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

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

1. Introduction

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

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

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

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

climatic conditions and its cultural acceptance. In this county, the crop is mainly consumed in the form of ugali or porridge because of its softness and sweet taste. The extent of cassava value addition is not known. Nonetheless there exist a number of opportunities that are believed to promote cassava commercialization. These include increased demand for underutilized crops especially in the urban markets, favourable climate for cassava production, presence of established cassava processing factories, high yielding cassava varieties and well-trained extension officers (MOA, 2013).

2. Literature Review

The concept of agricultural commercialization has been discussed extensively in literature. Govereh et al. (1999) and Lawal *et al*. (2014) defined commercialization as increasing the amount of output that is marketed by farm households. Pingali (1997) too argued that commercialization takes place when farm households produce according to market signals. His views were echoed by Gebremedhin and Geleta (2010) who opined that commercialization involves both market orientation and market participation and further distinguished the two terminologies which have been mostly considered to be synonymous. Zhou *et al*. (2013) on the other hand conducted a comprehensive review of agricultural commercialization and they concluded that the concept entails transformation from subsistence oriented production towards market oriented activities with an aim of making profit. These definitions address commercialization from only one perspective of orientation towards market participation. This entails accessing markets with the main goal of selling cassava products. An important aspect of commercialization which is value addition has been largely overlooked. This concept refers to processing of raw cassava into other usable products which are believed to be of high value. In contrast to the other studies, this paper has contextualized the concept of commercialization as not only involving market participation but also integrates value addition aspect.

Several factors have been identified to influence commercialization. (see, Jaleta *et al*., 2009; Falkowski, 2012; Pigatto, 2012; Lerman, 2004; Martey *et al*., 2012; Agwu and Ibeabuchi 2011). These include household characteristics, market and institutional, as well as technical factors. Based on the above findings, this study sought to determine whether these and other factors had significant influence on commercialization. There are different ways of measuring the wellbeing of households with the most approaches being household consumption, expenditure and income. Gebreselassie and Sharp (2008) measured the outcome of commercialization which is household welfare in terms of consumption of grains, livestock and other household expenditures. Similarly, Hailua *et al*. (2015) used the average annual income and livestock holding to measure livelihoods of farmers while Muricho (2015) used annual household expenditure to measure food security. In contrast to other studies, economic welfare was measured using three different income measurements namely; per capita income, income per acreage and annual income. The different methods captured the multidimensional nature of household welfare and highlighted ways by which the measurements differ.

Empirical literatures on agricultural commercialization especially in other countries have pointed out the contribution of agricultural crops including cassava towards household welfare. A study by Adeleke, (2013) conducted in Nigeria established that cassava project positively contributes towards household income. The study further noted that adoption of high quality cassava products is still low in many households yet it can contribute immensely towards household income. Obisesan (2012) examined cassava marketing and rural poverty among farm households in Nigeria. The study employed a Tobit regression model and the results established that marketing of cassava products is an income generating activity which may improve household welfare. The study further recommended for an establishment of efficient marketing systems and developing of sound linkages among the actors in a marketing chain. Other studies have also revealed that cassava production is a profitable venture hence farmers should be given incentives that can stimulate production as well as motivate value addition (Ogisi *et al*., 2013; Okoruwa *et al*., 2015; Yakasai, 2010).

A few empirical studies have been conducted in Kenya. Mutuku *et al*. (2013) examined the level of adoption of cassava commercialization in Nakuru County. The study revealed that only 6.1 percent of farm households in the county engaged in marketing of raw cassava. Other forms of value added cassava had not been explored. Importantly, the study pointed out that market oriented approach should be embraced by farmers. Waswa *et al*. (2009) studied crop diversification in Nzoia and Mumias sugar belts in Kenya and their role in enhancing household food and income security. The study revealed that cassava, sweet potatoes and indigenous vegetables are highly valued crops and have great potentials for income generation. They recommended that farmers should diversify crop production by embracing underutilized crops such as cassava which were prominently grown before. The studies found that there exists a strong association between cassava commercialization and household economic welfare. Cassava commercialization has huge potential for improving household income and hence poverty reduction. It is evident that a number of these studies which are related to cassava commercialization have been conducted mainly in West Africa and few in Kenya and none in Siaya County.

