

**FACTORS AFFECTING COMMERCIALIZATION OF SWEET POTATOES IN
KENYA
A CASE STUDY OF MOSOCHO DIVISION, KISII COUNTY.**

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partial fulfillment of the requirement for the award of Masters of Arts degree in
Economics**

DECLARATION

I declare that this project is my original work and has not been awarded for a degree award in other Universities and colleges.

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This research project is submitted for the award of a Master of Arts degree in Economics.

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AKNOWLEDGEMENT

My sincere thanks go to my family for their continuous support during my entire schooling. I also thank my Master's project supervisor Dr. Kamau Gathiaka for his guidance and support. Last but not least, I thank God for good health during the period.

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ABSTRACT

Commercializing Agriculture is important because it is necessary for unlocking opportunities including sustainable livelihoods for smallholder farmers as well as provision of better incomes. This study examines factors affecting commercialization of sweet potatoes in Mosocho Kenya. Lack of market information for sweet potato and support from the government as well as other agricultural institutions are major challenges that most sweet potato farmers experience. There are no proper researches on marketing of sweet potato. This study addresses this problem by investigating factors affecting sweet potato commercialization in Mosocho, Kenya. This will help to assess the economic viability of commercializing sweet potatoes as a first step out of poverty for smallholder farmers especially in areas where land is declining. The objectives of the study include to examine factors affecting sweet potato commercialization in Mosocho and to draw policy recommendations based on the findings. In this study, the Tobit Model was used to analyze data and the findings show that accessibility to Market information, Quantity of sweet potato sold, distance to the market and access to hired land positively affected sweet potato commercialization in Mosocho.

Key Words, Commercialization, Sweet Potato, Mosocho

LIST OF ACRONYMS AND ABBREVIATIONS

AGRA	Growing Africas Agriculture
CIP	International Potato Centre
FAO	Food Agricultural organization
HCI	Household commercialization index
ISA	International Starch Institute.
IYP	International Year of sweet potato
KALRO	Kenya Agricultural and Livestock Research Organization
KEBS	The Kenya National Bureau of statistics
UN	United Nations
USAID	United States Agency for International Development
VITAA	Vitamin A for Africa

CHAPTER ONE: INTRODUCTION

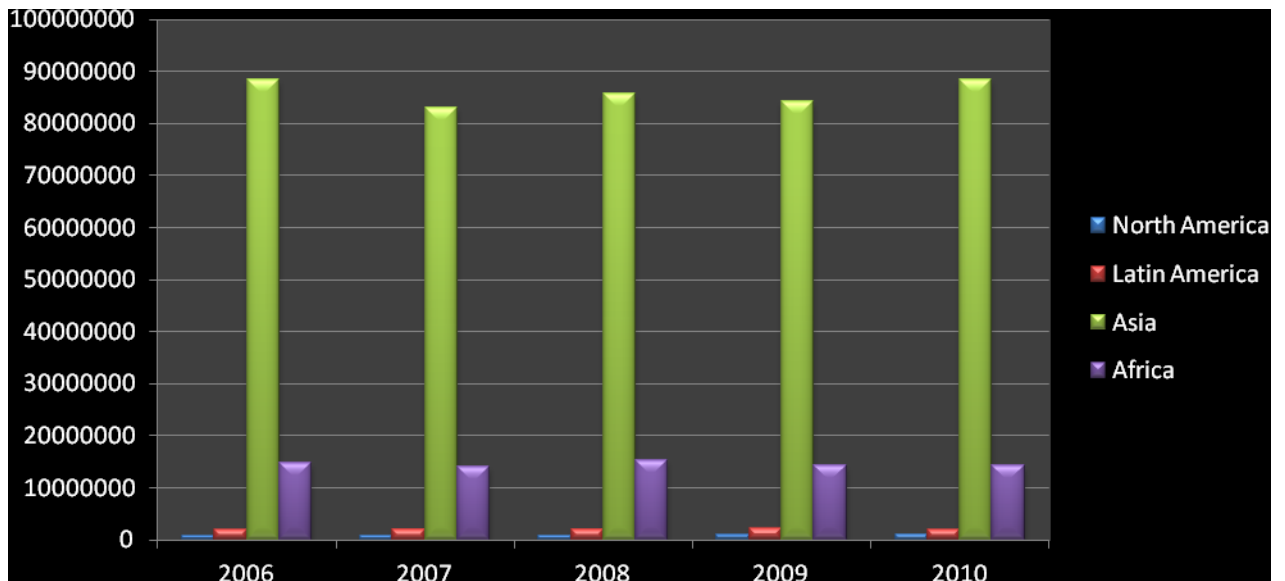
1.1 Background

Agriculture is the mainstay activity for many countries especially in the sub-Saharan Africa and it can be used to reduce hunger and poverty levels. India, China and Bangladesh among other countries have successfully reduced poverty through embracing agricultural growth. According to Thirtle et al. (2003), a marginal increase in agricultural activity reduces the number of people who live on less than one dollar a day by 0.6 percent to 1.2 percent one percentage increase in agricultural activity reduces the. Lipton (2001) emphasizes that no other sector apart from agriculture offers a capability of lifting people out of poverty as well as create employment.

Global market for sweet potatoes grows each and every year thus providing different opportunities for sweet potato to be exported by sea and air, so long as the required quality and volume is met. Sweet potato is ranked fifth as the most important food crop and its annual production is 133 million metric tonnes (Scott and Maldonado, 1999; Grant, 2003). In addition to that, the year 2008 was declared International year of sweet potato (IYP) by the United Nations. Sweet potato was recognized for its nutritional benefits, for its potential for food security, an income generating crop and its economic value (CIP, 2008).

According to Food Agricultural organization, FAO (2011), China produces 80 to 85% of the total world's production of sweet potato. Countries in the Asian continent have the next highest production then followed by Africa. The graph below shows Worlds' continents productivity of sweet potato from 2006 to 2010.

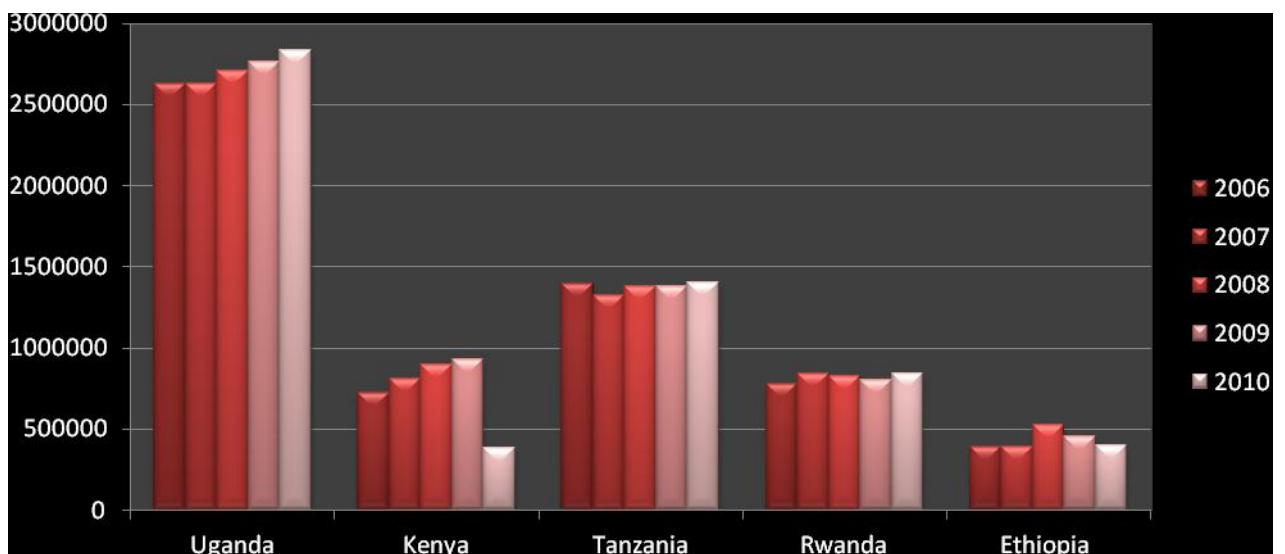
Fig : 1 Sweet potato production from 2006 to 2010



Source: FAOSTAT, 2012

Figure one above shows that Asia produces the highest output followed at a far distance by Africa. African’s trend in the produce of the crop seems to be constant with a slight variation.

