the dominant crops were cassava, maize and legumes. According to Chhatre *et al*. (2016), diversification into other crops is a risk management strategy. The study further revealed that farm households can improve total crop returns by appropriately choosing a mixture of crops. Karuri *et al.* (2001); Munga (2012) and Danda *et al.* (2015) also made similar observations.

According to Table 12, the average income per acre from cassava (Kes 6,851) and maize (Kes 2135) were slightly higher than the average earnings for Kilifi. This shows that there is more optimal use of resources in Siaya County compared to Kilifi. Generally in both countries, the cost of producing and processing cassava was found to be low in contrast to maize. This could be because of the difference in labour and input requirements. In both cases, farm households employed family labour with minimal engagement of hired laborers. However, it was established that minimal amount of resources was spent on processing and

marketing of cassava. This is consistent with the findings of Eze and Nwibo (2014) who found that cassava crop involves low operational costs making it more economically viable compared to other crops.

Labour costs may also involve other indirect costs which must be measured. In accounting for labour expenses, it was established that farm households use other modes of payments such as in-kind. The in-kind payment was commonly practised in Kilifi County where a number of households settled the labour costs with cassava products using fair market value instead of paying cash. In some cases, both modes of payments were used. This case is similar to that described by Kurosaki (2008) which revealed that when food security considerations are vital for farm workers as a result of poverty or thin markets, farm workers prefer in–kind wage payment instead of cash.

Table 13: Summary Statistics of Crops Harvested, Consumed and Sold

	Siaya County			Kilifi County		
Crop	Quantity Harvested (Kg)	Quantity Consumed (Kg)	Quantity Sold (Kg)	Quantity Harvested (Kg)	Quantity Consumed (Kg)	Quantity Sold (Kg)
Sorghum	132.36	56.90	41.79	1.65	1.55	0.10
Cassava	291.48	131.35	152.07	1370.47	568.62	761.33
Sweet potatoes	56.13	42.87	12.60	12.87	7.25	4.15
Maize	332.63	179.28	135.45	1125.46	843.54	233.12
Ground nuts	98.35	14.82	68.91	0.46	0.36	0.10
Other Legumes	120.71	43.50	25.04	19.23	12.50	11.11

Table 13 presents a summary of cassava output, quantities consumed as well as sold. It is evident that the main crops harvested were maize and cassava in Siaya County while legumes were least harvested. Additionally, 54 percent of maize produced was consumed while 41 percent was sold. Farmers consumed 45 percent of the cassava they produced and sold 52 percent of the output. This implies that maize was mainly used as a staple food while cassava was used for commercialization. Overall, sweet potatoes and ground nuts were least produced and most of the output were used for consumption. It is worthy to note that production of cassava and maize in Kilifi was about three times that of Siaya County. 41 percent of cassava

harvested was consumed while sales accounted for 56 percent. Concerning maize, 74 percent of the harvest was consumed while 21 percent was sold. Generally, in both counties high proportion of cassava was commercialized. The study made a comparison of the cash flow generated from cassava and other crops with respect to the overall household income as represented in Figure 9.

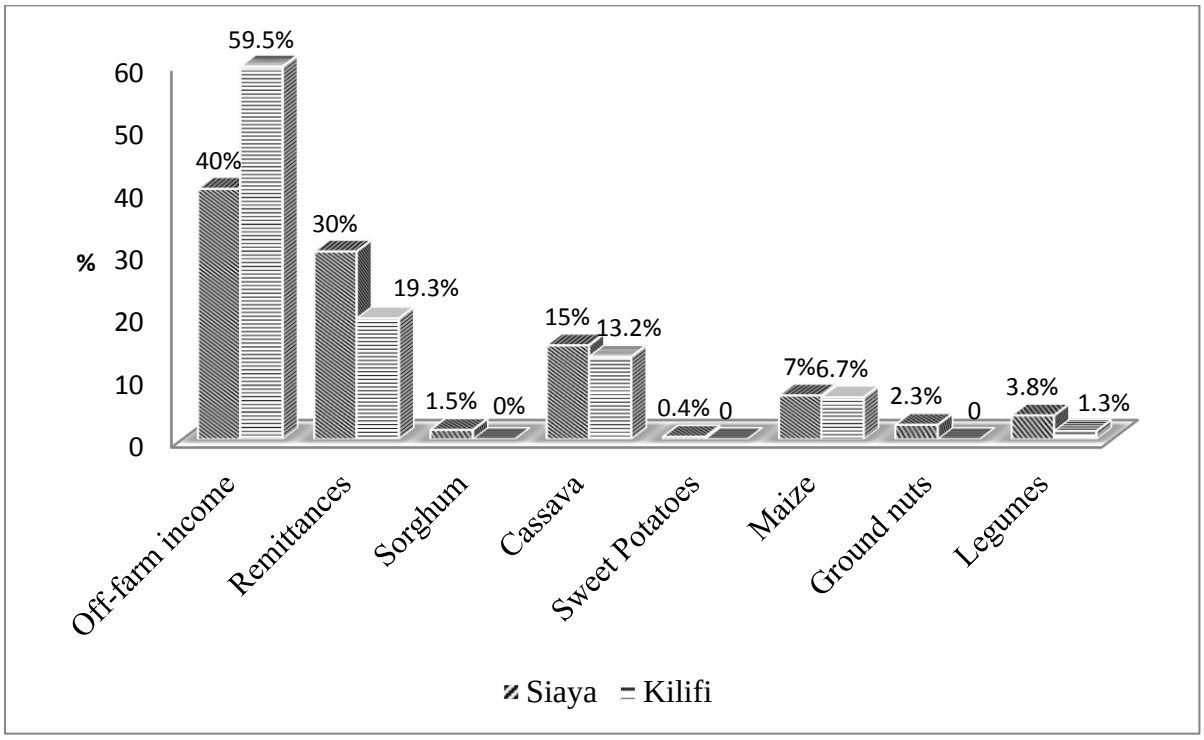

Figure 9: Contribution of Different Income Components to the Total Household Income

Figure 9 shows the proportion that the main income components contributed towards the total household income. Off-farm income contributed 40 percent (Siaya) and 59.5 percent (Kilifi), followed by remittances 30 percent (Siaya) and 19.3 percent (Kilifi). The aggregate proportions for off-farm and remittance incomes were 70 percent (Siaya) and 78.8 percent (Kilifi). This implies that 30 percent (Siaya) and 22.2 percent (Kilifi) incomes are accounted for from the other sources, mostly crop production. Out of the six crops that were considered, cassava contributed the highest amount in both counties; this is represented by 15 percent and 13.2 percent for Siaya and Kilifi respectively. The second highest contributor was maize crop as signified by 7 percent and 6.7 percent for Siaya and Kilifi respectively. The rest of the crops contributed less than 5 percent in both counties. It is of particular interest that in Kilifi County, some crops such as sorghum, sweet potatoes and groundnuts had insignificant returns recorded. This could imply that either the production of the crops were minimal or the crops were mainly produced for subsistence as evidenced by Ong'ayo (2017).

A report from the county of Kilifi GOK (2015) indicated that green peas and green grams are either rain fed or grown under irrigation. This makes them prone to harsh climatic conditions such as drought. These findings are consistent with the study of Munga (2000) and Danda *et al*. (2015) which found that maize is the main crop grown in Kilifi and Siaya Counties, and that it is mainly produced for household consumption since majority of households prefer its taste. Moreover, cassava crop is mainly produced for market participation especially in Kilifi County, whose potential can be enhanced. This is consistent with the findings of Martey *et al*. (2012) that the degree of maize and cassava commercialization is high in comparison to other crops. It has been recognized that cassava commercialization is a profitable venture that farmers should reconsider because of the cost advantages it has over other crops (Obasi *et al.*, 2015).

To understand the differences between the returns from various crops in relation to that of cassava, ANOVA test was performed. This aimed at determining whether the means of incomes from the various crops were significantly different from that of cassava. The null hypothesis stated that there was equality of the means for the incomes of the crops while the alternate hypothesis was that the mean of at least one crop was different from that of other crops (See Appendix 5). For Siaya, the null hypothesis was rejected at ($p<0.05$). This implies that at least one of the incomes generated from the other crops was significantly different from that of cassava. This was expected since the crops received different treatment and attention. This is consistent with the findings of Jayne *et al*. (2004) which found that variability in the incomes from various crops is a common occurrence.

The results further prompted a comparison between individual incomes from cassava with the income of the other crops to determine which ones significantly differed. This involved undertaking multiple comparison test based on Bonferroni test. The results are as presented in Table 14. The findings show that income from cassava was statistically different from incomes from groundnuts, sorghum and sweet potato ($p<0.05$).

Table 14: Comparison of Revenue Earned by Crops in Siaya County

	Cassava	Ground nuts	Legumes	Maize	Sorghum
Groundnuts	-2674.56 0.034**				
Legumes	-2499.09 0.065	175.47 1.00			
Maize	-1466.09 1.00	1208.47 1.00	1033 1.0		
Sorghum	-3135.5 0.005***	-460.939 1.00	-636.409 1.00	-1669.41 0.844	
Sweet potato	-2874.67 0.015**	-200.11 1.00	-375.58 1.00	-1408.58 1.00	260.829 1.00

Note: *** and **means significant at 1% and 5% respectively

Similar tests were conducted for Kilifi. Results (Appendix 7) revealed that the mean of the incomes were not equal, suggesting that at least one crop generated an income which was significantly different from the others ($p<0.001$). Therefore, the study had to establish which crops had income that varied from cassava income. Bonferroni test was performed to compare the difference of income between several pairs of crops. The results in Table 15 show that incomes generated from groundnuts and sweet potatoes were significantly different from that of cassava. The difference in incomes could be as a result of the factors surrounding the decision to commercialize. As explained earlier in the theoretical framework, consequences of commercialization are both endogenous and exogenous. This is consistent with the findings of Nwafor *et al*. (2016) which stated that income earned from cassava commercialization is generally higher than for other traditional crops and hence could be used in food expenditures as well as increasing production of other crops for both consumption and market orientation. Among the factors that perhaps led to differences in income between different crops is the costs involved in production and quantity sales. According to Sadoulet and De janvry (1995), costs can be an impediment to market participation especially when the crop is an essential commodity in the household thus reducing income. Difference in income can also be caused by response of urban consumers who purchase most of these commodities at the expense of the others (Jayne *et al*., 2004). Further, they cause price variations of other commodities. This could lead to more income earned from the commonly purchased crops than the ones that are not purchased. Another

aspect that could also explain the variation is the proportion of acreage under maize which tends to differ from the other crops.

Table 15: Comparison of Revenue Earned by Crops in Kilifi County

	Cassava	Ground nuts	Legumes	Maize
Ground nuts	-6052.57 0.005***			
Legumes	-3147.34 0.94	2905.24 1.00		
Maize	-3114.45 0.992	2938.12 1.00	32.884 1.00	
Sweet potatoes	-6184.84 0.005***	-132.263 1.00	-3037.5 1.00	-3070.38 1.00

Note: *** means significant at 1%

The study found that Kilifi farmers had big portions of land and that maize acreage was almost double that of cassava. From literature, larger land sizes increases the likelihood of producing marketed surplus as well as engaging in value addition. Groundnuts and legumes are however mostly produced for consumption. In most cases they were intercropped with maize or cassava and therefore cassava income was not majorly influenced by their production. Overall, the results indicate that a number of households produce sorghum, sweet potatoes, groundnuts and legumes for household consumption while cassava and maize are for market orientation. Obayelu *et al.* (2013) comparably had similar views. A study by Nwafor *et al*.(2016) and Nandi *et al*.(2011) also established that cassava commercialization is profitable and can uplift households from poverty

4.5 Evaluating Marketing Margins of Traders and Farmers

In this section, the study addressed the third objective of the study. This involved evaluating marketing margins among the actors along cassava marketing chain in the two counties to gain more understanding on the performance of traders and farmers along the chain. Sample statistics of the variables describing traders are summarized in Table 16.

Table 16 indicates that female respondents are the majority by 86.8 percent and 89.8 percent in Siaya and Kilifi Counties respectively. This suggests that cassava business is a women oriented venture. This is similar to earlier findings on the proportion of gender

involved in cassava farming which revealed that women participate in cassava production, processing and marketing activities. The results are in agreement with the findings of Okoye *et al*. (2016) and Olukunle (2016) which revealed that female have dominance over cassava related activities.

Table 16: Socio-Economic Characteristics of Cassava Traders in Siaya and Kilifi Counties

Variables	Siaya (53) Percentage	Kilifi (49) Percentage	Pooled (102) Percentage
Gender			
Male	13.2	10.2	11.8
Female	86.8	89.8	88.2
Age			
18-30	26.4	18.3	22.6
31-40	26.4	32.8	29.4
41-50	17.0	32.7	24.5
51 years and above	30.2	16.2	23.5
Marital Status			
Married	64.2	40.8	52.9
Single	9.4	38.8	23.5
Divorced	3.8	4.1	3.9
Widowed	22.6	16.3	19.7
Education level			
None	15.1	22.5	18.6
Primary	69.8	57.1	63.7
Secondary	15.1	16.3	15.7
Tertiary and College	0	2.0	1.0
Others	0	2.0	1.0
Years of Experience			
0-10	84.9	73.5	78.4
11-20	15.1	18.4	16.7
21-30	0	8.1	4.9

In terms of age group, a big proportion of respondents from Siaya County belonged to age groups 18-30 years and 31-40 years represented by 26.4 percent, while in Kilifi there was a slight difference in the distribution, 32.8 percent were in the age brackets of 31-40 years and 32.7 percent for the age group 41-50 years respectively. This indicates that older people (from 51 years and above) were less likely to participate in marketing of cassava products than the middle aged farmers who are assumed to be economically active and hence form a greater proportion of the working force.

The study also found that a large proportion of traders in Siaya (84.9%) and Kilifi (79.6%) had attained primary level education and below. A smaller percentage; Siaya (15.1%) and Kilifi (16.3%) represented the respondents with secondary and tertiary

education. This indicates that the learned individuals from Siaya could be possibly engaged in other off-farm jobs that require education. Notably, 15.1 percent and 22.5 percent of the traders from Siaya and Kilifi Counties correspondingly had not attained any level of education. Therefore, these results represent a low level of education among traders in both counties. It is known that the level of education has a strong relationship with access to information on marketing activities as well as the marketing margin (Abu *et al*., 2014). Education is envisaged to positively facilitate acquisition of information and knowledge thus increasing market opportunities through linkages. Traders who are well educated are able to exploit potential markets by gathering useful information which can guide them in pricing of their products as well as adopting technological innovation (Ajibefun, 2004).

Table 16 further indicates that in terms of cassava marketing experience, a large proportion of traders from Siaya (84.9%) and Kilifi (73.5%) had experience ranging between 0 and 10 years with the rest having an experience of above 10 years. It is hypothesized that traders who are more experienced are familiar with marketing techniques and could be more efficient in managing cassava business. A study by Rahman and Awerije (2014) found that experience significantly influence the marketing margin of cassava. The study argued that a marketer's experience predominantly influences marketing activities. A more experienced trader has a wide scope of knowledge and understanding of marketing techniques and approaches that are workable. The results obtained from the pooled analysis are in agreement with the single data analysis.

4.5.1 Marketing Characteristics of Cassava Traders

Table 17 indicates that 37 percent of the traders from Siaya County responded that inadequate demand for cassava products was the principal challenge which greatly hampered marketing activities. Their response however differed from that of farmers who observed that the demand for value added products was on the rise. Other marketing challenges experienced by traders from Siaya County which limited free marketing of cassava products include; distance to the market (24.5%), lack of storage facilities (15%), and fear of poisonous cassava varieties (13.3%). Therefore, distance to the market was the main challenge that traders experienced. The results also indicate that poor prices of cassava products was a marketing challenge that possiblly contributed to low margins. The results support the findings of Emokaro (2010) that low prices of cassava products contributes to low profitability and this has sometimes forced marketers to substitute cassava business with other businesses or

combine a number of businesses to mitigate the potential risk of losses. Traders from Kilifi County (28.6%) reported that the bulky nature of the crop particularly was the main challenge that they encountered in marketing cassava products. This perhaps suggests that besides value added cassava, they were involved in marketing of raw cassava. Poor prices (24.5%) and inadequate demand (20.4%) also limited participation in marketing activities.

Traders obtain cassava products from different sources, ranging from marketing their own products to purchasing directly from farmers as well as other traders. This study established five possible sources of cassava products. These include; local traders, traders from other markets, trader groups, farmers and self-production. Table 17 shows that majority of the respondents from Kilifi County sourced their stock of cassava products from local traders and farmers. This is represented by 24.5 percent and 34.7 percent respectively. This indicates that cassava marketing chain in the region is short which could probably be related to low transaction costs. This finding compares favourably with that of Asogwa *et al* (2013). The study found that marketers receive a significant marketing margin, mainly because majority of them get their stock directly from farmers. Siaya traders sourced for their stock mainly from local traders (50.9%).

