Factors Influencing Maize and Cassava Commercialization Among Smallholder Farmers in Uganda

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Abstract

Rapid smallholder agricultural productivity growth can significantly reduce poverty in rural areas leading to the attainment of most of the sustainable development goals. Yet smallholder farmers continue to face numerous challenges that impede agricultural productivity growth. Analyzing the factors that influence the level of commercialization can shed light on the constraints and drivers of agricultural productivity to tackle the problem of low agricultural productivity in developing countries. This study used the 2015/16 Uganda National Panel Survey (UNPS) data to establish the level of commercialization among maize and cassava smallholder farmers in Uganda. The study found that the level of commercialization for the two crops is low estimated at 14 percent and 11 percent for maize and cassava, respectively. The study estimated a Tobit regression model of maize and cassava commercialization and found that the level of commercialization is influenced by land productivity, gender of the household head, location of the household, household size, value of assets, soil type and marital status. The results suggest that the major driver of commercialization of agriculture in Uganda is land productivity and therefore policymakers should devise strategies for enhancing the productivity of land in Uganda. On the other hand, the study establishes that households headed by females or located outside of the central region or have many household members impede the commercialization of agriculture and therefore these factors should be addressed to increase the level of maize and cassava commercialization in Uganda.

Key words: Commercialization, Agriculture, Smallholder farmer, Uganda

I. Introduction

Agriculture is considered the backbone of many developing economies because of its role in employment, food security and linkages to other sectors such as industry. Over the years, the agricultural sector has continued to be the biggest employer and source of livelihood in Sub-Saharan Africa. The sector employs over 60% of the population and contributes about 23% of the region's gross domestic product (Goedde et al., 2019).

Agriculture has a significant role to play in the attainment of the 2030 Agenda for Sustainable Development. The initiatives under Agenda 2030 aimed at ending hunger, ensuring food security and improving food nutrition all revolve around ensuring better agricultural outcomes (Sakho-Jimbira & Hathie, 2020). However, agricultural production on the African continent is largely sub-optimal. Recent estimates (Goedde et al., 2019) posit that the continent has the potential to double or even triple its agricultural production. The sub-optimal levels of agricultural production partly explain why many of Africa's people continue to suffer hunger. The Food and Agriculture Organization (FAO) of the United Nations estimates that Africa is home to about 264.2 million undernourished people (24% of the population) despite the vast potential for food production.

One of the proven ways to boost agricultural production is to commercialize production. Commercialization in agriculture has been defined to refer to a gradual process through which households shift from producing mainly for their own consumption to market-oriented production (Endalew et al., 2020). Commercialization of agriculture is considered to be essential to economic growth and its related outcomes such as poverty reduction. This is especially important in the developing world where most poor households are predominantly agricultural households (Göttingen, 2010; World Bank, 2018; and Endalew et al., 2020).

This study therefore sought to investigate the factors that influence commercialization in Uganda's maize and cassava production. The study employed a Tobit model to analyze the factors that influence the level of commercialization for a bounded dependent (the commercialization index) using the Uganda National Panel Survey data of 2015/16. In doing so, the study analyzes both the level of commercialization of maize and cassava production in Uganda and examines the factors that influence the commercialization of the two crops.

Focus is placed on Maize and cassava which are two of the ten agricultural commodities earmarked to foster agro-industrialization and food security in Uganda's third National Development Plan (NDP III). Maize is the most widely produced agricultural commodity in most agricultural households. It is produced both for consumption (food security) and income generation (UBOS, 2020). Cassava is particularly essential to households due to its multi-industrial use potential and food security. It is drought resistant and can be stored (either un-harvested in the garden or harvested and dried) for up-to two years (NPA, 2020) – perhaps the only crop with this characteristic. Increased commercial production for these two crops therefore enhances food security and income generation for most Ugandan households.

Overall, the study found the level of commercialization among maize and cassava farmers to be low, estimated at 14 percent and 11 percent, respectively. Among the determinant factors, the study found a positive and statistically significant relationship between land productivity and commercialization of maize and cassava in Uganda (see section V for a details). In contributing evidence to improve commercialized agriculture, we envisage that the study findings will contribute evidence for policy formulation and implementation of Uganda's development goals on food security, export promotion (since half of Uganda's exports are agricultural products) and increase in incomes of households in subsistence agriculture. Uganda's overarching development goal for the five-year the NDP III is to increase household income and the quality of life for Ugandans (NPA, 2020). Considering that most Ugandan households are reliant on agriculture (mostly subsistence) for their livelihoods, it follows that increasing agricultural incomes is essential to increasing household incomes.