2.1 Theories Supporting Commercialization

A number of theories underpin agricultural commercialization. The main one is the utility maximization theory which explains the behaviour of farm households in relation to the optimization of choices. A farm household may decide to maximize income or utility, therefore modeling such decision would be based on a non-separable household model as suggested by (Mottaleb *et al*., 2014). Under this scenario, farm households are unexceptional to market decisions hence utility maximization plays a critical role in decision making. Braun and Kennedy (1994) pointed out that one of the gains realized from engaging in agricultural commercialization is enhanced marketed surplus known to boost household income. According to Barret (2007), smallholder farmers can participate in the market as either buyers or sellers and both the choices are driven by maximization theory whereby farm households try to maximize utility subject to income constraint. This can be created through various commercialization activities such as production, value addition and market participation amongst others. Several studies have applied the mentioned framework to explain the behaviour of commercial oriented farm households in a competitive market where imperfections exist (Abu, *et al*., 2014; Martey *et al*., 2012; Umar, 2013). These imperfections could be caused by transaction costs; thin markets as well as risks involved.

In conclusion, while it is generally recognized that agricultural commercialization has significant effect on household economic welfare, there is no evidence of a study that has been conducted on cassava commercialization in terms of market participation and value addition in Siaya County. Different studies have used only one of the several measures of household income in their analysis. This study has incorporated three measures of household income and hence has undertaken a more comprehensive study on commercialization.

3. Materials and Methods

3.1 Study Location

This study was conducted in Siaya County which is located in the South-West part of Kenya. The total population of the county is approximately 842,304 persons and with a total land area of 2530.4 square km. Among these, 754,789 persons are from rural area while 87,515 are urban dwellers (Siaya County Government, 2013). The region receives an annual rainfall of between 1170-1450 mm. The expected long and short rainy seasons occur annually in the period March-June and August-December respectively. Climatic variations are evident in the area and it plays a critical role in driving the socio-economic activities. It is also noted that smallholder farming is the main economic activity in the area and it is highly dependent on rainfall suggesting that cases of poverty and food insecurity are the main cross cutting issues in the region. According to KNBS (2007), poverty levels in Siaya region stood at 47.5 percent which is above the national rate of 45.2 percent. The county is dominated by mixed farming with the main food crops grown in the area being maize, sorghum, beans, cassava, sweet potatoes and groundnuts. Most of these crops are intercropped due to land limitation and non-availability of other farm resources. Siaya County was purposely chosen because cassava farming is the main agricultural occupation of the people in the region and among the leading producers of the crop. In addition, cassava crop is well accepted in the region and being a drought resilient crop, the climatic conditions support the cultivation of the tuber crop.

3.2 Data Collection

The study used a multi stage sampling method to identify household respondents from the region. In the first stage, Alego-Usonga and Ugenya constituencies were purposely selected. This was based on the potential of cassava productivity in the areas. The second stage involved random sampling of two locations from each constituency while in the third stage; six villages were randomly sampled from the locations to ensure fair representation of the commercialized and non-commercialized farm households. Out of the 184 respondents drawn through systematic random sampling method, 181 households responded through personal interview. Enumerators who speak both English and the local language were trained and engaged in the data collection process. The study focused mainly on farm households that had engaged in cassava production in 2015. The survey information covered household characteristics, institutional and market as well as technical factors. A part from household respondents, additional information was gathered through a census survey conducted on extension officers. In total, ten extension officers were interviewed. This exercise was useful as it aided further understanding, validated and strengthened the data collected from farm households.

4. Empirical Model

In this study, commercialization decision was modeled as self-selection behaviour since farm households are confronted with decisions to either belong to commercialization regime or not. The implication is that the decision to participate in either of the regimes is not independent of each other hence handling them separately would lead to selectivity bias (Maddala, 1983). This further means that decision to undertake cassava commercialization is an endogenous choice hence there exists unobservable variables that might affect the probability of engaging in commercialization and subsequently household income. To correct the problem of

endogeneity which arises from the selection bias, a two stage endogenous switching regression model was found appropriate as it accounts for the unobserved characteristics (Maddala, 1983; Elwert and Winship, 2014). This model was also found relevant because it supports the theoretical framework which states that the decision to commercialize is influenced by farm households' participation in the market as a result of marketed surplus. In the two stage model, a probit model was applied in the first stage to determine the probability of commercialization and identify factors that influence commercialization. The endogenous switching regression model was fitted by maximum likelihood estimation to adjust the estimation of the selection and outcome equations as suggested by (Lokshin and Sajaia, 2004). The selection equation for the decision to commercialize can be specified as follows:

