

**ANALYSIS OF FACTORS INFLUENCING SWEET POTATO VALUE ADDITION
AMONGST SMALLHOLDER FARMERS IN RACHUONYO SOUTH DISTRICT,
KENYA**

MARY AKINYI ORINDA

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

EGERTON UNIVERSITY

JANUARY, 2013

DECLARATION AND APPROVAL

Declaration

I declare that this Thesis is my original work and has not been submitted wholly or in part for any award in this or any other institution of learning.

Signed _____

Date _____

Mary Akinyi Orinda

Approval

We wish to confirm that this thesis has been prepared under our supervision and has our approval to be presented for examination as per the Egerton University regulations.

Signed _____

Date _____

Dr. J. K. Lagat

Department of Agricultural Economics & Agribusiness Management

Egerton University

Signed _____

Date _____

Dr. P. Mshenga

Department of Agricultural Economics & Agribusiness Management

Egerton University

COPYRIGHT

No part of this thesis may be reproduced, stored in any retrieval system, or transmitted in any form, electronic, mechanical, photocopying, recording or otherwise without prior permission of the author or Egerton University on her behalf.

© 2013

Mary A. Orinda

(REG NO. KM17/2052/08)

All Rights Reserved

DEDICATION

To my grandmother, parents and siblings

ACKNOWLEDGEMENT

I wish to thank God for guiding me through the whole process of proposal inception, development up to the final thesis submission.

Much thanks to Egerton University for admitting me to MSc. CMAAE program and CMAAE secretariat for giving me scholarship that has seen me through my Masters degree.

My gratitude to my supervisors; Dr. J.K. Lagat and Dr. P. Mshenga for their guidance, support and advice from proposal inception to thesis write up.

I will not forget to thank the Library Staff for their support in access to research materials and books.

I wish to appreciate my colleagues at Egerton University for their contribution to this work.

I would also like to thank my family for their endless financial and moral support while I pursued my studies.

Finally, to all those who had input in this work from its inception to the final production of the thesis, that I may not have mentioned above, thank you so much for your support.

ABSTRACT

Rachuonyo South district is resource endowed in terms of land productivity as is evidenced by annual production outputs of various crops. Sweet potatoes are the main cash crops grown in these areas alongside others such as pineapples, bananas and to some extent tea and coffee. The high outputs enjoyed from the productive lands have not however translated into good living conditions for the residents as their products fetch little in terms of market price the farmers get. Farmers have the option of adding value to their sweet potatoes to fetch optimal prices; which have been advocated in the district by many non- governmental organizations. This study therefore established different value addition techniques being practiced in the district and evaluated the factors influencing value addition and also extent. Systematic sampling method was used to obtain an appropriate sample size. Questionnaires were administered to the respective farmers. Data analysis was done using SPSS statistical software. Descriptive statistics was used to analyze different value addition techniques practiced in the district. Independent t-test and chi square were used to establish if there were any significant differences of socio economic characteristics between value adders and non value adders. Heckman two stage model was used to examine the factors influencing value addition. Results showed that majority of the farmers in the district were involved in grading and packaging, slicing and sun-drying, grinding the sweet potatoes into flour, baking, preparing additives and juice and jam as forms of sweet potato value addition. Some of the factors that were found to influence the decision to add value and extent of value addition were household size, total quantity produced, credit access, land size of the respondents, distance to the market and group membership, From the findings of this study, the policy makers should encourage farmer group formation, value addition loan packages for smallholder farmers, seminars, farmer field days, workshops to enable exchange of ideas among different farmers and further encourage farmers to produce more to enjoy economies of scale there. Marketing of the processed sweet potato products still remain a challenge which calls for proper marketing strategies such as linking farmers with supermarkets. Inadequate product development, proper packaging and labeling are other challenges that require urgent attention through acquiring certification from Kenya Bureau of Standards.

LIST OF ABBREVIATIONS

CBO	:	Community Based Organizations
CEFA	:	European Committee for Training and Agriculture
CIP	:	International Potato Centre
C-MAD	:	Community Mobilization Against Desertification
DAO	:	District Agricultural Office
GDP	:	Gross Domestic Product
GoK	:	Government of Kenya
IDCCS	:	Inter-Diocesan Christian Community Services
KARI	:	Kenya Agricultural Research Institute
MOA	:	Ministry of Agriculture
NGO	:	Non-Government Organizations
OFSP	:	Orange Fleshed Sweet Potato
USAID	:	United States Agency for International Development

TABLE OF CONTENTS

DECLARATION AND APPROVAL	ii
COPYRIGHT	iii
DEDICATION	iv
ACKNOWLEDGEMENT	v
ABSTRACT	vi
LIST OF ABBREVIATIONS	vii
TABLE OF CONTENTS	viii
LIST OF FIGURES	x
LIST OF TABLES	xi
CHAPTER ONE	1
INTRODUCTION	1
1.1 Background information.....	1
1.2 Statement of the Problem	3
1.3 Objectives of the study	4
1.4 Research questions	4
1.5 Justification of the study.....	4
1.6 Scope and limitations	4
1.7 Definition of terms	6
CHAPTER TWO	7
LITERATURE REVIEW	7
2.1. Background Information	7
2.2. Sweet potato value addition	8
2.3. Theoretical framework	11
2.4. Conceptual framework	13
CHAPTER THREE	16
METHODOLOGY	16
3.1 Study Area.....	16
3.2 Sampling Procedure and Sample size	18
3.3 Data Types and Sources	18
3.4 Data Analysis and Analytical Techniques.....	18
CHAPTER FOUR	22

RESULTS AND DISCUSSION	22
4.1. Comparison of socio economic characteristics of value adders and non value adders ...	22
4.2. Sweet potato value addition techniques practiced by the smallholder sweet potato farmers	28
4.3. Factors influencing sweet potato value addition amongst the smallholder sweet potato farmers	29
4.4. Factors determining extent of value addition	33
CHAPTER FIVE	36
CONCLUSION AND RECOMMENDATIONS	36
5.1 Conclusions	36
5.2 Policy Recommendations	36
5.3 Suggestions for Further Research.....	37
REFERENCES.....	38
APPENDICES	46

LIST OF FIGURES

Figure 1: Conceptual framework of factors influencing decision to add value	15
Figure 2: Map of study area	17

LIST OF TABLES

Table 1: Description and measurement of variables to be used in the model.....	21
Table 2: T-test of socio-economic characteristics of both value adders and non value adders	23
Table 3: Chi square test of socio-economic characteristics of both value adders and non value adders	25
Table 4: Different types of sweet potato value addition techniques practiced in the district.....	28
Table 5: Factors influencing sweet potato value addition	31
Table 6: Extent of value addition.....	34

CHAPTER ONE

INTRODUCTION

1.1 Background information

Sweet potato (*Ipomea batatas*) is a warm season tropical tuber crop which is globally the second most economically important tuber after Irish potato and is an important food crop in Sub – Saharan Africa (Mukunyadzi, 2009). It has the third greatest production level after cassava and yams and is amongst the widely grown tuber crops by small scale farmers in Sub – Saharan Africa (Kaguongo *et al.*, 2010). In Kenya, it is an important food crop for those who depend on cereals especially maize as their staple diet. Though grown by small-scale farmers for subsistence, its importance is rising as an attractive income generator. (Odendo and Ndolo, 2002; Hagenimana *et al.*, 1999). Its ability to give satisfactory yields under adverse climatic and soil condition as well as under low or non use of external inputs has made it gain popularity among many farmers in Kenya (Nungo *et al.*, 2007; Odendo and Ndolo, 2002). In addition, its flexibility in mixed farming systems and ability to take short period to mature thus offering household food security has made it an important livelihood strategy for small scale farmers (MoA and GTZ, 1998).

Sweet potato can play a very important role in food security strategy for Kenya since it is drought resistant, it is a relatively short term crop with flexible time of harvest allowing a high degree of flexibility in food security strategy and finally it improves the yield of maize in a crop rotation compared to continuous maize production (Westby *et al.*, 2003). Research has shown that rotating sweet potato with maize improves farmers' incomes through higher yields of maize as well as income from sweet potato (Odendo and Ndolo, 2002).

Sweet potato production in Kenya is mainly concentrated in Nyanza and Western Provinces and to a small extent the Coast and Central Province. There has been a steady increase in the area planted with sweet potato with; average yields being about 10 tons per hectare (MoA & GTZ, 1998). It is consumed as a snack or substitute for bread at breakfast in most households either boiled or roasted and a few instances raw forms (Nungo *et al.*, 2007). Average per capita consumption of sweet potato is about 24 kg per year with higher proportions consumed in the

western parts of Kenya (Kaguongo *et al.*, 2010; Odendo and Ndolo, 2002). Nutritionally, sweet potato is an excellent source of vitamin A, particularly the yellow fleshed varieties (Yanggen and Nagujia, 2005; Odendo and Ndolo, 2002). It yields more protein and calories per unit area than either maize or Irish potato (Nungo *et al.*, 2007; MoA and GTZ, 1998).

In Rachuonyo South, both white and orange-fleshed sweet potato is grown by most households on small holder farms. Some of the varieties grown include Kemb 10 (*united*), SPK 004 (*nyathi odiewo*), SPK 013 (*Kalamb Nyerere*), KSP 20 (*Kuny kibuonjo*), Kemb20 (*Nyamisambi*), Kemb 23 (*Nya migori*), *Mwavuli (Olombo japidi)*, Salyboro (*Lodha*) and *Mugande (Amina)* (CEFA, 2010). Although traditionally regarded as a subsistence crop, sweet potato is increasingly being produced for commercial purposes (Westby *et al.*, 2003; MoA & GTZ, 1998). Sweet potato production has also been influenced by other factors, such as new market outlets in urban centers, high cost of inputs for maize production, high cost of living which has forced people to consume cheaper foods for certain meals (IDCCS, 2009). This is evidenced by the steady increase in the area planted. It is the most important cash crop in Kabondo and Kasipul divisions, for instance, 215 acres of 410 acres of Kabondo division was under sweet potato cultivation (DAO, 2008). A survey by IDCCS in 2009 in the two divisions found that most farmers devoted approximately 75% of their land holdings to sweet potato production out of which they realized between 18 to 27 bags of 90kgs per acre every season.

Harvesting of the crop is done when the tubers have reached desirable marketing size and can either be piece meal or whole sale where big tubers are removed when a ready buyer is identified (CEFA, 2010). Because of perishability, excess production is initially stored in underground pits and trenches lined with dry grass but excessive moisture affects the quality of the tubers. Currently, farmers use cold rooms which are constructed strategically within the district (IDCCS, 2009).

Farmers with small surpluses might sell to neighbours or in the local market; or transport by head, bicycle or donkey to sell in the local trading centre. The farmers may also choose to sell to middlemen who later sell to wholesalers from the cities such as Nairobi, Nakuru and Mombasa though spot marketing is still in existence (Kaguongo *et al.*, 2010; IDCCS, 2009 and MoA >Z, 1998).

Sweet potato in the fresh form has a limited shelf-life (Tomlins *et al.*, 2008). Storage of fresh sweet potato as a form of value addition to extend the season has been practiced in a number of tropical countries with varying degrees of success. Huntrods (2009) and Westby *et al.* (2003) noted that unprocessed sweet potato has short shelf life leading to storage losses and reduced food security thus processing, freezing or drying may extend shelf life thereby benefiting producers and processors through increased market feasibility.