In relation to price determination, 62.2 percent of Siaya traders majorly relied on market rates while 48.9 percent of Kilifi respondents depended on farmers prices. This result has a close link with the sources of cassava products. Traders also considered some quality features before buying cassava products. Some of the characteristics that Siaya traders mainly considered when making purchase were moisture content and cleanliness. These are represented by 54.7 percent and 32.1 percent respectively. Kilifi traders on the other hand were keen on maturity of the crop and moisture content as represented by 40.8 percent 32.7 percent. Table 17 also shows that in both counties, formal contracts are almost non-existent apart from Kilifi County that had one response. Most of the purchases were made informally without any binding contracts with unarranged purchases taking the lead at 69.8 percent and 71.5 percent for Siaya and Kilifi counties respectively. The pooled data results were closely related to the above findnings. Inadequate demand (28.1%) was one of the major marketing challenges while majority of traders bought cassava products from the local traders. Also, prices were mainly determined by the market rate and generally traders considered the moisture content when buying the products.

Table 17: Distribution of Cassava Traders by Marketing Characteristics

	Siaya (53%)	Kilifi (49%)	Pooled (102)
Marketing Challenges	**Percentage (%)**	**Percentage (%)**	**Percentage (%)**
Poor prices	9.4	24.5	16.9
Distance to the market	24.5	16.3	20.4
Inadequate demand	37.8	20.4	28.1
Lack of storage facilities	15.0	2.0	8.5
Fear of poisonous varieties	13.3	8.2	10.8
Bulkiness	0	28.6	15.3
Sources of cassava Products	**Percentage (%)**	**Percentage (%)**	**Percentage (%)**
Local traders	50.9	24.5	36.7
Traders from other markets	18.9	16.3	17.5
Trader groups	0	4.1	3.1
Farmers	22.6	34.7	28.7
Self- production	7.6	20.4	14.0
Price Determination	**Percentage (%)**	**Percentage (%)**	**Percentage (%)**
Market rate	62.2	24.5	43.4
Farmer price	13.3	48.9	31.1
Negotiable	11.2	12.3	11.8
Group decision	13.3	14.3	13.7
Purchase considerations	**Percentage (%)**	**Percentage (%)**	**Percentage (%)**
Moisture content	54.7	32.7	43.7
Maturity	9.4	40.8	25.1
Cleanliness	32.1	20.4	26.3
Size of cassava	3.8	6.1	4.9
Contractual arrangements	**Percentage (%)**	**Percentage (%)**	**Percentage (%)**
Formal contracts	0	2.0	1.0
Informal contracts	30.2	26.5	28.4
None	69.8	71.5	70.6

4.5.2 Forms of Value Added Cassava

Table 18 shows the prices and quantities of both raw and value added cassava products for Kilifi and Siaya Counties. It is clear that in both counties, majority of smallholder farmers marketed raw cassava as indicated by the comparatively higher quantities of raw cassava sold than for value added products. It is also evident that different products fetched different prices. Raw cassava was sold at the least price. This price was even much lower in Siaya County than in Kilifi County. For value added products, the prices depended on the form of value addition. The highest level of value addition, frying, attracted the highest price while the lowest form of value addition attracted the lowest price. A comparison of prices across the counties show that value added products for Kilifi was more than double that for Siaya. This is represented by Kes 37.50 and Kes 89.12 for Siaya and Kilifi Counties respectively. Hence farmers should consider undertaking higher value addition practices as a way of enhancing commercialization for improved household income.

Table 18: Summary Statistics for Different Forms of Value Added Cassava

	Siaya County				Kilifi County			
Form of value addition	Yes	No	Quantity sold (Kg)	Price per Kg	Yes	No	Quantity Sold (Kg)	Price per Kg
Raw cassava	45.60	54.40	67.00	21.35	36.24	63.76	660.64	30.60
Roasting	3.31	96.69	0	0	16.00	84.00	22.63	31.25
Boiling	29.83	70.17	14.19	0	48.50	51.50	23.34	54.30
Drying	45.86	54.14	39.77	27.90	18.00	82.00	20.94	45.00
Milling	43.65	56.35	12.16	36.53	19.50	80.50	20.62	66.28
Frying	8.84	91.16	18.95	37.50	17.00	83.00	13.15	89.12

4.5.3 Computation of Marketing Margin for Traders

Marketing margin was computed as per Table 19. The results clearly indicate that the margin for traders from Kilifi County was more than double (Kes 34.44) that of Siaya (Kes 12.79). This was due to a significant difference between the buying and the selling prices. This could be supported by the fact that most traders from Kilifi County purchased the products directly from farmers while a considerable number of traders were also cassava producers. Traders from Siaya County on the other hand primarily obtained cassava products from other traders and this is presumed to have contributed to the low marketing margin. According to Abdullahi *et al*. (2004), purchases made through middlemen normally include a premium over the farm gate price which has to be factored in the selling price. Therefore high marketing margin is evidenced to be a sign of profitability as well as the capability of traders to settle marketing costs.

Table 19: Marketing Margin of Cassava Products per Kilogram

Variables Items	Siaya Amount (Kes)	Kilifi Amount (Kes)
Sale price of cassava products per Kg(a)	48.36	74.88
Purchase price of the products by traders per Kg (b)	35.57	40.44
Marketing Margin (a-b)	12.79	34.44
Ratio of the price difference	1.35	1.85

4.5.3.1 Determinants of Marketing Margins of Traders in Siaya and Kilifi Counties

A model that relates marketing margin and its determinants was fitted. The computed marketing margin was regressed against a number of independent variables. They include; quantity of cassava products sold, purchase times, transport costs, cost of labor, market charges, and cost of storage. An informative summary of the variables is presented in Table 20. Average quantity sold for Siaya was greater than that for Kilifi. The weights are represented by 444.23 kg and 253.71 kg respectively. This variation was expected to influence marketing margin. The higher the quantities sold, the lower the marketing margin which is as a result of low consumer prices since traders are able to enjoy the benefits derived from economies of scale. Average weekly purchases of cassava products are presented by; 28.75 weeks and 34.63 weeks for Siaya and Kilifi Counties respectively. The purchase frequency was expected to either lower or increase the marketing margins depending on the availability of customers and demand for products. Traders normally respond to an increase in demand by making frequent purchases.

Years of experience influences the ability to make rational based on the past experience and information gathered. Traders with more years of experience are assumed to have networked with different traders in other markets as well as farmers. Traders from Kilifi County had more years of experience indicated by 7.78 years than their counterpart who had 7.18 years. In reference to transaction costs incurred in marketing cassava, Table 18 shows that the mean transport costs were Kes 1264.91 and Kes1473.47 for Siaya and Kilifi respectively. This could probably be related to distance to market which is in conformity with earlier observation where Kilifi traders mentioned distance to the market as one of the major challenges they experienced. Therefore, traders are forced to raise consumer prices if they expect to gain from cassava business venture.

Table 20: Summary Statistics of Variables used in the Regression Models for Traders

Variables	Siaya (53)				Kilifi (49)			
	Min	Max	Mean	Std Dev.	Min	Max	Mean	Std Dev.
Marketing Margin	0	100	26.95	22.85	0	100	57.59	25.79
Age (Years)	18	58	12.75	39.19	19	57	39.08	10.59
Education (Years)	0	13	5.25	3.25	0	12	4.82	3.66
Quantities Sold (Kg)	60	2400	444.23	377.26	10	1200	253.71	257.43
Purchase no.(Weeks)	4	48	28.75	16.77	4	150	34.63	24.99
Years of Experience	0	40	7.18	6.83	0	26	7.78	7.25
Transport Cost(Kes)	0	7200	1264.91	1578.26	0	9600	1473.47	1977.35
Cost of labour (Kes)	0	5200	804.15	1521.93	0	3600	384.49	767.39
Market charges (Kes)	0	3200	833.69	857.11	0	2400	600.00	558.94
Cost of storage (Kes)	0	6000	730.19	1211.29	0	1600	322.96	477.07

The high costs could also imply that there exist inefficiencies on infrastructure which highly impacts on costs making most traders to market their products at farm gate or the nearest centres. Similar to that argument, Okoye *et al* (2016) and Adenoji (2012) found that farmers who experience high transportation costs are unlikely to participate in markets and that transport cost is one of the highest incurred costs in marketing of cassava. Cost of labour for Siaya was comparatively higher than for Kilifi County. The values were Kes 804.15 and Kes 384.49 for Siaya and Kilifi Counties respectively. Moreover, it can be observed that market charges and cost of storage were also higher for Siaya compared to Kilifi County. In general, traders from Siaya County comparably spent more on marketing costs and storage costs than Kilifi traders and this minimized the revenue earned from the venture as well as affected the marketing margin. Therefore, an estimation of the mentioned variables on the marketing margin was conducted and two different sets of data based on each of the counties were used. This is discussed below.

4.5.4 Results of Multiple Regression Analysis for Traders

Two different multiple regression models, namely, the linear and double-log models were fitted, compared and the one with the best fit was used for interpretation. Different criteria exist for selection of the best fit model as identified by Keene (1995). The criterion used to select the best fitted model in this study was based on the coefficient of determination (R-

squared) and other economic considerations such as the conformation of the estimated coefficients to the *a priori expectation*. The study also considered the existence of multicollinearity. Multicollinearity test was performed using VIF. According to Chatterjee and Hadi (2012), multicollinearity exists if the largest VIF is greater than 10. In this study, there was no evidence of multicollinearity (see Appendix 10). Interpretation was based on the double log models which gave the best fit. Therefore, the output in Table 21 shows that the r-squared was 0.542. This implies that explanatory variables explain 54.2 percent of the variation in the marketing margin.

Based on this model, age of the respondent ($p<0.05$) had a positive significant effect on the marketing margin. This implies that marketing margin of traders increased with age. An increae in age by one percent increased the marketing margin by 88 percent. This shows that as traders age increases, they become more experienced and therefore understand marketing tactics better than the young traders. This is of course very helpful when undertaking marketing activities such as sourcing for products at affordable prices and getting the right quality products. This is also seen in the descriptive statistics analysis where majority of traders were 51 years old and above. In support of this, Kalole and Kyanjo (2013) also found that age positively contributes to marketing margin since aged traders have established networks with other traders and this reduces time spent on information search and network building. Contrary to the finding, Tiri (2015) and Apata (2003) noted that old traders are less likely to be creative and innovative which highly reduces the flow of market information. Furthermore, older people tend to be inefficient compared to the young traders who are proactive and full of energy to drive marketing activities.

The frequency of cassava purchases had a positive significant influence on the marketing margin. The frequency of purchases could as well correspond with the demand for cassava products. When the demand for cassava products is high, more supplies are needed and restocking has to be done quite often. This then leads to increased sales which subsequently increases marketing margin. As a result, traders will make frequent purchases to meet the demand of products which is also occasioned by population growth and preference choices of consumers as argued by Ogisi, Begho, and Alimeke (2013) and Sharp and Allsop (2002). On the other hand, frequent purchases could imply that the products being sold have got a short shelf life aand this demands for frequent purchases. Nagessa *et al*. (2012) examined the association between purchase frequencies and marketing margin. The study concluded that increasing frequency of purchases is possible when traders market perishable products. Therefore the mixed results for Siaya and Kilifi could probably be supported by descriptive

statistics which show that traders from Siaya County sold more volumes than their counterparts.

Marketing experience of the household head positively influenced marketing margin (Table 21). An increase in experience by one percent, increased the marketing margin by 0.76 percent. A probable explanation is that, a more experienced trader is in a position to make rational decisions which can influence the profitability of cassava products. Besides, they have established good networks with other traders or farmers who offer reasonable prices and hence possess better bargaining skills as echoed by Nganga *et al*. (2010). Experience is also associated with efficiency; for instance, if a person engages in a business for a long period of time, he becomes more efficient in managing the operations and activities of the business. This further minimizes costs which consequently increases marketing margin. Moreover, traders with little experience have limited knowledge and understanding on the marketing dynamic forces and, intermittently, are manipulated by other traders. Therefore, the results are in line with Nduka and Udah (2015) who similarly found a positive relationship between marketing experience and marketing margin. They argued that a more experienced marketer is capable of making rational decisions.

Concerning the various costs that had been identified to contribute to marketing margin (Table 21), only two of them had a significant effect. Transport cost ($p<0.01$) and storage cost ($p<0.05$) had a negative significant influence on the marketing margin. A percentage increase in cost of transport lowered the marketing margin. It is argued that high transport costs, which is a major cost component in marketing of cassava, would lead to market inefficiencies hence lowering the profitability of cassava business (Emokaro *et al*., 2010). A study by Mojtaba *et al*. (2012) found that costs are normally passed on to consumers but sometimes buyers react to high costs forcing traders to lower the costs hence reducing the margins. Nduka and Udah (2015) made a similar observation in their study on marketing margin and determinants of net returns to Gari marketer. The findings of the study revealed that transport cost is one of the main contributors to marketing costs hence reducing the net revenue earned by traders. A closer examination at the results shows that cost of transport accounted for close to 20 percent of the overal costs. Therefore, both studies favorably show that transport cost is the main cost component of marketing costs which greatly determines the levels of cassava margin.

Table 21: Regression Coefficient Estimates of Determinants of Cassava Marketing Margins of Siaya Traders (Double Log Model)

Independent variable	**Coefficient**	**T-ratio**
Constant	-7.361	-1.270
Age of the trader	0.882	0.375**
Education of trader	0.631	1.270
Quantity of cassava sold	0.916	1.160
Purchase times	1.085	1.710*
Experience of household head	0.760	1.840*
Transport cost	-0.644	-3.590***
Labor cost	-0.198	-1.540
Market charges	-0.041	-0.230
Storage cost	-0.291	-2.210**
R (Coefficient of determination)	0.542	
F-Stat	6.42	
Sample size	52	

***=Significant at 1%, ** Significant at 5% and * Significant at 10%
Not: Dependent variable is marketing margin

Storage cost also had an implication on the marketing margin of traders from Siaya County. An increase in the costs by one percent further led to a decline in marketing margin by 0.29 percent. This could mean that most traders had inadequate storage facilities; either they did not have permanent stalls or shops where they stored their products. It was observed that a number of traders operated from verandas of shops, under trees or in open air. Also, some of the traditional storage facilities did not offer proper storage which could have led to deterioration losses. Some of the most commonly marketed products by traders were in dried or milled forms which are deemed novel storable products. Quaye and Kanda (2004) in their study found that storage charges vary from one market to another and that they are an important component of marketing costs that determines the price paid by customers for the products at the market place Similar results were obtained from a study conducted by Mojtaba *et al*. (2012). They found that an increase in storage costs reduced marketing margin consequently lowering marketing margin.

A similar analysis was conducted for Kilifi County and the criteria used to select the best fitted model was on the coefficient of determination (R-squared) as well as other economic

considerations such as signs of the estimated coefficients which are in line with the *a priori expectation* as suggested by Nandi *et al*. (2011). Based on the double log model, factors that were found significant include; education, quantities sold, purchase times, years of experience and labour costs. The independent variables outlined in Table 22 explained that 29.9 percent of the variation in marketing margin. It is clear that the sign of education, quantity sold and labour cost coefficients were positive and significant while that of purchase times and years of experience were negative. However the two variables were significant. This implies that if years of education were increased by one percent, then the marketing margin increased by 0.94 percent. This could be explained by the fact that more educated farmers are able to conceptualize information as well as make rational decisions by comparing prices from one farmer or local trader to another, hence getting the best out of all. Furthermore, they can get more information about prices and more profitable markets as well as increase their scale of operations. This argument is similar to that of Okoye e*t al*, (2016) who established that education helps in reducing transaction costs such as information search costs.

The study found that more educated traders have increased ability to acquire marketing skills which are very important in undertaking various marketing activities. However, some studies had different opinion with regards to education and instead argued that experience is more important than education since it leads to increased marketing (Oputa, 2015). Nduka and Udah (2015) also reckoned that more experienced farmers are able to predict problems and come up with solutions without compromising on costs.

Table 22: Regression Coefficient Estimates of Determinants of Cassava Marketing Margins of Kilifi Traders (Double Log)

Variables	**Coefficient**	**T-ratio**
Constant	0.893	0.160
Age of the household head	0.293	0.190
Education of household head	0.939	1.700*
Quantity of cassava sold	1.258	2.580**
Purchase times	-0.894	-2.040**
Experience of household head	-0.979	-1.790*
Transport cost	0.075	0.600
Labor cost	0.206	1.730*
Market charges	0.239	1.200
Storage costs	0.066	0.540
R^2 (Coefficient of determination)	0.299	
F – Stat	2.95***	
Sample size	49	

*****=**Significant at 1%, ** = Significant at 5% and *= Significant at 10%
Note: Dependent variable is the marketing margin

Regarding the amount of cassava sold, Table 22 revealed that an increase in the quantity of cassava sold by one percent increased the marketing margin by 1.25 percent. This could result from economies of scale which is a marketing strategy and an important aspect of profitability along the marketing chains. A study by Emokaro *et al*. (2010) argued that more sales yield high income which consequently increases the marketing margin. This outcome is comparable to the findings for Siaya County. However, the effect on change was larger for Kilifi than Siaya County. The finding is supported by the theory of profit maximization which explains that traders aim at maximizing profit by selling more quantities of products. This may demand for aggressive marketing of cassava products as well as having more differentiated products which could lead to more market power hence enjoying high marketing margins. Sexton *et al*. (2005) similarly found that besides marketing cost, quantity of cassava sold significantly explains positive variations in marketing margin.