$A^*_i = Z_i\alpha + \mu_i$ ……………………………………………….. (1)

A binary variable designating the regime under which farm households may choose to participate in commercialization is further described as follows;

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

$A_i = 0$ otherwise do not commercialize

The latent variable A^*_i denotes the expected benefits derived from cassava commercialization which cannot be directly observed but can be stated as a function of the observed individualities. The instrumental variable for the explanatory variables in the household income equation is represented by Zi. These variables determine the selector equation but not the outcome equation as pointed out by Heckman (1974). According to Abdulai and Huffman (2013) the decision concerning the regimes is premised on the net gains that are received by farm households, in this case the different income estimates. Estimate of per capita income for each farm household was obtained by the summation of all the possible incomes of the household divided by the total number of the household size. Per acre income was computed as production value of farm products less paid out costs, while annual household income consisted of the total amount of income brought in by persons who are 15 years and above

The equations of the regimes are presented as follows;

Regime 1: $y_{1i} = \beta_1\chi_{1i} + \mu_{1i}\ if\ G_i \geq \mu_i$ (commercialized farm households………………… (3)

Regime 2: $y_{0i} = \beta_2\chi_{2i} + \mu_{2i}\ if\ G_i \leq \mu_i$ (Non-commercialized farm households)………….. (4)

The quantities y_{1i} and y_{2i} represent household incomes for regime 1 and 2, respectively while χ_i represent the vectors of the explanatory variables determining household income. μ_i represents the error term which is distributed as $N(0, \delta^2)$ and an assumption is made that correlation exists between the error term μ_i with the regimes error terms μ_{1i} and. μ_{2i} The covariance matrix which indicates a trivariate normal distribution as indicated below.

$$COV(e_{1i}, e_{2i}, u_i) = \begin{pmatrix} \sigma^2_{e2} & \bullet & \sigma e2u \\ \bullet & \sigma^2_{e1} & \sigma^1 u \\ \bullet & \bullet & \sigma^2_u \end{pmatrix} \quad \text{………………………………………} \quad (5)$$

In equation 5, $\sigma^2{}_{e2}$ denotes the variance of the error term in the commercialization equation while $\sigma^2{}_{e1}$ and $\sigma^2{}_{\mu}$ presents the error terms in the main equation. According to Greene (1997), if the estimated co-variances are found to be statistically significant then endogenous switching regression model should be used. In case an endogenous model is fitted its adequacy

5. Results and Discussions

5.1 Descriptive Statistics for Characteristics of Farm Households

Descriptive statistics of the variables identified to influence cassava commercialization, and the dependent

variable, household income are presented in Table 1. The two stage endogenous Switching Regression results are presented in Table 2 and 3. This included the probit model (both joint and independent estimations). After presentation of each finding a discussion followed.

Table 1: Descriptive Statistics of Variables for the Sample

Variables	Total Sample		Commercialized (N=126)		Non-Commercialized (55)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Dependent Variables						
Annual household income (KES)	26677.49	52160.23	33118.06	58787.85	11922.73	27393.73
Per Capita Income (KES)	5465.61	11229.12	6977.95	12910.40	2000.97	4113.12
Per Acreage Income (KES)	11597.05	24531.30	12916.07	26345.52	8575.29	19644.54
Commercialization (Dummy)	0.696	0.461	1	0	0	0
Independent Variables						
Age (Years)	47.30	12.29	47.14	12.17	47.67	12.67
Gender (1=Male,0=Female)	0.23	0.42	0.26	0.44	0.15	0.36
Years of schooling(Years)	6.08	4.11	6.63	3.92	4.80	4.29
Household size (Number.)	5.79	2.66	5.88	2.70	5.58	2.58
Farming experience (Years)	15.10	12.23	15.19	12.29	14.89	12.21
Farm size (Acreage)	2.62	1.66	2.92	1.64	1.94	1.53
Remittance (1=Yes,0=No)	0.36	0.48	0.42	0.50	0.24	0.43
Off-farm income (1=Yes,0=No)	0.46	0.50	0.51	0.50	0.36	0.49
Access to credit(1=Yes,0=No)	0.38	0.49	0.46	0.50	0.18	0.39
Group Membership (1=Yes, 0=No)	0.73	0.45	0.79	0.41	0.60	0.49
Distance to Market(Km)	0.23	0.35	0.29	0.37	0.09	0.22