Initially, utilization of sweet potato in western Kenya was limited to boiling, roasting and chewing raw but currently this has been changing to value addition by processing the tubers into different products (Nungo *et al.*, 2007). Promotion of on -farm processing of sweet potato in the district has been going on since 1995. Products were promoted through field days, agricultural shows, individual or group training, neighbouring schools during sports days or at the local markets. Consumers preferred sweet potato products to wheat flour products (Nungo *et al.*, 2007; MoA & GTZ, 1998). Processing and utilization of sweet potato has the potential to enhance the production of the crop and further can play important place in the food/nutritional security and income generation among the rural households and even urban markets (Nungo *et al.*, 2007; Westby *et al.*, 2003; MoA & GTZ, 1998).

1.2 Statement of the Problem

Contemporary studies and research points to the need to add value to agricultural produce as it is perceived that farmers could maximize on their produce and also potentially increase their revenue in the process. Indeed, research carried out by International Potato Centre (CIP) on sweet potato productivity in developing countries found that value addition is an important post harvest need (Fuglie, 2007). Despite these documented initiatives and interests in the need for value addition, preliminary investigations as documented in a survey done by IDCCS in 2009 showed that majority of smallholder sweet potato farmers in Rachuonyo south district had not embraced value addition. This study therefore, sought to examine factors that influence sweet potato value addition and value addition techniques being practised by smallholder farmers in Rachuonyo south district.

1.3 Objectives of the study

The main objective of the study was to contribute to increase in smallholder farmers' incomes through sweet potato value addition in Rachuonyo south district.

The specific objectives were:

1. To compare the socio economic characteristics of sweet potato value adders and non value adders;
2. To establish different types of sweet potato value addition techniques practiced by the smallholders;
3. To examine the factors influencing sweet potato value addition amongst the smallholder farmers.

1.4 Research questions

1. What are the socio economic characteristics of both sweet potato value adders and non value adders in Rachuonyo south district?
2. What are the different levels of sweet potato value addition practiced by the smallholder sweet potato farmers in Rachuonyo south district?
3. What are the factors influencing sweet potato value addition in Rachuonyo south district?

1.5 Justification of the study

Change in weather patterns and the need to diversify away from over reliance on maize as staple food has seen sweet potato gain prominence among smallholder farmers. In essence, sweet potato has inevitably become an important food crop for both domestic and commercial use. (Odendo and Ndolo,2002; Kaguongo *et al.*, 2010). Considering the prominent role sweet potato is gaining in the national diet, it is necessary for farmers to engage in post harvest activities which will increase the utility of the sweet potato (Odendo and Ndolo, 2002). It is therefore hoped that the findings of this study will provide impetus on policy discussions about sweet potato value addition especially with regard to rural smallholder sweet potato farmer.

1.6 Scope and limitations

This study was confined to smallholder sweet potato farmers in Rachuonyo south district. The study was carried out between May to August 2010 and a total of 200 smallholder sweet potato farmers from both Kabondo and Kasipul divisions participated by being interviewed or filling a questionnaire. Data collected comprised farm, farmer, market and institutional characteristics. It should be noted that both the chosen geographical and physical locations of the

farmers limit the generalisability of the findings, however, the study's overall findings could be of value to future research endeavors in particular, replication studies in other rural areas.

1.7 Definition of terms

Household

An independent male or female producer and his/her dependants who must have lived together for a period not less than six months. The members are answerable to one person as the head and share the same eating arrangement.

Income

Money accrued from sale of sweet potato.

Smallholder

A farmer with a maximum of three hectares of land under sweet potato production

Value Addition

A deliberate activity which changes the form of the raw agricultural produce into a more refined or usable form thus increasing its value.

CHAPTER TWO

LITERATURE REVIEW

2.1. Background Information

Value addition to farm produce is key strategy to commercialize farming for small holder farmers in Africa. Processing, perishable farm produce reduce bulkiness, diversify consumption and enhance acceptability and marketability, increases shelf life hence contribute significantly to household food security and income generation since wastage is minimized (Ememwa *et al.*, 2008).

Widely established throughout the world, sweet potato (*Ipomea batatas L*) is a favorite staple of many cultures and is an ingredient in many ethnic cuisines (Huntrods, 2009). In the southern United States, it is far more extensively used in regional cuisines, and a large part of the crop is fed to livestock. Efforts are being made to breed varieties that will inexpensively produce better yields, so that they can be grown specifically for feed or industrial applications. Huntrods (2009) further noted that in developing countries, sweet potatoes use has diversified considerably over the last four decades, having great potential as a source of local value-added products and ingredients. Some examples include food products like noodles and desserts; animal feed; and some industrial products such as flour, starch and pectin for local and export markets. Furthermore, sweet potato flour can be fermented to make products like soy sauce and alcohol, or if immediately cooked, it can be further processed into wine, vinegar and *nata de coco*, or “on-the-go,” a dessert popular in the Philippines and in Japan.

In Kenya, sweet potato is an important food crop utilized by most household and available almost year round. Therefore, it has the potential of bridging the food gap due to diversified processing utilization technologies that have been developed (Nungo *et al.*, 2007) The sweet potato root is consumed either in fresh, boiled or roasted forms among many rural farmers in Kenya (Owori and Hagenimana, 1998). The orange fleshed /yellow varieties not only contain high calorific value but are also rich in proteins and minerals (calcium, iron, riboflavin and thiamine). They also contain high levels of β -carotene, which is a precursor for Vitamin A (Nxumalo, 1998; Kamau, 2004). Sweet potato generally contains more starch than the potato, and the starch has properties that are especially useful in many food products and manufacturing

processes (Huntrods, 2009). In China, production of sweet potato starch in recent years has evolved into a cottage industry that uses millions of tons of roots per year.

2.2. Sweet potato value addition

This entails deliberate activity to change the form of the raw sweet potato into a more refined or usable form thus increasing its value. Sweet potato can be processed and utilized in various ways for both household and the market purposes. Sweet potato is used for human consumption, as livestock feed, and in industrial processes to make alcohol and starch. Sweet potato is high in carbohydrates. The orange-flesh varieties also provide vitamins A and C. In addition, the green leaves of the plant can be consumed by both humans and animals providing additional protein, vitamins and minerals (Yanggen and Nagujia, 2005).

Some of the sweet potato products can be preserved for future use either alone or as additives to other foods. The sweet potato roots can be processed into dry chips and used in this form or ground into flour. The flour can then be used in enriching other different products such as weaning foods or used in combination with wheat flour to make other high value products such as cakes, biscuits, porridge, *ugali*, *chinchin* and crackies and other dishes (Nxumalo, 1998; Nungo, 2004). The sweet potato leaves can be used as fresh vegetables or preserved as dry vegetables. Processing of sweet potato into preservable products also addresses the farmer's storage problems while ensuring food availability in time of scarcity (Westby *et al.*, 2003). Traditional storage method used by most farmers is leaving the mature roots under-ground and harvesting piece meal. Abubakar *et al.*, (2010) revealed the value of sweet potato leaf as containing protein and crude fibre which are important for addressing deficiency diseases and colon diseases. The study further revealed that both sweet potato tuber and leaf contain micro nutrients necessary for healthy body.

Sweet potato offers processing opportunities into products for human and industrial use. There is potential for new uses of sweet potato such as processing into sweet potato juices for human consumption and sweet potato chips for use in animal feed industry. Sweet potato is an ideal livestock feed because the roots provide a source of energy while the leaves a source of protein, and both can be used in fresh and dried form or fermented into silage. Sweet potato juices offer the highest return on investment (Westby *et al.*, 2003) although currently the juice market is local and very small while the market size for sweet potato chips in animal feed is estimated to

be about 100 metric tonnes per month in Uganda. Sweet potato juices being produced are of different types, notably 100% sweet potato; mixture of sweet potato with oranges, passion and pineapples. There is potential for market growth according to research done by CIP and KARI scientists through developing various recipes (MoA & GTZ, 1998). Number of products that can be got from processing low priced sweet potato are numerous and this processing has proved to be cost effective hence giving these products a competitive edge thus benefiting farmers through creating better markets and participating in integrated production-processing marketing to add value to their produce (Fawzia *et al.*,2000). Research efforts have demonstrated that sweet potatoes can be made into liquid and semi-solid food products such as beverages, soups, baby foods, ice cream, baked products, restructured fries, breakfast cereals, and various snack and dessert items (Ray and Tomlins, 2010). Sweet potato can also be used instead of tomato in preparation of ketchup.

The use of sweet potatoes in the food industry often involves processing of the roots into purees that can be subsequently frozen, canned or packaged in aseptic conditions to produce shelf-stable products for year-round availability of the produce. For pureeing, roots of all sizes and shapes can be processed to make acceptable puree. Purees from the orange-fleshed sweet potatoes have been commercially produced in cans or in frozen form in the U. S. In Japan, both white- or orange-fleshed cultivars are utilized for processing into paste for incorporation into bread and ice cream (Ray and Tomlins, 2010).

According to a study by Lemaga (2005) introduction of sweet potato based enterprises to poor and marginalized smallholder farmers increased their income. Income increased as a result of sweet potato products sales and knowledge on post harvest technologies and food security also improved. He further noted that some households were able to cater for household basic needs like medical expenses, paying school fees. Other benefits included employment creation, improved nutrition through consumption of sweet potato products and improved social status.

A study by Yanggen and Nagujia (2005) established that to increase the commercial value of sweet potato, diversified uses of this crop have to be sought and that these products which are mostly consumed at the household level, may be attractive to many consumers, particularly in the urban areas. Commercial processing of sweet potato into other more (non-traditional) commercial products like sweet potato chips, juice, cakes, flour have been promoted through farmer groups, Non-governmental organizations and Community-based organizations.

Non-traditional products that have been promoted include bread, *chapati*, fried chips, sweet potato flour, *mandazi*, juice, pancakes, porridge, biscuits cakes and doughnuts.

On average, 16% of the sweet potato farmers in Uganda processed sweet potato into both traditional and non-traditional products. The most common processed products were *Otere*, sweet potato flour, *Ingingyo* and *Amukeke* which are traditional products. Sun-drying sliced pieces is practiced during the dry season as a means of storing roots and ensuring that sufficient food is available during the lean seasons. The processing of sweet potato is done basically to increase its shelf life thus improving the food security of the household.

There are a number of products that can be made by using sweet potato as a major ingredient and the development of new and improved processed products from sweet potato appears to represent an excellent means of increasing the utilization of this high yielding and nutritious crop (Singh *et al.*, 2003). Sweet potatoes can be fried, creamed or baked in their skins (Rono *et al.*, 2006). They are easily combined with both sweet and savoury dishes. Research has developed utilization methods like making of chips, blending of sweet potato flour with wheat flour for products like chapatti, mandazi or porridge (Nungo *et al.*, 2007). Sigh *et al.*, (2008) reported that addition of various proportion of sweetpotato flour in wheat flour can increase the nutritive values in terms of fibre and carotenoids. This also helps in lowering the gluten level and prevent from coeliac disease. Utilization of sweet potato-based confectionary was used as a step to reducing food crisis among women farmers in Imo state Nigeria because of the health benefits, environmental friendliness and ability to make a home food secured with little investments (Amamgbo *et al.*, 2010). Hagenimana (1999), established that there are myriad of products that can be made using sweetpotato as a major ingredient on testing the effect of sweetpotato flour as an ingredient on quality of yeast-raised doughnuts. He found that the overall quality not significantly lowered by addition of sweetpotato. The further showed that sweetpotato either in fresh grated, boiled and mashed, or flour form could, with high potential of success, partially replace wheat flour in processing of baked and fried products.