Fig: 2. Output of Sweet potatoes in Africa 2006 -2010



Source: FAOSTAT, 2012

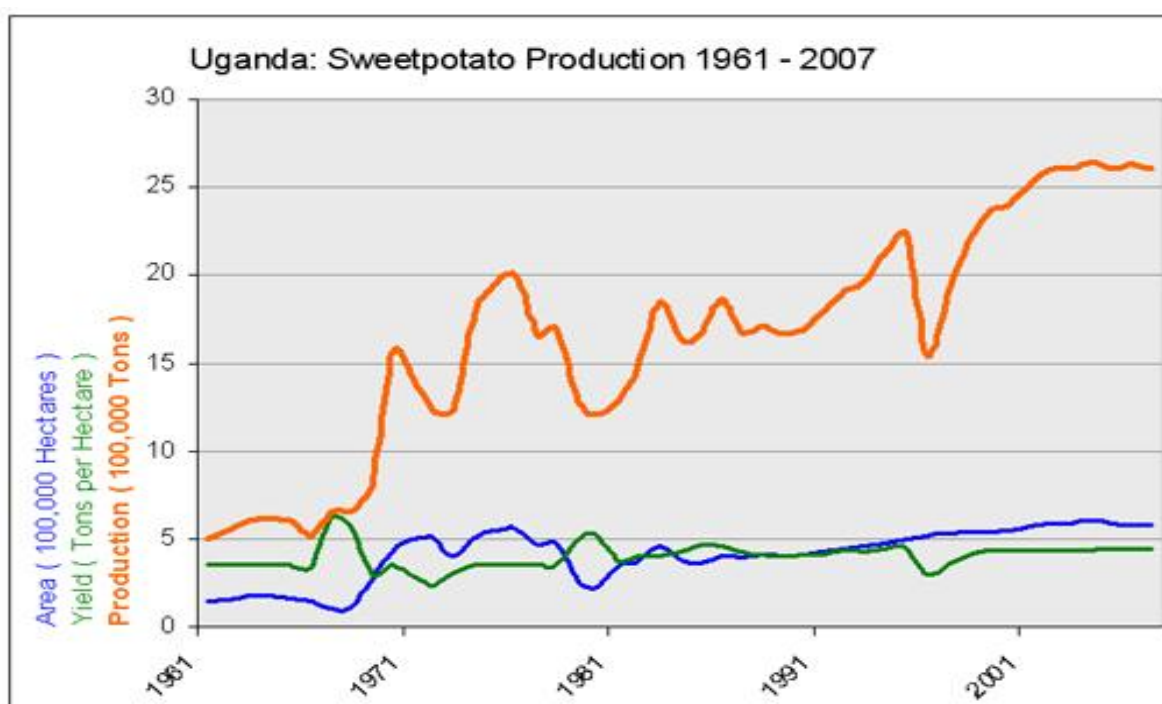
Figure two above shows how different countries vary in production of sweet potatoes. Sweet potatoes production seemed to increase from 2006 to 2009 in all shown countries but declined in 2010. However Uganda which is the leading producer in the region, sweet potatoes production has a steady increase in sweet potatoes from 2006 to 2010.

1.2 Origin of sweet potatoes

Sweet potatoes originated from Latin America. They belong to morning glory family (colvolvulaceae) and botanically referred to as *Ipomoea batatas* (L). According to Davidson (1999), the exact date of arrival of the crop in Africa is unknown. However, it is believed that slave traders brought it to Africa. Due to the fact that sweet potatoes have been in food systems for hundreds of years, they are considered by many farmers to be indigenous or traditional crops.

In Africa the leading sweet potato producer is Uganda which produces 50% of the total continent's production. The figure below shows the crops' production trend from 1961 to 2007.

Fig. 3. Uganda Sweet potato population between 1961 and 2007



Source: CIP 2007

1.3 Kenyan's situation in sweetpotato production.

In Kenya, about 61% live in rural areas and highly rely on agriculture. Agriculture provides employment for the rural population, source of food as well as a foreign income earner to the country. The Kenyan Agricultural sector contributes to 80 percent of national employment, 30 percent of GDP, 60 percent of total export earnings and plays a big role of feeding the country (Republic of Kenya, 1999).

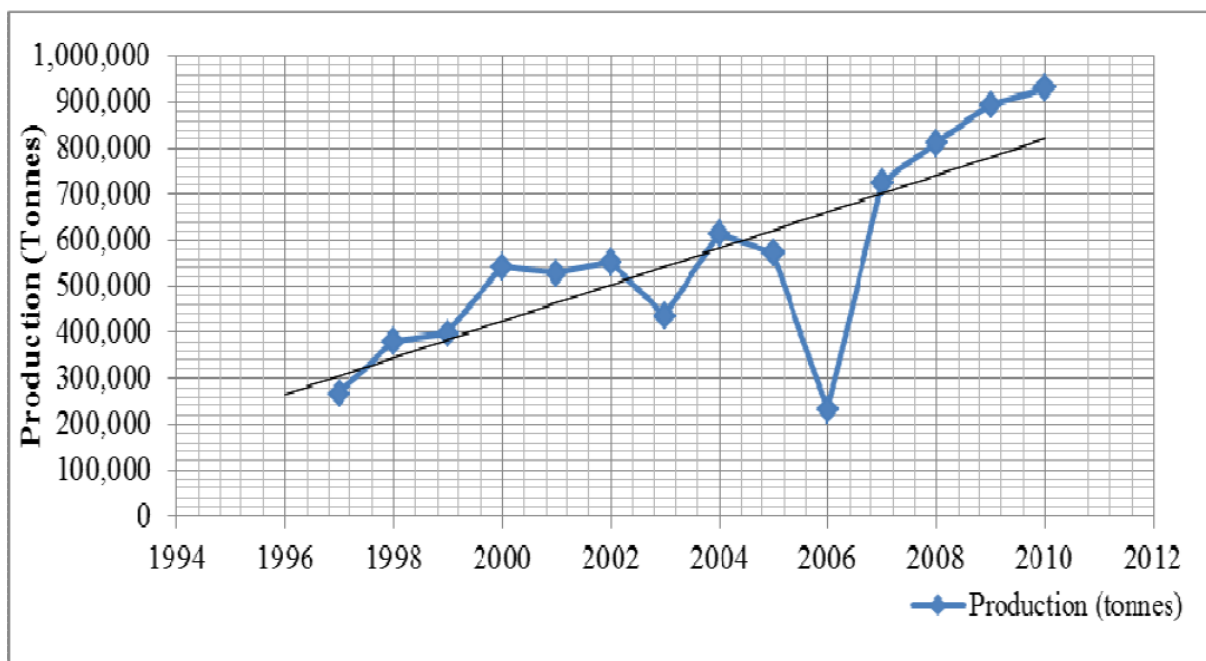
In Kenya, sweet potato is grown in areas including Kakamega County, Busia County, Kisii County, Siaya County, Homabay County and some parts of Kiambu County. The Kenya National Bureau of statistics, KEBS (2003) reports that over 60% of households in the mentioned counties live in abject poverty.

The potential of the sweetpotato crop to address issues including income generation, nutritional deficit and food security is yet to be fully realized in less developed countries (Woolfe,1992).