Table 22 also indicates that frequency of cassava purchases was negative and significantly influenced marketing margin. This further implies that an increase in the number

of purchases by one percent led to a decrease in the marketing margin by 0.89 percent when other factors were held constant. This signifies that more purchases could mean that most of the products are perishable and hence traders have to make frequent purchases which further lowers the mean prices. Sometimes traders reduce losses by handling small volumes or purchasing quantities that they are able to sell in the short run. The restricted volumes, which are justified by risks, involves increasing the number of purchases thereby increasing marketing costs thus leading to low margins. This finding is similar to that of Nagessa *et al*. (2012), which argued that reducing frequency of purchases is possible if traders market value added products which have long shelf life. He emphasized on the importance of trading with value added cassava products for longer shelf life and better prices.

The results further show that an additional year of experience by one percent reduced the marketing margin by 0.98 percent. This is a case of spurious correlation. Marketing experience does not directly affect marketing margin. It does so through another factor. This finding corresponds to that of Okwuokenye and Onemolease (2011), who found a negative relationship between marketing experience and marketing margin. They argued that a more experienced trader spend less time in marketing tasks as compared to new entrants into the market. The result was however contrary to the study expectation since more years of experience in marketing cassava should enhance traders' skills and enable them to be efficient and more cautious on the price settings of cassava products in order to avoid exploiting consumers. Furthermore, a more experienced trader is assumed to be familiar with sources of cassava products that are less costly. Studies have found that efficient markets especially in the developing countries should have a margin of less than ten percent if the products are non-perishable while low value added products should have a margin of between twelve to seventeen percent less than the consumer price (Enete, 2009).

It can be observed from Table 22 that the coefficient for labour cost is positive and statistically significant at 5 percent significance level. This shows that an increase in labor cost by one percent led to an increase in the margin by 0.21 percent. This could probably mean that some expertise was involved in marketing activities which yielded greater returns and this led to the positive effect of labour cost. This argument is similar to that of Oladejo (2016) who contended that when professional hands are involved in marketing activities then the margin tends to be high. However, this finding contradicts the finding of Emokaro *et al*. (2010) which found costs to contribute to low marketing margin since labour cost form a big proportion of the marketing costs. Comparing the results from the two regions, the study

found that factors influencing marketing margins differed across. This indicates the uniqueness of traders and marketing activities in the two counties.

A paired t-test was conducted to determine if there was a statistically significant difference between the selling price and the buying price of cassava products. The null hypothesis stated that there was no variation in marketing margins among the actors along the chain; this implied that the marketing margins were the same. This was rejected at 95 percent confidence interval. A statistical increase in the marketing margin by Kes34.4 and Kes 12.8 for Kilifi and Siaya respectively at $p<0.000$ was observed (Appendix 11). The results therefore provide sufficient evidence to conclude that there was a statistically significant difference between the selling price and the buying price of cassava products which further implied that cassava marketing was a profitable venture in the two counties. This result is consistent with that of Asogwa *et al*. (2013) which found that the marketing margin obtained from cassava marketers was 31 percent and profitable. A study on profitability and viability of cassava marketing in lean and peak seasons in Nigeria also revealed variations in the margins of cassava products (Emokaro *et al*., 2010).

4.5.5 Marketing Margin Analysis of Farmers in Siaya and Kilifi Counties.

Farmers are usually confronted with various marketing dynamics. Cassava marketing can be meaningful if they understand the marketing systems and how they operate. Therefore marketing margin analysis helps in understanding marketing performance and efficiency as farmers engage in cassava enterprises. The underlying factors that influence the variations in margins were identified and examined using multiple regression analysis. Other charactersistics that influence marketing margins were also analysed and the results and discussions are presented in the next sections.

4.5.5.1 Determinants of Prices for Cassava products

There are different ways of setting prices for agricultural products. These sometimes vary from region to region. Pricing takes into consideration the cost of production, marketing costs as well as understanding the products prices at other outlets. Ordinarily, farmers price their products for profits, for sale and against competition (Ernst, 2014). In Siaya County, cassava products prices were mainly determined by farmers (22%), while in Kilifi County farmers engaged more on negotiations (21%). Market forces likewise played a central role in determining prices. These were presented by 8 percent and 18 percent for Siaya and Kilifi

Counties respectively. Prices were therefore not fixed in many cases and dramatically varied from one farmer to another. This concept has been widely supported by many players in agricultural sector. For instance, FAO (2004) encouraged price negotiations in argument that accessing markets and participating competitively advocates for an understanding between the seller and the buyer. In this case, both parties will be partakers of the outcome and at the end of the transaction, a more long term based partnership is created which encourages repeat sales. There were other factors that determined cassava prices which actually form a great percentage. Some of the considerations include the size of the products, cleanliness, and maturity level amongst others. These statistics are given in Figure 10.

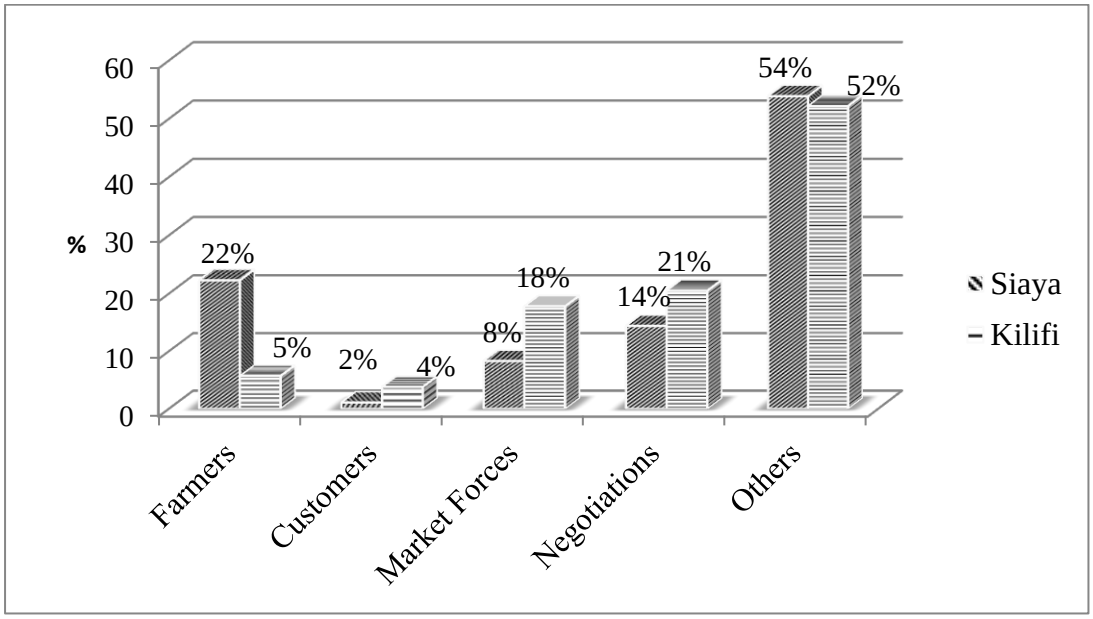

Figure 10: Determinants of Cassava Prices

To further understand the behaviour of prices for both value added and raw cassava products for the past five production years, respondents were asked to give their opinion concerning the price variations over the past five years. The study found that the market had been promising since a proportion of responses in Kilifi (33%) and Siaya (56%) were of the opinion that prices of value added products have been increasing (Figure 11). This view was however different from that of traders who felt that the demand for cassava was low.

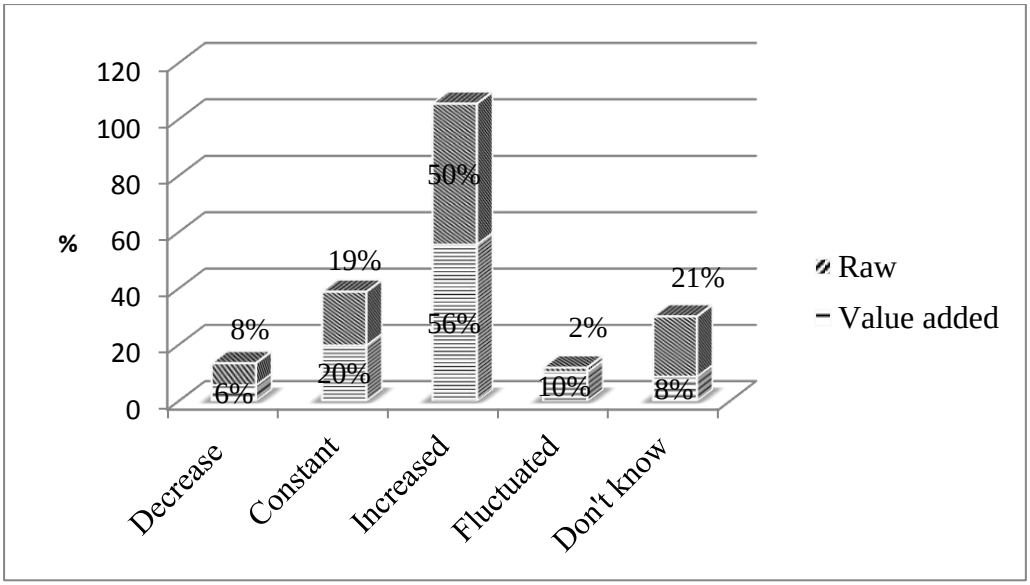

Figure 11: Price Trend for Value Added and Raw Cassava Products from 2010 to 2015 (Siaya County)

Regarding prices, Siaya and Kilifi farmers had a feeling that the prices for value added products had stagnated and that there was no evident change. This is represented by 20 percent for both counties. This finding was not different from the trend of prices of raw cassava products. More than half of the farmers from Siaya (50%) and Kilifi (56%) observed that raw cassava prices were on the rise. On the other hand, the proportion of traders who felt that there was no change was 19 percent in Siaya and 28 percent in Kilifi.

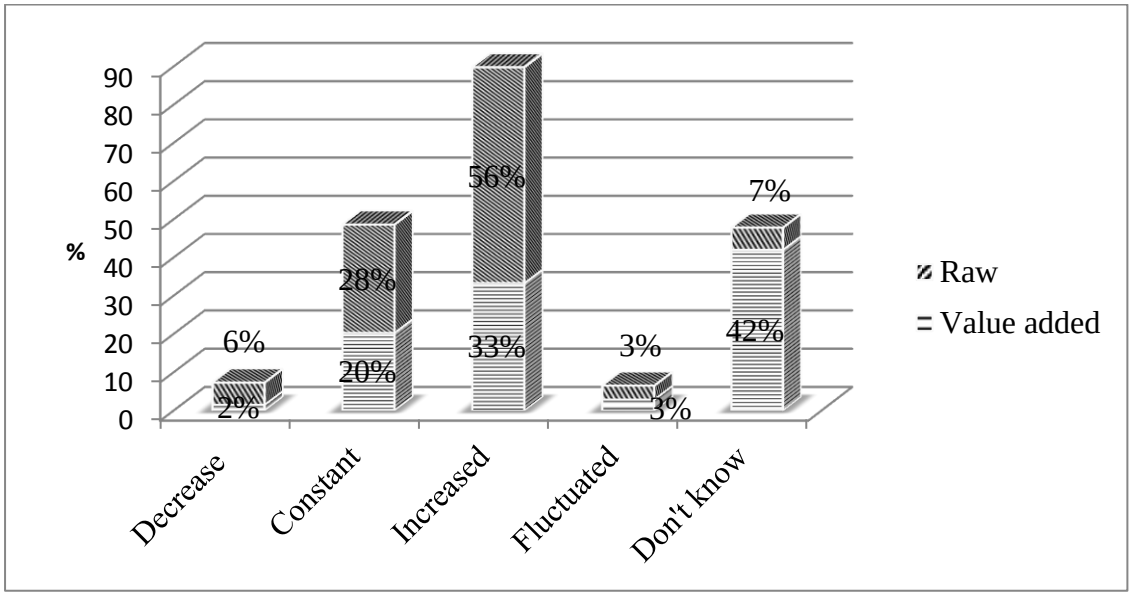

Figure 12: Price Trend for Value Added and Raw Cassava Products from 2010 to 2015 (Kilifi County)

These changes were also compared to the demand for value added cassava products. The study found that the demand for value added cassava was higher than the supply as indicated by the proportion that supported this view in Siaya (76%) and Kilifi (74%) as indicated in Figure 13. Possible explanation could be related to microeconomic concept of price elasticity; where the prices change responsively to the demand of value added cassava. Hence, for the prevailing demand to be met, product diversity such as value added cassava products should be embraced by farmers as well as other actors along the chain, and this is expected to trigger production as well. A number of farmers especially from Kilifi County (42%) are not familiar with the trend on value added products. This implies that farmers are not well informed about the market dynamics which have important implications on marketing decisions. According to Riley *et al*. (2016), information about the trend of cassava prices facilitate an understanding of the prevailing market opportunities as well as the challenges that exist among value chain.

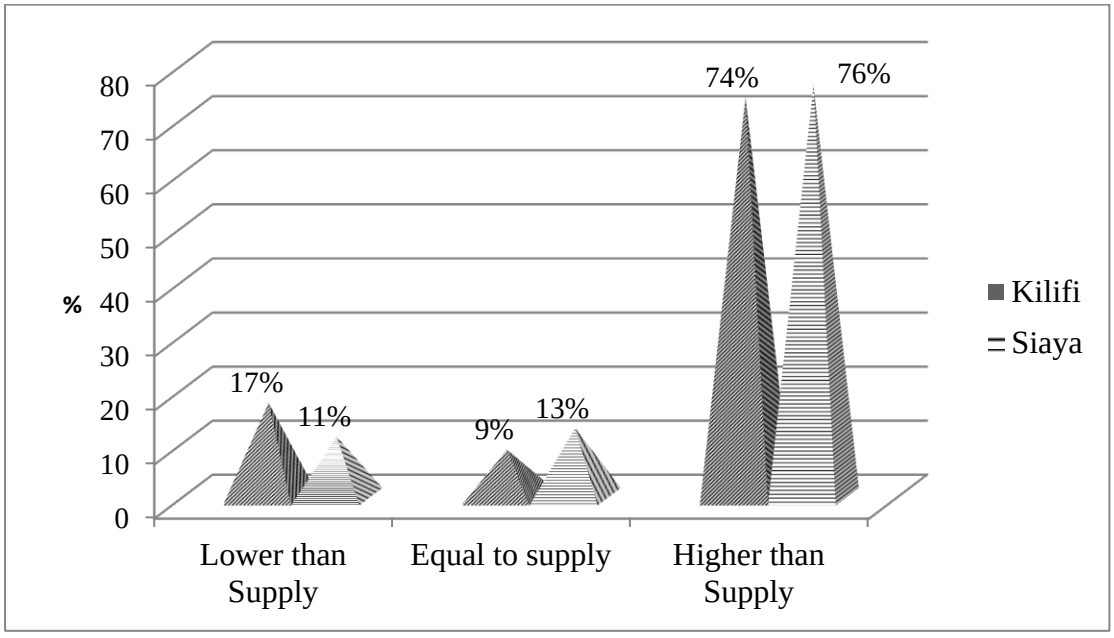

Figure 13: Demand for Value Added Cassava

4.5.5.2 Multiple Regression Results of Marketing Margin for Farmers in Siaya and Kilifi Counties

A multiple regression model was employed to estimate the effect of various factors on marketing margin. Two models; linear and double log models were considered for comparison of desirable results which exhibit the appropriate properties. The dependent

variable was the marketing margin while various factors ranging from household characteristic to marketing and institutional were fitted.

Table 23 indicates that the interpretation of the results was in reference to the double log model which was objectively selected because of its sufficiency and accommodation of the challenges presented by the linear model. Furthermore, the signs of the estimated coefficients were in line with the expected results as supported by Ussif (2003). Concerning the diagnostic tests, the F-statistics show that the regression model is statistically significant while R^2 indicates that 54 percent of the variation in the marketing margin was brought about by the explanatory variables. In addition, multicollinearity test was performed using variance inflation factors (VIF). The results showed no evidence of multicollinearity.

