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Analysis of the Determinants of Sweet Potato Value Addition by Smallholder Farmers in Kenya

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Abstract
Sweet potato value addition is increasingly being popularized among producers due to its potential to reduce wastage, increase market access and fetch optimal prices. Despite these documented benefits, smallholder sweet potato producers in Kenya have not implemented value addition widely. This study analyzed the factors influencing value addition and extent of value addition by smallholder sweet potato farmers of Rachuonyo South sub-county in western Kenya. Using a sample of 200 smallholder farmers, Heckman's Probit model with sample selection was employed to firstly identify the factors affecting a farmer's decision to adopt value addition, and secondly evaluate the factors that affect the extent of a farmer's participation in sweet potato value addition. Study findings show that the probability of adoption was significantly influenced by household size, total quantity produced, credit access, land size and training. Further results show that the distance to the market, group membership, credit access and total quantity produced were found to greatly influence the extent of value addition by sweet potato farmers. In order to leverage smallholder farmers' adoption of sweet potato value addition, it is important that county and national government policies should focus on encouraging farmers' group formation, provision of cheap value addition loan packages, seminars, farmer field days and workshops to enable exchange of ideas among different farmers and further encourage farmers to produce more to benefit from economies of scale. In addition, proper marketing strategies such as linking farmers with supermarkets, adequate product development, proper packaging and labeling are challenges that require urgent attention.
Keywords: Postharvest technologies, food security, Heckman two-stage selection model, sweet potato value chain, community based rural enterprise

1. Introduction

Sweet potato (*Ipomoea batatas* Lam.) is a major staple food and a source of income in several regions of Kenya and elsewhere (Keller, 2012; Were *et al.,* 2013). In Kenya, it is an important food crop for those who depend on cereals especially maize as their staple diet with an average per capita consumption of 24 kg per year, with higher proportions being consumed in the western parts of Kenya (Were *et al.,* 2013). The agronomic traits of sweet potato to give satisfactory yields under adverse climatic and soil condition as well as under low or non-use of external inputs has also made sweet potato production gain popularity among many farmers in Kenya (Nungo *et al.,* 2007). In addition, the flexibility of the crop in mixed farming systems and the ability to take short periods to mature, thus offering household food security, has made it an important livelihood strategy for small-scale farmers.

Although grown by small-scale farmers for subsistence, importance of sweet potato production as an attractive income generator has been rising (Fuglie, 2007). This has been influenced by 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 (IDCCS, 2009; Were *et al.,* 2013). This is evidenced by the steady increase in the area planted. For example, in Kabondo and Kasipul divisions of Rachuonyo south district, farmers devoted approximately 75% of their land holdings to sweet potato production, where both white- and orange-fleshed sweet potatoes are grown by most households on smallholder farms (CEFA, 2010; DAO, 2008). This indicates the important role sweet potato production plays in reducing poverty and improving rural incomes in these areas. Unfortunately**,** rapid post-harvest spoilage due to perishability, poorly developed market chains coupled with inherent bulkiness of the crop leading to costly transport over long distances, contribute to lower net returns for smallholder sweet potato farmers. For sweet potato, postharvest losses of up to 20-30% have been reported (AGRA, 2013), with higher losses during periods of abundance. Consequently, initiatives that offer the opportunity to increase demand for the crop and create value added products, thereby expanding the incomes of smallholder producers, are critical for sustainability of production in these areas.

1.1 Sweet potato value addition

Sweet potato value addition entails deliberate activity to change the form of the raw sweet potato into a more refined or usable form, thus increasing its value. For household and market purposes, sweet potato can be processed and utilized in various ways into beverages, soups, baby foods, ice cream, baked products, restructured fries, breakfast cereals, and various snack and dessert items (Ray and Tomlins, 2010; Nungo, 2004;

Fawzia *et al.,* 2000; Nxumalo, 1998). Initially, utilization of sweet potato in western Kenya was limited to boiling, roasting and chewing raw. However, this has been changing to value addition by processing the tubers into different products (Nungo *et al.*, 2007; Fawzia *et al.,* 2000).