Some people in Kenya are shifting their consumption to traditional foods including cassava, sweet potatoes, arrow roots and yams for health benefits. The shift to traditional foods is increasing in urban as well as rural areas. Sweet potato is gaining popularity as a healthy food crop, an income generating crop as well as a food security among communities (CIP, 2009)

The following figure shows the growing trend of sweet potato production trends in Kenya from 1994 to 2012.

Fig: 4. Sweet potato production in Kenya, 1994 to 2012



Source: USDA, 2011

Kisii County in Sweet Potato Production.

Kisii region experiences lightning most of the time especially when it rains, this causes the soils to have nutrients that are essential for food growth in general. Therefore, sweet potato from this region is exceptionally sweet thus giving it an edge in the market. According to Hill et al in their study of Atmospheric Nitrogen fixation by Lightening, they found out that total global production of nitrogen oxides by lightening is estimated to 14.4×10^6 tonnes of NO_2 per year. According to CIP (2009), Nitrogen influences sweet potato yield by increasing leaf area duration which in turn increases tuber weight and hence excellent tuber yield.

Additionally Kisii small-scale farmers have been encouraged to grow sweet potatoes to boost their food reserves and incomes. According to Kangerea (2013), a crops researcher and Director at the Kenya Agricultural and Livestock Research Institute, KALRO in Kisii, sweet potatoes can be grown with little or no fertilizer. The crop is environment-friendly in that it reduces soil erosion and has a short maturity period. Kangerea (2013), asserts that whereas soil in the county is fertile, many farmers are not aware of various ways through which they could increase their output without degrading the soil.

KALRO has been implementing an AGRA smart seeds project targeted at tens of thousands of smallholder farmers across the country yearly up to 2017.

1.4 Importance of commercializing sweet potatoes

Agriculture has various roles in Kenya's economy especially in terms of food security, income generation, foreign exchange earner and employment. The various agricultural activities that take place in Kenya are: dairy farming, coffee and tea farming, maize production and potato production just to mention but a few. Davis, (2006) asserts that a large percentage of smallholder farmers derive their livelihood from a mix of subsistence and commercial production and they rely largely on family members as a source of labour. According to Narayan and Gulati (2002), smallholder farmers in Sub-Saharan Africa (SSA) Kenya included are poorer as compared to Asia or South and Central America.

Haddad and Bouis (1990) define commercialization as the total percentage value of output that is marketed. Transforming from subsistence to market-driven production (commercialization) is referred to as Agricultural production. Households in rural areas adapt differently to market-driven production depending on their resource availability, socio economic conditions as well as government policies at county and national levels. When there is a guaranteed market access, other benefits including high produce prices and low input prices which are achieved through commercialization are transmitted to households that are poor. (IFAD, 2001).

According to Ndolo et al., (2001) sweet potato can be harvested in piecemeal therefore offers food to rural and urban poor population and provides a flexible source of income. In addition to being drought tolerant, it produces high yields yet requires few inputs such as fertilizer. It is usually used as a food for humans as well as feed for animals. Sweet potatoes dual nature makes it attractive especially in areas where land is declining (CIP, 2008).

Sweet potato is a highly nutritious crop. Over the past 20 years nutritionists and other health practitioners in less developed countries have come up with evidence that children under 5 years and adults have a deficiency of essential minerals and vitamins including vitamin A which is highly prevalent in sweet potatoes (UN,1997).

Most countries in sub Saharan Africa including Kenya have prevalent problems associated with lack of vitamin A. Foods including fish, milk, eggs, liver and butter are rich in vitamin A but expensive as compared to sweet potatoes. Sweet potato (especially the orange fleshed) is a promising plant source of Vitamin A (Hagenimana & Low,2000). A half a cup of sweet

potato a day (about 100g serving) of boiled sweet potato supplies 50% of the Vitamin A daily requirement.

Sweet potato has been used in the past to address deficiency of Vitamin A in Uganda. In the year 2007, some children had symptoms such as xerophthalmia, corneal scars which is associated with lack of Vitamin A. Vitamin A deficiency was also a risk factor for lactating mothers and pregnant women. To address this problem, the Ugandan government distributed Vitamin A capsules however distribution and supply was limited (CIP, 2007). The irony in this situation is that Uganda produces the highest quantity of sweet potato in the African continent.

The existence of Vitamin A deficiency in Uganda led to development of the Vitamin A for Africa (VITAA) project. VITAA project spearheaded growing of sweet potato International Potato Center is a major partner in research and development of resistant sweet potato varieties (Bachou, 2002). This project is a good example of sweet potato bio fortification that promotes minerals and vitamins and enhances sweet potato's nutritional benefit.

Table 1 Sweet Potato Nutritional Composition.

Nutrient	Unit	Value per 100 g
Water content	Grams	77.28
Energy Level	Kilojoules	359.00
Protein Content	Grams	1.57
Total lipid	Grams	0.05
Ash Content	Grams	0.99
Carbohydrate Content	Grams	20.12
Fiber, total dietary content	Grams	3.00
Calcium Content	Grams	30.00
Iron Content	Miligrams	0.61
Magnesium Content	Miligrams	25.00
Phosphorus Content	Miligrams	47.00
Potassium Content	Miligrams	337.00

Sodium, Na	Miligrams	55.00
Vitamin C	Miligrams	2.40
Pantothenic acid	Miligrams	0.80
Vitamin B-6	Miligrams	0.21
Vitamin A	IU	14187

Source: USDA, 2009

Sweet potato can be used as a feed for livestock because it can substitute Napier grass. The crop is not only an energy giving feed and also has protein content which is higher than Napier grass as indicated below.

Table: 2. Sweet Potato Compared to Napier Grass as Animal Feed

	Napier Grass		Sweet potato Leaves		
	Land on flat area	Soils on Rocky areas	Rwanda	Uganda	Kenya
Fresh yield Content per ton per hectare	34.0	17.5	70.0	70.0	90.0
Percentage Fresh yield content	14.0	15	13.0	13.0	13.0
Percentage dry matter yield	4.9	2.60	8.10	9.1	11.60
Protein yield	0.45	0.25	1.92	1.82	2.34

Source: Harvest plus Presentation Kigali Rwanda 2006

Table two above shows comparison of Napier grass and sweet potato as animal feed. The Sweet potato is superior to Napier grass because it has higher fresh yield, dry yield, and protein yield. This is an indication that sweet potato is a good animal feed.

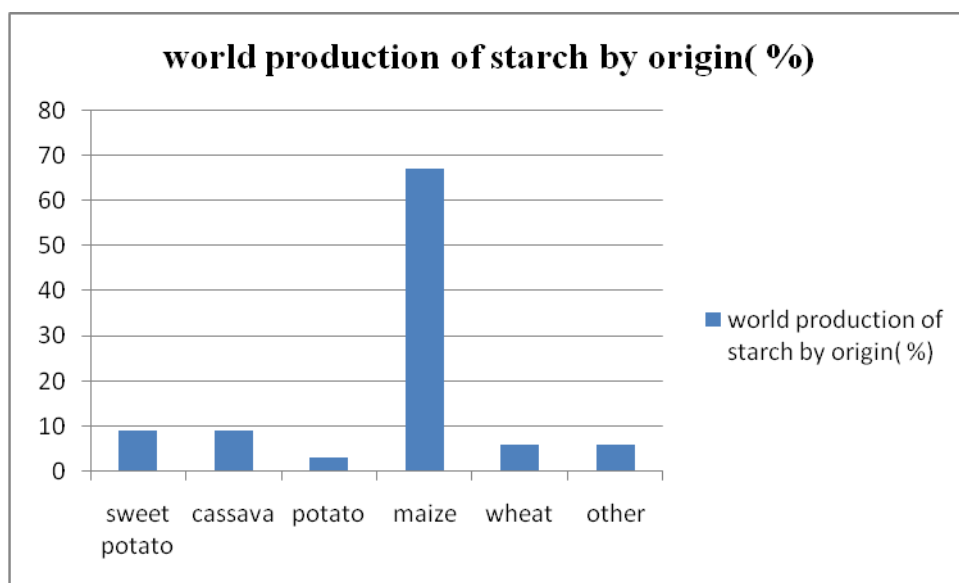
According to CIP (2009), Sweet potato tubers can be used to feed poultry, rabbit, pigs cattle, sheep and goats. In some parts of Papua New Guinea, farmers slice up the sweet potatoes and mix them with vines in order to make them more digestible. Boiled sweet potatoes are used to fatten pigs especially in Philippines. In poultry feeding sweet potato improves the dressing percentage and it can be substituted up to 50 percent of maize ratio.