Table 23: Estimation of Factors Affecting Marketing Margin of Farmers in Kilifi County

Variables	**Coefficient**	**T-value**
Constant	1.345	3.170
Gender	0.155	0.570
Access to extension services	0.168	0.790
Market charges (cess and Licence)	-0.075	-2.630***
Labor cost	0.042	0.910
Value addition index	-0.189	-1.110
Distance to market	-0.132	-0.820
Quantity sold	0.478	9.500 ***
Schooling years	-0.167	-1.430
Household size	-0.397	-2.280**
Value addition Experience	0.139	1.170
R^2 (Coefficient of determination)	0.539	
F – Stat	38.34***	
Sample size	198	198

Note: The dependent variable was the contribution margin and interpretation of the results was based on the double- log functional form. Figures in parenthesis present the t-values. ***Significant at p<0.01, **Significant at p<0.05 and * Significant at p<0.10

The model reported that out of the ten variables that were fitted, only three were found statistically significant. Quantity sold was positive and statistically significant (p<0.01). This finding indicates that a one percent increase in the amount of cassava products sold translated to an increase in the margin by 0.48 percent. An explanation to this is that more sales are

associated with high demand for cassava products. When the demand for cassava products is high then farmers are able to increase their sales, subsequently increasing revenue. Besides, they are able to enjoy low marketing costs per unit products. According to Nduka and Udah (2015), marketing margins grow due to derived demand for cassava products. This finding compares favourably with that of Olukunle (2016) who also argued that high demand leads to economies of scale which subsequently reduces cost of marketing, hence leading to greater margins.

The study also found that an increase in market charges by one percent was likely to reduce marketing margin by 0.08 percent. However, this could differ depending on the number of days that one visits the market, and the marketing arrangements that are in place. High charges on license and cess, which are sometimes paid on a daily basis to the county government affect market prices which are responsible for marketing margins. Another explanation is that, when farmers incur more market costs, they may decide to either transfer the charges to retailers or experience low margins. This result corroborates that of both Fafchamps and Gabre-Madhin (2004) and Adeniji *et al*. (2012) which revealed that market costs comprise a large proportion of the marketing margin and significantly brings about the changes in the margin.

The negative coefficient associated with the household size indicates that a one percent increase in the size of the household lowered the marketing margin by 0.4 percent. Although large households are undoubtedly assumed to enjoy cheap labour as previously observed, sometimes this is not the case as households with large household size are constrained by limited resources. This has enormous effect on the marketing margin because farm households are forced to dispose of considerable amount of surplus at lower prices in order to meet the immediate household demand. This finding is in line with *a priori expectation* given that large household sizes dominated the study area and a good proportion of the household members were children. Further implication on this is that a large household size reduces marketable surplus which subsequently lowers the margins. This argument is however contrary to the findings of Tiri *et al*. (2015) which reported that the larger the household size, the more efficient marketers tend to be. Their argument was based on labour availability and promptness in undertaking various activities without much effort.

Table 24 presents the results of the estimated values of the regression model for Siaya. The double log functional model was used for interpretation because it had a good level of fitness whereby the explanatory variables explained 64.8 percent of the variation in the marketing margin. Furthermore, the signs of the coefficients were as expected while the

linear model had some coefficients with wrong signs which according to Ussif (2003) do not have theoretical support.

Table 24: Estimation of Factors Affecting Marketing Margin of Farmers in Siaya County

Variables	**Coefficient**	**T-value**
Constant	0.325	0.730
Gender	0.329	1.270
Access to extension services	0.501	2.260**
Market charges (Cess and license)	-0.023	-0.870
Labour cost	0.017	0.560
Value addition index	-1.49	-1.100
Distance to market	-2.412	-14.070***
Quantity sold	0.074	1.680 *
Schooling years	0.088	0.880
Household size	-0.056	-0.360
Value addition Experience	-0.132	-1.110
R^2 (Coefficient of determination)	0.648	
F – Stat	61.54***	
Sample size	179	

Note: The dependent variable is the marketing margin and interpretation of data was based on the double log functional form. Figures in parenthesis present the t-values.
***Significant at p<0.01, **Significant at p<0.05 and * Significant at p<0.10

The results show that access to extension services and quantity sold positively influenced marketing margin at 5 percent and 10 percent significant levels respectively. This means that farm households that had access to extension services experienced higher marketing margins than their counterpart. Since extension is a dummy variable, it is not possible to create a double log specification hence the coefficient cannot be interpreted directly. Duquette (1999) suggested that in order to appropriately interpret the coefficients of dummy variables in a double log function; they should be transformed by getting the anti-log. Having done this, it was evident that farm households which had access to extension services contributed 65 percent marketing margin change relative to those who did not receive extension services. Extension service is very important since it empowers farmers with knowledge and information which can enable them to undertake farm operations effectively and efficiently. In addition, farmers who had contacts with extension officers were less likely to spend much

money on information search hence enabling them to maximize on the marketing margin. Empirical evidence shows that extension services are positively related to marketing margins. Okwuokenye and Onemolease (2011 conducted a study on the influence of socio economic factors that determine the marketing margin of yam marketers. The study found a significant relationship between extension services and marketing margin. They argued that farmers become more knowledgeable on where to get farm inputs at affordable prices which helps in attracting more margins. Also, they possess pricing strategy ideas which limits the likelihood of being manipulated by other traders.

The results in Table 24 also show that distance to market was negative and statistically significant ($p<0.01$). This indicates that a one percent increase in distance to the market decreased the marketing margin by 2.41 percent. This reflects the conjecture that distance increases cost of transportation especially in rural areas where road networks are in poor condition (Zulu, 2015). Furthermore, distance to the market influences market accessibility which in turn has a bearing on the prices. Farmers who are located far away from the markets are likely to incur extra costs unlike their counterparts who are located adjacent to the market centres. Therefore, the longer the distance and travelling time to the nearest marketing center, the lesser the farm gate prices received by producers (Ebata *et al*., 2015). Graubner *et al*. (2011) in their study stated that distant markets can enable oligopolistic trading which in many cases lower farmer prices thus lowering the farmer margins. Farmers from Siaya County majorly complained of existing poor roads that led to high transportation costs hence most of them traded their products at farm gate where prices in most cases had no discernible effect on marketing margin.

In both counties, transport cost stood out as the main factor influencing marketing margin. However, other factors independently determined the margins in Siaya and Kilifi Counties. These include; household size, farmer experience and distance to the market. Therefore, it is obvious that marketing margin responded to changes brought about by marketing factors with low relationship existing between household characteristics and marketing margin. To determine whether farmers were making profit or not, a t-test was performed. The null hypothesis stated that profit was equal to zero. On the basis of the sample used, we failed to accept the null hypothesis. This indicated that there was a statistical significant difference between the selling price and buying price in each of the two counties. This was evidenced by t-statistics for Kilifi (-4.71) and Siaya (-2.68) whose p-values were less than 0.05. These results are similar to the findings of Asogwa *et al*. (2013) which also

highlighted that a significant difference exists between consumer and farm gate prices of cassava products. This therefore, makes cassava business to be a profitable venture.

4.6 Effect of Cassava Commercialization on Household Income

This section presents the findings of the fourth objective which addressed the effect of cassava commercialization on household income. Descriptive statistics of the key variables identified that influence commercialization have been summarized in Table 25 and 26 as well. The econometric results were generated by endogenous switching regression model which involves two stage analyses. The probit model was used in the first stage to evaluate factors influencing cassava commercialization, while in the second stage, selection equations were used to determine the effects of cassava commercialization. Three different measures of household incomes, namely: per capita, annual and per acre incomes were considered. The use of the three alternative incomes was necessary in order to establish if the results could vary with the choice of income measurement. The annual income represents total collection of the income for the year while per capita and per acre incomes represent measures of efficient use of resources.

From Table 25, it is clear that there is a difference between the descriptive statistics obtained for the different income measurements for the commercialized and non-commercialized regimes. Farm households that commercialized had greater returns than the non-commercialized group in all the income indicators. This could be attributed to the fact that those who commercialized had bigger land and greater acreage under cassava production. This clearly indicates that commercialization improves household welfare. Further analysis of descriptive statistics revealed interesting results. It is evident that the mean age for the commercialized group (46 years) was slightly higher than for the non-commercialized (45 years). This implies that farmers are of mature age. Age being a proxy for experience, it indicates that mature farmers are more experienced and are likely to make viable decisions as well as use their established networks for marketing opportunities. These findings are similar to those of Ele *at al*. (2013) who established that a typical age for farm household heads is 45-46 years. Level of education was measured in years and the results show that the average year of education for those who commercialized was 4.55 years. This signifies a low level of education.

Table 25: Summary Statistics of Continuous Variables used in Endogenous Switching Regression Model (Kilifi County)

	Commercialized (138)		Non-Commercialized (62)		Difference in means
Variables	Mean	Std. Dev.	Mean	Std. Dev.	t-value
Dependent variables					
Annual household income (Kes)	53555.12	89484.93	38431.45	58532.37	-1.218
Per Capita Income (Kes)	11056.81	222161.98	6354.19	10016.11	-1.591
Per Acreage Income (Kes)	10769.26	21863.53	8906.87	15338.05	-0.607
Independent variables					
Age (Years)	45.89	12.65	44.76	10.31	-0.622
Education (Years)	4.55	4.37	3.90	4.29	-0.975
Household size (Number)	7.17	3.59	7.42	2.88	0.474
Value addition experience (Years)	10.42	9.25	10.69	10.14	0.187
Farm size (Acreage)	7.71	6.97	6.69	7.02	-0.958
Distance to market (Km)	0.15	0.32	0.84	0.69	-7.557***

****, denotes statistically significant at 1%

The average household size for the commercialized (7.17) and non-commercialized (7.02) groups differed slightly. It is also evident that household heads who commercialized had less years of value addition experience (10 years) relative to their counterparts (11 years). It is theorized that value addition experience is paramount if farmers were to explore opportunities and diversify in various cassava products. A study by Agwu (2013) found that a more experienced farmer is likely to commercialize because of the endowed knowledge and skills. Also, mean farm size for farmers who commercialized (7.71 acres) is higher than for non-commercialized farm households (6.69 acres). Land is considered an important resource of production. It is expected to positively drive commercialization (Martey, 2014). Therefore, its availability and accessibility is expected to increase marketed surplus leading to enhanced cassava commercialization.

The average distance to the market centre for farm households that commercialized (0.15 km) is lower than that for the non-commercialized group (0.84km). This is plausible since distance could be a hindrance to smooth participation in markets due to increased transaction costs. According to Agwu *et al*. (2012), market location significantly influences market

participation. If farm households are located far away from the markets, then chances of engaging in marketing activities reduces. Furthermore, farm households opt to market their products at farm gates which in many cases give low returns since the products are sold at low prices.

Similarly, descriptive statistics for Siaya County as represented in Table 26 indicate that household income was relatively higher for the commercialized farm households than the non-commercialized households. The annual household income for the commercialized households (Kes33,118.06) was more than for the non-commercialized group (Kes11,922.73). Likewise, per capita and per acreage incomes were more for the commercialized group than the non-commercialized. Similar to the case of Kilifi, the commercialized households have higher income than the non-commercialized group. The level of education for household heads from Siaya County was slightly higher than for Kilifi. Overall, the commercialized group (7 years) had attained higher education compared to the non-commercialized group (5 years). Farm households who are more educated are presumed to be familiar with agricultural practices and possess management skills, and show a better understanding of market dynamics (Makhura *et al*., 2001; Martey *et al*., 2012).

Table 26 shows that the average farm size for the commercialized group was 2.92 acres. This was considerably lower for Siaya than Kilifi. This was seen as an impediment to cassava commercialization in the county. Another remarkable difference is on value addition experience where the commercialized group (15.19 years) had higher experience than for the non-commercialized groups (14.89 years). This implies that farmers were able to exploit the potential of value addition and marketing opportunities. This could be reflected in the incomes. Besides the numerical variables, other factors that brought about the variation between the two regimes were gender, access to credit facilities and group membership.

Table 26: Summary Statistics of Continuous Variables used in Endogenous Switching Regression Model (Siaya County)

	Commercialized (n=126)		Non-Commercialized (n=55)		Difference in means
Variables	Mean	Std. Dev.	Mean	Std. Dev.	t- value
Dependent Variables					
Annual household income (KES)	33118.06	58787.85	11922.73	27393.73	-2.522*
Per Capita Income (KES)	6977.95	12910.40	2000.97	4113.12	-2.794***
Per Acreage Income (KES)	12916.07	26345.52	8575.29	19644.54	-1.096
Independent Variables					
Age (Years)	47.14	12.17	47.67	12.67	0.266
Education(Years)	6.63	3.92	4.80	4.29	2.816***
Household size (Number.)	5.88	2.70	5.58	2.58	-0.695
Value addition experience (Years)	15.19	12.29	14.89	12.21	-0.155
Farm size (Acreage)	2.92	1.64	1.94	1.53	3.773***
Distance to Market (Km)	0.29	0.37	0.09	0.22	-3.712***

****, and * denotes statistically significant at 1% and 10 % respectively

Chi-square test was used to examine the association between the explanatory variables and cassava commercialization. Categorical variables which were significant include group membership, gender, off-farm income and access to credit (Table 27). Traditionally, women have been greatly involved in agriculture as men engage in off-farm activities to supplement the household income (Woldeyohanes *et al*., 2015). Therefore, gender is ostensibly expected to influence cassava commercialization since it affects decision making and allocation of resources in a household. The study revealed that in Kilifi County, 72.46 percent of the female headed households and 27.54 percent of the male headed households engaged in commercialization. This was not different from Siaya County where 73.81 percent and 26.19 percent of those who commercialized were women and men respectively. In both cases, gender was significant at 10 percent level. The study revealed that the proportion of those who engaged in off-farm activities were 45.65 percent for the commercialized and 35.48 percent for those who had not commercialized. It was noted that 33.33 percent of farmers who commercialized received some form of credit facilities while the remaining 66.67

percent did not. Access to credit either informally or formally encourages commercialization since credit links farmers with modern technology. This plays a role in enhancing their abilities and knowledge (Lerman, 2004). Additionally, credit enables farmers to adapt new techniques, facilitate the purchase of inputs and payment of labour.

Table 27: Descriptive Statistics of Categorical Variables and their Relationship with Commercialization.

Categorical variables	Commercialization	Kilifi (%)	Non-Commercialization (%)	χ^2 value	Siaya Commercialization	Non-Commercialization	χ^2 value
Gender	Female	72.46	66.12	0.096*	73.81	85.45	0.085*
	Male	27.54	33.88		26.19	14.55	
Off-farm income	Yes	45.65	35.48	0.179	50.79	36.36	0.073*
	No	54.35	64.52		49.21	63.64	
Access to credit	Yes	33.33	45.16	0.091*	46.03	18.18	0.000***
	No	66.67	54.84		54.97	81.82	
Group membership	Yes	78.99	80.65	0.072*	78.57	60.00	0.010**
	No	21.01	19.35		21.43	40.00	
Remittances	Yes	31.88	27.41	0.526	42.06	23.64	0.018**
	No	68.12	72.59		57.94	76.36	

****, ** and * denotes statistically significant at 1%, 5% and 10 % respectively

Groups can be a source of information for farm households, hence active participation in agricultural based groups is likely to boost commercialization. The results further illustrates that the average mean of remittance was 42 percent for farmers who commercialized and 23 percent for those who did not commercialize. Generally, a small proportion (31.88 %) of farm households received substantial income from remittances. Past studies have revealed that remittance has a mixed effect on commercialization. Quinn (2009) argues that inflow of remittances to farm households can boost farm inputs and assets purchases. Other studies have also found that remittances negatively contribute towards commercialization. Woldeyohanes *et al*. (2015) and Kan *et al.* (2006) found that most households spend remittances on household consumption rather than increasing agricultural productivity which contributes to enhanced marketed surplus. Mixed outcome was therefore expected from the study as far as remittance is concerned and this could as well be supported by the expected utility of farm households.

4.6.1 Determinants of Cassava Commercialization (Value addition and Market Participation) and its Effect on Household Income

Determinants of cassava commercialization were analyzed in the first stage of endogenous switching regression model that involved an estimation of the selection equation using the probit model. In the second stage, accounting for selection bias was done. Diagnostic tests such as multicollinearity and heteroskedasticity tests were performed in evaluating the model. Multicollinearity test was based on variance inflation factor (VIF), which is a widely used method in measuring multicollinearity of independent variables in a regression model. For multicollinearity test, the largest VIF in the model was 1.34 (schooling years), which is below the maximum value of 10 (this is the rule of thumb). This implied that the problem of multicollinearity did not exist in the model. Heteroskedasticity tests were performed using Breuche-Pagan test and the test statistics for Siaya (0.0029) and Kilifi (0.000) were significant at 1 percent significance level. This indicated that there was no heteroskedasticity. The results of both diagnostic tests indicated that the model was adequate.

The diagnostic tests confirmed that the estimated coefficients of the two instrumental variables (group membership and distance to the market) were jointly insignificant ($p>0.10$) in the income equation while they were in fact significant individually in the commercialization equation. Since the test statistics are insignificant, the instrumental variables are valid. This justifies their use in the outcome equation as they do not directly affect income. The likelihood ratio tests (LR) for the joint independence of the three equations were significant in the three groups (See Table 28 and 29). This suggests that the equations are jointly dependent hence providing evidence of endogeneity. The probit model was estimated on both the independent (selection equation) and joint (selection and outcome) equation using full information maximum-likelihood method (FIML). The analysis was done by county and inferences centred on the estimates for each county.