Contemporary studies and research point to the need of value addition of agricultural produce as it is perceived that farmers could maximize on their produce and also potentially increase their revenue in the process. Value addition in sweet potato has the potential to enhance the production of the crop and further play an important role in the food/nutritional security and income generation among the rural households and even urban markets (Nungo *et al.,* 2007; Westby *et al*., 2003). In addition, processing of sweet potato into non-perishable products also addresses the farmer's storage problems while ensuring food availability in time of scarcity (Westby *et al.,* 2003). Therefore, this is a key strategy to commercialize farming for small holder farmers in Africa. According to a study by Lemaga (2005), the introduction of sweet potato based enterprises to poor and marginalized smallholder farmers increases their income as a result of sweet potato products sales and their knowledge on post-harvest technologies leading to improved food security. Indeed, research carried out by the International Potato Centre (CIP) on sweet potato productivity in developing countries found that value addition is an important post-harvest need (Fuglie, 2007).

In Rachuonyo South sub-county, commercial processing of sweet potato into other more (non-traditional) commercial products have been promoted through farmer groups (FG), farmer field schools (FFS), non-governmental organizations (NGO) and community-based organizations (CBO) (IDCCS, 2009; Nungo *et al.,* 2007). The promotion of on-farm processing of sweet potato in the district has been going on since 1995. In 2002, nearly 60% of the farmers in western Kenya were reported to be aware of utilization and processing technologies that aim at adding value and expanding sweet potato market potential (Odendo and Ndolo, 2002). Despite these documented initiatives and potential benefits of value addition, the majority of smallholder sweet potato farmers in Rachuonyo South sub-county have not embraced value addition widely. The factors that keep the sweet potato farmers from engaging in value addition are not clear and hence there is a need to investigate which factors determine their participation in the different value addition activities and the extent of value addition being undertaken. The result will be of interest to several development stakeholders, including relevant Government agencies (research, extension, policy and planning) and Non-Governmental Organizations (NGOs) to allow more informed decisions on how to promote value addition adoption and how to design appropriate policies to develop the sweet potato sub sector by the government.

1.2 Theoretical framework

This study assumes that there is a 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 and thus impacting positively on their livelihoods. The decision to engage in value addition is predicted by its perceived utility which is expected to be higher than without value addition. A profit maximization framework was used to examine the decision to add value or not. It is assumed that smallholder sweet potato producers will only add value if the expected net benefit from this option is significantly greater than it 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:

$$U_i = \beta_n \mathrm{X}_n + \varepsilon_i \text{ and } U_j = \beta_n \mathrm{X}_n + \varepsilon_j \tag{1}$$

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_n are parameters to be estimated, ε_i and ε_j are error terms assumed to be independently distributed (Greene, 2002). 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:

$$U_{ni}(\beta_i \mathrm{X}_n + \varepsilon_i) > (U_{nj}(\beta_j \mathrm{X}_n + \varepsilon_j)) \qquad i \neq j \tag{2}$$

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

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

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 which underlies the random disturbance term, several qualitative choice models can be estimated (Greene, 2002).

2. Materials and Methods

2.1 Description of the study area

The study was conducted in Rachuonyo South sub-county, which is located in Homabay County in western Kenya (Fig. 1). The region was selected because it is the leading sweet potato production area in Kenya. Rachuonyo South sub-county falls between longitude $34^0$25'S 35^oE and latitude 0^o15'S 45'S, covering an area of 509.5 km^2 with 196,210 inhabitants and 44660 small farm holdings as per the 2009 population census of Kenya (GoK, 2009). The altitude ranges from 1300 – 1770 m above sea level along the Lake Victoria shores to the upper areas bordering Kisii and Nyamira Districts. The district has an inland equatorial climate which is modified by the effect of altitude and proximity to the Lake Victoria with temperatures ranging from 17°C to 25°C. Rainfall is distributed bi-modal around the year and ranges from 800-1400 mm per annum. The crops grown include maize, sorghum, cotton, groundnuts, sweet potatoes, cassava, sunflower and beans.