Commercialization of maize and cassava is essential if Uganda is to close the productivity gaps registered in the production of the two crops. The country's NDP III indicates an average farm yield of 2.3 tons per hectare against a potential yield of 8 tons per hectare for maize. Cassava production even has a bigger productivity gap of 3.3 tons per hectare against a potential yield of 20 tons per hectare (NPA, 2020). The production gap of these two crops is only eclipsed by fruits and vegetables among the priority crop commodities highlighted by the NDP III (see Figure 1 for details).

Contextual Analysis

It is important to commercialize agriculture given the changing dynamics globally that are epitomized by climate change, rising populations that are placing greater demand on land and food production, technological advancement and rapid urbanization (Rabbi et al., 2019). For instance, climate change manifestations such as erratic rainfall pattern and rising temperatures have negatively affected agricultural production and food security (CGIAR, 2017). These dynamics have mostly affected traditional agriculture in a negative way requiring an increase in agricultural productivity.

However, commercialization of agriculture is not a new phenomenon. Developing countries such as Uganda have been pursuing commercialization of agriculture since the turn of the century to varying degrees of success or mixed results. Despite several Government of Uganda initiatives over the years such as the Plan for the Modernization of Agriculture (PMA) and the National Agricultural Advisory Service (NAADS), most of the agricultural production in the country remains subsistence in nature.

Uganda is currently faced with several development challenges that necessitate a renewed focus on the commercialization of agriculture. The country has one of the fastest growing populations in the world, growing at a rate of 3.3% (as per World Bank Statistics) and youngest populations in the world with three quarters of the population being under the age of 30 years. Close to half (44%) of the population is below 15 years of age which translates into a high dependency ratio. This nature of population growth poses threats to food security by exerting more pressure on arable land and increasing the demand for food. The demand for food is further heightened by the conflict in some of the country's neighboring countries, which constrains agricultural activity in these countries.

Uganda must therefore commercialize its agriculture if it is to strike a balance between feeding its burgeoning young population and remaining a food basket for the East African region. Commercialized agriculture is at the heart of Uganda's development strategy. The country's third

National Development Plan (NPA, 2020) places its agro-industrialization program at the forefront of its growth strategy in the five-year period ending June 2025. Under the program, commercialization of agriculture is one of the major aims and it is expected to enhance competitiveness of agricultural products along their respective value chains.

II. Conceptual Framework/Theoretical Background

Commercialization of agriculture refers to a shift from subsistence production to market oriented production with the aim of maximizing profits (Endalew et al., 2020; Rabbi et al., 2019). Commercialization does not only consider selling output in the market but also focuses on product choice and use of tradable inputs in production based on the principle of profit maximization (Rabbi et al., 2019). Commercialization of agriculture can be measured using different indicators such as the incidence of farmers participating in the market (Adong et al., 2021), proportion of farm output sold in the market (Endalew et al., 2020; Immink & Alarcon, 1993), and the proportion of purchased inputs used in production.

Common in the literature is the consideration of the incidence and intensity of farmers to participate in the market (Adong et al., 2021; Adong et al., 2021). The propensity to participate in the market is measured by a binary variable capturing whether a farmer sells in the market, while the intensity to participate in the market is measured by the volume or proportion of farm output sold in the market. The intensity of a farmer's participation in the market is often measured using the commercialization index. However, Pingali & Rosegrant, (1995) note that the concept of commercialization of agriculture can be classified into three categories based on the purpose of farming, such as subsistence production system where farmers produce only for home consumption; semi-commercial production system where farmers produce for both household consumption and the market; and commercialized production system where farmers produce entirely for the market. Pingali & Rosegrant, (1995) note that as farmers become more commercialized, they increase the proportion of traded inputs and also diversify their incomes to include off-farm income.