Source: Household Survey Data (2016)

The initial analysis involved comparing statistics obtained for the variables between commercialized and non-commercialized groups. From Table 1, it is observed that the mean annual household income for the commercialized households (Kes 33118.06) was more than the non-commercialized group (Kes 11922.73). Similarly, per capita and per acreage incomes were more for the commercialized group than the non-commercialized. Also, the average age of the household head for the commercialized group was 47.14 years and non-commercialized 47.67 years. In regards to gender, 26% of the men engaged in commercialization while 15% did not commercialize. This indicates that majority of farm households who had commercialized were headed by women. In measuring education level of household head, years of schooling was used as a proxy. The mean education level was higher for households that commercialized (6.63 years) than non-commercialized (4.80 years). An educated farmer is assumed to be more enlightened and knowledgeable with regards to farming activities relative to the one who is not educated (Muricho, 2015). Households that commercialized had an average family size of 5.88 persons while the non-commercialized group had 5.58 persons indicating slight variation. Household size is hypothesized to have mixed results on commercialization. First it can influence the demand for more household needs, both food and non-food related needs; secondly it can be a source of farm labor force (Balint, 2005).

Concerning farming experience, the commercialized regime (15.19 years) had more years of experience than the non-commercialized (14.89 years) group. This experience is deemed important as it intensifies the capacity to undertake farm operations in a more organized and competent way. In addition, a more experienced household head is believed to possess adequate information which can enable him improve productivity and efficiency. This explanation counters that of Lawal *et al.* (2014), which found that more experienced farmers are less likely to adopt new techniques due to rigidity and resistance to change. This could have negative implication on the household income.

The results of Table 1 also show that the commercialized group had a mean farm size of 2.92 acres compared to their counterparts who had 1.94 acres. Theoretically it is expected that a positive relationship exists between farm size and household income. Farm size facilitates excess production which can be consumed as well as marketed (Martey *et al*., 2012; Ele *et al*., 2013). Therefore the low mean farm size probably supports the dominance of smallholder farmers in Siaya County.

Table 1 further shows that approximately 42% of those who commercialized and 24% of the non-commercialized group received remittances. Similarly 51% and 36% of the commercialized and non-commercialized households engaged in off-farm activities. On average, about 46% of farmers received off-farm income. This indicates that besides farm income, households depend on other off-farm activities as sources of income. Indeed, 46% and 18% of farm households' in the commercialized and non-commercialized groups

respectively had access to credit facilities. The proportion of commercialized (79%) and non-commercialized (60%) were affiliated with farm based groups. Another important variable is related to distance to the market. The study found that farm households that commercialized were farther from the market (0.29 km) centers compared to the non-commercialized group (0.09km). Presumably, farmers avoid engaging in marketing activities when the cost of transport is high. This can occur when farm households are located farther from the market places or if infrastructural network is unfavorable and thus crippling market access and participation (Gebremedhin and Jaleta, 2010; Omiti *et al*., 2009; Agwu *et al*., 2012). This could mean that other than distance there are other motivators to participate in marketing activities.

Table 2: Probit Model Results for Determinants of Cassava Commercialization (Value Addition and Market Participation).