2.2 Study design and data

The study uses both primary and secondary sources of data. Primary data was collected using questionnaires which were administered to the sampled households. During sampling process, a two-stage sampling procedure was used to select sample farmers that were included in the study. In the first stage, out of the total 18 locations of the Rachuonyo South sub-county four locations were selected purposively based on their sweet potato production. In the second stage, from the selected locations, systematic random sampling technique was adopted to randomly select respondents based on probability proportional to size of households of each location. As a result, two hundred farmers were chosen for the study. Primary data were collected from the selected farmers through a well-structured questionnaire which was randomly administered to farmers. 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.

Descriptive statistics involving mean, percentage and standard deviations were used to assess the household characteristics and institutional factors affecting farmers' response to adoption of value addition technologies. Both Pearson Chi square analysis and t-test were used to compare the qualitative determinants affecting the decision of both non-value adders and value adders. These analyses were performed using SPSS version 17.5 (IBM, NY, USA).

2.3 Empirical approach and model specification

In this study both descriptive statistics and econometric models were utilized to assess the relationship between explanatory and dependent variables. For the econometrics model, the Heckman two stage selection model was used to assess the factors influencing sweet potato value addition. It included various variables such as household characteristics, institutional characteristics and marketing characteristics.

It is 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 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, in which estimations 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 that the error term is normally distributed 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:

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

where Y_i is an indicator variable equal to unity of households that add value, φ is the standard normal distribution function, βs are the parameters to be estimated and Xs 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:

$$Y_i = \beta_i X_i + V_i \quad (5)$$

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:

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

Empirically, the model can be represented as follows:

$$Y = \beta_i X_i + \varepsilon_i \quad (7)$$

where Y is the probability of a household adding value given farm, farmer and market and institutional characteristics X_i and the error termε_i . 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 IMR 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.

$$E(Z_i \, Y = 1) = f(x_i\beta) + y\tilde{\lambda} + \mu_i \quad (8)$$

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_i 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:

$$Z_i^* = \beta_i X_i + y\tilde{\lambda} + \mu_i \quad (9)$$

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:

$$Z_i = \beta_i X_i + y\tilde{\lambda} + \mu_i \quad (10)$$

where Z_i is the extent of value addition given the farm and farmer characteristics X_i, the Inverse Mills Ratio $\tilde{\lambda}$ estimated in step one of the Heckman model and the error term μ_i. Equation (7) and (10) were then jointly estimated using the Heckman two stage procedure in STATA 9 (StataCorp LP, Texas, USA).

The explanatory variables used in the two stage Heckman selection included age of respondent, gender household head, access to extension services, household size, accessibility to credit, training, education level, quantity of potato harvested, off-farm employment, distance to the nearest local market and farmer group membership (Table 1). The a *priori* expectation of the survey was that age, gender of the household head, distance to the market and household size would influence value addition either positively or negatively, while total quantity produced, education level, credit access, group membership, training and land size were hypothesized to positively influence uptake of value addition technologies.

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

Variables	*Description*	*Unit of measurement*
Dependent Variable		
Value addition	Whether respondent adds value or not	1= adding value, 0 = not adding value
Explanatory variables		
Age	Age of the respondent	Years
Household head	Head of the family	Dummy(1=yes,0=No)
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)

3. Results

Sampled households were heterogeneous in various attributes. The average mean age of the respondents was 42.72 years with an average household size of 7 people. Table 2 shows the summary statistics of the socio-economic characteristics of smallholder sweet potato farmers in the sub-county.

Table 2: Socio-economic and institutional support characteristics of the study population

Characteristic	*Frequency*	*Percent*	*Mean*
Gender			
Male	53	26.5	
Female	147	73.5	
Marital Status			
Single	1	0.5	
Married	143	71.5	
Widowed	56	28	
Education Level			
None	33	16.5	
Primary	108	54	
Secondary	45	22.5	
College	14	7	
Involvement in off-farm activity			
Yes	135	67.5	
No	65	32.5	
Average quantity produced (bags)			17.23
Average land size (acres)			3.12
Average household size (numbers)			7.95
Average age (years)			42.72
Institutional Support Characteristics			
Distance to the market (km)			0.72
Group membership			
Yes	121	60.5	
No	79	39.5	
Credit access			
Yes	70	35	
No	130	65	
Access to training			
Yes	103	51.5	
No	97	48.5	
Technical advice source			
NGOs	79	39.5	
Government	35	17.5	
Others	86	43	

In the study area, the land size per household ranges from 0.13 to 13 acres with the average land holding of about 3.12 acres. In the study households, involvement in off-farm activity accounted for 67.5% against 32.5% who never engaged in the activity. The majority of the respondents were members of farmer

groups (60.5%) which enabled easier access to training and technical advice from various sources. However, credit access was low among the study population.