These different methods are intended to increase utilization hence, increasing sweet potato production leading to improve incomes and food security among the poorer segments of the rural population. Odo and Ndolo, (2002) found that nearly 60% of the farmers in western Kenya were aware of utilization and processing technologies that aim at adding value and

expanding sweet potato market potential through processing of various products such as doughnuts, “*mandazi*” and flour.

2.3. Theoretical framework

A review of adoption studies by Kaguongo *et al* (2010) indicated that adoption decisions are influenced by a number of socioeconomic, demographic, ecological and institutional factors and are dependent on the technology. A study which evaluated the effect of women farmers’ adoption of Orange Fleshed Sweet Potato (OFSP) in raising Vitamin A intake, found that women farmers were likely to adopt the OFSP if the clones were sufficiently high in starch, low in fiber and if they were introduced through community- level education programmes that focused on the health of young children (Hagenimana and Oyunga, 1999). Mazuze (2005) found that key factors affecting adoption of OFSP were availability of vines, intensity of extension service and number of times the respondent received vines. Among other factors, whether to adopt a technology or not depends on the profitability of the technology, farmer education/learning and other observed and unobserved differences among farmers and across farming systems. In Kenya, studies by International Maize and Wheat Improvement Center (CIMMYT) and other similar research institutions examined the factors that condition adoption of farm technologies among maize growers. These studies showed that farmer characteristics such as age, gender, level of education and wealth, and institutional factors as access to capital and labour markets, land tenure security, social capital as important factors in farm technology adoption decisions (Mwabu *et al.*, 2006).

This study assumes that there is potential for sweet potato value addition and that households who engage in value addition activity will increase their purchasing power due to increase in income thus impacting positively on their livelihoods. The decision to engage in value addition is predicted by perceived utility which is expected to be higher. Profit maximization framework was used to examine the decision to add value or not (Pryanishnikov and Katarina, 2003). It is assumed that smallholder sweet potato producers will only add value if the expected net benefit from this option is significantly greater than is the case without it. Suppose that U_i and U_j represent a household’s utility for two choices, then the model is specified as;

$$U_i = \beta_n X_n + \varepsilon_i \text{ and } U_j = \beta_n X_n + \varepsilon_j \text{.....(1)}$$

where U_i and U_j are perceived utilities of value addition and non value addition choices i and j , respectively, X_n is the vector of explanatory variables that influence the perceived attractiveness of each choice, β_i and β_j are parameters to be estimated, ε_i and ε_j are error terms assumed to be independently and identically distributed (Greene, 2000). In the case of sweet potato value addition, if a household decides to use option i , then the expected utility from option i is greater than the utility from option j , which is defined as;

$$U_{ni}(\beta_i X_n + \varepsilon_i) > (U_{nj}(\beta_j X_n + \varepsilon_j)) \quad i \neq j \text{-----} (2)$$

The probability that a farmer adds value and chooses option i instead of j , is then defined as:

$$\left. \begin{aligned} P(Y = 1|X) &= P(U_{ni} > U_{nj}) \\ P(\beta'_i X_n + \varepsilon_i - \beta'_j X_n + \varepsilon_j > 0|X) \\ P(\beta'_i X_n - \beta'_j X_n + \varepsilon_i - \varepsilon_j > 0|X) \\ P(X^* X_n + \varepsilon^* > 0|X = F(\beta^* X_n)) \end{aligned} \right\} \text{-----} (3)$$

where P is a probability function, U_{ni} , U_{nj} represent a household's utility for two choices and X_n is the vector of explanatory variables that influence the perceived attractiveness of each choice, $\varepsilon^* = \varepsilon_i - \varepsilon_j$ is a random disturbance term, $\beta_i^* = (\beta_i' - \beta_j')$ is the net influence of the vector of independent variables influencing adoption of value addition, and $F(\beta^* X_n)$ is a cumulative distribution function of ε^* evaluated at $\beta^* X_n$. The exact distribution of F depends on the distribution of the random disturbance term, ε^* . Depending on the assumed distribution that the random disturbance term follows, several qualitative choice models can be estimated (Greene, 2000). This theoretical framework emphasizes any household decision on the alternative choices.

2.4. Conceptual framework

The interrelationship of key variables involved in the study is outlined by the conceptual framework in Figure 1. Not all sweet potato farmers will decide to add value, some will choose to add value while others will choose not to. The decision to add value is influenced by market, institutional arrangements as well as farmer and farm circumstances. Poor access to markets is caused by high transaction cost brought about by lack of information on prices, demand, quality and other physical factors such as transport problems leading to poor returns to the farmers as a result of asymmetric information (Westby *et al.*, 2003). Farmers who access credit for example can enhance their ability to practice value addition since they will be able to purchase the value addition equipment.

Group participation helps in the choice and ability to practice value addition since group involvement ensures accessibility to credit, equipment and collective marketing which is more effective than individual marketing thus fostering value addition. According to studies done by Lemaga (2005) and Westby *et al.*, (2003), farmers who are organized into groups have better access to markets since they have higher bargaining power thereby increasing their marketing efficiency and institutions providing support in post harvest innovations than those who are not. On the other hand, farmers who have neither knowledge and skills nor access to information regarding value addition options resort to distress sale thus receiving very low prices due to perishability nature of their produce (Sadangi, 2005). Access to extension services also influences technology adoption. Extension agents supply farmers with important information and skills on production, management and marketing. The availability of relevant and adequate information reduces the risk associated with new technology. The reduction in the risk therefore provides an incentive to the farmers to embrace the technology. According to Onemolease and Alakpa (2009) argument, farmers in contact with extension agents are two times more likely to increase adoption of crop-related innovations than those with no contact. Study of Abebe (2007) on adoption of improved box hive in Tigray region, Ethiopia investigated that adoption of crop varieties were influenced by frequency of contact between the farmers and extension. The study also indicated that the higher contact time positively influenced the adoption decision of the farmers. A study by Makokha *et al* (1999), confirmed that farmers characteristics such as participation in field days and demonstration, attendance at workshops and seminars contact with extension and leadership position have significant influence on perception and hence adoption

decision of farmers. They also found that technological attributes such as supply (availability), economic and yield benefit and convenience had significant influence on adoption decision.

Farmer and farm characteristics that can influence value addition are age, education level, gender, level of social capital and sweet potato output. Farmer's age can positively or negatively influence both the decision to adopt and extent of adoption of technology. It can be that older farmers are more risk averse and less likely to be flexible than younger farmers and thus have a lesser likelihood of adopting new technologies. However, it could also be that older farmers have more experience in farming and are better able to assess the characteristics of modern technology than younger farmers, and hence a higher probability of adopting the practice (Teklewold *et al.*, 2006). Education level can positively influence value addition in terms of training and skills required to grasp new techniques and undertake value addition. A person with higher education level is expected to have a better access to information and more clarity about emerging institutions (Birtal *et al.*, 2005). The gender of household head may influence the ability of the household to adopt new technologies. The amount of sweet potato produced will also positively influence value addition, with farmers with higher output expected to be participating in more value addition. An increased size of the household tend to discourage value addition and selling of smallholders' produce since there is need to meet the consumption requirements of the household while an increased area of land under cultivation stimulates participation in the market as it allows for an increased production extending beyond the consumption requirements (Makhura *et al.*, 2001). Farmers with other sources of income may not participate fully in value addition since off farm employment offers additional income. Higher levels of off-farm income are associated with reduced adoption of technology as Hareth and Hiroyuki, (2005) found in Sri Lanka where farmers who mostly engaged in off- farm income generating activity had reduced engagement in intercropping of immature rubber stands. Farmers who engaged themselves on off-farm activities had less time to pursue on-farm diversification. The findings concur with that of Rono *et al.* (2006) who found that households that receive off-farm income are less likely to pursue on-farm diversification as a method of reducing financial risk. However, some studies have found contrary results, for example Igbokwe and Okoye (2000) found off-farm and on-farm income significantly and positively correlating with adoption of rice farming technologies. The argument was that availability of both farm and off-farm income increases ability of farmers in acquisition of new agricultural technologies. The level of value addition is therefore expected to

influence some key household livelihood outcomes. Value addition is expected to increase farm income leading to increased purchasing power thus impacting positively on the smallholder farmers' livelihoods.

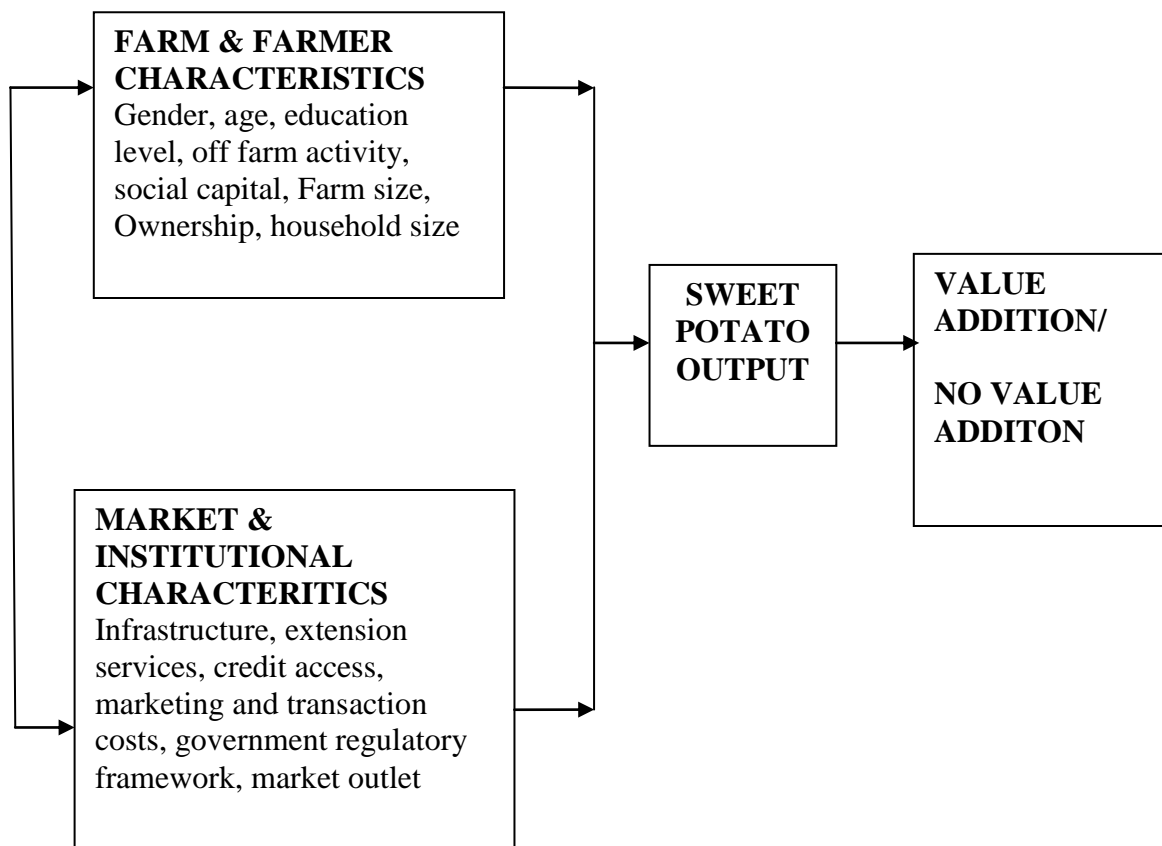


Figure 1: Conceptual Framework of factors influencing sweet potato value addition

Source: Own conceptualization

CHAPTER THREE

METHODOLOGY

3.1 Study Area

Rachuonyo South, one of the Districts in Nyanza province was chosen as a study area because it leads in sweet potato growing. It shares a common border with Nyakach district to the north, Kisii and Nyamira to the south and Homa bay and Rachuonyo North to the west and Kericho to the east. It is located between longitude 34⁰ 25' East and 35⁰ East and Latitude 0 degrees 15' South and 45' south. It covers an area of 503.5 sq. km. It is divided into two divisions namely; Kabondo and Kasipul, which are further divided into 18 locations and 42 sub locations.