	Jointly Estimated Probit			Independent Estimated Probit
Variables	Per acre Estimates	Per Capita Estimates	Yearly Inc. Estimates	Coef.
Education (Years of schooling)	0.341** (0.147)	0.319** (0.145)	0.332** (0.146)	0.318** (0.152)
Value addition experience(Years)	0.240* (0.145)	0.226* (0.143)	0.234* (0.144)	0.195 (0.147)
Household size (Numbers)	-0.292* (0.195)	-0.307* (0.193)	-0.290* (0.195)	-0.249 (0.204)
Farm size (Acres)	0.449** (0.176)	0.456*** (0.174)	0.442** (0.175)	0.519*** (0.177)
Off-farm income (KES)	0.319 (0.249)	0.297 (0.248)	0.300 (0.249)	0.237 (0.251)
Gender (1=Male, 0= Female)	0.110 (0.324)	0.116 (0.322)	0.113 (0.323)	0.021 (0.322)
Age (Years)	0.419 (0.294)	0.429 (0.296)	0.425 (0.294)	0.274 (0.289)
Receive remittance (1=Yes,2=No)	0.448* (0.254)	0.423* (0.254)	0.439* (0.254)	0.392* (0.258)
Group membership (1=Yes, 2=No)	0.387* (0.254)	0.424* (0.248)	0.399* (0.249)	0.443* (0.272)
Distance to market (Km)	-1.918*** (0.548)	-1.853*** (0.549)	-1.856*** (0.548)	-2.001*** (0.681)
_cons	-1.379 (0.548)	-1.298 (0.578)	-1.348 (0.580)	-1.258 (0.599)
No. of observations	181	181	181	181
Prob>chi-squared				0.000
Pseudo R^2				0.323
LR chi2 (10)				71.87
χ^2 - Statistic for over identification				2.304 (0.129)

Note: The jointly estimates were based on yearly income, per capita and per acre income.
***, ** and * represent significance at 1%, 5% and 10% respectively.

The results on Table 2 show the estimates of coefficients for the determinants of cassava commercialization. The coefficient of determination R^2=0.323 indicate that the independent variables explain 32.3 % of the variation in cassava commercialization. The model is adequate (p-value=0.000), showing a good fit. The χ^2 statistics shows that the instrumental variables employed are valid and the model is well specified. According to Lokshin and Sajaia (2004), it is a requirement that an instrumental variable estimator is fitted in the selection equation in order to obtain dependable estimates. Group membership and distance to the market were identified as the instrumental variables since they had a direct effect on cassava commercialization but not on household income.
The results show that years of schooling, farm size, remittance and group membership have both positive and significant effect on commercialization in the independent and jointly estimated models while value addition experience was positive and significant in the jointly estimated probit model only. Household size was significant in the jointly estimated probit model even though it had a negative effect while distance to the market had a negative relationship in both regimes. The positive relationship between years of schooling and cassava commercialization implies that the more educated the household head, the higher the probability of participating in cassava commercialization. This is supported by the idea that education is an indicator of sound management skills and it increases the ability to synthesize and interpret information (Bahta, 2012). Besides, it enhances productivity through adoption of new techniques (Godoy *et al.*, 1997). These explanations are consistent with the

results of Martey *et al*. (2012) who also found that education influences management abilities and facilitates responsiveness to market needs. On the other hand, it contradicts the findings of Mathijs (2002) who argued that well educated farmers focus more on off-farm activities.

The study found that farm size had a significant and positive relationship with cassava commercialization in both the independent and jointly fitted models. This implies that farmers with large farms are likely to engage in commercialization. Large farm size enhances production thus creating enough quantity for household consumption and a marketing surplus for market participation. Martey *et al*. (2012) argued that farmers with large productive farm-land have better opportunities to produce marketed surplus which is a motivation to commercialization undertakings. The result is however inconsistent with that of Falola *et al*. (2016) which found that farm size had a negative influence on commercialization. The researchers argued that farmers with large parcels of land concentrate more on the production side of agricultural chain than on the market side. The positive significance of remittance indicates that, income received from relatives or friends increases the probability of engaging in cassava commercialization. The implication is that farm households who received remittances were able to increase cassava production and commercialization. Remittance plays a vital role on the welfare of rural farm households. It can influence various household activities such as expenditure on consumption goods, education, healthcare, agriculture amongst others (Xing, 2015). This result supports the a priori expectation and the findings of a study by Kikulwe *et al*. (2013) which revealed that remittances reduce financial constraints hence promote access to markets. Moreover, it facilitates payments of various agricultural expenses such as labor, input, processing and marketing costs.