Commercialization of agriculture is driven by several factors. Among them are household and community resources and endowments; access to markets; social and cultural factors affecting consumption preferences and production practices; market opportunities and constraints (Allan, 1986; Barrett, 2008; Hazell & Wood, 2008; Pender & Alemu, 2007). Other scholars have identified factors such as availability of credit, extension services; market information; access to agricultural inputs and supporting facilities such as storage and processing (Christiaensen & Demery, 1995; Bernard & Rondinelli, 1986). Lastly, scholars have used household characteristics such as age of the household head, gender of the household head, education of the household head, farmland size, asset ownership of equipment used in agricultural production to determine the level of commercialization (Martey, 2012; Idrisa et al., 2012; Adong et al., 2021), 2014; Endalew et al., 2020; Tafesse et al., 2020)

Scholars have used different methods to analyze the determinants of commercialized agriculture including linear models (OLS), non-linear models (e.g., Tobit and Logit) and simultaneous models such as the two-stage Heckman selection model. For example, Martey, (2012) uses a Tobit model to analyze maize and cassava commercialization in Ghana using primary data of 250 households involved in the production of the two crops. The study established that the product price, farm size, access to extension services, distance to market and market information determine the level of commercialization. Similarly, Martey, (2012) used Tobit and Logit models to establish the determinants of the likelihood of adopting improved soya bean seed in agricultural production in Borno State in Nigeria. The results indicated that the extent of adoption of soya bean among farmers in Nigeria is influenced by farm size and distance to source of technology.

Furthermore, Martey, (2012) analyzed the determinants of the commercialization of wheat among smallholder farmers in Ethiopia using the beta regression model. Their results indicated that the gender of the household head and education status positively and significantly affect the commercialization of wheat. Similarly, Tadesse & Teka (2019) investigated the factors that affect the commercialization of agriculture among smallholder farmers in Ethiopia using a binary logistic regression model. Their study established that education, farm size, training, access to extension services, access to market information, access to irrigation, access to private transportation and price volatility positively and significantly influence commercialization of agriculture in Ethiopia. Further the study notes that marital status, family size, off-farm income and access to transport negatively and significantly affect commercialization of agriculture.

Likewise, Adong et al., (2021) examined the drivers of food crop commercialization in Uganda using two waves of panel data – 2005/06 and 2009/10. Employing a binary logistic regression model and ordinary least squares (OLS), they analyzed the determinants of incidence and intensity of market participation of farmers growing maize, beans, cassava, sweet potatoes and bananas. Their findings suggest that commercialization of crop production is affected by characteristics of the household head (e.g., gender, age and education), household characteristics (e.g., household size, land size, distance to feeder road, road in the community, ownership of cattle, exposure to drought and household has three meals a day) and community-level characteristics (e.g., region).

III. Data

The study used one wave of the Uganda National Panel Survey (UNPS) of 2015/16. The study could not use the several waves of UNPS including: 2009/10, 2010/11, 2011/12, 2013/14, 2018/19 and 2019/20 because the data in the agriculture model does not have unique identifiers with regard to households and parcels to successfully merge the waves. Besides the lack of unique identifiers, the UNPS was refreshed in 2013/14 and therefore most of the households in prior waves were dropped and new ones included which results in a highly unbalanced panel dataset. Furthermore, the study could not use relevant community variables such as extension services, market information and community infrastructure because we could not get a unique identifier to merge the data in the community module with the data in the agriculture module. We decided to use the 2015/16 UNPS wave because we were able to access cleaned data for this wave.

As shown in Table 1 (provided in section IX), the sample has a total of 4,446 farmers, with 64 percent of the farmers involved in maize production, while 36 percent of the farmers are involved in cassava production. It is clear that the level of commercialization of both crops is low estimated at 14 percent for maize and 11 percent for cassava. The majority of the farmers, or about 80 percent, are still involved in subsistence agriculture for both crops; therefore, it is important to establish the drivers of commercialization of the two widely grown crops in Uganda to reap from the outcomes of commercialization of agriculture at household and national level. It is surprising that there are more farmers involved in commercialized agriculture than semi-commercial for both crops, with only 5.77 percent of maize farmers involved in semi-commercialized agriculture and cassava at 8.29 percent

From the summary statistics provided in Table 2 & 3, the study notes that commercialized farmers for maize are relatively younger than for cassava with the average age of the household head estimated at 44 and 48 years of age, respectively. The summary statistics reveal a low representation of female-headed households in commercialized maize and cassava production, constituting about a quarter of the sample. Interestingly, commercialized farmers are relatively less educated than their counterparts in semi-commercialized agriculture, especially for maize production. The study notes that household size reduces with commercialization, but the value of assets is almost constant across the three levels of commercialization.