The district has an inland equatorial climate which is however modified by the effect of altitude and proximity to the Lake Victoria which makes the temperatures range from 17° to 25° centigrade. It is divided into two main relief regions namely; the lakeshore lowlands and the upland plateau which starts at 1,220 metres above the sea level. The district has two rainy seasons with long rains starting from late March to June and range from 800mm-1800m. The short rains start in August to December ranging from 250mm-700mm. Kasipul and Kabondo receive reliable rainfall. The district has 452 acres of arable land of which 95% are small scale holdings and is characterized by a variety of soils; the dominant of which are alluvial, loamy and sandy soils. It has 44660 small farm holdings, between 1.2 to 3.0 acres on which food crops such as sweet potato, maize, cassava, and sorghum are grown. The population of the district was 196,210 (National Population Census, 2009) and is projected to grow with youth forming majority.

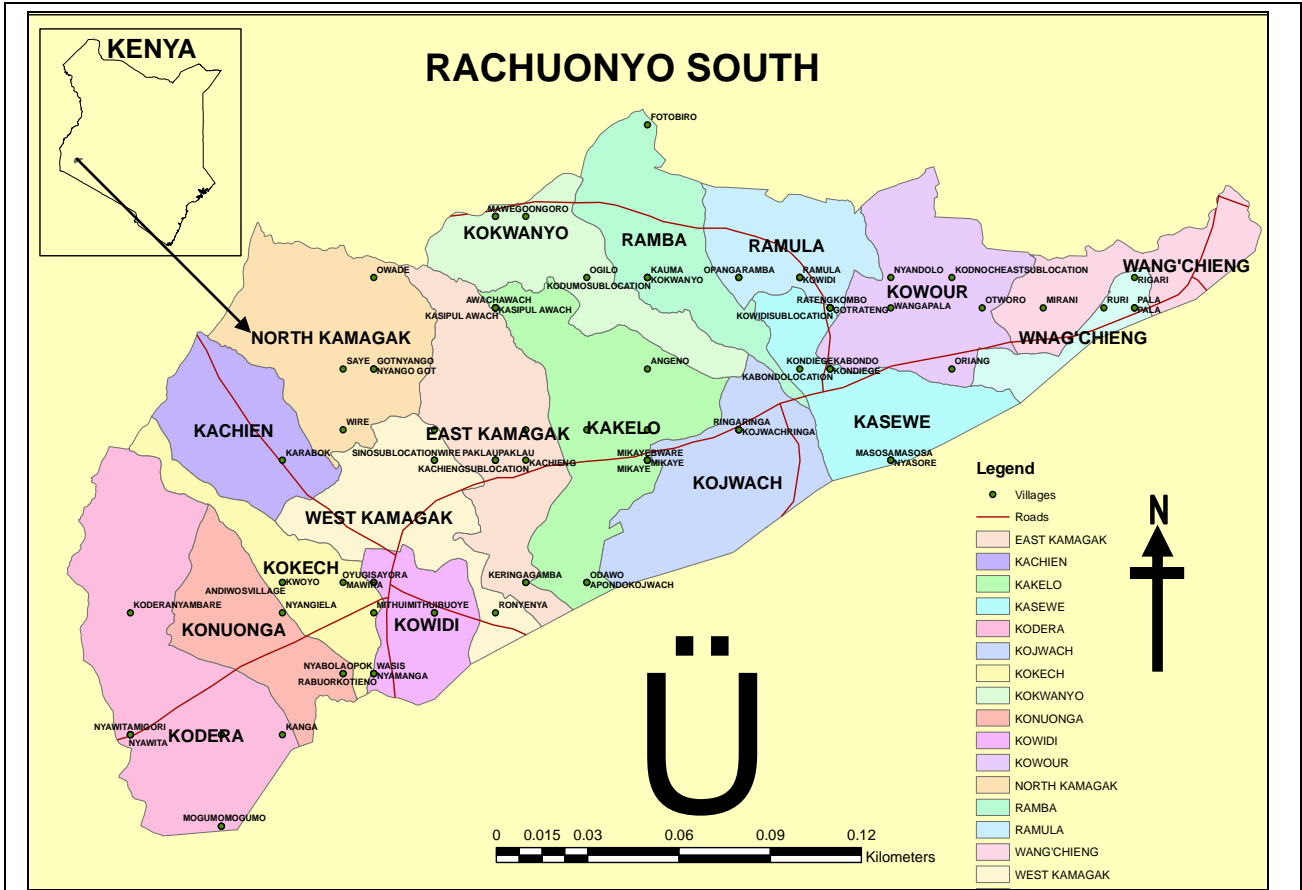


Figure 2: Map of Study Area

Source: District Bureau of Statistics

3.2 Sampling Procedure and Sample size

Systematic sampling method was used to obtain appropriate sample size. With the help of a list from the NGOs working in the district, the names of the farmers were serially numbered and then selected at an interval of five numbers to get an appropriate sample size of 200 farmers. To get appropriate sample size, probability proportionate to size sampling methodology was used as specified by Anderson *et al*, (2007). The formula is specified as below:

$$n = z^2 pq / e^2$$

where n is the sample size, p is proportion of the population containing the major attribute of interest, q is (1-p), z is the standard variate at a given confidence level ($\alpha = 0.05$), and e is the acceptable error (precision).

Using P= 0.6 given that the previous study indicates that approximately 60% of the households are sweet potato farmers in the district (IDCCS, 2009), Z = 1.96, q = 0.4 and e is an acceptable error, q is the weighting variable and is computed as 1-p. The sample was determined as;

$$n = 1.96^2 * 0.6 * 0.4 / 0.0678^2 = 200$$

3.3 Data Types and Sources

Primary data was collected using questionnaires schedule which was administered to the sampled households. Secondary data was collected from the District Agricultural Reports, NGO's such as CEFA, IDCCS and C-MAD and Government databases. Data collected included marketing outlets, various value addition activities and various sweet potato value added products.

3.4 Data Analysis and Analytical Techniques

SPSS version 11.5 was used for both descriptive and econometric data analysis. In the first objective, both Chi square analysis and T- test were used to compare the socio – economic characteristics of both non value adders and value adders. Descriptive statistics were used to examine the second objective on value addition techniques being practiced in the district

In the third objective, Heckman two stage selection model was used to assess the factors influencing sweet potato value addition which entailed various variables such as household characteristics, institutional characteristics and marketing characteristics. It was hypothesized

that the farmers' behavior is driven by the need to derive or maximize the utility associated with the practice. Depending on the farmers' perception on the utility they are likely to derive from the practice, a choice is made, either to add value or not. This farmers' behavior that leads to a particular choice is modeled in a logical sequence, starting with the decision to add value, and then followed by a decision on the extent of the value addition. Since the farmers utility maximization behavior cannot be observed, the choice made by the farmer is assumed to represent the farmers' utility maximization behavior. Based on the nature of these decisions, it is justified to use the Heckman two stage selection model whose estimation involves two stages. In the first stage, the decision to add or not to add value was assessed using a probit model. The choice of this model is based on the fact that the decision to add value is discrete; it is either one adds value or not. Furthermore, the study assumes a normal distribution and hence the choice of the probit model. The reasoning behind the two stage approach is that the decision on the extent of sweet potato value addition (the number of 90 kilogram bags used for value addition) is usually preceded by a decision to engage in the process of value addition. The probit model used in the first stage is as specified in Equation 4 below:-

$$\text{Prob} \left(Y_i = 1 \mid X = \int_{-\infty}^{x'\beta} \varphi(t) dt = \varphi(X'\beta) \right) \text{-----} (4)$$

where Y_i is an indicator variable equal to unity for households that add value, $\varphi(\cdot)$ is the standard normal distribution function, β s are the parameters to be estimated and X s are the determinants of the choice. When the utility that household j derives from value addition is greater than 0, Y_i takes a value equal to 1 and 0 otherwise. It follows therefore, that:

$$Y_i^* = \beta_i X_i + V_i \text{-----} (5)$$

where Y_i^* is the latent level of utility the household gets from value addition and $V_i \sim N(0,1)$
 Given this assumption, it follows that:

$$Y_i = 1 \text{ if } Y_i^* > 0 \text{ and } Y_i = 0 \text{ if } Y_i^* \leq 0 \text{-----} (6)$$

Empirically, the model can be represented as follows:

$$Y = \beta_j X_i + \epsilon_i \text{-----} (7)$$

where Y is the probability of a household adding value given farm, farmer and market and institutional characteristics X_i and ϵ_i is the error term. In the second step the Inverse Mills Ratio (IMR) is added as a regressor in the extent of value addition equation to correct for potential selection bias. It was expected that the extent of value addition is self selected in the sense that only some farmers choose to add value, hence the decision of the extent of value addition is preceded by the decision to add value. Consequently this raises an empirical problem of self selection. To reconcile this problem, the decision to add value is treated endogenously in this study to control for the potential sample selection problem. Therefore, first the determinants of the decision to add value are estimated, then the Mills ratio from the selected equation is used as an independent variable in the target equation, that is used to assess the determinants of the extent of value addition.

$$E(Z_i | Y=1) = f(x_i\beta) + \gamma\tilde{\lambda} + u_i \text{-----} (8)$$

where E is the expectation operator, Z_i is the (continuous) extent of value addition measured by the proportion of value added sweet potato output, x is a vector of independent variables influencing the extent of value addition and β is a vector of the corresponding coefficients to be estimated, $\tilde{\lambda}$ is the estimated IMR. So Z_i can be expressed as follows:

$$Z_i^* = \beta_i X_i + \gamma\tilde{\lambda} + u_i \text{-----} (9)$$

where Z_i^* is only observed if the farmer is undertaking value addition ($Y=1$), hence $Z_i = Z_i^*$. Empirically, this can be represented as:

\3

$$Z_i = \beta_i X_i + \gamma\tilde{\lambda} + u_i \text{-----} (10)$$

where Z_i is the extent of value addition given the farm and farmer characteristics, X_i . $\tilde{\lambda}$ is the inverse Mills Ratio estimated in step 1 of the Heckman model and u_i is the error term. Equation (7) and (10) are then jointly estimated using the Heckman two stage procedure in STATA. The variables used in the two stage Heckman selection model are as shown in Table 1.

Table 1: Description and measurement of variables to be used in the model

Dependent Variable	Description	Unit of measurement
value addition	Whether respondent adds value or not	1= adding value, 0 = not adding value
Independent variables		
Age	Age of the respondent	Years
Household head	Head of the family	
Household size	Number of people living in the respondents' compound	Number
Extension services	Access to extension services	Number of times visited by extension officer
Credit	If the respondent was able to acquire any loan	Dummy(1=access, 0=otherwise)
Training	If have ever attended farmer training	Dummy(1=yes,0=No)
Education	Level of respondent's education	Years
Gender	Gender of household head	Dummy(1=male,0 = female)
Output	Quantity of potato harvested	Kilograms.
Off-farm employment	Hours spent on daily off-farm activity	Hours
Distance	Distance to the nearest local market	Kilometres
Group	If member of a group	Dummy(1=yes,0=No)

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the findings of the study. The results have been presented in three sections according to the number of objectives.