Membership to farm based groups was found to positively influence commercialization. Therefore household heads who participated in farming groups were more endowed with information that could boost cassava commercialization. This is possible since group networks empower farmers with knowledge which helps in reducing information asymmetry. It can also be a source of labor, collateral for obtaining credit facilities and other support systems which are vital in marketing agricultural products. This finding is consistent with the study of Mwaura (2014) which found a positive relationship between membership to groups and cassava output. Olwande (2010) also found that group membership had a positive influence on access to production and market information which can facilitate decision making with regards to commercialization. The study also found that value addition experience had a positive relationship with cassava commercialization. This suggests that farmers with more experience on value addition are likely to process various forms of cassava product and engage in market participation than the ones with less experience. This is consistent with the findings of Agwu *et al*.(2013) who found that experience expands the knowledge of understanding and it enhances agricultural commercialization. The study also revealed that household size was significant in the jointly estimated models but insignificant in the independent estimated probit model. It could be argued that farmers had some unobservable characteristics such as competence, attitude and willingness to participate in commercialization that might have led to the variation in the results of the two models. Furthermore large households are more likely to have limited market surplus (Martey *et al*., 2012). The coefficient of distance to market was negative and statistically significant in all the model specifications implying that farmers farther away from market places are less likely to undertake cassava commercialization activities than those who are near. This is because high transaction costs resulting from long distances tend to limit farm household's from commercialization. The long distance to markets can be due to other factors including poor infrastructure which makes farmers to use longer routes. This result supports that of Ochieng' *et al*. (2015) which recommended for improved infrastructural and market information systems as a way of reducing transaction costs. Overall, the variations across the income estimates were minimal and there were no changes in the direction of the effects.

Table 3 results shows the estimates of endogenous switching model for the three different income measures. From the test statistics, the equations are jointly dependent since the (p-values=0.002, 0.003, 0.002) for per acre, per capita and the annual income respectively are significant. This implies the existence of sample selectivity bias which has been controlled in the model. Notably, the correlation coefficient of farm households which had commercialized ($\rho_{\mu_i} v$) was negative and this further confirms the existence of selection bias. The estimates of the covariance indicate that commercialization improves household income. This finding is in agreement with that of other studies (Abdulai and Huffman 2014; Seng, 2016; Kim *et al*.1999). Contrary, $\rho_{\mu_0} v$ which represents the coefficients for non-commercialized households shows that there is no significant difference between the two regimes. This could be due to unobserved behaviour of farmers.

The results presented in Table 3 shows that the variables which significantly influenced household income are; household size, remittance and off-farm income. Household size is statistically significant in explaining per capita income in both the commercialized and non-commercialized regimes; however, the estimate was greater for the commercialized regime indicating a greater effect. The implication of the finding is that any additional member to farm household reduces the likelihood of improving household per capita income for both the commercialized and non-commercialized households and more so for those who commercialized. This is

because large household size exerts pressure on the resources available. Furthermore, an increase in household size is related to higher household expenditure hence less reserves for commercialization. This contrasts with the results of Kabiti *et al*. (2016) which indicated that an increase in household size affects output commercialization consequently leading to an improved household income. The study argued that as the household size expands, more human labor for commercialization activities becomes available

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Table 3: Endogenous Switching Regression Results for the Effect of Cassava Commercialization (Value addition and Market Participation) on Household Income

	Commercialization (n=126			Non-Commercialization(n=55)		
Variables	Per Acre. Coef.	Per Capita Coef.	Per yr. Coef	Per Acre. Coef.	Per Capita. Coef.	Per Yr. Coef.
Education (Years of Schooling)	0.291 (0.307)	0.264 (0.218)	0.242 (0.330)	0.052 (0.329)	0.156 (0.282)	0.089 (0.329)
Value addition Experience (Years)	-0.063 (0.274)	-0.147 (0.248)	-0.136 (0.295)	-0.587* (0.311)	-0.406* (0.268)	-0.528* (0.314)
Household size (Numbers)	0.255 (0.388)	-0.600* (0.352)	0.294 (0.418)	-0.286 (0.454)	-0.584* (0.395)	-0.389 (0.457)
Land size (Acres)	-0.151 (0.385)	0.465 (0.350)	0.559 (0.416)	-0.708* (0.375)	-0.263 (0.324)	-0.353 (0.374)
Remittance (KES)	1.672*** (0.467)	1.557*** (0.424)	1.812*** (0.504)	4.080*** (0.623)	3.544*** (0.536)	4.260*** (0.627)
Off-farm income (KES)	4.378*** (0.465)	4.045*** (0.421)	4.583*** (0.502)	7.464*** (0.547)	6.480*** (0.473)	7.885*** (0.551)
Gender (1=Male,0= Female	0.662 (0.550)	0.702 (0.498)	0.854 (0.592)	0.997 (0.739)	1.108* (0.643)	1.228* (0.748)
Age	-0.389 (0.498)	-0.354 (0.451)	-0.367 (0.536)	0.639 (0.674)	0.686 (0.589)	0.850 (0.680)
_cons	4.050 (1.203)	4.743 (1.113)	4.248 (1.309)	2.367 (1.113)	1.936 (0.972)	2.155 (1.128)
$In\sigma_{\mu_1}v$	0.947*** (0.071)	0.850*** (0.074)	1.023*** (0.073)			
$\rho_{\mu_i}v$				-0.846*** (0.252)	-0.905*** (0.079)	-0.888*** (0.282)
$In\sigma_{\mu_0}v$	0.537*** (0.095)	0.396*** (0.095)	0.549*** (0.954)			
$\rho_{\mu_0}v$				0.003 (0.444)	0.002 (0.434)	0.019 (0.428)
LR test of indep. Equations	0.002	0.003	0.002			
Log Likelihood				-468.823	-448.152	-478.497