Commercialization of agriculture has the potential to reduce poverty and food insecurity, but changes in priority setting is required especially in the rural areas of Kenya (Geda et al., 2001). Marketing and value addition are the measures which farmers should take into consideration in order to promote lives (Republic of Kenya, 2005a; Republic of Kenya, 2003).Changes in consumption behavior towards highly valued crops are triggered by urbanization, changing global trends and a rise in per capita income. These varying changes create a good market niche for food crops like sweet potatoes.

Sweet Potato in Starch Production

International starch Institute ISA (2006), Sweet potato produces 9 percent of the total worlds production.

FIG 5: World Production of Starch by Origin (%)



Source: ISA (2006)

Starch obtained from sweet potato is used to manufacture artificial sweeteners, used a stabilizer and thickener, used in textile industries and produces it is an excellent substitute of mung bean starch.

1.5 Statement of Research Problem

Sweet potato has been treated as an orphan crop in Kenya with maize, coffee, tea being given priority due to availability of information from the various research institutions and availability of marketing boards. Despite sweet potato's potential to address universal goals including poverty eradication, wealth creation, diversification of small-scale farmers and food security little empirical study has been done on the crop worldwide (Andea, 2012).

Furthermore, many farmers cultivate sweet potato as a subsistence crop. Majority of farmers lack the commercial incentive because of poor markets for sweet potatoes and lack of information regarding the crop (CIP 2009).

Lack of market information for sweet potato and support from the government as well as other agricultural institutions are major challenges that most sweet potato farmers experience. There are very few studies worldwide on commercializing of sweet potato. This study addresses this problem by investigating factors affecting sweet potato commercialization in Mosoch, Kenya. This will help to assess the economic viability of commercializing sweet potatoes as a first step out of poverty for smallholder farmers especially in areas where land is declining.

1.6 Research Questions

1. What are the factors affecting sweet potato commercialization in Mosoch?

1.7 Objectives of the study

1.7.1 General Objectives of the Study

The broad objective of this study is to establish factors affecting sweet potatoes commercialization in Kenya.

1.7.2 The specific objectives of the study are

- (i). To find out factors affecting sweet potato commercialization in Mosoch.
- (ii). To draw policy recommendations based on the study findings.

1.8 Justification of the study

The study outcome will be helpful in three folds: First is for smallholder farmers who grow sweet potatoes so that they can provide food security, generate income and find better ways to promote their crop

Secondly, the policy makers will be able to formulate informed decisions from the empirical results of this study. The local and international investors involved in Sweet potato supply chain will stand to benefit from the increased information and lastly it will add to the existing body of literature by using the Kenyan data which will form the basis for further research.

CHAPTER TWO: LITERATURE REVIEW

This chapter discusses the theoretical and empirical literature review and summarizes by looking at the literature over view

2.1 Theoretical Literature

In his article, “The politics of Hunger,” Collier (2008) brings out a heated debate on small-scale agricultural farming which most African countries participate. He proposes that Africa should embark on large-scale farming which gives high returns in terms of produce and income. In his view, if Africa focuses on smallholder farming instead of large scale productivity, it will never achieve agricultural growth, food security, income generation as well as poverty reduction. Collier proposes a shift to large scale commercial agriculture. The proposers of colliers’ view have illustrated the Cerrado farms in Brazil (The Economist 2010) as an example of large-scale production farms that have increased crop yield as well as quality by embracing large scale farming as opposed to smallholder cultivation.

Colliers view has received criticism from different scholars for example Byerlee et al (2009) who argues that excluding peasant farmers as well as small-scale cultivators will leave majority of Africa’s population in total poverty. In many parts of Kenya, land holding sizes are declining due to subdivision in response to real estate development as well as population pressure (CIP, 2012). This makes cultivation of short-term crops that require little land space thus making sweet potato relevant today.

Pingal & Rosegrant (1995), explain that agricultural commercialization normally takes 3 important stages, firstly subsistence agriculture, secondly semi-commercial agriculture and thirdly a fully commercialized agricultural stage

In subsistence level, farmer’s main goal is the provision of his/her own food by using household and non-tradable inputs. In the semi-commercial level the farmer’s objective changes to generating a surplus which could be traded in the market. He/she uses both tradable and non tradable farm equipment. In a fully commercialized agricultural level the farmers’ objective is profit maximization. Farmers’ farm inputs are obtained from the market (Pingal & Rosegrant, 1995).

2.1.1 Concepts and Measures of Agricultural Commercialization

Approaches of Levels of Commercializing Agriculture

Leavy and Poulton (2007) came up with three levels of agricultural production. They include: Small-scale farmers, small investor farmers and large scale business farmers. Small-scale farmers are divided into two groups' non-commercial farmers and commercial farmers.

1. Small-scale farmers

Non-commercial small-scale farmers (Type A)

The non-commercial farmers focus only on subsistence production, but sometimes they could sell a part of their produce if they have a surplus in their yields. They don't rely on agriculture for their living.

Commercial small-scale farmers (Type B)

This group of farmers is well market-oriented than type A farmers because they produce crops for both market and household consumption. They tend to practice specialization on highly valued cash crops.

2. Small-investor farmers

This group of farmers is also referred to as "emerging commercial farmers. According to Samuel and Sharp (2007), this group of farmers include individuals who are educated and urban based. The farmers engage exclusively in commercial agriculture. All their produce is meant for the market.

3. Large-scale business farming

Samuel and Sharp (2007) define this group as capital intensive enterprises that are either state or private owned. In Kenya, an example of such a case is the Delamere farm.

The three modes explained above dictate different policy measures that a government can use to enable peasant farmers as well as small-scale farmers increase their income levels and meet their needs including healthcare, food and schooling for their children.

2.1.2 Process of Commercialization

According to Pingali and Rosengran, (1995) and Leavy and Poulton, (2007), there are three levels of market participation which include: subsistence level, Semi commercial level and a

fully commercial level. The different levels are differentiated based on farmers objective, source of input and product mix.

Table 3 below shows the three different classifications with the associated characteristics of Farmers household.

Table: 3.Level of Market Participation

Classes of Market participation	Households goal/objective	Sources of Inputs	Produce assortment	Farmers' main source of income
Subsistence level	Food self sufficiency	Inputs are developed by the household	Broad range of produce	Mostly from Agriculture
Semi-commercial level	Surplus generation	Includes non tradeables and tradable inputs traded	Semi specialized	Both Agriculture and other sources which are not agriculture based
Fully Commercialized level	Profit maximization	Highly Tradable inputs	Highly specialized	Predominantly non-agricultural

Source: Pingali & Rosegrant (1995).

The different levels of market participation may be applied in less developed countries as simple as it is. Kenya is an appropriate example where this categorization can be applied as the country is predominantly agrarian.

2.1.4 Benefits of Agricultural Commercialization

Govereh et al. (1999) argues that increased market participation increases productivity as well as farmer's income. Some farmers tend to concentrate on commercializing cash crops and ignore non cash crops. These farmers assume that cash crops have higher returns.

However, Govereh et al. (1999) warn that concentration of cash crops in the marketing system may not promote commercialization of non –cash crops.