4.1. Comparison of socio economic characteristics of value adders and non value adders

The socioeconomic characteristics of both value adders and non value adder are presented in Table 2. Out of 200 respondents, 63% added value against 37% who did not. The socioeconomic characteristics considered here were age, land size, household size, market distance and total quantity produced. The mean age of the respondents was found to be 42.72 years, however, the mean age of the value adders was 43.21 years and that of the non-value adders was 41.46 years. Value adders were a bit older than non value adders. Old age comes with experience which might explain their engagement in value addition while at the same time, younger people might view engagement in value addition as a menial job thus look for white collar jobs. There was no significant mean differences in both age and land size of both value adders and non value adders.

The overall land size mean was 3.122 acres while mean land size of both value adders and non value adders were 3.0132 acres and 3.4018 acres respectively. Value adders had small pieces of land compared to non value adders prompting them to do value addition to maximize benefits out of their small land holdings. Land is perhaps the single most important resource, as it is a base for any economic activity especially in rural and agricultural sector. Farm size influences households' decision to adopt or not to adopt new technologies. It also influences scale of technology use (Negash, 2007).

There were significant mean relationships of household size, distance to the market and total quantity produced of value adders and non value adders. The overall household size mean was 7 persons but value adders and non value adders had mean of 7 and 8 persons respectively. The means were both higher than the national average of 5 persons (National Population Census, 2009). Household size, a proxy to labour availability, may influence the adoption of technology positively as its availability reduces the labour constraints (Teklewold *et al.*, 2006). Though larger household size ensures availability of enough labour to be utilized in value addition

activities, it is, at the same time might translate to many mouths to be fed thus reducing the amount of sweet potato left for value addition.

The overall mean distance of market outlets was 0.7213 kilometres whereas the mean market distance where non-value adders sell their sweet potato produce was 0.4738 kilometers reflecting ease of market access. This scenario lends credence why these farmers opted to sell their sweet potato produce in raw form. It is therefore apparent that market proximity makes no compelling reason for these farmers to engage in value addition. On the other hand, mean distance of market outlets where value adders sell their produce was 0.8175 kilometers showing that these farmers are compelled to engage in any form of value addition in order to increase shelf life, reduce the bulk and obtain higher prices.

Table 2: T- test of Socio-economic characteristics of both value adders and non value adders

Characteristic	Value adders		Non-value adders		Overall mean	t-test of difference in mean t	P-value
	Mean	SD	Mean	SD			
Age (years)	43.21	8.665	41.46	11.37	42.72	1.166	0.245
Household size (numbers)	7.69	2.358	8.61	3.686	7.95	-2.092	0.038**
Land size (acres)	3.0132	1.1696	3.4018	2.1688	3.122	-1.629	0.105
Distance from home to market (Km)	0.8175	0.7035	0.4738	0.8006	0.7213	2.983	0.003*
Total quantity produced (90Kgs/bag)	20.80	7.33	8.04	3.558	17.23	12.455	0.000*

Source: Survey data, 2010

*** indicates significance at 10%, ** significance at 5% and * significance at 1% SD means Standard Deviation

Value adders produced more bags (20.80) than non value adders (8.04) which may encourage value addition while overall mean production was 17.23 bags. This is plausible because the more a farmer produces the more they will have surplus for value addition. Increase in quantity produced ensures that a household would produce beyond household consumption needs and thus have the surplus for value addition. An increased production stimulates participation in the market as it allows for an increased production extending beyond the consumption requirements of the household (Makhura *et al.*, 2001).

Chi square results of socio economic characteristics of value adders and non value adders are shown in Table 3. Amongst the married respondents, 69.2% added value while 30.85% did not. All the single respondents added value while 67.9% widowed respondents engaged in value addition against 32.1% who did not. A greater percentage of married and widowed respondents engaging in value addition may be explained by high responsibility of taking care of the family prompting them to look for ways of increasing their revenues. There was no statistical significant difference in marital status of value adders and non value adders.

Amongst the respondents who were involved in off farm activity, 70.6% added value while 29.4% did not. For those who were never involved in off farm activity, 67% added value against 33% who did not.

About 73.5% of females participated in sweet potato cultivation as compared to 26.5% of non value adders, at the same time 43.4% male respondents added value against 56.6% who did not. The low percentage of male participation in value addition may suggest their lack of appreciation of the activity. A greater male participation would have reinforced the efforts of women in pursuing value addition activities. Furthermore, studies have indicated that sweet potato is considered a woman's crop (Nungo *et al.*, 2009) which may explain high female participation in value addition.

Table 3: Chi square test results of Socio-economic characteristics of both value adders and non value adders

Characteristic	Value adders	Non value adders	Chi square	P-value
	%	%		
Gender				
Female	73.5	26.5	5.180	0.023**
Male	43.4	56.6		
Marital status				
Single	100		0.487	0.784
Married	69.2	30.8		
Widowed	67.9	32.1		
Education level				
None	54.5	45.5	20.977	0.033**
Primary	61.1	38.9		
Secondary	47.8	52.2		
College	100			
Involvement in off-farm activity				
Yes	70.6	29.4	0.302	0.583
No	67	33		
Group Membership				
Yes	84	16	31.046	0.0000*
No	46.9	53.1		
Credit Access				
Yes	54.3	45.7	10.901	0.001*
No	76.9	23.1		
Training				
Yes	95.1	4.9	67.871	0.0000*
No	41.2	58.8		

*** indicates significance at 10%, ** significance at 5% and * significance at 1%

Source: Survey data, 2010

Among those who attained college level of education, 100% added value; secondary level of education, 47.8%; primary level of education 61.1%; and 54.5% of non- educated respondents engaged in value addition. Education level had a strong influence in the involvement in value addition. The influence of education levels in technology uptake is well documented. Mishra, (2010) found that farmers with higher education have better access to information and

knowledge that are beneficial to farming operation. They also tend to possess higher analytical capability of the information and knowledge necessary to successfully implement new technology and realize expected results. Hence, higher education allows farmers to make efficient adoption decision and be the early adopters who can take advantage of new technology and profit most from it. Highly educated farmers also tend to adopt technology with greater intensity (Nzomo *et al.*, 2007). Highly educated farmers and marketers are better adopters of improved technologies than less educated ones. Educated producers and marketers have exposure to new technologies and innovation and are more receptive to new ideas and are more willing to adopt, hence the positive correlation between education and technology adoption. Better educated farmers have the capacity to understand, appreciate and respond to market trends. Education also enhances their potential to process information and make the best out of any situation hence enable them to minimize risk and face uncertainties (Tura *et al.*, 2010). The human capital assets (education, skills, and training) of the household head affect the profitability of modern technology, as they reflect unobservable productive characteristics of the decision maker, such as farming skills and entrepreneurship. Education increases the ability of farmers to obtain, process, and use information relevant to the technology leading to greater use of new technologies (Olwande *et al.*, 2009).

Group membership, credit access and training are some of the important facilitating institutional factors. Amongst the farmers that joined various farmers groups, 84% were involved in value addition against 26% because of the significant role it plays in increasing agricultural production, farm income, poverty reduction and improvement in food security. Non group members comprised 46.9% value adders against 53.1% non value adders. The benefits of group membership include: access to credit, shared labor, joint input purchase, group marketing, group training, lobbying for favorable agricultural policies and unity among member farmers (Owuor *et al.*, 2004).

With respect to credit access, only 54.3% of farmers who accessed credit added value. Among the farmers who accessed credit, 50% borrowed from micro-finance institutions, 42.9% from farmer groups, 5.7% from informal lenders such as friends and neighbours and 1.4% from commercial banks. Teklewold *et al.* (2006) reported that farmers with better access to credit are significantly more likely to be adopters of the technology and that credit schemes tend to focus

on the distribution of very few inputs but restricted to only few group of farmers. Farmers who have access to credit may overcome their financial constraints and therefore buy inputs. Farmers without cash and no access to credit will find it very difficult to attain and adopt new technologies. Olanguju (2007) found that sweet potato farmers who accessed credit increased their output unlike their counterparts which he attributed to the fact that farmers without credit make use of smaller physical inputs than their counterparts. Among the reasons for borrowing, 52.9% borrowed to buy production inputs, 14.3% to pay school fees, 5.7% to pay medical bills, 8.6% to buy value addition equipment and 18.6% had other reasons such as to meet funeral expenses, emergency and accidents expenses and daily household expenses. The small amount of funds devoted to purchase of value addition equipment explains why few farmers add value to their sweet potato. Farmers are still on the lower part of the commercial scale of buying production inputs and making non commercial payments. When the orientation turns to a larger percent on value addition, then commercialization in sweet potato would be realized.

Training and access to extension services enhances adoption of new technology since farmers get to share knowledge, ideas and skills amongst themselves. From the analysis, results indicate that 95.1% of farmers who added value had access to training on topics touching on sweet potato. Amongst the farmers who had not attended trainings, 41.2% added value while 58.8% did not. Training was mostly through workshops, seminars, and farmer field days. Tura *et al.*, (2010) found that competitiveness of credit and labor markets, as well as access to extension, were some of the determinants of adoption and continued use. Extension provides farmers with information on availability and properties of the new technology and technical skills for using it. Access to extension has been widely reported to positively influence adoption and continued use of agricultural technologies (Knowler and Bradshaw, 2007). Similarly, the frequency of visits by extension officers and development agents was found to significantly influence the decision to use new agricultural technology. The extension officers have a number of services they render to the community that includes advices on crop management, crop pest control, and availability of agricultural inputs. Extension services would inform and build the capacity of farmers, increasing their knowledge and reducing their uncertainty in decision-making.

4.2. Sweet potato value addition techniques practiced by the smallholder sweet potato farmers

Different sweet potato value addition techniques have been developed through research that range from simple to more advanced techniques that require advanced inputs. These techniques are intended to improve shelf life, increase incomes and improve food security of the rural poor farmers (Nungo *et al.*, 2007). Results show that sweet potato farmers in the district engage in different value addition techniques as presented in Table 4. These techniques included grading, packaging, slicing and sun drying, grinding into flour, baking, preparation of additives and juices and other techniques which encompass preparation of potato jam.

Table 4: Sweet potato value addition techniques practiced in the district

Value addition techniques	%
Grading & Packaging	30.57
Slicing & Sun-drying	22.84
Grinding into flour	18.53
Additives & juices	14.93
Baking	7.91
Others	5.22

Source: Survey data, 2010

The technique involving grading and packaging comprised 30.57% of farmers while 22.84% engaged in slicing and sun- drying, 18.53% ground into flour,14.93% prepared additives and juice, 7.91% were involved in baking and 5.22% were involved in other value addition techniques such as jam preparation. Grading, packaging, slicing and sun drying and grinding into flour forms the lower level of value addition and were the most popular since they require few inputs. On the other hand, baking, preparation of additives and juices and jam are considered more advanced techniques of value addition which require more inputs (Rono *et al.*, 2006).