Note: The income equation was jointly estimated with the selector equation.
*** Significant at 1%, ** significant at 5%, * significant at 10%

Value addition was insignificant for the commercialized group. However, it was significant and negatively influenced household income for the non-commercialized household. This could mean that besides experience there were other factors that influenced household income. The coefficient for remittance was positive and significant ($p<0.001$) in both the regimes meaning that farm households that received more remittances enjoyed increased household income. The effect is significant for both the commercialized and non-commercialized groups. However, the effect is more conspicuous amongst the non-commercialized than the commercialized group which could further suggest that farm households who did not commercialize majorly relied on remittances as a source of income. Similarly, off-farm income was positive and significant in both the models, though the coefficients varied slightly. An explanation could be that farm households who never commercialized engaged more in off-farm activities and this improved their household income. Seng (2005) argued that agriculture alone may not be instrumental in lifting up small scale farm households from poverty.

Gender was noted to influence the non-commercialized group and household income. In this case, the male household heads positively contributed to non-participation on cassava commercialization and household income. The implication is that men put a lot of emphasis on off-farm activities while women engage in cassava

commercialization. Forsythe *et al*. (2016) carried out a study on women's experiences on cassava commercialization in Nigeria and Malawi. The study found that men participate more in marketing of processed cassava products while the female were more engaged in processing activities. This is contrary to the findings of this study as well as that of Adenegan *et al*. (2012). The latter found that men are more disengaged from commercialization of cassava activities. Therefore promotion and integration of both genders in cassava commercialization can offer a basis for improving household income.

6. Conclusion and Recommendation

The objective of the study was to establish the determinants of cassava commercialization in Siaya County and its effect on household income. This study took into consideration the importance of value addition in augmenting market participation to enhance commercialization. The study found that there were observed differences in the regimes for the non-commercialized and commercialized households which were accounted for with the application of endogenous switching model. This was evidenced by the significance of the covariance estimates after the inclusion of the inverse mills ratio to correct for the selectivity bias. The negative coefficients on the inverse mills ratio for the non-commercialized regime reveals a negative effect of the unobserved characteristics on household income. Overall, cassava commercialization was found to contribute towards improved household income as highlighted in the empirical findings. The selection equation model showed that cassava commercialization was positively driven by; years of schooling, cassava output, farmer experience, farm size and group membership which was expected. Further, distance to the market was negative and significant in all the models while household size was only significant in the jointly estimated models. This indicates that farm characteristics and institutional factors contribute significantly to cassava commercialization. Apart from remittance and off-farm income that explained an increase in household income, the expected variables such as value addition experience and land size were insignificant. Also, the study expected different results for the various measured income estimates. However, this was not the case. Based on the significant variables, this study recommends that interventions which can support cassava commercialization should be enhanced. These include; employing strategies that can increase the amount of cassava output such as use of high yielding cassava cuttings, fast maturing cassava varieties as well as trainings and education to enhance their technical knowledge. Therefore the government should ensure that planting materials are availed to farmers at the right time and at affordable cost. Also, farmers should be encouraged to embrace value addition through trainings and provision of equipment. This enhancement requires the activation of the stalled processing factories to support various value addition activities such as chipping, drying and milling. Notably, through product diversification, cassava farmers are capable of intensifying market participation which further leads to increased household income hence improved welfare.

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