3.1 Description of sweet potato farmers' characteristics by adoption status of value addition

Table 1 gives the report of descriptive statistics disaggregated by farmers' adoption status and socio-economic, institutional and market characteristics for 200 surveyed sweet potato farmers. In this study, adopters were defined as farming households that planted sweet potato and were engaged in at least one of the value addition activities.

Table 3**:** Descriptive statistics of adopters and non-adopters of sweet potato value addition in the study area

Characteristic	*Value adders* (N = 126)	*Non-value adders* (N = 74)	*T-test / ^{2} value*
Age (years)	43.21	41.46	1.166†
Household size (numbers)	7.69	8.61	-2.092†**
Land size (acres)	3.01	3.40	-1.629†
Distance from home to market (Km)	0.82	0.47	2.983†*
Total quantity produced (90Kgs/bag)	20.80	8.04	12.455†*
Gender			
Female (%)	73.5	26.5	
Male (%)	43.4	56.6	5.180**
Marital status Married (%)	69.2	30.8	0.487
Education status Above Primary (%)	61.1	38.9	20.977**
Involvement in off-farm activity (%)	29.4	70.6	0.302
Group Membership (%)	84	16	31.046*
Credit Access (%)	76.9	23.1	10.901*
Training (%)	95.1	4.9	67.871*

*** significant at 0.1, ** significant at 0.05 and * significant at 0.01, † T-test values

The household survey results show that 63% (126 out of 200) of the sampled sweet potato farmers participated in different forms of value addition. Gender also played a significant role in decision making, with women more likely to participate in value addition than men. Of the sample value addition adopting households, 73.5% of sweet potato farming was done by females compared with 26.5% in non-adopting households. T-test results also showed that distance to market and the production level had significant influence on adoption.

Results for the average household sizes showed that the mean household size for value addition adopters was 7.69 compared with 8.61 for the non-adopters. Although these values are higher than the national average family size, the differences were significant at $p < 0.1$. The value adopters (61.1%) had a higher level of education, the majority had group membership (84%), credit access (77%) and were exposed to higher number of trainings than non-adopters in the study population. The differences in level of education, membership to farmer groups, access to credit and number of trainings between the two groups were statistically significant at 0.01 significance level.