Timmer (1997) explains that benefits of commercializing agriculture include; high level of specialization, high production level hence higher earnings from sale of produce. In addition to that, Timmer (1997) & Fafchamps (2005) further stated that the increased productivity and incomes help in poverty reduction, improves food security and promotes a country's economic growth at large outcomes.

Researchers assert that the final product of market-oriented agriculture is dependent on whether the product markets are efficient or not. Efficient markets lead to separation of consumption and production thus improves allocative efficiency at Macro-level and overall stability of the household (Bernard et al., 2007). However, if markets are inefficient, then transaction costs will be high and smallholder farmers will fail to get rewards of commercialization.

According to Samuel and Sharp (2007) commercializing agriculture is a bridge through which peasant farmers and small-scale cultivators achieve welfare goals. In their analysis (Samuel and Sharp, 2007) use high value foods, access to health facilities, household spending to buy shoes clothes among other items. These scholars emphasize that when farmers have a greater involvement in output markets, the result is high productivity which is an always result to higher productivity which leads to higher income .Therefore, commercialization of agriculture brings about welfare goals.

2.2 Empirical Literature

This section reviews some of the recent empirical studies done and their findings

A study on commercialization of agriculture in Ghana carried out by (Martey et.al , 2012) found that output price, access to extension services, output price ,farm size, access to market information and distance to the market determined the extent of agricultural commercialization. They used a Tobit regression model in their data analysis.

Goitom (2009) carried out a research analyzing farm and household characteristics to determine commercialization level of farmers in Ethiopia. He focused on farmers who had already participated in the output market. The study attempted to identify reasons as to why

some farmers to sell more and some farmers less (in value terms). He used a linear regression model in his analysis and found that market information, access to credit, and access to transport affect commercialization.

Asante et al, (2013) carried out a study in Ghana on factors influencing commercialization of pineapples and tomatoes in Ghana. He found out that tomato commercialization was determined by land productivity and labor force. On the other hand the key determinants of pineapple commercialization was farmers saving rate and land productivity.

A study carried out in Tanzania by Fengying and Chen in 2011 analyzing the factors affecting level of market orientation of smallholder rice farmers in five major rice producing regions in Tanzania. The study used Tanzania National Panel Survey (NPS) data compiled data by FAO. Quantitative as well as qualitative analyses were performed; quantitative analysis involved estimation of Weighted Least Squares (WLS) and the Tobit regression models were used to analyze factors affecting volume of sales and determinants of market participation respectively. The household socio-demographic characteristics of smallholder rice farmers were analyzed and discussed in relation to their influence on production and market participation. The WLS results indicated that 10 variables out of 11 significantly influenced quantity sold. While age has a positive relationship with quantity sold but was insignificant implying that age of the household head does not directly affect the volume of sales. Results of the Tobit regression model indicated that household consumption, land cultivated, livestock owned and dummy for rural areas indicated a positive significant relationship while nonfarm income, dummy region for Mbeya region and Tabora region indicated that, a negative and significant relationship with market participation. Further, low rice production, underdeveloped transport infrastructure and lack of reliable markets closer to higher rice producing regions and inadequate access and use of improved seeds and input were found to be the main of the problems associated with smallholder farmers in Tanzania.

Kirui and Njiriani ,(2013) carried out a study on Role of IT in commercializing agriculture among the rural poor. They found out that capital endowment, Household characteristics farm specific characteristics and use of IT (mobile phones) affected level of commercialization positively. They used a Tobit regression model in their data analysis.

In a study carried out by Omiti et al. (2009) on Factors affecting the level of market orientation by small-scale farmers. This study applied a truncated regression model in its

analysis. Results indicated that distant to the market and output prices are the major factors affecting agricultural commercialization in rural areas

A study by Mukras et al, (2009) on factors affecting Sweet Potato profit level in Rachuonyo, they found out that farmer's experience, labour quality, sales growth rate and cost of production affected profit level. They used an OLS model in their data analysis

A study by Mahelet, (2007), On agricultural commercialization based on the data collected from SNNP, indicates that the number of labor employed and land size are crucial factors determining agricultural sales in the zone. Additionally, the study found that other factors such as education, shifting of production to high value crops and technology (such as irrigation could help a lot in improving earnings and reducing poverty of smallholder farmers in the region.

A study carried out by Balint,(2004) on the effect of institutional factors affecting agricultural sales in Romania, found that farm size, production costs, lack of farming assets, high transaction costs and lack of cooperation among farmers were contributing factors to the low agricultural sales in Romania. In line with this study, (Lerman, 2004) found similar results on market orientation of small-scale farmers in countries on transit.

2.3 Overview of the Literature

Findings from various studies show that there is an increase in commercialization especially in semi-urban areas. Few small-holder famers participate in the markets due to different constraints. For example limited value addition at rural areas, high transportation problems, poor market access and exploitation in marketing. Further research is required to improve the quantitative and qualitative commercialization approach especially in areas where land is declining, and incorporate dynamic community-level understanding of agricultural commercialization processes in policy formulation and implementation.

CHAPTER THREE: METHODOLOGY

3.1 Econometric approaches to modeling market participation

According to Burton et al. (2000), the different models that have been used to measure market participation by farmers include; the Tobit model, Heckman sample selection model, Probit Model and Double hurdle model. This study will apply a Tobit model because, the HCI (household commercialization index is bound between zero and one.

Methodology

In order to answer the three specific research questions stipulated in chapter one, I shall follow the theoretical frame work discussed below.

In order to answer question one which is: What is the specific household commercialization Index of sweet potatoes and what are the factors affecting sweet potato commercialization of sweet potatoes in Mosocho?

The specific household commercialization index will be measured using the HCI (household Commercialization Index. to determine household specific level of commercialization (Govereh et al., 1999; Strasberg et al., 1999). The index measures the ratio of the gross value of crop sales by household *i* in week *j* to the gross value of all crops produced by the same household *i* in the same week *j* expressed as a percentage. The advantage of this approach is that commercialization is treated as a continuum thereby avoiding crude distinction between “commercialized” and “non-commercialized” households. The HCI_i effectively bring subsistence food production to the center of discussions about commercialization.

$$HCI_i = \frac{\text{Gross value of Sweet potato sold in week } j}{\text{Gross value of total sweet potato produced in week } j} \times 100 \dots \dots \dots (1.0)$$

The HCI Index measures the rate at which a farmer is oriented to the market. A value of 100% would signify a farmer is fully commercialized whereas a value of zero would mean a farmer is subsistence

The first part of question one is “What are the factors affecting sweet potato commercialization of sweet potatoes in Mosocho?”It attempts to identify the factors affecting farmer’s market participation/ level of commercialization represented by (HCI). The Tobit model will be used to capture between the dependent variable (HCI) which is the Y and the independent variables that are specified in table 3.1. The independent variables include Age, education, marital status access to credit, labour force among others.

Tobit Model is used to capture effects of independent variables on the dependent variable (HCI). The Y which is the HCI is bounded on an interval of 0-100% and therefore use of OLS technique will lead to inconsistent and biased and results thus Tobit Model is preferred.

3.2 The Tobit model

The Tobit model is mostly defined as a latent variable model

$$Y^* = \beta_0 + x\beta + u|x \sim \text{Normal}(0, 2) \dots\dots\dots (1)$$

$$Y = \text{Max}(0, y^*) \dots\dots\dots (2)$$

The variable Y* which is the latent variable satisfies classical model linear

Equation (2) implies:

y, is equivalent to y* when y* = 0, but y = 0 when y* = 0.