With regard to geographical variation of level of commercialization, there is a higher level of commercialization of maize in the central region and a higher level of commercialization of cassava in the northern region. The summary statistics for farm size confirm that production is by smallholder farmers with the average farm size of 1.64 acres for maize farmers and 1.62 for cassava farmers. Furthermore, the statistics reveal that land productivity increases with level of commercialization. As regards the land tenure system, freehold land tenure is dominant for maize commercialization, which is the dominant land tenure system in central region, while the customary tenure is popular among cassava farmers, which is the dominant land tenure system in northern Uganda. With regard to the soil type, the sand-loam soil is favorable for both maize and cassava production.

IV. Methods

The study seeks to examine the factors that influence the commercialization of maize and cassava production among smallholder farmers in Uganda using the UNPS 2015/16 data. Following Endalew et al., 2020, a commercialization index was constructed as a ratio of the quantity sold and quantity harvested, expressed as follow:

Commercial index = (Quantity of output harvested that was sold / quantity harvested) *100 (1)

The farmers were categorized based on the level of commercialization, where if the farmer's commercialization index lies between 0 -25 then they are regarded as subsistence farmers, those with an index between 25 – 50 were categorized as semi-commercialized, while farmers with an index between 50 -100 were grouped as commercialized farmers.

The Tobit model[1] can be used to analyze the factors that influence the level of commercialization for a bounded dependent variable such as the commercialization index. The Tobit model can be expressed as:

[1]The study estimated a multinomial logit model but checked for the independence of irrelevant alternatives (IIA) assumption using the Hausman-McFadden test which provided a negative chi-square implying that the null

$$Y_i^* = \beta' X_i + U_i, Y_i = \begin{Bmatrix} Y_i^* \; if \; Y_i^* > 0 \\ 0 \; if \; Y_i^* <= 0 \end{Bmatrix} \quad (2)$$

where Y_i^* represents a latent variable which is unobserved but influences the outcome variable Y_i which is the percentage of output harvested that is sold for observations i=1…n. The β' is a vector of parameters to be estimated, X_i is a vector of explanatory variables and U_i is the error term assumed to be independently and normally distributed.

The available literature on commercialization of agriculture provides a wide range of explanatory variables that influence the intensity of commercialization of crops, such as age of household head (Martey, 2012; Adong et al., 2021; Endalew et al., 2020; Tafesse et al., 2020); gender of the household head (Idrisa et al., 2012; Adong et al., 2021; Endalew et al., 2020; Tafesse et al., 2020), education attainment of the household head (Edward Martey, 2012; Endalew et al., 2020; Adong et al., 2021; Endalew et al., 2020; Tafesse et al., 2020); household size (Endalew et al., 2020; Adong et al., 2021; Tafesse et al., 2020); household assets (Adong et al., 2021; Endalew et al., 2020; Tafesse et al., 2020); region (Adong et al., 2021); land size (Martey, 2012; Endalew et al., 2020; Endalew et al., 2020; Tafesse et al., 2020); and land ownership (Martey, 2012). In addition to the variables analyzed in literature, we included a variable that measures the productivity of land and soil type which we think could influence the level of commercialization of maize and cassava.

Therefore, the study estimated the following empirical model separately for maize and cassava production:

$$Y_i^* = \beta_0 + \beta_1 Age + \beta_2 Gender + \beta_3 Educ + \beta_4 HHSize + \beta_5 Asset + \beta_6 Region + \beta_7 Farm\_size + \beta_8 Landptivity + \beta_9 Landtenure + \beta_{10} Soil_{type} + \beta_{11} Married + U_i \quad (3)$$

The variables in equation (3) are described in Table 4.