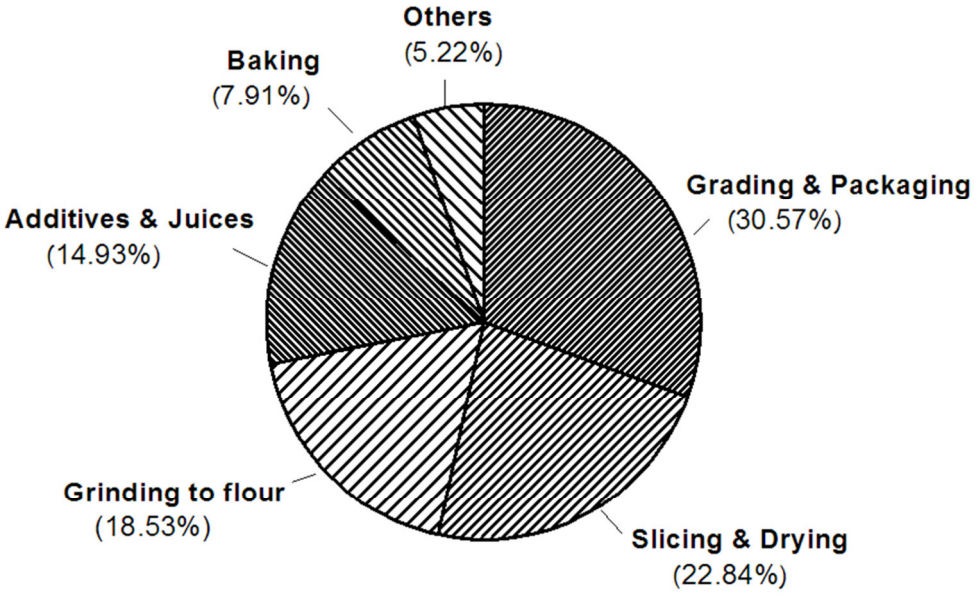

Figure 1: Sweet potato value addition techniques practiced in the study area

Figure 1 shows the various sweet potato value addition techniques practiced in the study area. The findings revealed that the majority of sweet potato farmers were practicing grading and packaging (30.57%), and slicing and sun-drying (22.84%). Other forms of value addition practiced included flour processing (18.53%), additives and juice (14.93%), baking (7.91%) and other techniques (5.22%). Grading, packaging, slicing, sun drying, and grinding into were the most popular due to low input and technical support requirements. Baking, preparation of additives and juices and jam are considered more advanced techniques of value addition which require more inputs thereby limiting their wider adoption by the farmers.

3.2 Factors affecting the adoption of sweet potato value addition

From the descriptive statistics, it is clear that there are important differences in the various characteristics between the adopters and non-adopters of sweet potato value addition. The causal analysis of the determinants of value addition was performed to delineate the contribution of the different explanatory variables. This study adopted the Heckman two-stage model to assess the socio-economic/demographic characteristics that influence the farmers' adoption and extent of adoption of sweet potato value addition technology.

Table 4 presents the estimated parameters and the statistically significant variables explaining the decision to adopt value addition technologies. Diagnostic statistics showed that the model had a good fit as the likelihood function of the Heckman probit model was significant (Wald χ^2=392.98, with p <0·0001), showing its strong explanatory power. The results showed that production level, access to credit, household size, land size and training were statistically significant indicating their importance in determining farmers' decision to participate in value addition practices.

Table 4: Factors influencing sweet potato value addition using Heckman Two-stage model

Variable	*Coefficient*	*Std Error*	*Z*	*P-value*
Age (Years)	0.014	0.002	0.92	0.359
Gender (Male/Female)	0.174	0.030	0.57	0.565
Education level(Years)	-0.034	0.017	-0.21	0.832
Total quantity produced (90 kg/bag)	0.191	0.006	3.30	0.001
Distance(Km)	-0.085	0.025	-0.35	0.724
Credit access (Amount)	-1.181	0.065	-2.66	0.008
Household size (Number)	-0.102	0.006	-1.68	0.093
Group membership(Yes/No)	-0.161	0.038	-0.44	0.660
Training (Number of times)	0.920	0.057	1.82	0.069
Land size (acres)	-0.420	0.017	-2.53	0.011
N				
Censored observations				
Wald χ^2				
Probability of χ^2				
log likelihood				
Y fitted values (predict)				

*** significant at 0.1, ** significant at 0.05 and * significant at 0.01

In the second stage, the extent of value addition adoption was examined. To correct the sample selection bias, Inverse Mills Ratio was used. Table 5 shows that group membership (P=0.000), credit access (P=0.059) total quantity produced (P=0,069) and distance to the market place (P=0.096) significantly influenced the extent of value addition by the farmers.

Table 5: Determinants of the extent of sweet potato 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
Mills				
Lambda	2.832	2.30	0.022	
Rho	0.813			
Sigma	3.481			

*** significant at 0.1, ** significant at 0.05 and * significant at 0.01

4. Discussion

Most literature on agriculture technology adoption consider that the decision to adopt technologies including value addition is affected by the characteristics of the farm household, market and institutional characteristics (Ng'ombe *et al*., 2014; Kaguongo et al., 2010; Tura *et al.,* 2010; Ememwa *et al*., 2008; Amsalu and de Jan, 2007; Croppenstedt *et al*. 2003; Makhura *et al.,* 2001). This article was set out to identify the determinants of adoption of sweet potato value addition through empirical evidence and further evaluate the factors that affect the intensity of value addition by smallholder farmers in Rachuonyo South sub-county of Kenya.