Because y* is normally distributed, y has a continuous distribution over strictly positive values. In particular, the density of y given x is the same as the density of y* given x for positive values. Further,

$$P(y = 0 / x) = P(y^* < 0 / x) = P(\mu < -x\beta) \dots\dots\dots (3)$$

$$= P(\mu / \delta < -x\beta / \delta) = \phi(-x\beta / \delta) = (1 - x\beta / \delta) \dots\dots\dots (4)$$

u/δ has a standard normal distribution and is independent of x; Therefore, if (x_i, y_i) is a random draw from the population, the density of y_i given x_i is

$$(2\pi\delta^2)^{-1/2} \left[- (y - x_i\beta)^2 / (2\delta^2) \right] = \varphi[(y - x_i\beta) / \delta], y > 0 \dots\dots\dots 5$$

$$P(y_i = 0 | x_i) = 1 - \varphi(x_i\beta) / \delta \dots\dots\dots 6$$

ψ is the standard normal density function. Equations 5 and 6 enable us get the log-likelihood function for each observation i , shown in equation 7 below.

$$L_i(\beta, \delta) = 1(y_i = 0) \log[1 - \varphi(x_i\beta) / \delta] + (y_i > 0) \log\{ (1/\delta) \varphi[(y_i - x_i\beta) / \delta] \} \dots\dots\dots 7$$

Following the discussion on the model, empirical model for analyzing is shown below as below

$$y_j^* = \beta_0 + \beta_1 Age + \beta_2 Mast + \beta_3 Gen + \beta_4 Ed + \beta_5 Qt + \beta_6 Lb + \beta_7 Fm + \beta_8 Lana + \beta_9 Cred + \beta_{10} Inf + \beta_{11} Dis + \beta_{12}$$

Table: 4. Explanation of the variables and a priori expectations

Variable	Description of the Variable	How it will be measured	The sign expected
Age (AGE)	Age of farmer	Number of years of farmer	Inconclusive
Marital status (MAST)	Farmers Marital status	If farmer is married =1 if otherwise = 0	+
Gender (GEN)	Gender of the farmer	If farmer is male=1 if female = 0	Inconclusive
Education (EDU)	Number of years of farmers formal education	Number of years in school	+
Labor force LB	Number of adults equivalents in the household who assist on the farm	Number of people who work in the farm	+
Quantity of commodity (QTY)	Total output of sweet potatoes per week in Kilograms	90kg Bag	+
Land access (LANACES)	Access to more hired land	1 if yes; 0 if otherwise	+

Credit accessibility (CRDAV)	Farmers accessibility to credit (Loan)	Amount of loan taken in the last one year in KSH	+
Market information access (INFO)	Household membership to a cooperative Society	If farmer gets information from society = 1 if Not = 0	+
Market distance (DISMKT)	Distance between the residence of household head and the nearest market	Kilometers	-
Farmers off – farm income (OFMI)	Others sources of income that the farmer accesses to facilitate farm activities	If Yes =1 If No =0	Inconclusive
Unit price (PR)	The unit price of output is In this case sweet potato is normally sold in (DEBE)which is an equivalent of 25kg	KENYAN SHILINGS KSH	+

CHAPTER FOUR: FINDINGS, ANALYSIS AND INTERPRETATION

Introduction

This chapter begins with a brief description of data that has been used. It is then followed by Pre-estimation tests and post estimation tested. Lastly there is estimation of results and discussion.

4.1 Summary

From the above table, Household commercialization Index HCI displays a mean of 0.44 and a standard deviation of 0.23 and a respective minimum and maximum of 0.12 and 1. The average age of respondents in Mosocho is 38 years old. The youngest sweet potato farmer is 21 years old whereas the oldest among the 108 respondents is 75 years old.

There 62 households in Mosocho are headed by men while 42 households are headed by women. Out of 108 respondents, 68 are married and in the remaining 40 respondents are either widowed or not married. The mean of education level is form one in Mosocho whereas the highest level of education attained is a university degree and the lowest level of education is class 5. The mean of labor force used in sweet potato farming is 3. Where as the minimum the highest quantity sold of sweet potatoes is 54 debes while the minimum is 2. The average quantity sold is 12.5 and its standard deviation is 9.55.

TABLE 5. This table shows the Descriptive statistics

VARIABLE	RESPONDENTS	MEAN	STD. DEV.	MIN	MAX
HCI	108	0.44472	0.23004	0.12	1
Age	108	38	10.1834	21	75
GEN	108	0.62963	0.86807	0	1
Marsta	108	0.64815	0.48516	0	1
EDU	108	9.69444	2.97484	5	16
LF	108	3.53704	2.07083	1	13
Qs	108	12.4815	9.54525	2	54
AccLand	108	0.4537	0.50017	0	1
AccExt	108	0.55556	0.49922	0	1
AccCre	108	0.50926	0.50225	0	1
MKTInfo	108	0.55556	0.49922	0	1
AccTrans	108	0.51852	0.50199	0	1
DistinKM	108	3.85185	2.80459	0.2	15
NonFAInc	108	0.55556	0.49922	0	1
Price	108	245.509	16.4194	200	285

Source: Own computation

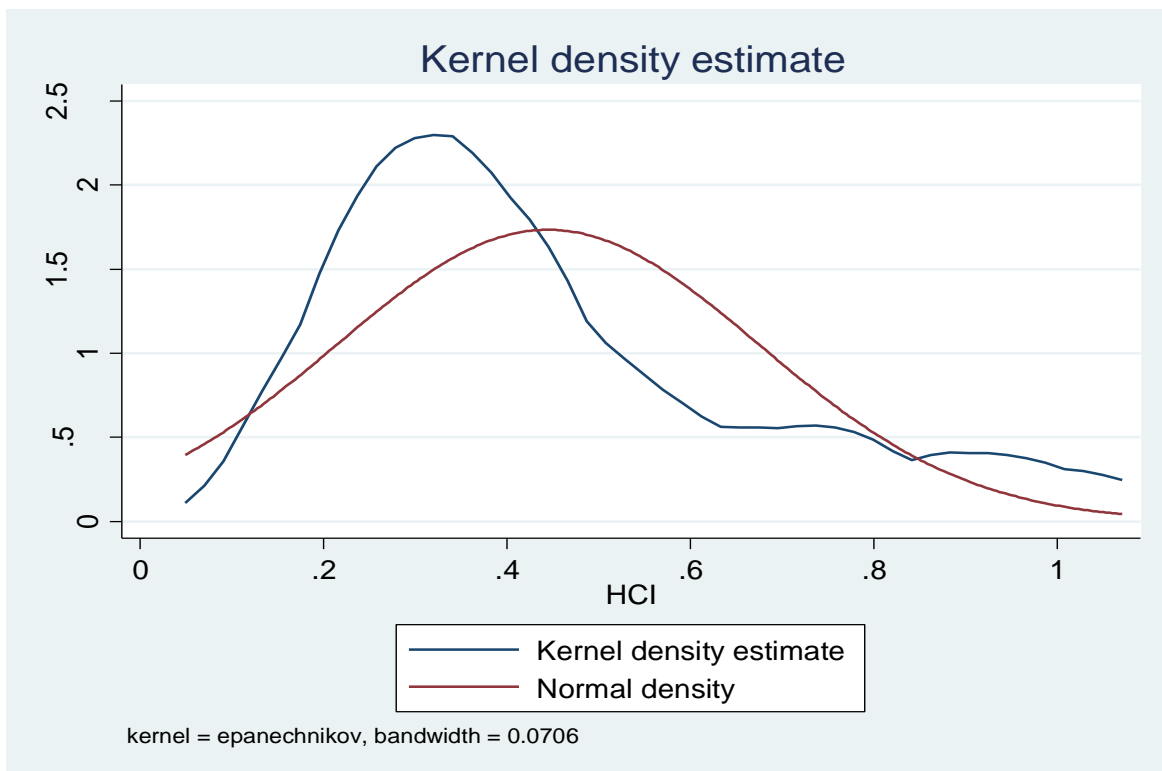
4.2:Pre-estimation tests and statistics

4.21 Normality Test

Greene (2003) explains that Kernel estimation is used in data smoothing where results are based on random data samples. Kernel density can also be referred to as Parzen–Rosenblatt. The bandwidth of the kernel is the parameter which is used to estimate the results.