Grading involves sorting the sweet potato into different categories based on physical characteristics such as bruises, colour and size. This is done immediately after the produce is harvested and washed. Graded produce is packaged in sacks and polythene paper bags though research has shown that they are not ideal and should be avoided at all cost despite being

inexpensive and readily available. Sacks only aid in easy handling when transporting to the market (Mukunyadzi, 2009). Furthermore, this type of packaging lacks basic important information such as net weight, common name, place of origin, name and address of the shipper or packer, quality attributes such as size and grade which are the basic requirements from Kenya National Bureau of Standards. This deters most consumers who would rather buy the unpacked sweet potatoes which they can assess their quality before buying. Slicing and sun drying involves washing and peeling the skin, then cutting into pieces and then spreading outside on direct sunlight to dry for future use or grinding into flour to be mixed with finger millet flour for porridge preparation.

Baking involves use of sweet potato flour and wheat flour in proportions to prepare products such as *chapati*, *mandazi*, biscuits and loaves of bread. Sweet potato crisps can also be prepared by thinly slicing the sweet potato, salting and deep frying. Frying is not common because it requires fat which not all households can afford (Rono *et al.*, 2006). Odebode *et al.*, (2008) found that these products were acceptable to consumers due to their palatability and inexpensiveness. Hagenimana, (1999) indicated the high acceptability and good competitiveness of the sweet potato baked products, especially in small urban trading centers close to the sweet potato production. Products containing cooked and mashed sweet potato were exceptionally highly accepted by consumers who expressed a high level of willingness to pay the same price for sweet potato products as for similar products they have been buying. Sweet potato improves the taste, texture, freshness, appearance, sweetness and color of buns, *chapatis*, and *mandazis*.

Preparation of juice involves extraction of the sap/ juice and then adding either sugar alone or sugar and lemon juice. Though juice and jam preparation is going on, acceptability is still low because the product is still new to the consumers.

4.3. Factors influencing sweet potato value addition amongst the smallholder sweet potato farmers

The Heckman two-step procedure was used to determine the factors influencing sweet potato value addition and extent of value addition. The procedure was chosen for estimation to correct the sample selection bias as proposed by Heckman (1979). Both selection and outcome equations were estimated simultaneously. Post estimation of selection equation results was done to determine marginal effects of variables for use in interpretation. The reason is that coefficients have no direct interpretation because they are just values that maximize the likelihood function.

Marginal effects have direct interpretation and hence facilitate discussion of the results. Results of the Heckman selection model found total quantity produced, household size, credit access, land size and training to influence the choice to engage in sweet potato value addition.

Household size had a significant influence on value addition at ten percent significance level. A unit increase in the size of household reduces the probability of a household engaging in value addition by 1%. This is implied by the idea that the larger the family size, the more mouths to feed thus no surplus for value addition. An increased size of the household tend to discourage value addition and selling of smallholders' produce since there is need to meet the consumption requirements of the household (Makhura *et al.*, 2001). This is in contradiction to findings of Amsalu and Jan de (2007) and Croppenstedt *et al.*, (2003) that household size has a significant and positive effect on determinants of adoption and continued use of a new technology, furthermore, a large household accords the farmer fewer labour shortages at peak times and hence more likely to adopt agricultural technology and use it intensively.

Credit access increases the respondent's participation in value addition of sweet potatoes at one percent level of significance. Access to a credit market offers farm households the opportunity to obtain the resources necessary to adopt technologies. Access to credit, by helping farmers to finance the acquisition of value addition equipment could enhance adoption and continued use of the value addition technology. This is expected as farming households rarely have sufficient means to buy value addition equipment and other associated components, magnifying the importance of credit. However, access to credit by itself is not enough and should be provided in such ways that clients will be able to repay in time without staying indebted for long, thus ending up abandoning the livelihood improving technology.

Table 5: Factors influencing sweet potato value addition

Variable	dy/dx	Coefficient	Std Error	Z	P-value
Age (Years)	0.002	0.014	0.002	0.92	0.359
Gender (Male/Female)	0.017	0.174	0.030	0.57	0.565
Education level(Years)	-0.004	-0.034	0.017	-0.21	0.832
Total quantity produced					
(90kgs/bag)	0.200	0.191	0.006	3.30	0.001*
Distance(Km)	-0.009	-0.085	0.025	-0.35	0.724
Credit access (Amount)	-0.173	-1.181	0.065	-2.66	0.008*
Household size (Number)	-0.011	-0.102	0.006	-1.68	0.093***
Groupmembership(Yes/No)	-0.017	-0.161	0.038	-0.44	0.660
Training (Number of times)	0.104	0.920	0.057	1.82	0.069***
Land size (acres)	-0.044	-0.420	0.017	-2.53	0.011*
Number of observations =	200				
Censored observations =	56				
Wald Chi ² =	392.98				
Prob> Chi ² =	0.0000				
log likelihood =	-30.38				
Y = fitted values (predict) =	0.9490				

*** indicates significance at 10%, ** significance at 5% and * significance at 1%

Source: Survey data, 2010

Training has a positive influence on sweet potatoes at ten percent level of significance. Through training, farmers acquire skills and techniques they need to engage in value addition. Farmers who attended workshops and seminars on various topics touching on sweet potato were more exposed in terms of information, skills and knowledge concerning importance of sweet potato and how to improve prices they get from the produce. Training, competitiveness of credit and labor markets, access to extension, were some of the determinants of adoption and continued use (Tura *et al.*, 2010). Extension provides farmers with information on availability and properties of the new technology and technical skills for using it. Access to extension has been

widely reported to positively influence adoption and continued use of agricultural technologies (Knowler and Bradshaw, 2007). Similarly, the frequency of visits by extension officers and development agents was found to be significantly influencing the decision to use new agricultural technology. This is because extension services provide information, knowledge and skills that enable farmers to be aware and use the technology. Extension services play a central role of providing support for institutional mechanisms designed to support the dissemination and diffusion of knowledge among farmers and demonstration of gains from new technologies (Baidu-Forson, 1999).

Land size has a negative influence on value addition. Increase in land size reduces respondent's participation in value addition at one percent significance level. This can be attributed to the fact that those with large tracks of land devote large chunks to other competing enterprises such as maize which is considered a staple food in the area. This is contrary to Makhura *et al.*, (2001) findings that an increased area of land under cultivation stimulates participation in the market as it allows for an increased production extending beyond the consumption requirements. The findings further contradict Barungi and Maonga, (2011) findings that the fixed transaction costs decrease with an increase in farm size, which explains why the adoption of new divisible technology might begin with larger farms, secondly, because larger farms have a greater ability to raise capital, to bear the cost of the innovations and bear the risk of failure, they are likely to make risky investments compared to smaller farmers.

Total quantity produced influences value addition positively. A unit increase in quantity produced increases the respondent's engagement in value addition at one percent significance level. This is plausible because the more a farmer produces the more they will have surplus for value addition. Increase in quantity produced ensures that a household would produce beyond household consumption needs and thus have the surplus for value addition. Kelley (1997) found that the earliest adopters of new technology were large farms. It was attributed to the advantages of large size or economies of scale. An increased production stimulates participation in the market as it allows for an increased production extending beyond the consumption requirements of the household (Makhura *et al.*, 2001).

4.4. Factors determining extent of value addition

There were only four variables influencing the extent of value addition; total quantity produced, distance to the market place, credit access and group membership.

Total quantity produced has a positive influence on the extent of value addition. This can be attributed to the fact that increased production ensures availability of surplus for value addition. Rono *et al.*, (2006) found that farmers who had surplus sweet potato harvests were likely to add value for consumption than those who did not. This implies that the utilizations technologies should be targeted at a wide range of households particularly those with surplus production that may go into waste.

Market outlet has a significant influence on the extent of value addition. This can be explained by the fact that sweet potato being bulky compels those farmers who are far away from the market outlets to add value so as increase shelf life and also get better prices than their counterparts who next to market outlets and can easily dispose their produce. This is inconsistent with the findings of Ali (2005) that rural road improvement and nearness to market increases total acreage for crops and increases value of agricultural output by showing that rural road improvement also intensifies production through technology adoption.

Group membership positively contributes to the extent of value addition and this can be explained by the fact that individuals in groups are easily influenced by their associates than those in isolation. Most farmers who are members in different farmer groups participated in value addition. This can be attributed to the fact that farmers in groups get to exchange ideas and influence each other leading to adoption of value addition techniques. Group membership ensures collective production, marketing, training ensuring pooling of resources together and reduction of information asymmetry thus reducing transaction costs and ensuring economies of scale. Ndegwa *et al.*, (2000) found that groups can be very effective especially when it comes to pooling external inputs and disseminating information. Group membership enables farmers to access loans which will enable them to purchase value addition equipment. Moreover, most NGO's that advocate for value addition work through groups. Farmers in groups have a strong bargaining power when marketing their products and in turn receive better returns for their produce. This is in addition to penetrating wider markets and being offered contracts by major buyers. This case has been supported by Shiferaw *et al.*, (2006), who argue that collective marketing, allows small-scale farmers to spread the costs of marketing and transportation and

improve their ability to negotiate for better prices, and increase their market power. As is the case in many rural areas, farmers acting individually face high transaction costs because they deal in small quantities.

Table 6: Extent of value addition

Variable	Coefficients	Std Error	Z	P- value
Age (Years)	0.055	0.038	1.47	0.140
Gender (Male/Female)	0.311	0.683	0.45	0.649
Education level(Years)	0.101	0.312	0.32	0.745
Total quantity produced (bags of 90kgs)	0.091	0.050	1.82	0.069***
Distance(Km)	0.777	0.467	1.66	0.096 ***
Credit access (Amount)	0.002	0.796	1.03	0.059***
Household size (Number)	0.084	0.136	0.62	0.536
Group membership(Yes/No)	2.921	0.769	3.80	0.000*
Land size (acres)	0.075	0.272	0.28	0.782
Advice (Number of times visited by extension officer)	0.246	0.170	1.44	0.149
<hr/>				
Mills				
Lambda	2.832		2.30	0.022
Rho	0.813			
Sigma	3.481			

*** indicates significance at 10%, ** significance at 5% and * significance at 1%

Source: Survey data, 2010

Credit access influences extent of value addition positively. Access to credit enables farmers to acquire value addition equipment. Teklewold *et al.* (2006) reported that farmers with better access to credit are significantly more likely to be adopters of the technology and that credit schemes tend to focus on the distribution of very few inputs but restricted to only few group of farmers. Ali (2005) noted that the wealthy farmers adopted high yielding rice variety before others because they were less likely to be credit constrained.

Mignouna *et al.*, (2011) found membership to be significantly associated with a higher probability of adopting Imazapyr resistant maize in western Kenya. He further argues that the

most important issue in adopting a new technology is group unity. Such unity is attributed to a spirit of teamwork and cooperation where there is communication. Membership to a group may enable farmers to learn about a technology via other farmers and from other development agencies. Information flow between members of farmer groups is usually very rapid and important. Farmer groups give their members a wider opportunity for educating each other. Higher interactions among members of a group increase chances to widen understanding of new technologies and their advantages.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

From the findings of the study, it emerged that there are several sweet potato value addition techniques being practiced in Rachuonyo South district. These value addition techniques include grading which is done according to size, colour and lack of bruises, packaging which is done in polythene bags and sacks, slicing and sun-drying, grinding sweet potato into flour, preparing additives and sweet potato juice, baking and other forms of value addition such as jam preparation. Baked products included *mandazi*, *chapati*, and loaves of bread, biscuits and crisps.

The study also compared the socio economic characteristics of value adders and non value adders using t test and chi square and found that the means of household size, distance to the market, total quantity produced, education level, training, credit access, gender and group membership were statistically different between the groups.