The econometric analysis showed that institutional characteristics such as credit access, number of trainings (extension services), membership to associations and production level (total quantity produced) influenced value addition positively, that conformed to the a *priori* expectations. This was in agreement with study by Tura *et al*. (2010) that showed that training, competitiveness of credit and labor markets, access to extension as some of the important determinants of adoption and continued use of new technologies. In their study on the transfer of postharvest technologies for cassava and sweet potato in western Kenya, Ememwa *et al.* (2008) also reported these aforementioned factors as the major hurdles of production. In terms of production, total quantity produced influenced value addition positively indicating that the more a farmer produces the more they will have 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. Kelley (1997) found that the earliest adopters of new technology were large farms due to the advantages of large sizes 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).

Access and uptake of credit by the sweet potato farming households was very low with only 35% respondents having access to credit contributing to low adoption of value addition observed. This was expected as poor farming households rarely have sufficient resources to buy value addition equipment and other associated components, magnifying the importance of credit. Availability of credit also helps farmers to finance the acquisition of value addition equipment that could enhance adoption and continued use of the value addition technology. 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.

Training through extension services has been widely reported to positively influence adoption and continued use of agricultural technologies (Knowler and Bradshaw, 2007; Baidu-Forson, 1999). In the study, it was observed that trainings played an important role on farmer's decision to adopt value addition. 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. Baidu-Forson (1999) opined that 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.

Household size had a negative ($p<0.1$) influence on value addition, where a unit increase in the size of household reduced the probability of a household engaging in value addition by 1%. Similarly, land size had a negative influence on value addition. In the study area, the average household size and land size were 7.95

persons and 3.12 acres, respectively. It was expected that large family would have positive influence on the adoption of value addition by farmers. The works of Amsalu and Jan de (2007) and Croppenstedt *et al*. (2003) stated that household size has significant and positive effect on adoption and continued use of a new technology in Ethiopia, whereby, a large household accords the farmer fewer labor shortages at peak times and hence more likely to adopt agricultural technology and use it intensively. An increased area of land under cultivation generally stimulates participation in the market as it allows for an increased production extending beyond the consumption requirements beside decreasing fixed transaction cost. The contradicting observation made in this study implied that in larger households the need to meet the consumption requirements is high and therefore tends to discourage value addition and selling of farm produce.

Results also showed that increase in land size reduced respondent's participation in value addition. In the study area, farmers with large tracks of land devoted large chunks to other competing enterprises such as maize which is considered a staple food in the area. In addition, households that had off-farm income were found to be less likely to adopt value addition. This might be because off-farm activities would divert the time from being allocated to agricultural investments and result into the farm household to less likely adopt value addition technologies. This could be attributed to the perception of sweet potato as a crop of low commercial value in the area. This could also explain the low participation of male in sweet potato farming observed. It is anticipated that a greater male participation would have reinforced the efforts of women in pursuing value addition activities.

Several factors like farm household, market access and institutional characteristics were also found to significantly affect the extent of adoption of value addition by smallholder farm households in Kenya. Total quantity produced and market accessibility (distance to market) had a positive influence on the extent of value addition. While increased production ensures availability of surplus for value addition, farmers who are far away from the market outlets are compelled to add value so as increase shelf life and also get better prices than their counterparts who are nearer to market outlets. This could also be attributed to the fact that sweet potato being bulky and highly perishable products, value addition help reduces transport costs and increase shelf life to access markets further away from the site of production. 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.

Group membership positively contributed to the extent of value addition, whereby most farmers who are members in different farmer groups participated more in value addition. This could be explained by the fact that farmers in groups get to exchange ideas and influence each other leading to adoption of value addition techniques. Furthermore, 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 advocated for sweet potato value addition in the study site worked through farmers' 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. 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.

Similarly, credit access influenced extent of value addition positively. Access to credit enables farmers to acquire value addition equipment. The result of the study is in agreement with Teklewold *et al.* (2006) who 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 groups of farmers.

5. Conclusion and Policy Implications

Sweet potato farming is an important agricultural practice in Kenya, particularly in the western region. However, the economic benefits derived from it are not yet optimized due in part to inadequate knowledge of appropriate value-adding technologies coupled with poor infrastructure facilities and the absence of coherent policies to support such an undertaking, especially in rural areas. Sweet potato value addition has the ability to create employment, absorb excess labour from agriculture, enable rural residents to capture more margins from agriculture, hence raising rural income levels. Based on the findings from the analysis of the factors affecting

adoption and the extent of value addition by smallscale farmers in Rachuonyo South Sub-county, it is recommended that for the smallholder sweet potato farmers to benefit from value addition, several policy and institutional issues need to be addressed.