Table 28 presents the estimated coefficients of the selection equation on determinants of cassava commercialization in Siaya County. The results indicated that years of schooling, land size, remittances and group membership had a positive and significant effect on commercialization in both the independent and jointly estimated models, while value addition experience was only positively significant in the joint models. Household size had a negative and significant effect on the joint models but insignificant in the independent model. Distance to the market had a negative and significant effect in both models.

Years of schooling has a positive and significant effect on cassava commercialization. This implies that more educated farm household heads are likely to participate in cassava commercialization than the less educated ones. This could be argued that education helps farmers to understand value addition and market participation dynamics faster and clearer relative to their counterparts with low level of education. Further, education enhances sound management skills and the ability to synthesize and interpret information (Bahta, 2012). These results are consistent with the findings of Martey *et al*. (2012) and Agwu *et al*. (2015) who argued that education influences management skills and enables a farmer to be responsive to market needs. On the other hand, it contradicts the findings of Mathijs (2002) who found that farmers who are well educated focus more on off-farm activities and this minimizes their engagements on farm related activities such as commercialization.

Value addition experience had a positive and significant influence on cassava commercialization. Value addition experience increases the probability of a farmer's engagement in cassava commercialization activities. Low value addition experience can slow down the uptake of commercialization, especially when farm households lack the required skills and knowledge for value addition of cassava which can only be sharpened and enhanced through experience (Parveen *et al*., 2014). Therefore, value addition experience makes farmers to take greater responsibilities in commercialization. The results are consistent with the findings of Agwu *et al*. (2013) who found that farmers with experience on value addition are likely to heighten the processing of various forms of cassava products and engage in market participation.

Household size had a negative and significant influence on cassava commercialization. This implies that the larger the household size, the less likely that a farm household would engage in commercialization. Large households exert pressure on household resources. This is because for every one person increase in the household, commercialization decreases. This would therefore mean that any extra production would be channeled to meet the household demand hence lowering marketed surplus. It is also argued that larger households tend to be less market oriented especially when majority of the members are children who are below the working age and are likely not to contribute much towards farm labour. This therefore leads to more demand for food consumption than labour contribution (Omiti *et al*., 2009). This finding is similar to that of Martey *et al*. (2012) who found that an increase in household size increases household consumption thus lowers commercialization.

Farm size had a positive and significant influence on cassava commercialization. This means that households with larger acres of land are more likely to engage in cassava

commercialization. The implication is that farmers with large sizes of land tend to increase the acreage under cassava production. This creates greater opportunities for higher production and hence marketed surplus. Therefore, farm households are able to engage more in commercialization activities (Martey *et al.*, 2012). This result contradicts the finding of Falola *et al*. (2016) who found that farmers with large sizes of land may not engage in commercialization. The study argued that such farm households may concentrate more on the production side than on the market side.

Remittances had a positive and significant influence on cassava commercialization. The positive coefficient of remittance indicates that income received from relatives or friends increases the probability of engaging in cassava commercialization. Remittances are pathways to increasing household income which can facilitate commercialization activities in farm households. Remittances could encourage farmers to diversify in crop production. Moreover, remittances can facilitate smooth payments of costs such as labour, transportation, processing besides purchasing of inputs. Kikulwe *et al*, (2013) found that remittances greatly contribute to household income besides promoting agricultural commercialization. They further stated that remittances reduce financial constraints thereby promoting access to markets.

Group membership had a positive and significant influence on commercialization. Membership to a group was an expected *a priori* to contribute to commercialization. This could be because group membership enhances social network of a farmer which correspondingly improves access to information, credit facilities (collateral), source of labour and other support systems that are crucial in marketing agricultural products. This result is similar to the findings of Olwande (2010) who found that membership to a group increases access to production and market information which are helpful in decision making. Mwaura (2014) also found a positive relationship between membership to groups and improved cassava yields. The study found that group networks empower farmers with knowledge on farming and marketing hence reduces market asymmetry.

Table 28: Probit Model Results for Determinants of Cassava Commercialization (Siaya County)

	Jointly Estimated Probit			Independent Estimated Probit
Variables	Per acre Estimates	Per Capita Estimates	Yearly Inc. Estimates	Coef.
Education (Years of schooling)	0.341 ** (0.021)	0.319 ** (0.028)	0.332** (0.023)	0.318** (0.037)
Experience in Value addition (Years)	0.240* (0.098)	0.256* (0.085)	0.234* (0.099)	0.195 (0.184)
Household size (Numbers)	-0.292* (0.076)	-0.307* (0.063)	-0.290* (0.075)	-0.249 (0.123)
Farm size (Acres)	0.449** (0.011)	0.456*** (0.009)	0.442** (0.012)	0.519*** (0.003)
Off-farm income (1=Received, 0=)	0.313 (0.210)	0.297 (0.231)	0.300 (0.229)	0.237 (0.345)
Gender (1=Male, 0=Female)	0.110 (0.734)	0.116 (0.720)	0.113 (0.727)	0.021 (0.949)
Age (Years)	0.419 (0.154)	0.429 (0.143)	0.425 (0.149)	0.274 (0.342)
Receive remittance (1=Yes, 2=No)	0.448* (0.077)	0.423* (0.096)	0.439* (0.084)	0.392 (0.108)
Group membership (1=Yes, 0= No)	0.387* (0.086)	0.424* (0.067)	0.399* (0.091)	0.443* (0.056)
Distance to market (Km)	-1.918*** (0.000)	-1.853*** (0.001)	-1.856*** (0.001)	-2.001*** (0.003)
_cons	-1.379 (0.018)	-1.298 (0.025)	-1.348 (0.020)	-1.258 (0.036)
No. of observations	181	181	181	181
Prob>chi-squared				0.000
Pseudo R^2				0.323
LR chi2 (10)				71.87***
χ^2 - Statistic for over identification				2.304 (0.129)

Note: Figures in parenthesis are the p-values. ***, ** and * represent significance levels at 1%, 5% and 10% respectively. Jointly estimates were based on household annual income, per capita and income per acre. The measurement standard of an acre of land is equivalent to 0.045 hectares and an eighth of a plot.

The study found that distance to the market had a negative and significant influence on cassava commercialization. This implies that farmers located farther from the markets are less likely to undertake cassava commercialization. Distant markets are associated with high transportation and transaction costs which limit farm households' active engagement in commercialization. This is in conformity with the findings of Ochieng'*et al*. (2015) who found that households which are located closer to the markets incur lower transaction costs.

In addition, Omiti *et al*. (2009) found that distance from farm to another point of sale highly influences market participation. They further stated that road networks especially from the farms to market centers should be developed so as to ease smooth transportation and movement of cassava products.

In the second stage of endogenous switching regression, the determinants of household income were analyzed. Table 29 presents the results obtained. To test for selectivity bias, the covariance coefficients of the two regimes were determined. The results indicate that the coefficients for the non-commercialized group were negative (-0.846, -0.905 and -0.888) and statistically significant ($p<0.01$). This indicates that there exists sample selectivity hence implying that there was endogeneity. Further implication that farm households who commercialized differed from the non-commercialized group and that commercialization may not have similar effects on the non-commercialized farm households supposing they decide to commercialize as supported by Lokshin and Sajaia (2004). The results also show that the coefficients of variance of error terms were positive and significant ($p<0.01$), indicating that commercialization contributed to improved household income. Farm households who choose to commercialize have more returns which further improves household income compared to those who have not commercialized. Therefore, these results confirm the appropriateness of endogenous switching model in addressing the unobserved behaviour of the commercialized and non-commercialized groups. A comparison was made for the significance of the explanatory variables for both commercialized and non-commercialized based on the model containing the three income estimates as indicated in Table 29.

Table 29: Estimates of Endogenous Switching Regression for the Effect of Commercialization on Household Income (Siaya County)

	Commercialization (n=126			Non-Commercialization(n=55)		
Variables	Per Acre. Coef.	Per Capita Coef.	Per yr. Coef	Per Acre. Coef.	Per Capita. Coef.	Per Yr. Coef.
Education (Years of Schooling)	0.291 (0.343)	0.264 (0.343)	0.242 (0.463)	0.052 (0.875)	0.156 (0.580)	0.089 (0.786)
Experience in Value addition	-0.063 (0.818)	-0.147 (0.554)	-0.136 (0.644)	-0.587* (0.060)	-0.406 (0.130)	-0.528* (0.092)
Household size	0.255 (0.511)	-0.600* (0.088)	0.294 (0.481)	-0.286 (0.527)	-0.584 (0.139)	-0.389 (0.394)
Farm size	-0.151 (0.693)	0.465 (0.184)	0.559 (0.179)	-0.708* (0.059)	-0.263 (0.417)	-0.353 (0.345)
Remittance	1.672*** (0.000)	1.557*** (0.000)	1.812*** (0.000)	4.080*** (0.000)	3.544*** (0.000)	4.260*** (0.000)
Off-farm income	4.378*** (0.000)	4.045*** (0.000)	4.583*** (0.000)	7.464*** (0.000)	6.480*** (0.000)	7.885*** (0.000)
Gender	0.662 (0.229)	0.702 (0.177)	0.854 (0.150)	0.997 (0.177)	1.108* (0.085)	1.228* (0.098)
Age	-0.389 (0.435)	-0.354 (0.343)	-0.367 (0.493)	0.639 (0.343)	0.686 (0.244)	0.850 (0.211)
_cons	4.050 (0.001)	4.743 (0.000)	4.248 (0.001)	2.367 (0.033)	1.936 (0.046)	2.155 (0.056)
$In\sigma_{\mu_1}v$	0.947*** (0.000)	0.850*** (0.000)	1.023** (0.000)			
$\rho_{\mu_i}v$				-0.846*** (0.001)	-0.905*** (0.002)	-0.888*** (0.002)
$In\sigma_{\mu_0}v$	0.537*** (0.000)	0.396*** (0.000)	0.549*** (0.000)			
$\rho_{\mu_0}v$				0.003 (0.995)	0.002 (0.996)	0.019 (0.963)
LR test of indep. equations	0.0006	0.0007	0.0006			
Log Likelihood				-468.823	-448.152	-478.497

Note: The income equation was jointly estimated with the equation on cassava commercialization. σ_{μ_1} Present the square root of the variance of the error terms while ρ_{μ_i} present the correlation coefficients of the error terms of the selection equation and outcome equation as represented in equation (32a and 32b). *** Significant at 1%, ** significant at 5%, * significant at 10%.

Value addition experience had a negative and significant effect on per acre and annual income for the non-commercialized households. This implies that additional year of household head in value addition activities reduced the household income for the non-commercialized group. Perhaps, the non-commercialized group incurred costs in undertaking value addition yet these value added products were not sold. This therefore reduced household income. Studies have found that value addition approaches offer expanded

opportunities that can improve farm income hence increasing household income (Punjabi, 2007). This should occur for commercialized farmers who undertake value addition to obtain higher sales.

Household size had a negative and significant influence on the commercialized and non-commercialized regimes for the model that involved per capita income. This means that an additional member to a farm household decreases the probability of improving household per capita income. Per capita income is a function of household size; therefore, when there are more people in a household, this value is expected to reduce. Household expenditure increases as household size grows subsequently lowering household income. Majority of these households barely have enough land to cultivate. Any additional member to the household may be a constraint to the farm households. This finding contradicts the findings of a study by Kabiti *et al*. (2016) who reported that an increase in household size is associated with an increase in output commercialization consequently improving household income. They contended that an increase in the size of a household is a means for more human labor who can work on farms therefore reducing the cost of labor.

The coefficient of farm-size was negative and significant on per acre income for farm households who did not commercialize. The findings indicate that increasing farm size for the non-commercialized farm households reduces per acre income. This could imply that the non-commercialized farm households may not have the means to cultivate larger parcels of land even if they had extra acreage of land. These results are consistent with the findings of Huffman and Rozelle (2011) who stated that even though farm households could be in possession of big parcels of farm land, lack of resources could limit the optimal use of these farms so as to generate income. Seng (2016) also revealed that non-commercialized farm households are sometimes not keen enough to utilize land in a productive way hence limiting the returns.

Table 29 also shows that the signs of the estimated coefficients for remittance were positive and significant across the three models. However, the coefficients of the model for non-commercialized households were larger than for households that commercialized. This implies that for the non-commercialized households, those who received remittances had greater income than those who commercialized. This indicates that remittances play a pivotal role in enhancing household income, even though it could promote minimal involvement in cassava commercialization activities. Further, it can also be inferred that most farm households who did not commercialize relied greatly on remittances as a source of income. This finding is also supported by the descriptive statistics obtained for both commercialized

and non-commercialized group. The commercialized group received less remittance possible because they had higher income than the non-commercialized group. Besides the direct effect, remittances can also facilitate output productivity which results in increased household income. Gonzalel (2011) argued that remittances may increase the degree of specialization and adoption of high value farming which can improve the net gains of farm households.

The coefficients of off-farm income were positive and significant. This implied that farmers who engaged in off-farm activities had higher household income than those who did not. As was the case for remittances, the coefficients for the non-commercialized farmers were higher than those for the commercialized. This meant that the effect of off-farm income on commercialization was greater for the non-commercialized group compared to the commercialized group. The non-commercialized farm households generally engage in off-farm activities at the expense of cassava commercialization. Therefore off-farm activities contribute significantly towards their income. For the commercialized group, the positive relationship between off-farm income and household income could mean that even though cassava commercialization could be a source of income, farm households also diversify into off-farm activities as an income diversification strategy. The results are consistent with those of Kabiti *et al*. (2016) who stated that households may invest part of the income earned from off-farm activities in purchasing inputs and facilitating other commercialization activities.

Table 30 shows the results for Kilifi County. First, positive factors are discussed followed by the negative factors that influenced commercialization. The econometric results indicate that group membership was positive and only significant for the per acre income model; that is, group membership influenced farm households' engagement in commercialization activities. Groups open up opportunities to output markets through collective bargaining for appropriate prices as well as pooling up of resources (Magreta *et al*., 2010). In addition, farm households are able to acquire skills and knowledge through free interaction with members of similar social network. This finding is supported by the qualitative evidence that was gathered during field work which indicated that most household heads that belonged to some particular farm based groups were more privileged in terms of the benefits derived compared to the non-participants.

Table 30: Probit Model Coefficient Results for Determinants of Cassava Commercialization (Kilifi County)

	Jointly Estimated Probit			Independent Estimated Probit
Variables	Per acre Estimates	Per Capita Estimates	Yearly Inc. Estimates	Coef.
Education (Years of schooling)	0.075	0.062	0.113	0.109
	(0.391)	(0.429)	(0.276)	(0.284)
Experience inValue addition (Years)	-0.044	-0.033	0.068	0.067
	(0.629)	(0.715)	(0.551)	(0.556)
Household size (Numbers)	-0.286*	-0.313*	-0.299	-0.298
	(0.041)	(0.063)	(0.143)	(0.141)
Farm size (Acres)	0.007	0.044	0.194	0.194
	(0.939)	(0.692)	(0.126)	(0.126)
Off-farm income (Kes)	-0.736***	-0.753***	-0.356*	-0.359*
	(0.000)	(0.000)	(0.083)	(0.080)
Gender (1=Male, 0= Female)	-0.008	-0.007	-0.328	-0.322
	(0.967)	(0.967)	(0.137)	(0.138)
Age (Years)	-0.405**	-0.412**	-0.538**	-0.539**
	(0.025)	(0.021)	(0.015)	(0.015)
Receive remittance (1=Yes, 0=No)	-0.063	-0.083	0.271	0.267
	(0.707)	(0.172)	(0.220)	(0.223)
Group membership (1=Yes, 0=No)	0.106***	0.107	-0.241	-0.242
	(0.000)	(0.647)	(0.345)	(0.253)
Distance to market (Km)	-0.236***	-0.244*	-0.454***	-0.455***
	(0.000)	(0.092)	(0.004)	(0.004)
_cons	1.335	1.345	1.000	1.009
	(0.001)	(0.003)	(0.079)	(0.571)
No. of observations	200	200	200	200
Prob >chi-squared				0.006
Pseudo R^2				0.098
LR chi2 (10)				24.43***
χ^2 - Statistic for over identification				0.533 0.383

Note: Figures in parenthesis are the p-values. ***, ** and * represent significance levels at 1%, 5% and 10% respectively. The jointly estimates have been computed using three different measures of income (Yearly, per capita and income per acre). The measurement standard of an acre of land is equivalent to 0.045 hectares and an eighth of a plot.

Off-farm income had a negative and significant influence on cassava commercialization. This implies that farm households who engaged in off-farm activities were less likely to engage in cassava commercialization. Farm households must strike a balance between engaging in off-farm activities, and cassava farming as well as commercialization. Those who have prioritized commercialization may not have time to undertake off-farm activities and

vice versa. This is in agreement with the finding of Muricho (2015) who stated that off-farm income lowers the incentive to commercialize.