V. Results

In Table 5 the results for the Tobit regression for maize and cassava production are provided. The results show that the level of commercialization of maize is associated with the gender of the household head, regional location of the household, land productivity, type of soil cultivated and the marital status of the household head. All the significant variables have the expected sign except marital status. A household that is headed by a female is less associated with intensity of commercialization of maize production by 0.913 percentage points. Similarly, households not located in the central region (the reference group) are less associated with commercialization of maize production. Interestingly, land productivity offers the only positive relationship with commercialization of both maize and cassava, signaling it as the major driver of commercialization

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hypothesis of difference in coefficients not systematic was rejected. Therefore, it was not appropriate to use the multinomial logit model.

of agriculture in Uganda. Also, the soil type has a significant association with commercialization of maize where the sandy loam soil is preferred to other forms of soil types. Lastly, being married negatively influences commercialization of maize production which could be depicting the household dependence burden, which constrains production and selling to the market.

With regard to commercialization of cassava production, three variables stand out – household size and land productivity. As in the case of maize production, land productivity is the only positive factor that influences the commercialization of cassava. As expected, the household size, which is a proxy for dependence burden, is negatively associated with the commercialization of cassava.

VI. Conclusion

This study sought to analyze the level and determinants of commercialization of maize and cassava production among smallholder farmers in Uganda using UNPS data. Due to data limitations, the study could not successfully construct a panel dataset consisting of relevant data from the agriculture, household and community module. There were three major challenges: i) lack of unique identifiers across the waves for the agriculture module; ii) lack of unique identifiers to merge the agriculture data with the community data to include relevant variables such as access to market information, extension services and other relevant infrastructure and social networks; iii) data consisting of duplicates. Consequently, the study used only one wave of the UNPS – 2015/16 because we were able to access clean data which we could use within the timeframe of the project. The study therefore used household characteristics and farming characteristics to establish the determinants of maize and cassava commercialization among smallholder farmers in Uganda.

First, the study established that the level of commercialization among maize and cassava farmers is very low, estimated at 14 percent and 11 percent, respectively. In the case of maize production, the level of commercialization is influenced by the gender of the household head, regional location of the household, level of land productivity, type of soil and marital status. A household has a higher likelihood of maize commercialization if it is headed by a male, located in central region, has a higher land productivity, the farm land has loam soil and the head is married. With regard to cassava production, the level of commercialization is determined by the household size, land productivity, value of assets and other variables in the constant. Therefore, a household has a higher chance of cassava commercialization if it has a smaller household size (a proxy for dependency burden), a higher level of land productivity, has a higher value of assets (which is a proxy for income status) and other variables not accounted for in the model.

The results of the study suggest one key policy variable which is land productivity. This variable captured how much a plot of land can produce given its size. The study is cognizant of the fact that land productivity entails a number of contributory factors such as farming practices that include: use of improved seeds, fertilizers, pesticides and labor. The study could not individually use some of these variables because they had few observations and other variables such as hired labor were insignificant. Therefore, to provide conclusive recommendations, it may be necessary to decompose the land productivity variable into farming practices that improve crop yield to ascertain the exact variables that require policy action to improve maize and cassava commercialization in Uganda. It is also important to establish the factors that impede female headed households from commercializing maize production. Equally, important is to establish the factors that impede the commercialization of maize in the three regions – northern, eastern and western Uganda.