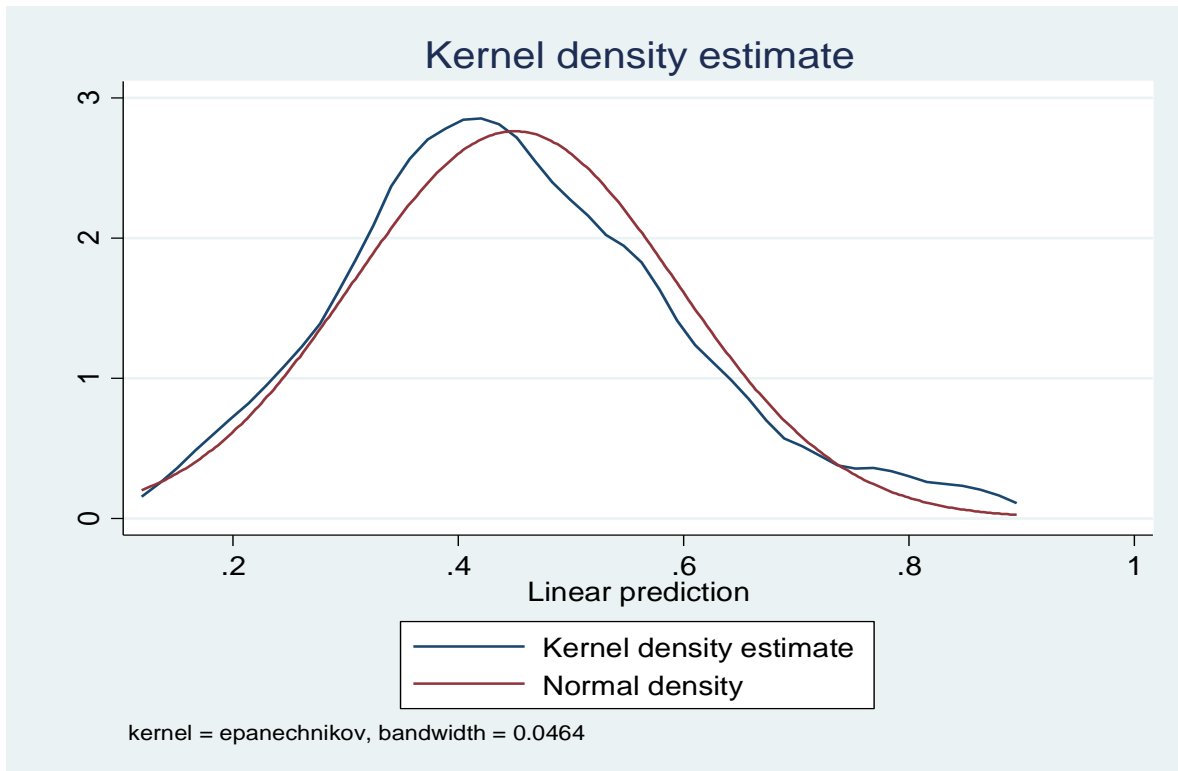
In figure 6, the normal density curve is normally distributed with a mean of zero and variance of 1. The blue curve which represents the Household commercialization index (HCI) has a bandwidth of 0.0706. It is considerably optimally smoothed since its density is close to normal.

FIG 6: Kernel density estimation For HCI (Household Commercialization Index)



On figure 7 below, the normal density curve (Red curve) has a mean of 0 and variance of 1, on the other hand the blue curve with a bandwidth of 0.0464 is considered to be optimally smoothed since its density is close to the normal. The blue bandwidth represents the explanatory variables. Therefore all explanatory variables are normally distributed.

FIG 7: Kernel density estimation For Independent Variables



On figure 7 above, the normal density curve (Red curve) has a mean of 0 and variance of 1, on the other hand the blue curve with a bandwidth of 0.0464 is considered to be optimally smoothed since its density is close to the normal. The blue band width represents the explanatory variables. Therefore all explanatory variables are normally distributed.

4.22 Multicollinearity Test Results

Cooper &Schidler, (2008), Multicollinearity is a problem which occurs when correlation coefficients in the matrix of correlation are greater than 0.80. In the table below, it is noted that all coefficients are less than 0.80 indicating that there is no correlation between the identified set of variables.

Table 6: Autocorrelation Matrix

	Age	GEN	EDU	LF	Qs	MemAsso	AccLand	Cred	MKT	TRAN	DIST	price
Age	1											
GEN	0.046	1										
EDU	-0.329	0.057	1									
LF	0.11	-0.01	0.084	1								
Qs	0	0.048	0.279	0.402	1							
MemAsso	-0.02	-0.09	-0.008	0.042	0.053	1						
AccLand	0.1	-0.04	-0.12	0.124	0.124	0.218	1					
AccCre	-0.08	0.091	0.017	-0.05	0.003	0.149	0.076	1				
MKTInfo	-0.145	0.134	-0.004	-0.1	-0.03	0.136	0.029	0.128	1			
AccTrans	-0.204	0.069	0.069	-0.06	-0.01	-0.016	0.096	0.129	-0.041	1		
DistinKM	0.087	-0.09	-0.044	0.193	-0.06	-0.188	0.15	-0.14	0.018	-0.02	1	
NonFAInc	-0.22	0.209	0.121	-0.08	0.115	-0.012	0.029	0.128	0.025	-0.041	-0.223	1
Price	0.178	-0.14	0.043	0.101	-0.09	0.084	0.108	0.143	0.079	-0.078	0.012	1

Source: Own computation

4.3 Post Estimation Tests

4.3.1 Omitted Variables test

Ramsey Test

The Null Hypothesis is H_0 - model has no omitted variables

According to Wooldridge (2004) if the P-value is greater than the critical value then do not reject the null hypothesis. If otherwise, reject the null hypothesis. In this case the probability of the F-statistic is 0.5188, which is greater than critical value of 0.05.

Therefore, there are no omitted variables in the model.

Table 7: Ramsey test for omitted variables

Ramsey Test			
F-Statistic	0.76	Probability	0.5188

Source: Own computation

4.32 Heteroscedasticity Test

Heteroscedasticity test was done to test for correlation across observations.. The test for Heteroscedasticity was conducted using the *Whites Test* where the F-statistic and its associated p-value was reported The null hypothesis was that the data does not suffer from heteroscedasticity, that is, residuals have a constant variance (homoskedasticity). The test results are shown in Table 8 below.

Table 7: White Test for Homoskedasticity

White Heteroskedasticity Test:			
F-Statistic	2.57	Probability	0.0021

Source: Own computation

P-value 0.0021 is less than the critical value of 0.05 therefore the null hypothesis of homoskedasticity is rejected and thus there is heteroskedasticity. Given that there is heteroskedasticity, this implies that the error should be corrected. It was corrected using robust standard error as displayed in the figure below.