There is need to review and strengthen policies that will improve access to and use of credit and educate the farmers on the importance of value addition as a tool for poverty reduction, employment creation and economic development. Policy makers should come up with loan packages 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. Furthermore, policy makers should encourage farmer group formation and make farmers feel part of it since majority felt that they pool their resources and only a few individuals benefit from it. Group membership has an element of collective action which gives the farmers bargaining power when selling their produce. 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. 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.

References

AGRA (2013) Establishing the status of post-harvest losses and storage for major staple crops in eleven African Countries. Available at: https://agra.org/resource-items/establishing-the-status-of-post-harvest-lossess-and-storage-for-major-staple-crops-in-eleven-african-countries-phase-i/ Last accessed: 18.10.2015.

Amsalu, A. & 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.

CEFA (2010) Good agronomic practices for Sweet Potato in Western Kenya. Training manual for Trainers. Available at: http://www.cefaonlus.it/biblioteca/biblioteca.asp. Last accessed: 23.12.2011.

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.

Croppenstedt, A., Demeke, M. & Meschi, M. M., (2003) Technology adoption in the presence of constraints: the case of fertilizer demand in Ethiopia. *Review of Development Economics* 7, 58-70.

Ememwa I., et al. (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 &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* 42,1200-1206.

Government of Kenya (2010). *Kenya Integrated Household Budget Survey*. Government Printers, Nairobi, Kenya.

Greene, W. H. (2002). *Econometric analysis*, 5th edition. Prentice Hall, Upper Saddle River, New Jersey, United States, pp.663–728.

Inter-Diocesan Christian Community Services (IDCCS) (2009) ‘‘Sweet Potato Mapping and Baseline Survey.’’ Economic Empowerment Project. (Unpublished).

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.*

Keller, H. (2012). Orange-fleshed Sweet Potato Situational Analysis and Needs Assessment. Tanzania report. www.hki.org. (last accessed: on 6.10.2014).

Kelley, M. R. (1997). Firm size and capabilities, regional agglomeration and the adoption of new technology. http://repository.cmu.edu/heinzworks/294/ (*last accessed: 19.11.2010).*

Knowler D. and Bradshaw B. (2007) ‘Farmers’ adoption of conservation agriculture: A Review and Synthesis of recent research.’ *Food Policy*, 32, 25 – 48.

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 (last accessed: 10.2.2010).

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.*

Mignouna D. B, et al. (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

Ndegwa, J.M., et al. (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.*

Ng'ombe J., et al. (2014). Econometric Analysis of the Factors that Affect Adoption of Conservation Farming Practices by Smallholder Farmers in Zambia. *Journal of Sustainable Development*. Vol. 7 (4).

Nungo R. A. (2004). Nutritious Sweet Potato Recipes, Training Manual No.1 for Extension workers. Unpublished.

Nungo R.A., et al. (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.*

Odendo M. and Ndolo P.J. (2002). Impact of improved sweet potato varieties in western Kenya: Farmers' Perspectives. http://www.fao.org (last accessed: 23.9.2011)

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.* https://repository.lib.ncsu.edu/foodscience (Last accessed: 3.2.2013)

Rono, C.S., et al. (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*.

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.

Teklewold. H. T., Dada L., Ayami.,and Dana. N., (2006). Determinants of Adoption of Poultry Technology: A Double –hurdle Approach. *Livestock Research for Rural Development 18(3),* (last accessed: 8.2.2011).

Tura M., et al. (2010). 'Adoption and continued use of improved maize seeds: Case study of central Ethiopia.' *African Journal of Agricultural Research*. **5**: 2350 -2358.

Were H.K., et al. (2013). Sweet Potato Production and use in Sugarcane growing areas of western Kenya. *International Journal of Disaster Management & Risk Reduction.* 5(1).

Westby, A., et al. (2003). Maximizing incomes from sweet potato production as a contribution to rural livelihoods. Natural Resource Institute. Crop Post Harvest Programme. http://www.researchintouse.com (last accessed: 20.1.2010).