Age of the household head was also found to be negative and had a significant influence across all the models. This implies that ageing reduces the likelihood of engaging in commercialization especially after going past maturity age (50 years and above). Generally, productivity declines as farmers get older, hence impacting on commercialization activities. This finding is consistent with that of Agbola (2004) who found that as household heads advance in age, they only engage in basic farming activities for short hours and spend less time on commercialization activities such as value addition and market participation. The study however contradicts the findings of Hailua *et al*. (2015) who found a positive relationship between age and commercialization. They argued that age being a proxy of farming experience, increases commercialization since older household heads have more insights and adequate knowledge that can enhance commercialization. It was observed that majority of the farmers who were involved in commercialization were in their prime active age with very few elderly farmers participating in cassava commercialization.

Another institutional factor that had significant effect on cassava commercialization was distance to the market. It had a negative and significant influence on commercialization across all the three models. Farmers who are farther away from market centers are less likely to commercialize. This could be that most rural transportation networks are not properly linked to the villages where majority of the farm households populate. In addition, most of the rural roads are impassible during wet season. This increases the cost of transportation hence deterring farmers from competitive participation in markets (Pingali *et al*., 2015).

Table 31 shows the results on the effect of cassava commercialization on household income for Kilifi County. The findings reveal that the coefficients for value addition experience were positive and significant only in the annual income model for the households that commercialized. This means that an increase in value addition experience of a household head leads to improved household income. Annual income is recorded over a year period. It is therefore a function of time hence within a year, a farmer can gain experience that may affect his output. The findings are consistent with that of Kehinde and Aboaba (2016) who found that value addition techniques enhanced through trainings and experience can promote efficiencies and diversification thereby increasing household income.

Table 31: Results of Endogenous Switching Regression Model for the Effect of Commercialization on Household Income (Kilifi County)

	Commercialization (n=138)			Non-Commercialization (n=62)		
Variables	Per Acre. Coef.	Per Capita Coef.	Per yr. Coef	Per Acre. Coef.	Per Capita. Coef.	Per Yr. Coef.
Education (Years of Schooling)	0.000 (0.998)	0.046 (0.846)	0.142 (0.590)	-0.012 (0.975)	-0.018 (0.960)	-0.012 (0.980)
Experience inValue addition	0.276 (0.318)	0.238 (0.367)	0.475* (0.097)	0.341 (0.401)	0.316 (0.422)	0.404 (0.403)
Household size	0.000 (0.999)	-0.947** (0.020)	-0.316 (0.465)	-0.569 (0.584)	-0.384 (0.178)	-0.797 (0.513)
Farm size	-0.604** (0.041)	0.287 (0.327)	0.789** (0.016)	-0.898* (0.051)	-0.073 (0.873)	-0.096 (0.889)
Remittance	-0.068 (0.896)	-0.006 (0.991)	0.579 (0.282)	2.573*** (0.002)	2.309*** (0.004)	3.157*** (0.003)
Off-farm income	3.251*** (0.000)	3.233*** (0.000)	3.888*** (0.000)	5.496*** (0.000)	5.257*** (0.000)	6.399*** (0.000)
Gender	0.747 (0.184)	0.748 (0.145)	0.125 (0.825)	0.628 (0.402)	0.733 (0.318)	0.738 (0.443)
Age cat3	0.385 (0.514)	0.369 (0.477)	-0.547 (0.390)	-0.186 (0.851)	-0.155 (0.873)	-0.375 (0.778)
_cons	7.218 (0.000)	7.317 (0.000)	5.119 (0.000)	3.820 (0.406)	4.0771 (0.357)	3.740 (0.384)
$In\sigma_{\mu_1}v$	1.112*** (0.000)	1.092*** (0.000)	1.039*** (0.000)			
$\rho_{\mu_i}v$				-11.096 (0.142)	-0.845*** (0.001)	0.047 (0.416)
$In\sigma_{\mu_0}v$	1.006*** (0.000)	0.983*** (0.000)	1.186*** (0.000)			
$\rho_{\mu_0}v$				0.089 (0.912)	0.003 (0.995)	0.214 (0.787)
LR test of indep. equations	0.000	0.000	0.763			
Log Likelihood				-549.753	-544.289	-611.322

Note: The income equation was jointly estimated with the equation on cassava commercialization. σ_{μ_1} represents the square root of the variance of the error terms while ρ_{μ_i} represent the correlation coefficients of the error terms of the selection equation and outcome equation as represented in equation (32a and 32b). *** Significant at 1%, ** significant at 5%, * significant at 10%.

Results on Table 31 indicate that the coefficient of the household size was negative and significantly influenced household per capita income for the farm households that commercialized. This is similar to the results of Siaya County. The negative relationship indicates that increasing the household size, reduces the likelihood of improving household per capita income. The results are inconsistent with the finding of Effiong (2005) who stated that large households can enhance the availability of farm labour hence lowering the cost of

production. It is noteworthy to consider also the composition of a household in terms of age representation. A household that is composed of mature working adults will have better household income relative to a farm household composed of young, economically unproductive children (Bongaarts, 2001).

Farm size had mixed outcomes for the different income measurements. It was positively and significantly related to the annual income model for the commercialized group. However, it had a negative relationship with income per acre model for the commercialized and non-commercialized groups. The positive coefficient of farm size variable in the annual income model supports the view that large farm sizes encourage production of marketed surplus which can be an inducement to commercialization. Also, smallholder farmers with large farm sizes can improve their household income through a varied portfolio of activities (Adams, 2002). The negative coefficient in the income per acre model means that farmers with large acreage earn less average income per acre than those who have small acreage. This could be because most of the households are peasant farmers who may not have enough resources required to manage large parcels of land efficiently unlike farmers with small acres of land who can fully develop the land resulting in higher income per acre.

Remittance had a positive and significant influence on the different income measurements for the non-commercialized households. This means that household income for those who received remittances were higher for the non-commercialized households than those who did not receive remittances. This is in agreement with the findings of Xing (2015) who stated that remittance directly influenced household income. According to Leones and Feldman (1998), remittance is also recognized as a resource diversification strategy and relaxes the constraint on household income amongst smallholder farmers. However, remittance was not significant amongst the commercialized group. This result was expected because the commercialized groups are not highly depended on remittances because they also earn significant income from cassava commercialization.

Off-farm income had a positive and significant influence on the different income measurements in all the models. This implies that farm households who undertook off-farm activities had higher household income than those who did not. For the non-commercialized group, the sizes of the coefficients were larger than the ones for the commercialized group. This could mean that such households had consolidated their energy and resources on off-farm activities more than the farm households who had commercialized. Most farm households undertake various off-farm activities to supplement farm income. It was noted that the coefficients of off-farm were different in magnitude. Notably, the coefficients were

larger for the annual income than the per capita and acre. This is because the annual income has a higher value than per capita and per acre incomes, which are averages and are explained by the same independent variable. Interestingly, off-farm coefficients for Siaya County were larger than for Kilifi. It should be noted that coefficients represent rate of change as opposed to absolute amount. Off-farm income, though categorical, it is measured on absolute scale while the coefficients represents rate of change. Hence this indicates the variations as well as the magnitude of change in the coefficients.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study underscores the role of cassava commercialization in improving household income of smallholder farmers in Siaya and Kilifi Counties. Cassava commercialization is one of the pathways towards transforming smallholder farmers in these areas, which are characterized by high poverty levels, thus improving their household income. In a marked departure from past studies, this study addressed commercialization in a broader way by integrating both value addition and market participation aspects. In addition, the study examined how commercialization affected income from three different aspects, namely; per capita income, per acre and annual income.

5.2 Conclusion

The first objective was concerned with determination and characterization of different levels of commercialization practiced by smallholder farmers. An integrated index was developed and used to profile farm households into different commercialization categories. Based on this index, most farmers practiced medium level commercialization while a few embraced high level commercialization. This means that most farmers have not embraced the highest level of value addition as well engaging in aggressive marketing activities. These farmers can be encouraged to step up value addition practices so as to exploit the benefits of pursuing optimum commercialization. Since both aspects of commercialization are equally important, smallholder farmers should take an active role in market participation. This will generate stable income and hence improve household income.

Different sets of factors influenced commercialization. The common factors in the two counties were cassava acreage and distance to the market. It can be inferred that allocating more land to cassava production may influence marketed surplus hence enhancing commercialization. Distance to the market is a barrier to active participation in markets. Most farmers are discouraged from marketing their products especially when they are located farther from the market places. From the descriptive statistics, women played a key role in cassava commercialization in both counties. With regards to cassava commercialization, women were the main decision makers and participated in a number of commercialization

activities ranging from production to marketing of the products. This implies that facilitation of women folk could play a key role in improving commercialization.

The second objective was concerned with comparing income earned from sale of cassava products with that generated from other crops. Several crops were grown in both counties for both consumption and commercialization. Maize and cassava were the main crops produced and sold while other crops such as sweet potatoes, sorghum and legumes were produced in small quantities mainly for consumption. Cassava and maize were intercropped with other crops, though they occupied bigger acreage compared to other crops. Comparing cost of production for maize and cassava, the study revealed that it is less costly to produce cassava than maize. Maize was found to be the main staple food in Siaya and Kilifi counties since almost all the households consumed both raw and dry maize limiting marketable surplus. Cassava was, however, used for commercialization purposes as a major portion of the output was sold in various forms. Income from cassava generally exceeded income from other crops. It appears that cassava can play a major role in commercialization and hence improve household income especially in ASAL areas.

Cassava farmers made more profit than traders and the margin difference between them was significant. The low profit levels for traders was due to high cost of transactions incurred especially on cassava transportation as well as the low volumes of cassava products traded at the market. Prices for both value added cassava products and raw cassava had increased in the past years. Similarly, the demand for the products was also on the rise. This clearly indicates that there exists marketing opportunities for cassava products which are yet to be exploited. Different forms of cassava products fetch different prices. Higher levels of value addition which included fried products attracted better prices compared to raw or dried cassava products. Therefore, farmers who undertake higher forms of value addition have a higher probability of engaging in high level commercialization.

The main objective of the study was to establish the effect of cassava commercialization on household income. Based on endogenous model, cassava commercialization was found to have a strong linkage with household income. Farm households who had commercialized earned more income compared to the non-commercialized households. Therefore farmers should be encouraged to undertake commercialization activities in order to enhance household income. Commercialization was influenced by different factors in the two countries. It was positively driven by value addition experience as well as land size. Farm households should be encouraged to undertake commercialization activities so as to improve their household income. Factors such as; household size, farm size, education, off-farm

income, age and distance to market influence commercialization and therefore much attention should be paid to these controllable factors.

5.3 Recommendations

Conditioned on the evidence brought forth in the study, it is imperative that policies should be developed for successful realization of improved household income through cassava commercialization amongst smallholder farmers. Since farmers were found to belong to different commercialization levels, specific policy interventions for households in each level should be developed. Specifically, strategies should be identified that can help farmers who are in lower level commercialization advance to higher levels of commercialization. This should be done especially for households who are in the medium level category to move to high level commercialization. One of the policy possibilities is to strengthen market interaction by ensuring that road networks linking farmers with the main roads are maintained and markets are well structured. To maximize on production, farmers should be encouraged to increase acreage for cassava and increase productivity. This can be addressed by developing high yielding and fast maturing varieties of cassava for farmers' adoption. Extension officers should ensure that there is adequate and equitable supply of cassava planting materials to farm households.

Concerted effort by various organizations promoting cassava commercialization should be strengthened to include in-depth training on processing of cassava products as well as supporting smallholder farmers to have appropriate technology for value addition. A few processing plants were spotted in the counties; however most of them were not operational. This is because of the management wrangles between the project initiators and the community. This calls for proper integration of all the stakeholders involved in value addition activities.

Transport cost and distance to the market also emerged as barriers to cassava commercialization. This can be addressed by upgrading the rural road networks to ease the cost of transportation besides improving the market structures. In addition, the local government should support the institution of commercially oriented farm based groups which can help farmers exploit different markets such as supermarkets as well as jointly link farmers with potential buyers. It was also drawn from the study that women are the major players along cassava value chain. Gender dynamics should therefore be looked into and if possible men should be integrated into the chain. Finally, there is need for intensive

awareness creation about the effect of cassava commercialization on household income especially in the ASAL areas. This is because a considerable number of farm households still value cassava as a subsistence crop.

5.4 Suggestions for Further Research

While many studies have looked at commercialization from market participation view, this study was keen on both market participation and value addition. Therefore commercialization was contextualized as value addition and market participation. The main aim of the study which was based on the effect of commercialization on household income, purposed to unravel the opportunities available as well as reveal gaps on cassava commercialization. The study has proposed the following areas for future research in order to complement the present study;

1. Another in-depth study similar to this one, should be conducted separately in each of the counties studied to affirm the findings of this study. This should also be extended to other counties with potential cassava production and commercialization. However, data can be collected in stages-during plantation, harvesting, marketing seasons for the different crops.
2. A study based on panel data should be conducted since measurement of income in a single year of production may be unreliable because farm household incomes vary annually.
3. An in depth study on the effect of off-farm income on cassava commercialization would be necessary.
4. The dynamics of using in kind labour payments; (labour payments were mainly by cassava products) should be further studied especially in Kilifi County. This can reveal more about other economic opportunities of cassava.
5. A deeper analysis should be conducted for each county to explore other factors that could influence cassava commercialization.

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Appendix 1: Questionnaire for Farmers

Kindly tick where appropriate (√).

SECTION I: GENERAL INFORMATION

Number of questionnaire [……..…]

Location of the farmer

Sub- County…….……

Location…….……..……

Village……...…….……

SECTION II

A: FARMERS' HOUSEHOLD CHARACTERISTICS

QUESTIONS	**CODES**	**RESPONSE**
1. Gender of respondent	*1=Male; 0=Female*	
2. Are you the household head?	1= Yes; 0 = Otherwise	
3. Age in years or year of birth of the respondent	Actual number of years	
4. Marital status	*1=Single; 2=Married; 3=Divorced; 4=Widowed 5=others (specify)*	
5. Level of education	*1= None* *2=Primary level* *3=Secondary level* *4= Tertiary college level* *5=University level* *6=others(specify)*	
6. Number of years of schooling	Actual number of years	
7. What is your household size? a) Male adults b) Female adults c) Children	*Number*	
8. What is your current occupation?	*1=farming; 2= off-farm business; 3=salaried*	

	4=others (specify)	
9. How many years have you been undertaking cassava farming?	*Number of years*	

B: STRUCTURE OF LAND OWNERSHIP AND USE

10a) Total land available to farmer for farm activities and off farm and tenure system

Tenure System in (Acres)				
Owned	Rented in	Rented out	Communal	Total Acres

b) Distribution of the total land among farm enterprises as of the last production year (2015).

	Variety	**Acre**	**Month of planting**	**Month of harvesting**	**Harvested in quantity (Kgs)**	**Quantity used in home consumption in Kgs**	**Quantity sold in Kgs**
Sorghum							
Cassava							
Sweet potato							
Maize							
Ground nuts							
Beans							
Cow peas							
Green grams							
Garden peas (specify)							
Total							

C ASSET OWNERSHIP

11 a) which farm assets do you own?

Asset	**Size or number**	**Date acquired/built**	**[ii] Source of income for purchase**	**[iii] Who has access to these assets**
Plough				
Wheelbarrow				
Panga				
Slasher				
Hoes				
Jembes				
Tractors				
Bicycles				
Motorcycles				
Disc harrow				
Irrigation pump				
Farm store				
Van				
Rake				
Spade				
Carte				
Others (Specify)				

[ii]*Codes for source of income 1= equity 2=loan 3= own savings and funds 4= others(specify)……*

[iii] *Asset access 1=Husband 2=Wife 3=Children 4=All members of the family 5=Others*

D: LABOUR DISTRIBUTION

12 a).How did you use labour in the last production season (2015)?

Ploughing	Planting	Weeding	Fertilizer application	Herbicides /pesticides application	Harvesting	Post-harvest handling	Marketing of cassava

Codes 1=Husband only; 2=Wife only; 3=Husband mostly; 4=Wife mostly; 5=Husband and Wife equally; 6=Children; 7=Hired labour; 8=Other (specify)……

E: CASSAVA PRODUCTION ASPECTS

13 a) which of the following farm inputs have you purchased and applied as of the last cassava production year?

S.N	Description	1.Yes 0.No	Quantity per unit	Cost per unit(KES)	Accessibility	Source of financing
i.	Fertilizer					
ii	Improved cassava variety					
iii	Organic fertilizer					
iv	Pesticide					
v	Family labour(days)					
vi	Hired labour (days)					
vii	Others(specify)					

CODES:

Cost	Accessibility	Source of financing
1=Low	0=Not accessible	1= Own savings and funds

2=Medium 2= Accessible 2= Credit/Loan

3=High 3= Others

4=Very high

14 a) Kindly rate the following statements as to some of the factors that influence cassava production levels.