COEFF	STD. ERR.	ROBUST STD. ERR.
Age	0.002295	0.0021909
Marsta	0.042763	0.0386571
GEN	0.024331	0.0159759
EDU	0.007746	0.0076871
LF	0.012153	0.0102908
Qs	0.00295	0.003095

Fasz	0.070554	0.0875459
AccLand	0.044166	0.0469263
AccCre	0.042862	0.0414595
MKTInfo	0.041631	0.0395793
AccTrans	0.042354	0.0430785
DistinKM	0.008207	0.0071719
NonFAInc	0.043441	0.0395031
Price	0.001319	0.0011739
_cons	0.327325	0.3035795

4.4 Estimation of Results and Discussion

The general objective of this study was to find the factors affecting sweet potato commercialization. In order to accomplish this objective, Household commercialization level was supposed to be obtained. This study found out that the Household commercialization index for sweet potato farmers in Mosocho was 44.98%

The factors affecting sweet potato commercialization in Mosocho include Quantity sold, Distance to the market, Access to market information, and access to Transport at 10% significant level

$$y=0.4498$$

Explanatory Variable	DY/DX Marginal Coefficients	Standard Error Value	P-VALUE
Age	0.003844	0.00228	0.092
Gender	0.0073019	0.02414	0.762
Education Level	0.003915	0.00774	0.613
Labour Force	0.0044411	0.01123	0.692
Quantity of sweet potato sold	0.0073776	0.00248	0.003
Farmers access to hired land	0.0209113	0.04278	0.625
Farmers access to credit	0.0170601	0.04256	0.688
Farmers accessibility to market	0.0747357	0.04152	0.072

information			
Farmer access to Transport	0.0495299	0.042	0.238
Distance to nearest market	0.0270117	0.00776	0
Non-farm income	0.097587	0.04296	0.023
price of sweet potato per debe	0.0014338	0.00131	0.275

Quantity sold positively influenced sweet potato commercialization at level 5% significance. Findings from this study show that for a unit increase in quantity sold of sweet potato, sweet potato commercialization rate is expected to increase by 0.011 units, holding all other variables constant. For a standard deviation increase in quantity sold of sweet potato, the sweet potato commercialization level is expected to increase by 0.003 standard deviations, holding all other variables constant.

If a farmer has access to more land on which he/she will use for sweet potato cultivation, sweet potato commercialization is expected to increase by 0.02 units, holding all other variables constant. Further, for a standard deviation increase if a farmer has access to more land, sweet potato commercialization is expected to increase by 0.04 standard deviations holding all other factors constant. This means that if a farmer has access to more farming land then his ability to commercialize increases. This is in line with (Agwu et al 2013).

Accessibility to credit increases the expectation to sweet potato commercialization by 0.05 units, holding all other variables constant. For a standard deviation increase in accessibility to credit, the sweet potato commercialization is expected to increase by 0.04 standard deviations, all other variables being constant. Thus availability of credit has a positive impact towards sweet potato commercialization. Funds obtained from credit institutions are expected to improve farmer's knowledge and skills, buy farm inputs, pay wages and thus productivity will increase therefore enhance farmer's market participation. This finding is in line with (Lerman, 2004; Martey et al, 2012)

Access to transport is positively related to sweet potato commercialization at 10% significant level. Accessibility to transport increases the expectation to commercialize sweet potato by 0.02 Units holding all other variables constant. Additionally for a standard deviation increase in accessibility to transport, sweet potato commercialization is expected to increase by 0.04 standard deviations, holding all other variables constant.

Existence of non-farm income increases the expectation to sweet potato commercialization by 0.052 units, holding all other variables constant. Furthermore, for a standard deviation increase in non-farm income, sweet potato commercialization is expected to increase by 0.05487 standard deviations holding all other factors constant. Household income from nonfarm activities implies low dependency on the crop thus more market participation. In

addition (Agwu and Ibeabuchi (201)) and (von Braun and Kennedy, 1994) had similar findings that income leads to high output traded thus increase in commercialization.

Distance to the market positively influenced sweet potato commercialization. A unit increase in distance from the market increases the likelihood of commercializing sweet potato by 0.02 units, holding all other variables constant. Additionally, for a standard deviation increases in distance, sweet potato commercialization is expected to increase by 0.009 standard deviations holding all other variables constant. This is different from the other findings including findings of (Omiti et al., 2009, Barrett; 2007 and Rios et al., 2008) who found out that households that live far away from markets have low market orientation thus less commercialization. However this result explains that farmers near markets have smaller plots of land due to selling their land to investors for commercial purposes compared to those far away from the markets thus they bring less sweet potato to the market. My finding is consistent with that of (Nhuri 2004) and (Ruhangawebare, 2010).

CHAPTER FIVE: Summary and conclusion

This study has revealed factors affecting sweet potato commercialization as well as the commercialization index in Mosocho division Kisii, Kenya. Sweet potato commercialization index is 44.98% and the minimum commercialization rate is 12%. It is therefore recommended that more markets should be created in order to facilitate sweet potato commercialization. Access to transport had a positive relationship to sweet potato commercialization. This shows that farmers who have access to transport facilities supplied more sweet potato to the market to be sold. Therefore providing a means of transport to the farmers would relieve them of the bulkiness of the crop as well as distance.

It is important to note that there was a positive relationship between farmer access to market information and sweet potato commercialization. This suggests that farmers who have market information bring large proportions of sweet potatoes to the market for sale. Consequently it is clear that providing market information to sweet potato farmers will increase their market participation. These results further showed that sweet potato farmers located at longer distances from the market offered more produce to the market for sale. This indicates that farmers are willing to supply sweet potatoes to reliable markets where better prices are offered despite the long distances. This indicates that provision of reliable markets proximal to sweet potato farmers could improve farmer participation and increase sweet potato sales rates.

It can be concluded that sweet potato farmers are willing to sell their produce despite the existence of market constraints. Interventions including access to means of transport, access to credit access to market information and availability of reliable markets will increase sweet potato sales rate and thus improve farmer's participation in sweet potato commercialization.

5.1 Policy recommendation

The findings of this study have crucial policy recommendations to research institutions, farmers, policy makers as well as the government of Kenya. First there is need to improve means of transport for farmers. Access to transport means as well as good roads will facilitate easy transportation of sweet potatoes to the market.

Additionally policies should be made towards coming up with a resistant sweet potato variety which can be traded at all times of the year. This is important because high amounts of produce promote sweet potato commercialization.

Finally, farmers should be encouraged to participate in other non-agricultural activities so as to have alternative income that will supplement income from the farm. This is important as household income from nonfarm activities implies low dependency on the crop thus more market participation

5.2 Areas of Further Research

Finally, I would like to acknowledge limitations of this study which should be improved in future studies. This study was carried out in Mosocho Location Kisii County. It is important for a similar study to be carried out in other counties especially where sweet potato is grown. Secondly, this study was on sweet potato commercialization other future studies can be done on other crops including cassava, millet sorghum among other crops. Lastly other studies could apply other models including the double hurdle model.

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APPENDIX

Household Questionnaire

FACTORS AFFECTING COMMERCIALIZATION OF SWEET POTATOES INKENYA (A CASE STUDY OF MOSOCHO DIVISION, KISII COUNTY.)

This questionnaire is purposed to collect data on factors affecting sweet potato commercialization in Mosocho division, Kisii County. I kindly request the respondent to answer the questions genuinely. The information obtained from respondents will be held confidentially.

Thanks for cooperating.

A. Characteristics of the Household Head

Age of head of Household(In years)	Marital Status of head of household If Married:1, otherwise: 0	Gender If male :1 , Female: 0	The highest Level achieved by head of household	

Household Head

B. Farm Characteristics

1. How many family members in your household participate in sweet potato cultivation?
(Number)
2. How much sweet potatoes did you harvest in the past one week? (Debes)
3. Apart from your existing land, do you have access to hired land?

If YES: 1, Otherwise: 0

4. Do you have access to credit facilities that can fund your sweet potato farming?
If Yes: 1, No: 0

5. If your answer is NO, What was the reason as to why you didn't get credit/loan?

6. Are you a member of a farmer's cooperative society?
If Yes: 1, No: 0

7. Do you have access to market information?
Yes: 1, No: 0

If yes, how do you get it?

8. Do you have access to transportation services (Carts, Donkey and Vehicles) for sweet potato product from the farm to the Market?

Yes: 1, No: 2

9. What is the Distance between your farm and the nearest market Centre in Kilometers?

10. Apart from farm income, do you have any other source of income?
Yes: 1, No: 0

11. How much do you sell a Debe of sweet potatoes in Kenyan shillings?