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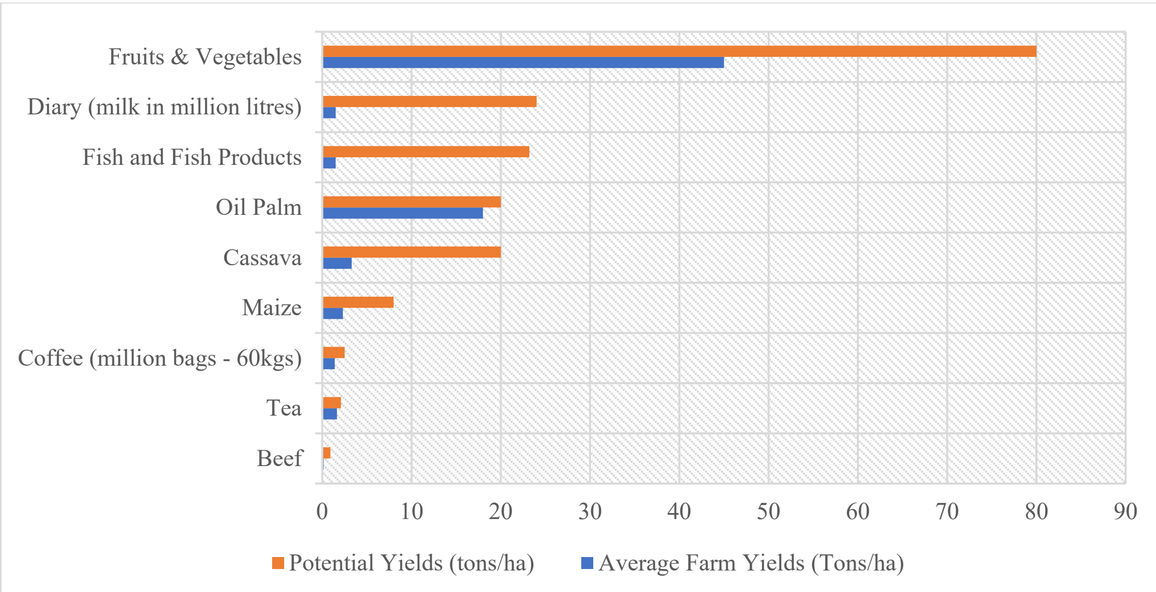
IX. Figures and Tables

Figure 1: Plotting Average Farm Yields against Potential Yield of the NDP III Priority Commodities (in tons/ha unless specified otherwise)



Data Source: UBOS as quoted in the NDP III

Table 1: Sample Size

Level of Commercialisation	Overall		Maize Production		Cassava Production	
	Number	Percent	Number	Percent	Number	Percent
Subsistence	3,563.0	80.14	2,267.0	79.77	1,296.0	80.80
Semi-commercialised	297.0	6.68	164.0	5.77	133.0	8.29
Commercialised	586.0	13.80	411.0	14.46	175.0	10.91
Total	**4,446.0**		**2,842.0**	**63.92**	**1,604.0**	**36.08**

Source: Author's computation using UNPS 2015/16 data.

Table 2: Summary Statistics for Maize Production by Level of Commercialization

Variable	Subsistence			Semi commercialised			Commercialised		
	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev
Age	2,267	46.83	14.45	164	46.30	14.93	411	44.16	14.44
Gender	2,267	0.32	0.47	164	0.29	0.45	411	0.212	0.41
Educ	2,130	4.18	4.21	162	5.09	4.21	399	4.41	4.41
HHSize	2,214	6.55	3.05	161	6.40	3.04	401	6.31	3.09
Assets	2,217	14.47	1.50	162	14.19	1.45	408	14.50	1.49
Central (region)	1,553	0.37	0.48	107	0.41	0.49	268	0.42	0.49
Eastern (region)	1,553	0.38	0.48	107	0.38	0.41	268	0.32	0.47
Northern (region)	1,553	0.14	0.35	107	0.10	0.31	268	0.08	0.28
Region _western	1,553	0.11	0.31	107	0.10	0.31	268	0.18	0.38
Farm size	1,553	1.46	4.27	107	1.17	1.05	268	1.64	1.73
Land_producitivity	2,267	229.01	283.38	164	484.00	392.55	411	832.20	2062.50
Land tenure (mailo-lease)	1,548	0.04	0.20	107	0.28	0.17	268	0.04	0.19
Land tenure (customary)	1,548	0.30	0.46	107	0.28	0.45	268	0.26	0.44
Land tenure (freehold)	1,548	0.66	0.47	107	0.69	0.46	268	0.71	0.46
Soil_type (sandloam)	1551	0.53	0.50	107	0.51	0.50	268	0.53	0.50
Soil_type (sandclay)	1551	0.28	0.45	107	0.33	0.47	268	0.28	0.45
Soil_type (blackclay)	1551	0.18	0.39	107	0.17	0.38	268	0.19	0.393
Married	1,041		0.40	72	0.80	0.40	168	0.78	0.42

Source: Author's computation using UNPS 2015/16 data.