Use the scales as follows to rate the statements**:**

1 2 3 4 5

Strongly Disagree Neither agree Agree Strongly

Disagree nor disagree Agree

S.N	**Statement**	**1**	**2**	**3**	**4**	**5**
i	Scarcity of planting material					
ii	Little access to the improved cassava variety					
iii	Lack of reliable post-harvest facilities and infrastructure such as roads, means of communication and input supply system.					
iv	Small uneconomic land holdings(Small farm sizes)					
v	Primitive production technologies					
vi	Poor soils					
vii	High cost of labour					
viii	Pest and diseases					
ix	Long cassava maturity period					
x	Little access to credit and agricultural services in the production system.					
xi	Others(specify)					

b) In your own opinion what needs to be done to improve cassava production?

1. Awareness creation 2. Provide affordable credit facilities 3. Improved planting materials 4. Provision of extension services 5. Proper control and management of pests and diseases 6. Others (Specify)

F: CASSAVA VALUE ADDITION

15 a) Do you add value to your cassava products? 1. Yes [ ] 0. No [ ]

b) If yes what is the main motive ……

c) If no, why? **.....**

16. How long have you been adding value to your cassava? ……..years

17 a) Did you sell value added cassava 1. Yes [ ] 0. No [ ]

b) What are the two main forms of value addition you carry out for your cassava?

1 = roasting 2 =drying 3 = frying 4 = boiling 5 = milling 6. Others (specify)**…….**

c) Which are the most popular forms of value addition to cassava in your (this) area?

Fill in the table below

Types of Value Added	Final product	Estimated quantity of the value added product in Kg	Price of the final product per Kg
Roasting			
Drying			
Frying			
Boiling			
Milling			
Packaging			
Others(specify)			

18. How do you spend the extra income earned from cassava value addition?

1. To buy other foodstuff 2. To increase production of other crops
3. To pay school fees 4. For leisure 4. Others (specify)…….

19. Rank four main challenges which hinder cassava value addition in your area.

1. High cost of value addition 2. Inadequate information 3. Insufficient funds 4.Others

20. Suggest the possible interventions for improving cassava value addition in your area.

1. Creating value addition awareness 2. Establishing processing centers 4. Formation of groups 5. Increasing production 6. Others (Specify)

G CASSAVA INSTITUTIONAL AND MARKETING FACTORS

21 a) Do you sell your cassava? 1. Yes [ ] 0. No [ ]

b) How do you transport your cassava products to the market?

1. Bicycles 2= Motorcycle 3= Pick-Up 4=On foot 5= Others(Specify)

c) What is the distance (Km) from the farm to the nearest market where you sell your products?

22 a) Who are the main customers of raw cassava (tick the main)

S/N	**Customers**	**[ii]Main location**	**Price/kg(KES)**
i	Local consumers		
ii	Local intermediary traders		

iii	Others (specify)		

[ii]Codes: 1= Market centers 2= Farm gate 3= Others (Specify)

b) The main customers of value added cassava (tick the main)

S/N	Customers	Main location	Price/kg(KES)
i	Retailers		
ii	Small scale hoteliers		
iii	Final consumers		

[ii]Codes: 1= Market centers 2= Farm gate 3= Others (Specify)

c) Who determines prices of the final products?

1=The farmer [ ] 2=The customer [ ] 3=The market forces [ ] 4=Negotiable [ ]

d) What is it that you consider most when pricing your cassava products?

1. Demand 2. Distance to the market 3.Quality 4. Others(Specify)

e) How was the price trend for raw cassava from 2010 to 2015?

1= Decreased [ ] 2= Constant [ ] 3= Increased [ ]

f) How was the price trend for the value added cassava from 2010 to 2015?

1= Decreased [ ] 2= Constant [ ] 3= Increased [ ]

g) How do you characterize the demand for value added cassava?

1=Lower than supply [ ] 2=Equal to supply [ ] 3= Is higher than supply [ ]

c) What costs do you incur in marketing cassava?

Type of cost	Unit	Value in (KES)
Transport	Per Km	
Cost of labour	Per person	
Value addition	Kg	
Cess or licence	Per batch	
Cost of storage	Per month	

23 a) How do you acquire market information pertaining output prices most often?

1. Extension officers 2. Group membership 3. Phone calls 4. Media 5.From local traders 6.Others (Specify)

24 a) Do you have access to credit facilities? 1. Yes 0. No

b) If "No", what is the main reason?

1. Lack of Access 2. High interest rate 3.Collateral requirement challenge 4. Availability of other alternatives 5. Other (specify) ……

c) If yes, how much did you borrow in the last production season (2015)?…… (KES)

d.) If yes, what was your **major source**?

1. Savings and credit institutions 2. Group/Associations 3.Commercial Banks 4.others.

e) What did you do with the borrowed money?

S.N	Target activity	1=Yes 0=No	Rank According to degree of expenditure (1=Low, 2=medium 3= high)
i	Purchased inputs such as fertilizer, improved seeds, etc		
ii	Hired labour		
iii	Rented-in land		
iv	Cassava value addition		
v	Others(specify)		

f) How do you assess the cost of getting credit (interest and other charges)?

1. Expensive 2.Affordable 3. Cheap

25 a) Are you a member of any farmer group? 1. Yes 0.No

b) If yes, which association do you belong to?

1. Farmer's Cooperative
2. Savings and Credit Institution
3 .Women's Association
4. Other (please specify**):** ……

c) How does the membership benefit you?

S.N	Membership benefits	1=Yes 0=No
i	Fast input Delivery	
ii	Affordable input price	
iii	Fair farm gate output Price	
iv	Strong bargaining Power	
v	Easy access to credit	
vi	Low cost credit	
vii	Agricultural information access	
vii	Others(specify)	

26 a) Did you receive any extension service in the last production season? 1=Yes 0=No

b) If yes, how many extension visits did you receive per month / year ?……..

c) What are some of the benefits that you derived from the extension visits in the last production season?

1. 2. 3.

H. HOUSEHOLD INCOME

27 a) Did you participate in non-farm activities /off- farm employment?

1 Yes 0. No

b) If your answer is yes how much did you receive as income from your participation?

	Type of activity	Self-employment	Off-employment	Total income earned in the year (KES)
1				
2				
3				
4				
5				

28. What is the total expenditure on other household crops listed below for the past one year and current year?

Crop	**Total Expenditure (KES) In the past one year (2015)**	**Total Expenditure (KES) In the current year**
Sorghum		
Cassava		
Sweet potato		
Maize		
Ground nuts		
Beans		

29. Estimation of household income from agricultural products for the last twelve months.

Product	**Quantity sold in the year (2015)**	**Total Value earned from sales (in KES)**
Cassava		
Sorghum		
Sweet potato		
Maize		
Groundnuts		
Beans		
Green grams		
Others		

30. Rate how important the sales are to your household income? (0-3)

(0=not at all important - 1=slightly important - 2=somewhat important - 3=very important

31. Did you receive remittances from relatives or friends in the last production year?

1= Yes 0=No

32. If yes, how much did you receive…….KES

33. How did you spend the remittances?

1= To buy food items 2. Pay school fees 3. Increase farm production 4. For leisure 5. Others

Appendix 2: Questionnaire for Traders

Kindly circle where appropriate (√).

Number of questionnaire [……..…]

Location of the trader

Sub-

County…….……

Location…….……...……

…Village……...…….……

…….

Market

Centre…….

Section I: Socio-Economic Characteristics of Traders

1. Age of the trader (years)

2. Gender of the trader: 1=Male [ ] 0=Female [ ]

3. Marital status: 1=Single [ ] 2= Married [ ] 3=Divorced [ ] 4=Widowed [ ] 5=others (specify)…….

4. Level of education ( )

1= None [ ] 2=Primary [ ] 3=Secondary [ ] 4= Tertiary College level [ ] 5.University level [ ] 6=Other (specify)……

5. How many years have you been in cassava trade business? ……years

6. Other than cassava trade what other related business activities do you undertake within the same premise: 1= sale of grains 2= sale of household items 3= others(specify)……

……

……

Section II: Cassava Marketing Aspects

7. From whom do you mostly source your cassava value added / raw products?

1. Local traders within the region 2. Traders from other markets or regions 3. Trader groups 4.Farmers 5.Self-production 6. Others (specify)…….

8a) How often do you procure cassava?……..

……..

b) What quantities of cassava do you procure per month? 1. Less than 5 kg 2. 5- 10 kgs 3. 10-15 kgs 4. More than 15 kgs

9a) At what price do you buy your Cassava? Kes….. ..Per kg

b) How do you determine the buying price? 1. Market rate 2.Farmer price 3. Other (specify)

10 a) What do you look for when buying cassava? 1. Moisture content 2. Cassava maturity

3. Cleanliness of Cassava 4. Size of Cassava 5.Any other (specify)……

b) Are there any contractual agreements between you and your suppliers? 1. Yes 0. No.

c) If Yes. What kind of arrangements? 1. Formal contracts 2. Informal contracts 3. Any other (specify)…….

11 a) Where do you sell your cassava?

1= Market Centre 2= Farm gate 3. Institutions 4.Others

b) In what form do you sell your cassava?

1= Value added cassava 2= Raw cassava 3 Both

c) What form of value added cassava do you sell?

1= Dried 2= Milled 3= Roasted 4= Fried 5= Boiled 6= Others(Specify)

12 a) What quantities of Cassava do you sell on a weekly basis in Kg?

1. Less than 5 kg 2. 5- 10 kg 3.10-15 tins 4. More than 15 tins

b) At what price do you sell your Cassava? Kes….. ..Per kg

c) How do you acquire market information pertaining cassava prices most often?

1= Extension officers 2.=Group membership 3.=Phone calls 4=Media 5.= Other traders within the local market 6= Others

13. What costs do you incur in marketing cassava (Specify the units where necessary)?

No.	Type of cost	Cost per Unit (Kes)	Total cost in (Kes)
1.	Transport (Km)		
2.	Cost of labour		
3.	Value addition costs		
4.	Market charges		
5.	Cost of storage		

14. What are the main problems that you encounter in cassava marketing?

1= Bulkiness 2= Poor prices 3=Distance to the market 4.=Poor roads 5=Demand related issues 6 =Challenges in Storage 7=Fear of poisonous varieties 8= (Specify)Any other

15. In your own opinion what needs to be done to improve cassava quality, trade and even value addition?

1. Good network of feeder roads 2. Formation of marketing groups 3. Establish processing firms 4. Educating farmers and traders 5. Others (Specify)……

Appendix 3: Questionnaire for Extension Officers

Questionnaire number…….

Name of the respondent…….

Respondent location……..

1. Major Crops produced in the area (give number according to relative importance of the crop.1 for most important……. and 5 for least important crop.

Sorghum

Cassava

Sweet potato

Maize

Beans

Green peas

Groundnuts

Others (specify)……..

2. Are there factories for value addition of any of the mentioned crops in the sub-county? 1=Yes [ ] 0= No[ ]
   a. If yes (please specify)
   b. If yes are they fully utilized? 1=Yes [ ] 0= No [ ]
   c. If No (give the reason)…….
3. Do you offer cassava value addition extension services? 1= Yes [ ] 0 = No [ ]
   a. If 'Yes' specify ……
   b. If 'No' give a reason…….
4. Which other extension services do you offer to cassava farmers?.....
5. How frequent do you have contacts with farmers
   i= Very frequent -Once per every 2 weeks
   ii= Frequent -Once per month
   iii= Not frequent -Once per 3 months
   iv= Irregular -When they have a problem
6. How do you normally contact the farmers?

i. individual calls ii. Groups meetings iii. Invitations iv. Others (specify)……

7. Do farmers participate in the following post-production activities after receiving extension advice? Which areas need more advice?

Post production Activities(Cassava)	**1=Yes 0= No**	**Tick the areas that need more advice**
Storage		
Marketing		
Transportation		
Processing		
Packaging		
Others (specify)		

8. What are the main challenges that hinder farmers from cassava value addition and market participation?

i…… ii……

iii……iv……..

Appendix 4: Description, Measurements and Expected Signs of the Variables used in Analysis

VARIABLE	DESCRIPTION	MEASUREMENT	EXPECTED SIGN
DEPENDENT VARIABLES			
(Levels of Commercialization)	Indicates decision to carry out value addition and market participation	0= None ,1= Low, 2=Medium, 3=High	
PER ACRE	The amount of income earned from cassava per acre	Kes	
PER CAPITA	Income earned	Kes	
PER YR	Amount of income earned in a year	Kes	
INDEPENDENT VARIABLES			
AGE	Age of the respondent	Years	+/-
GEN	Gender of the respondent	Dummy:1= if male ; 0 otherwise	+/-
EDUC	Education level of the household head	Years	+/-
MARST	Marital status of the household	Categorical	+
HHZSIZE	Household size of the household	Number of people in the household	+/-
FARMEXP	Farmer experience in farming	Number of years in farming	+/-
GRPM	Membership to a group	Dummy: 1= member;0= otherwise	+/-
CRT	Farmers access to credit	Dummy: 1= member;0= otherwise	+
FRMSIZE	Total amount of land cultivated to cassava and other crops	Acres	+

HHINC	Total annual household income	Kes	+
OFFINC	Off- farm income	Kes	+/-
OUTPUT	Total output of cassava produced in the last production season	Kgs	+
EXTCON	Farmers contact with the extension officers	Number of contacts in a month	+
PRICE	Average price at which each Kg of cassava product is sold	Kes. per Kg	+
MKTINFO	Farmers access to market information	Dummy:1=Access;0= Otherwise	+
DISTANCEM	Distance to the market	Km	_
TRANSPORTC	Transport Cost	Kes	-
HARVESTOUTP	Quantity of cassava harvested	Kg	+

The positive sign (+) means that an increase in the variable is hypothesised to have a positive influence on the outcome, while negative sign (-) means that an increase in the variable is hypothesised to have a negative influence on the outcome.

Appendix 5: Independent Sample T-Test for Means of Commercialization Index (CI)

Hypotheses	Levene's Test for Equality of Variances		t-test for Equality of Means				
	F	Sig.	t	df	Sig.(2-tailed)	Mean Difference	Std Error Difference
Equal variances assumed (H_{o1})	.488	.485	-.281	379	.779	-0.007	.0258
Equal variances not assumed (H_{A1})			-.280	371.4	.780	-0.007	.0253

Appendix 6: Comparison of Means of Crop Incomes for Siaya County

Analysis of Variance Source	SS	df	MS	F	Prob > F
Between groups	1.2621e+09	5	2.52E+08	3.65	0.0028***
Within groups	7 .4607e+10	1080	69080643		
Total	7.5869e+10	1085	69925567		

Note: ***= Significant at 1%

Appendix 7: Comparison of Means of Crop Incomes for Kilifi County

Source	Analysis of Variance SS	df	MS	F	Prob > F
Between groups	5.1629e+09	5	1.03E+09	3.65	0.0028***
Within groups	2.7853e+11	984	283055265		
Total	2.8369e+11	989	286844618		

Note: ***= Significant at 1%

Appendix 8: Bonferroni Test of Means of Crops for Siaya and Kilifi Counties**.**

Variable	Siaya		Kilifi	
Crop	Coefficient	P-Value	Coefficient	p-Value
Sorghum	1.011	0.000***		
Cassava	5.202	0.000***	6.0363	0.000***
Maize	1.838	0.000***		

Note: The results are for Bonferroni, Scheffe and Sidak tests.