Among the factors that influenced sweet potato value addition in the district are household size, credit access, land size and training. A larger household deters value addition due to many mouths to feed thus fewer surpluses for value addition. Increase in land holdings discourages value addition due to competing crops such as maize thus reducing amount produced leading to less surplus for value addition. Credit access enables farmers to purchase value addition equipment and expand their micro enterprises thereby facilitating value addition while at the same time; training equips farmers with technical skills of value addition. Household size, credit access, total quantity produced and group membership were found to influence the extent to which farmers added value to their sweet potatoes. Group membership enhances value addition since farmers within a group get to share ideas amongst themselves, lend each other within the group and also produce and market as a group thereby taking advantage of economies of scale as transaction costs are reduced.

5.2 Policy Recommendations

For the smallholder farmers to benefit from value addition, the policy makers should take the following issues into consideration.

They should encourage farmer group formation and make farmers feel part of it since majority felt that they pool their resources together and only a few individuals benefit from it. Furthermore, group membership has an element of collective action which gives the farmers bargaining power when selling their produce.

Farmer training in form of workshops, seminars and farmer field days should be encouraged so as to enable farmers exchange ideas on how to add value to their sweet potato and learn from each other while at the same time encouraging them to produce more so as to take advantage of economies of scale.

Policy makers should come up with loan package intended for those interested in value addition. Mechanisms should also be put in place on follow up on how the funds borrowed are used. This is because those who accessed loans only devoted a small portion to value addition.

The government extension system needs to address the factors which affect the decision to use a technology continuously. An effective and efficient extension system can render an innovation sustainable and useful for economically and spatially disadvantaged groups, thus, contributing towards alleviating poverty and reducing inequality among rural communities.

Sweet potato value addition has the potential of increasing farmers' income and as such the poor smallholder farmers should be encouraged to take up the value addition technology so as to get better prices for their produce which translates to increased income thereby increasing their purchasing power and improving their living standards.

Marketing of the processed sweet potato products still remain a challenge which calls for proper marketing strategies such as linking farmers with supermarkets. Inadequate product development, proper packaging and labeling are other challenges that require urgent attention through acquiring certification from Kenya Bureau of Standards.

5.3 Suggestions for Further Research

This study has only focused on factors influencing sweet potato value addition amongst smallholder farmers in Rachuonyo south district but there is need to establish the marketability of these value added products if these farmers are to benefit from this technology.

REFERENCES

- Abebe, W. (2007). 'Determinants of adoption of improved box hive in atsbi wemberta district of eastern zone, Tigray region'. Unpublished M.Sc. Thesis, Haramaya University, Haramaya.
- Abubakar, H.N., Olayiwola, I.O., Sanni. S. A. and Idowu, M. A. (2010). 'Chemical composition of sweet potato (*Ipomea batatas Lam*) dishes as consumed in Kwara state, Nigeria' *International Food Research Journal* **17**: 411-416.
- Ali, R. (2005). 'Impact of Rural Road Improvement on High Yield Variety Technology Adoption: Evidence from Bangladesh.' Ph.D. Thesis, Department of Applied Economics and Management, Cornell University, Ithaca.
- Amangbo, L. E. F., Akinpelu, A. O. and Ekumankama, O.O (2010). 'Utilization of sweetpotato based confection technology: A panacea to food crisis among women farmers in Imo state.' *Journal of Agriculture and Social Research (JASR) vol. 10, no. 1, 2010.*
- Amsalu, A. and De Jan G. (2007). 'Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed.' *Ecological economics* **61**: 294 – 302.
- Anderson, D. R, Sweeny, J.D, William,T.A, Freeman, J and Shoesmith, E (2007) *Statistics for Bussiness and Economics*. Thomson Learning.
- Baidu-Forson, J., (1999) 'Factors influencing adoption of land-enhancing technology in the Sahel: lessons from a case study in Niger.' *Agricultural Economics* **20**: 231-239.
- Birthal S.P., Joshi P.K and Gulati A. (2005). Vertical co-ordination in high value food commodities: Implications for smallholders. *International Food Policy Research Institute*. Paper No. **85**: 25 – 34.
- Bradshaw B. and Knowler D. (2007) 'Farmers' adoption of conservation agriculture: A Review and Synthesis of recent research.' *Food Policy*, **32**: 25 – 48.
- CEFA (2010) Good agronomic practices for Sweet Potato in Western Kenya. Training manual for Trainers. <http://www.cefaonlus.it/biblioteca/biblioteca.asp> (accessed on 23rd December, 2011)

- Croppenstedt, A., Demeke, M. and Meschi, M.M., (2003). 'Technology adoption in the presence of constraints: the case of fertilizer demand in Ethiopia.' *Review of Development Economics* 7 (1), 58–70.
- Ememwa I., Nungo R.A., Obiero H.M. and Ndolo P.J. (2008). Challenges and Experiences in Transfer of post harvest Technologies to Farming Communities in western Kenya: A case of cassava and Sweet potato processing. Paper presented in 11th Biennial scientific conference and 3rd agricultural forum, 10th – 13th November, 2008.
- Fawzia A., Karuri E.G and Hagenimana V. (2000). 'Sweet Potato Ketchup: Feasibility, Acceptability and Production costs in Kenya.' *Journal of Food technology in Africa*. 5:14 - 18.
- Fuglie K, O (2007). 'Priorities for sweet potato research in developing countries: Results of a survey.' *Hortscience* 42(5), 1200-1206
- G.o.K (2002) *District Development plan 2002: 2007 Rachuonyo District*. Government Printers, Nairobi, Kenya.
- G.o.K, (2008). *First Medium Term Plan (2008-2012), Kenya Vision2030, A Globally Competitive and Prosperous Kenya*. 63 – 70
- Greene, W. H. (2002). *Econometric analysis*, 5th edition, Prentice Hall, Upper Saddle River, New Jersey: Prentice-Hall.663 - 728
- Hagenimana. V., Carey, E., Oyunga, M., Gichuki, T and Imungi, K. (1999). 'Carotenoid contents in fresh, dried and processed sweet potato products.' *Journal of Ecology of food and Nutrition*. 37: 455 – 473.
- Hagenimana V. (1999). Micro- scale enterprise approach to sweet potato and potato improvement systems. Post harvest programme. International Potato Center.
- www.dfid.gov.uk/r4d/PDF/Outputs/.../R7036_File17_Paper_Benin_Vital.pdf (Accessed on 25th November, 2010)

- Hagenimana V and Oyunga M. (1999). The effect of women farmers' adoption of orange fleshed sweet potatoes: raising vitamin A intake in Kenya. International Center for (ICRW/OMNI Research Program) <http://www.harvestplus.org/sweetpotato.html>, (accessed on 23rd December 2011)
- Heckman, J.J, (1979). "Sample Selection Bias as a Specification Error". *Econometrica* 47 (1): 153-161.
- Herath P and Hiroyuki T. (2005). 'Factors determining intercropping by rubber smallholders in Sri Lanka: A logit analysis.' *Journal of International Association of Agricultural economics*. **29**: 159 – 168.
- Huntrods D. (2009) A national information resource for value-added agriculture, Agricultural Marketing Resource centre, Iowa State University.
http://www.agmrc.org/commodities_products/vegetables/sweet_potatoes.cfm (Accessed on 23rd February, 2010)
- IDCCS (2009) "Sweet Potato Mapping and Baseline Survey." Economic Empowerment Project. (Unpublished).
- Igbokwe E. M and Okoye T. K., (2000). 'The relationship between socio – economic variables and adoption rate of rice farmers in the Agwu plains, Enugu State.' *Journal of Agricultural Extension*, **4**: 9 – 14.
- Kaguongo W., Ortmann G.F., Wale E., Darroch M.A.G. and Lowi J. (2010). Factors influencing adoption and intensity of adoption of orange flesh sweet potato varieties: evidence from an extension intervention in Nyanza and Western province, Kenya. Paper presented at the joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September 19 – 23, 2010
- Kamau, S., (2004). Everything is Sweet about Potato. *Daily Nation*. 6th October 2004.
- Kelley M. R (1997). Firm size and capabilities, regional agglomeration and the adoption of new technologies. <http://www.dsppsd.pwgsc.gc.ca/Collection/Statcan/.../88F0017MIE2001012.pdf> (Accessed on 19th November, 2010).
- Lemaga, B. (2005) Improving the Livelihoods of small-scale sweet potato farmers in central Uganda through a crop post harvest-based innovation system. Crop post Harvest Programme.

http://www.researchintouse.com/nrk/RIUinfo/outputs/R8273_FTR.pdf (Accessed on 10th February, 2010)

Makokha, M., H. Odera, I.K.Martim, J.R. Okelabo and D.M.Iruria, (1999). 'Farmers' Perception and Adoption of Soil Management Technologies in Western Kenya.' *African Crop Science Journal*, Vol.7 (4)

Makhura M.N., Kirsten J. and Delgado C. (2001). Transaction costs and smallholder participation in the maize market in the northern province of South Africa. *Paper presented in the seventh eastern and southern Africa Regional maize conference 11 – 15 February, pp. 463 - 467.*

Mazuze F.M. (2005). 'Analysis of adoption and production of Orange Fleshed Sweetpotatoes: the case study of Gaza province in Mozambique.' MSc. Thesis submitted to Michigan State University, Department of Agricultural Economics.

Mignouna D. B, Manyong V. M., Mutabazi K. D. S. and SenkondoE. M (2011). 'Determinants of adopting imazapyr-resistant maize for *Striga* control in Western Kenya: A double-hurdle Approach.' *Journal of Development and Agricultural Economics* **3**: 572-580

Mildred Barungi and Beston B. Maonga (2011). 'Adoption of soil management technologies by smallholder farmers in central and southern Malawi.' *Journal of Sustainable Development in Africa*. **13**:1520-5509

Mishra A.K. (2010). Net effects of education on technology adoption by U.S. farmers. *Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 6 – 9, 2010.*

MOA & GTZ. (1998). Post Harvest Systems of Potato and Sweet Potato in Kenya. <http://www.MoA & GTZ.org/wairdocs/X5420E/x5420e00.html#> (Accessed on 6th March, 2010)

Mwabu, G., Mwangi W., and Nyangito H. (2006). Does adoption of improved maize varieties reduce poverty? Evidence from Kenya. *Conference Paper, Intenational Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006.*

- Negash R. (2007). 'Determinants of adoption of improved haricot bean production package in Alaba special Woreda, Southern Ethiopia.' Unpublished M.Sc. Thesis, Haramaya University, Haramaya.
- Ndegwa, J.M., Norrish, P., Mead, R., Kimani, C.W. and Wachira, A.M. (2000). A research process and methodology focusing on indigenous Kenyan chickens. *Proceedings of the International Network for Family poultry Development symposium during the XXI world's poultry congress, 20-24 August 2000, Montreal, Canada, pp3-12.*
- Nungo R. A. (2004). Nutritious Sweet Potato Recipes, Training Manual No.1 for Extension workers. Unpublished.
- Nungo R.A., Ndolo P. J., Kapinga, R and Agili S. (2007). Development and promotion of sweet potato products in Western Kenya. *Proceedings of the 13th ISTRC symposium, pp 790 – 794*
- Nxumalo M.H. (1998). The potential role of root crops in Swaziland. *In proceeding of the sixth triennial symposium of the international society for tropical root crops. Africa Branch Lilongwe Malawi 22-23 October, pp.57-61.*
- Nzomo J.N., Byaruhanga J.K., Maritim H.K. and Omboto P.I. (2007). 'Determinants of technology adoption in the production of horticultural export produce in Kenya.' *African Journal of business management. 1:129 – 135.*
- Odebode S.O., Egeonu N. and Akoroda M.O. (2008). 'Promotion of sweet potato for the food industry in Nigeria.' *Bulgaria Journal of Agricultural Sciences. 14:300 -308*
- Odendo M. and Ndolo P.J. (2002). Impact of improved sweet potato varieties in western Kenya: Farmers' Perspectives. http://www.fao.org/docs/eims/upload/agrotech/2009/R8299_FTR.pdf (Accessed on 3rd March, 2010)
- Olagunju F. I. (2007). 'Impact of credit use on resource productivity of sweet potatoes farmers in Osun-State, Nigeria.' *Journal of Social Science. 14:175-178*
- Olwande J., Sikei G. and Mathenge M. (2009) Agricultural technology adoption: A Panel analysis of smallholder farmers' fertilizer use in Kenya. *Contributed paper prepared for presentation at the*