Table 3: Summary Statistics for Cassava Production by Level of Commercialization

Variable	Subsistence			Semi commercialised			Commercialised		
	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev
Age	1,296	46.49	15.71	133	46.28	16.80	175	48.48	16.06
Gender	1,296	0.28	0.45	133	0.30	0.46	175	0.25	0.43
Educ	1,272	4.30	4.11	129	3.67	3.86	171	4.19	4.30
HHSize	1,271	6.22	3.06	127	5.46	2.35	170	5.53	2.52
Assets	1,275	14.10	1.46	131	13.81	1.49	175	14.38	1.52
Central (region)	1,032	0.19	0.39	110	0.15	0.35	138	0.18	0.39
Eastern (region)	1,032	0.23	0.42	110	0.10	0.30	138	0.22	0.42
Northern(region)	1,032	0.41	0.49	110	0.60	0.49	138	0.49	0.50
Western (region)	1,032	0.17	0.38	110	0.15	0.36	138	0.11	0.31
Farm size	1,032	1.56	4.84	110	1.32	1.36	138	1.62	2.07
Land_productivity	1,294	616.68	765.71	133	1076.23	1177.86	174	1095.83	1343. 19
Land tenure (mailo-lease)	1,032	0.01	0.11	110	0.03	0.16	138	0.01	0.85
Land tenure (customary)	1,032	0.55	0.50	110	0.60	0.49	138	0.58	0.49
Land tenure (freehold)	1,032	0.43	0.50	110	0.37	0.49	138	0.41	0.49
Soil_type (sand-loam)	1,032	0.47	0.50	110	0.31	0.46	138	0.46	0.50
Soil_type (sand-clay)	1,032	0.39	0.49	110	0.52	0.50	138	0.40	0.49
Soil_type_(black-clay)	1,032	0.14	0.35	110	0.17	0.38	138	0.14	0.35
Married	855	0.81	0.39	90	0.81	0.39	112	0.85	0.36

Source: Author’s computation using UNPS 2015/16 data.

Table 4: Description of Variables

Variable Name	Description	Measurement	Expected sign
Age	Age of household head	Continuous variable of age in complete years	-/+
Gender	Gender of household head	Binary variable where 1 is female, 0 otherwise	-
Educ	Education attainment of the household head	Continuous variable of number of years of schooling of the household head	+
HHSize	Household size	Continuous variable of number of people living in the household	-
Assets	Total value of household assets	Continuous variable of the logarithm of the value of total assets	+
Region_	Regional location of household	Categorical variable where 1 is central, 2-eastern, 3-northern and 4 western region.	-
Farm_size	Total acres of land owned by the household	Continuous variable of total size of land in acres	+
Land_ptivity	Land productivity	Ratio of quantity of output over size of plot planted	+
Land_tenure_	Type of land tenure system for the plot planted	Categorical variable where 1 is mailo lease, 2- customary and 3- freehold land tenure	+
Soil_type_	Type of soil plot planted	Categorical variable where 1 is sand loam, 2 is sand clay, 3 is black clay	-
Married	Marital status of the household head	Binary variable where 1 is married and 0 otherwise	+

Table 5: Factors Influencing the Level of Commercialization

Variables	Maize Production		Cassava Production	
	Coef	Std. Err	Coef	Std. Err
Age	-0.006	0.007	0.006	0.007
Gender	-0.913***	0.278	-0.029	0.297
Educ	0.015	0.225	-0.005	0.026
HHSize	-0.023	0.035	-0.153***	0.043
Assets	-0.109	0.071	0.179**	0.081
Eastern	-0.701**	0.303	0.337	0.514
Northern	-1.360***	0.375	0.865*	0.480
Western	-0.540*	0.321	0.113	0.471
Farm size	0.024	0.000	-0.005	0.029
Land_ptivity	0.002***	0.000	0.001***	0.000
Land tenure_customary	0.533	0.567	0.875	1.385
Land tenure_freehold	0.296	0.518	0.776	1.383
Soil_type_sandclay	-0.171	0.214	0.344	0.234
Soil_type_blackclay	-0.524*	0.279	0.213	0.332
Married	-0.638**	0.306	0.318	0.352
Constant	0.285	1.194	-5.996***	1.905
Observations	1,249		1,013	
P-Chi^2	0.0000		0.0000	
Pseudo R^2	0.0915		0.0379	

Note: *** 1 percent significancy level, ** 5 percent significancy level and * 10 percent significancy level