Appendix 9: Normality test of Regression Variables

Test for multivariate Normality					
Doornik-Hansen (Siaya)	chi2(14)	14314.78	Prob>chi2	=	0.000
Doornik-Hansen (Kilifi)	chi2(10)	43261.96	Prob>chi2	=	0.000

Appendix 10: Multicollinearity Test for Regression Model (Siaya Traders)

Variable	VIF	1/VIF	VIF	1/VIF
Education	1.39	0.720581	1.24	0.805
Market charges	1.36	0.735471	1.30	0.767
Experience	1.23	0.810682	1.26	0.793
Cost of storage	1.22	0.818236	1.39	0.719
Age	1.22	0.819922	1.27	0.789
Procurement times	1.21	0.823313	1.45	0.691
Quantity sold	1.20	0.831075	1.56	0.641
Cost of labor	1.17	0.856627	1.06	0.945
Transport cost	1.07	0.932569	1.22	0.822
Mean VIF	1.23		1.31	

Appendix 11: Comparison Test of Cassava Prices for Traders

	Kilifi		**Siaya**	
	Selling Price	Buying Price	Selling Price	Buying Price
Mean	74.88	40.48	48.36	35.57
Hypothesized mean difference	0		0	
Degree of freedom	48		52	
t-value	-8.129		-9.428	
t-critical two tail	0.000		0.000	

Appendix 12: Comparison Test of Cassava Prices for Farmers

	Kilifi		Siaya	
	Selling Price	**Buying Price**	**Selling Price**	**Buying Price**
Mean	31.54	14.61	34.17	27.23
Hypothesized mean difference	0		0	
Degree of freedom	126		62	
t-value	-4.71		-2.68	
t-critical two tail	0.000		0.009	

Appendix 13: Linear Regression Results for Marketing Margin of Traders in Kilifi County

Independent Variables	Coef.	Std. Err.	t	p>t
Age of household head	-214.048	157.3546	-1.360	0.182
Education of household head	181.558	662.2066	0.270	0.785
Quantity of cassava sold	39.283	11.63654	3.380	0.002
Purchase times	-35.059	80.27054	-0.440	0.665
Experience of household head	-163.195	272.6572	-0.600	0.553
Transport cost	2.245	1.232574	1.820	0.076
Labor cost	1.138	3.611542	0.320	0.754
Market charges	0.790	5.167746	0.150	0.879
Storage cost	-1.875	2.339386	-0.800	0.428
Constant	6194.404	11355.14	0.550	0.589
Number of Observations	49			
Prob>F	0.002			
R-Squared	0.475			

Dependent variable is the marketing margin

Appendix 14: Linear Regression Results for Marketing Margin of Traders in Siaya County

Independent variable	Coef.	Std. Err.	t	P>t
Age of household head	-85.528	76.538	-1.120	0.270
Education of household head	-303.483	164.325	-1.850	0.072
Quantity of cassava sold	11.844	2.052	5.770	0.000
Purchase times	4.119	53.531	0.080	0.939
Experience of household head	-13.858	72.020	-0.190	0.848
Transport cost	0.019	0.057	0.330	0.746
Labor cost	-0.466	0.797	-0.590	0.562
Market charges	-0.192	1.042	-0.180	0.855
Storage cost	0.905	1.001	0.910	0.371
Constant	5380.802	3654.291	1.470	0.148
Number of Observations	52			
Prob>F	0.000			
R-Squared	0.494			

Dependent variable is marketing margin

Appendix 15: Double- log Regression Results ForMarketing Margin of Siaya Traders

Independent variables	Coef.	Std. Err.	t	P>t
Age of household head	0.882	0.375	2.350	0.024
Education of household head	0.631	0.497	1.270	0.211
Quantity of cassava sold	0.916	0.790	1.160	0.253
Purchase times	1.085	0.636	1.710	0.095
Experience of household head	0.760	0.413	1.840	0.073
Transport cost	-0.644	0.179	-3.590	0.001
Labor cost	-0.198	0.128	-1.540	0.130
Market charges	-0.041	0.183	-0.230	0.822
Storage cost	-0.291	0.132	-2.210	0.033
Constant	-7.361	5.795	-1.270	0.211
Number of Observations				
Prob>F				
R-Squared				

Dependent variable is marketing margin

Appendix 16: Double-log Regression Results For Marketing Margin of Kilifi Traders

Independent variables	Coef.	Std Err.	t	p>t
Age of household head	0.293	1.513	0.190	0.847
Education of household head	0.939	0.553	1.700	0.097
Quantity of cassava sold	1.258	0.488	2.580	0.014
Purchase times	-0.894	0.439	-2.040	0.049
Experience of household head	-0.979	0.547	-1.790	0.081
Transport cost	0.075	0.124	0.600	0.549
Labor cost	0.206	0.119	1.730	0.092
Market charges	0.239	0.200	1.200	0.237
Storage cost	0.066	0.121	0.540	0.592
Constant	0.893	5.42	0.160	0.870
Number of Observations	49			
Prob>F	0.009			
R-Squared	0.299			

Dependent variable is marketing margin

Appendix 17: Linear Regression Results for Marketing Margin of Kilifi Farmers

Independent variables	Coef.	Std. Err	t	p>t
Gender of the household head	3.308	5.801	0.570	0.569
Extension services	4.958	4.422	1.120	0.264
Market charges (cess and license)	-0.000	0.000	-1.070	0.286
Labor cost	0.002	0.003	0.950	0.344
Value addition index	75.872	8.319	9.120	0.000
Distance to the market	19.909	3.316	6.000	0.000
Quantity of cassava sold	0.002	0.001	1.970	0.050
Schooling years of household head	-0.188	0.596	-0.320	0.753
Total household size	-0.179	0.614	-0.290	0.771
Value addition experience	0.405	0.219	1.850	0.066
Constant	10.565	9.192	1.150	0.252
Number of Observations	198			
Prob>F	0.000			
R-Squared	0.433			

Dependent variable is the marketing margin

Appendix 18: Double- log Regression Results for Marketing Margin of Kilifi Farmers

	Coef.	Std Err	t	p>t
Gender of the household head	0.155	0.272	0.570	0.571
Extension services	0.169	0.213	0.790	0.428
Market charges (cess and license)	-0.075	0.029	-2.630	0.009
Labor cost	0.042	0.046	0.910	0.364
Value addition index	-0.189	0.171	-1.110	0.269
Distance to the market	-0.132	0.160	-0.820	0.412
Quantity of cassava sold	0.478	0.050	9.500	0.000
Schooling years of household head	-0.166	0.117	-1.430	0.156
Total household size	-0.397	0.174	-2.280	0.024
Value addition experience	0.139	0.1181	1.170	0.242
Constant	1.345	0.425	3.170	0.002
Number of Observations	198			
Prob>F	0.000			
R-Squared	0.539			

Dependent variable is the marketing margin

Appendix 19: Linear Regression Results for Marketing Margin of Farmers Siaya

Independent variables	Coef.	Std. Err.	t	p>t
Gender of the household head	0.439	4.589	0.100	0.924
Extension services	7.941	4.312	1.840	0.067
Transport cost	0.002	0.001	0.990	0.322
Labor cost	-0.000	0.001	-0.200	0.839
Value addition index	14.894	8.214	1.810	0.072
Distance to the market	67.799	8.520	7.960	0.000
Quantity of cassava sold	0.001	0.007	0.190	0.852
Schooling years of household head	0.209	0.502	0.420	0.677
Total household size	2.346	0.649	3.610	0.000
Value addition experience	0.067	0.166	0.410	0.686
Constant	-12.861	5.002	-2.570	0.011
Number of Observations	179			
Prob>F	0.000			
R-Squared	0.535			

Dependent variable is the marketing margin

Appendix 20: Double-log Regression Results for Marketing Margin of Siaya Farmers

Independent variables	Coef.	Std. Err.	t	p>t
Gender of the household head	0.329	0.259	1.270	0.206
Extension services	0.501	0.222	2.260	0.025
Transport cost	-0.023	0.025	-0.870	0.386
Labor cost	0.017	0.029	0.560	0.574
Value addition index	-0.149	0.136	-1.100	0.273
Distance to the market	-2.412	0.171	-14.070	0.000
Quantity of cassava sold	0.074	0.044	1.680	0.095
Schooling years of household head	0.088	0.101	0.880	0.380
Total household size	-0.056	0.157	-0.360	0.720
Value addition experience	-0.132	0.119	-1.110	0.270
Constant	0.325	0.442	0.730	0.464
Number of Observations	179			
Prob>F	0.000			
R-Squared	0.648			

Dependent variable is the marketing margin

Appendix 21: Diagnostic Test for Multicollinearity of Variables for Probit Model

	Kilifi		Siaya	
Variable	VIF	1/VIF	VIF	1/VIF
Schooling years	1.10	0.912	1.34	0.746
Age	1.09	0.917	1.06	0.942
Off- farm a	1.05	0.951	1.12	0.896
Gender	1.05	0.952	1.14	0.880
Experience	1.05	0.955	1.18	0.849
Remittance	1.05	0.956	1.12	0.896
Land size	1.05	0.957	1.19	0.839
Membership group	1.04	0.960	1.14	0.880
Distance	1.02	0.979	1.15	0.872
Household size	1.02	0.983	1.17	0.854
Mean VIF	1.05		1.16	

The table shows that all the values of the variance inflation factors are less than the maximum value which is 10, according to the rule of thumb.

Appendix 22: Heteroskedasticity Test using Breusch-Pagan Test

Siaya

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of Total income

chi2(1) = 8.87
Prob > chi2 = 0.0029

Kilifi

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of Total income

chi2(1) = 34.88
Prob > chi2 = 0.0000

Note: The null hypothesis states that the residuals are homoscedastic; therefore we accept the null hypotheses since the p-values are significant.

Appendix 23: Kilifi Probit Results on the Determinants of Cassava Commercialization

Variable	Coef.	Std. Err.	z	P>z
Schooling years	0.1098	0.1024	1.07	0.284
Farmer Experience	0.0668	0.1133	0.59	0.556
Total Household size	-0.2981	0.2026	-1.47	0.141
Total land size	0.1944	0.1272	1.53	0.126
Off-farm	-0.3588	0.2052	-1.75	0.08
Gender of the household head	-0.3229	0.2177	-1.48	0.138
Age of the household head	-0.5386	0.2214	-2.43	0.015
Remittance	0.2669	0.2192	1.22	0.223
Membership group	-0.2423	0.2529	-0.96	0.338
Distance to the market center	-0.4547	0.1561	-2.91	0.004
Constant	1.0091	0.5707	1.77	0.077
Log likelihood	111.605			
Number of observations	200			
LR $\chi^2(10)$	24.43			
Prob > chi2	0.0065			
Pseudo R2	0.0987			

Note: The dependent variable was cassava commercialization

Appendix 24: Siaya Probit Results on the Determinants of Cassava Commercialization

Variable	Coef.	Std. Err.	z	P>z
Schooling years	0.3177	0.1521	2.09	0.037
Farmer Experience	0.1954	0.1470	1.33	0.184
Total Household size	-0.2490	0.2042	-1.22	0.223
Total land size	0.5188	0.1766	2.94	0.003
Off-farm	0.2369	0.2507	0.94	0.345
Gender of the household head	0.0206	0.3223	0.06	0.949
Age of the household head	0.2744	0.2889	0.95	0.342
Remittance	0.3924	0.2580	1.52	0.128
Membership group	0.4434	0.2718	1.63	0.103
Distance to the market center	-2.0008	0.6806	-2.94	0.003
Constant	-1.2581	0.5987	-2.1	0.036
Log likelihood	75.219			
Number of observations	181			
LR $\chi^2(10)$	71.87			
Prob > chi2	0.000			
Pseudo R2	0.323			

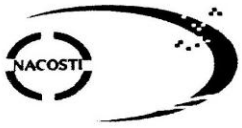
Note: Dependent variable was commercialization

Appendix 25: Test of Overidentification of Instrumental Variables

		Siaya		Kilifi	
Sargan (score)	chi2(1)	2.30424	(p = 0.1290)	0.533	(P=0.388)
Basmann	chi2(1)	2.29527	(p = 0.1298)	0.535	(P=0.383)

Note:Since the test statistics are not significant, then the instrumental variables are valid and the model is well specified.

Appendix 26: Research Permit



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Date: **1st August, 2016**

Florence Achieng Opondo
Egerton University
P.O. Box 536-20115
EGERTON.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Evaluation of cassava commercialization among smallholder farmers and its effect on household income: A comparative study of Siaya and Kilifi Counties,"*** I am pleased to inform you that you have been authorized to undertake research in **Siaya and Kilifi Counties** for the period ending **30th July, 2017.**

You are advised to report to **the County Commissioners and the County Directors of Education, Siaya and Kilifi Counties** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. STEPHEN K. KIBIRU, PhD.
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Siaya County.

The County Director of Education
Siaya County.

The County Commissioner
Kilifi County.

Appendix 27: Publication Papers

Publication Paper 1

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Is Cassava Commercialization a Strategy for Improving Household Income of Smallholder Farmers in Kenya? Endogenous Switching Model Approach

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Abstract
Improving the economic welfare of smallholder farmers through agricultural commercialization strategy has been of great concern in sub-Saharan Africa. This is especially so in the Arid and Semi-Arid (ASAL) areas of Kenya which are prone to drought and poverty challenges. Among the few crops that can thrive in these areas and be used in commercialization is cassava. Therefore this study purposed to evaluate the effect of cassava commercialization on household income among smallholder farmers in Siaya County, Kenya. A multistage sample of 181 households was obtained. An econometric analysis based on endogenous switching regression model was performed. The study found that farmers who undertook cassava commercialization had a significant higher income relative to those who did not. In addition, several factors were found to significantly affect commercialization. These included farm size, years of education and remittances which positively ($p<0.05$) influenced cassava commercialization and group membership ($P<0.10$). However distance to the market ($p<0.01$) had a negative effect. The study recommends that cassava commercialization should be enhanced in the region through various interventions by key stakeholders. These include providing farmers with high yielding cassava varieties, promoting value addition of cassava and upgrading rural road networks to facilitate easy movement of actors and products to markets.
Keywords: Commercialization, Cassava, Strategy, Household income, Smallholder farmer

1. Introduction

Agriculture is the main economic activity for majority of the rural dwellers in Kenya who form about 75% of the total population. In fact it is the key driver of economic growth among rural households and is capable of lifting them out of their poverty situation by improving household income since approximately 70% of rural households rely on agriculture (IFAD, 2015). Majority of the Kenyan rural populace comprise smallholder farmers who produce crops mainly for consumption with very little left for market oriented activities. Studies have confirmed that poverty reduction and improved household welfare through income generation can be achieved by increasing productivity of agricultural crops and promoting commercially oriented agriculture (IFAD, 2010).

The Kenyan government and other development organizations have been keen on promoting commercially oriented crop farming among the rural households as an effort towards improving their livelihoods. One of the target crops has been cassava (*Manihot esculenta Crantz*) which, for some reasons, has not fully evolved from subsistence to a commercially oriented crop, this notwithstanding the efforts to promote its commercialization (FAO, 2011). Most of the cassava produced in Kenya is used in its fresh form for human consumption or as traditional processed products (Munga *et al.*, 2012). As far as commercialization is concerned, a study by Karuri *et al.* (2001) found that cassava is mainly marketed as a fresh root commodity in the proximity of the production areas with few value added cassava products sold at the market centers.

Cassava production in the world varies. Cassava quantity produced in Kenya does not compare favorably with the world production. In 2013, the world cassava production quantity stood at 276,721,585 tonnes FAOSTAT, (2013), while Kenya's production was 1,112,420 tonnes which accounted for 0.4 percent of the total production. The area under cassava production in all the Kenyan counties during that period was 70,000 hectares compared to 69,169 tonnes in 2012 (FAOSTAT, 2013). This production was not evenly spread throughout the country; mainly it was grown in the Coastal and Western regions. In the Western region, the main production area is Siaya County. In 2013, the area under cassava cultivation in Siaya was about 5,000 hectares. This is an insignificant acreage compared to the potential of about 30,000 hectares, with yields ranging between 12 to 16 tonnes per hectare across the county (MOA, 2013). These statistics show that there is high potential for cassava production in Siaya County and in Kenya generally which can be exploited to promote commercialization.

Siaya County is located in the South-West part of Kenya. It lies in the ASAL zone which forms approximately 80 percent of the Kenyan land (GOK, 2011). The county experiences high poverty level of about 47.5 percent which is above the national poverty rate which stands at 45.9 percent. Agriculture is the dominant economic activity among households in the county making it a potential target for commercialization. Amongst other crops produced in the county, cassava is one of the crops grown by farmers because of the favourable

Publication Paper 2

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Full Length Research Paper

Characterization of the levels of cassava commercialization among smallholder farmers in Kenya: A multinomial regression approach

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Cassava commercialization is a concept that has been used by many development practitioners because of its possible strategic role in transforming livelihoods of smallholder farmers in sub-Saharan Africa, including Siaya and Kilifi Counties in Kenya. This concept can easily be implemented when the levels of commercialization is known. However, empirical evidence reveals little information on the levels of cassava commercialization amongst smallholder farmers in these counties. Thus effective policy interventions on cassava commercialization for these farmers are difficult to implement, since there is no proper understanding of their levels of cassava commercialization. Therefore the main objective of this paper was to characterize levels of cassava commercialization among smallholder farmers. Factors influencing cassava commercialization were also evaluated. The data was collected from 381 farm households in Siaya and Kilifi Counties (Kenya).This data was used to calculate the Household Commercialization Index (HCI) and Value Addition Indices (VAI) which were then integrated to form the Commercialization Index (CI). This integrated index formed the basis for categorizing the levels of commercialization. A multinomial regression model was used to evaluate factors that affect levels of commercialization. The results obtained revealed that majority of smallholder farmers' operate at low and medium categories with very few of them at high level. Distance to the market, cassava acreage, schooling years, gender and marketing costs were the key determinants of the levels of commercialization. In order to promote high level commercialization, the study recommends developing policies that enhance formal education among farmers, optimal usage of land and minimization of transportation costs through infrastructural development.

Key words: Commercialization, cassava, smallholder farmers, value addition, market participation.

INTRODUCTION

In sub-Saharan Africa, agricultural sector is one of the key sectors that have contributed to rural development. Majority of rural household dwellers, who represent 70% of the poor, depend upon agriculture for their livelihood (Diao et al., 2010). Thus agriculture primarily contributes towards economic development of most African countries

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