African Economic Research Consortium Conference on Agriculture for Development, May 28th - 29th, Mombasa, Kenya

- Onemolease E. A. and Alakpa S. O., (2009). Determinants of Adoption Decisions of Rural Youths in the Niger Delta Region of Nigeria. Department of Agricultural Economics & Extension, Faculty of Agriculture, Ambrose Alli University, PMB 14, Ekpoma, Edo state, Nigeria.
- Owori C. and Hagenimana V. (1998). Development of Sweet Potato Snacks Products in Rural Areas; *Case study of Iira District in Uganda in proceeding of the seventh triennial symposium of the international society for tropical roots crops. Africa Branch. Lilongwe Malawi 11-17 October, 1998 pp. 655 - 661.*
- Owuor, G., Wangia, S.M., Onyuma, S., Mshenga, P., and Gamba, P., (2004). 'Self-Help Groups, A social Capital for Agricultural Productivity. The Case of Smallholder Maize Farmers in Ukwalu Division, Siaya District, Kenya.' *Egerton Journal of Humanities.*
- Pryanishnikov, I. and Z. Katarina. (2003). 'Multinomial logit models for Australian labor market.' *Australian Journal of Statistics.* **4**: 267–282.
- Ray R. C. and Tomlins K. I. (2010). Sweet potato purees and powders for functional food ingredients. *Paper of the FSR08 Journal Series of the Department of Food, Bioprocessing and Nutrition Sciences, NC State University* [http:// www. ncsu.edu/foodscience/USDAARS/Acrobatpubs/S114-150/S134.pdf](http://www.ncsu.edu/foodscience/USDAARS/Acrobatpubs/S114-150/S134.pdf) (Accessed on 12th January, 2010)
- Rono, C.S., J.M. Wanyama , L.O. Mose, C.M. Mutoko, C.M. Lusweti, E. Wanjekeche, and B. Wachiye. 2006. Assessing the Impact of Sweet Potato Production and Utilisation Technologies on Food Security in North Rift Region. *A paper presented in 10th. KARI Biennial Scientific conference and the second Agricultural forum held between 13th. – 17th. November 2006 in Nairobi, Kenya.*
- Sadangi A. (2004). Integrating Markets, Products and Partners: An Action Research to Explore and Develop a Management System for Linking Tribal communities to Markets Through Value Addition, Orissa University of Agriculture and Technology Centre for Community Development

http://www.researchintouse.com/nrk/RIUinfo/outputs/R8266_FTR.pdf (Accessed on 10th February, 2010)

Shiferaw B., Obare G. and Muricho G. (2006). Rural Institutions and Producer Organizations in Imperfect Markets: Experiences from Producer Marketing Groups in Semi – Arid Eastern Kenya. CAPRI Working Paper 60 jointly released as ICRISAT Socioeconomics and Policy Working Paper Series No. 23. Patancheru, Andhra Pradesh.

Singh S., Raina C.S, Bawa A.S. and Saxena D.C. (2003). Optimization of processing variables in the preparation of sweet potato chips using response surface methodology, Department of Food Technology, Saint Longowal Institute of Engineering and Technology, Longowal, India. <http://www.springerlink.com/content/a1kf854gaav8tcpv/fulltext.pdf> (Accessed on 5th March, 2010)

Singh S., Riar C. S. and Saxena D. C. (2008). ‘Effect of incorporating sweetpotato flour to wheat flour on the quality characteristics of cookies.’ *African Journal of Food Science*. **2**: 065-072

Smith, N.E. and Ocitti p’Obawoya C.N. (1994). Piece meal Harvesting of Sweet potato. Its effect on Yield loss due to Sweet potato Weevils. *3rd Conference. African Potato Association Sousse. Tunisia*

Teklewold. H. T., Dadi .L., Ayami.,and Dana. N., (2006). Determinants of Adoption of Poultry Technology: A Double –hurdle Approach. *Livestock Research for Rural Development* 18(3), 2006. <http://www.lrrd.org/lrrd18/3/tek118040.htm> (Accessed on 8th February, 2011)

Tomlins, K., Ndunguru, G., Kimenya, F., Ngendello, T., Rwiza E, Amour, R., Van Oirschot, Q. and Westby, A. (2008). ‘On-farm evaluation of methods for storing fresh sweet potato roots in East Africa,’ *Tropical Science Journal*. **47**: 197 - 210.

Tura M., Aredo D., Tsegaye W., Girma T., Mwangi W. and Mwabu G. (2010). ‘Adoption and continued use of improved maize seeds: Case study of central Ethiopia.’ *African Journal of Agricultural Research*. **5**: 2350 -2358.

USAID (1995). “*Policy Determination No. 19*” Bureau for Program and Policy Co-ordination, USAID, Washington DC.

Westby, A., Tomlins K., Ndunguru, G., Burnett D., Ngendello, T., Rwiza, E., and Van Oirschot, Q. (2003). Maximizing incomes from sweet potato production as a contribution to rural livelihoods. Natural Resource Institute. Crop Post Harvest Programme

http://www.researchintouse.com/nrk/RIUinfo/outputs/R7498_FTR.pdf (Accessed on 10th February, 2010)

Yanggen, D. and Nagujia S. (2005). The use of orange-fleshed sweet potato to combat vitamin A deficiency in Uganda: A study of varietal preferences, extension strategies and post-harvest utilization. Report prepared for the harvest plus bio-fortification initiative. <http://www.cipotato.org/publications/pdf/003247.pdf> (Accessed on 10th February, 2010)

APPENDICES

Code: _____

Appendix 1: Questionnaire

Introduction

The purpose of this study is purely academic and more so to contribute to the understanding of the constraints of value addition in sweet potato among smallholder farmers in the district. Respondents are requested to **VOLUNTARILY** participate in answering this questionnaire and are assured that any information shared will be strictly **CONFIDENTIAL**.

Section A: General Information

1. Date of interview _____
2. Name of enumerator _____
3. District _____
4. Division _____

Section B. Farmer Characteristics

1. Name of respondent: _____
2. Area of residence: (1) District: _____ (2) Division : _____
(3) Location : _____ (4) Village : _____
3. Gender: 1. Female 2. Male
4. Age of respondent: _____
5. Marital status (*please tick one*)
1. Single 2. Married 3. Widowed 4. Divorced
6. What is the highest level of education you have attained? (*Please Tick One only*)
 1. None
 2. Primary (1-8 years)

- 3. Secondary (9-12 years)
- 4. College/University (>12 years)
- 5. Others (specify)

7. What are your household's main sources of income? *(Please tick appropriately)*

- 1. Food crop farming
- 2. Cash crop farming
- 3. Livestock keeping
- 4. Remittance
- 5. Food aid
- 6. Others (specify)

8. Approximately, how much do you earn per year? (KShs)_____

9. Are you involved in any off-farm income generating activity?

- 1. Yes
- 2. No

10. If yes in No.9 above, state approximately how many hours are spent in the activity_____

11. Household members living permanently in the compound:

Household members	Number
Men	
Women	
Children	

12. Are you a member of any sweet potato production group/ organization?

- 1. Yes
- 2. No

13. If yes, give reason for joining the group *(Please tick one that is most appropriate)*

- 1. Collective production

- 2. Group marketing
- 3. Purchase of inputs
- 4. Farmer training
- 5. Group lending

Section C. Farm Characteristics

- 14. What is the size of your land? _____(acres)
- 15. What size of your land is under sweet potato cultivation? _____(acres)
- 16. In the table below, indicate quantity produced, consumed and quantity sold.

Total Quantity Produced (90 Kg bags)	Quantity Consumed (90 Kg bags)	Quantity Sold (90 Kg bags)

Section D: Sweet Potato Value Addition/Marketing

- 17. Are you involved in any sweet potato value addition activity?

- 1. Yes
- 2. No

- 18. If yes, indicate different types of value addition you are in involved in

Grading &Packaging	Slicing &Sun-drying	Grounding into flour	Preparing Additives	Baking	Others

- 19. Indicate the quantity used in different types of value addition

Grading &Packaging (90 Kg bags)	Slicing & Sun-drying (90 Kg bags)	Grounding into flour (90 Kg bags)	Preparing Additives (90 Kg bags)	Baking (90 Kg bags)	Others (90 Kg bags)

20. What factors enabled you to add value?

1. Availability of value addition equipment
2. Knowledge of value addition
3. Enough income/capital for value addition
4. Ready market for the products (high demand)
5. Others (specify)

21. What was your reason for adding value?

1. Improve shelf life
2. Get higher prices
3. Buyers' demands
4. Others (Specify) _____

22. How much did you sell a kg of products of value addition?

Value addition type	Grading &Packaging	Slicing &Sun-drying	Grounding into flour	Preparing Additives	Baking	Others
Cost/unit (KShs/Kg)						

23. What is the approximate distance from your homestead to the market? _____ (Km)

24. What type of buyers do you sell your sweet potato to?

1. Middlemen
2. Individual Consumers
3. Retailers

- 4. Wholesalers
- 5. Trader groups
- 6. Others (Specify) _____

25. Why did you choose the buyer?

- 1. Gives better prices
 - 2. Under contract
 - 3. Consistent & pays cash
 - 4. Only proximate trader
 - 5. Others (Specify)
-

Section E: Credit Access and Training

26. Have you ever acquired any credit in the last one year?

- 1. Yes
- 2. No

27. What was your reason for borrowing?

- 1. Buy value addition equipment
 - 2. Buy production inputs
 - 3. Medical bills
 - 4. School fees
 - 5. Others (Specify)
-

28. What was the source of the credit advanced?

- 1. Commercial banks
- 2. SACCO
- 3. Microfinance institutions
- 4. Informal lenders
- 5. Farmer groups

29. What was the approximate amount borrowed? (KShs.)_____

30. From the amount borrowed, approximately how much was used in value addition activities? (KShs.)_____

31. If **No** in no. **26**, give reason (*please tick one that is most applicable*)

- 1. No collateral
- 2. Defaulted on previous loan
- 3. High interest rate
- 4. Not aware of credit facilities
- 5. Others (Specify)_____

32. Have you ever attended any training or seminar on sweet potato?

- 1. Yes
- 2. No

33. If yes, which topics were discussed?

- 1. Production of sweet potato
- 2. Marketing of sweet potato
- 3. Sweet potato value addition techniques

4. Book-keeping & accounts

5. Others _____

34. Where do you get technical advice on sweet potato production and marketing?

1. IDCCS

2. Extension officers

3. Farm concern international

4. C-MAD

5. Other NGOs (Name)

6. Other sources (Specify) _____

35. How many times are you visited per month by extension officer? _____

END. THANK YOU!!