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Determinants of transition in farm size among cassava-based farmers in Nigeria

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Abstract

Cassava production in Nigeria is fraught with varying levels of constraints which reduce its international competitiveness. Consequently, the area of land allotted to cassava production varies widely. This paper analyzed factors that influence changes in farm size among cassava-based farmers in Nigeria. The data employed for the study were sourced from the Living Standards Measurement Study (LSMS)/Integrated Survey Agriculture (ISA) survey which were conducted in 2010/2011 and 2015/2016 covering all 36 states in Nigeria. Analysis was conducted using descriptive statistics, the Markov chain process, and a random effects Poisson model. The Markov analysis revealed that cassava-based farmers in Nigeria are more likely to maintain a small scale level of cassava production or move to a small scale from past medium scale or large scale production. In the long run, the percentages of farmers producing at the small, medium, and large scales were 95.5 percent, 4.28 percent, and 0.24 percent, respectively. The regression results revealed that sex, age, household size, asset ownership, education, cassava income, distance to main road, and access to credit significantly influence change in farm size. The study recommends consistency in agricultural policies and mainstreaming more cassava farmers into the Agricultural Transformation Program.

Introduction

Cassava is the most important food crop for Nigeria by production quantity next to yam, which is the most important food crop by value (Food and Agriculture Organization of United Nations [FAOSTAT], 2012). As a crop with a variety of uses, it has played and continues to play a central role in Nigeria's agricultural sector. Cassava is an important source of dietary carbohydrate and provides food for over 60 million people in Nigeria (Abdulahi, 2003). Its production was estimated at 37.5 million t in 2010 (FAOSTAT, 2012) and the total area harvested in 2009 was 3.13 million/ton with an average yield of 11.7 t/ha (FAOSTAT 2010). It is predominantly produced by small farmers (99 percent) with 1—5 ha of land intercropped with yams, maize, or legumes in the rainforest and savannah agro-ecologies of Southern, Central, and lately Northern Nigeria (Federal Ministry of Agriculture and Rural development [FMARD], 2011).

Cassava's adaptability to relatively marginal soils, erratic rainfall, its high productivity per unit of land and labor, the certainty of obtaining some yield even under the most adverse conditions, and the possibility of maintaining continuity of supply throughout the year (Nweke, 1994) makes this root crop a basic component of the farming system in many areas in Nigeria. The crop and its derivatives have excellent potential in animal feed

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formulation, textile industry, plywood, paper, brewing, chemicals, pharmaceutical and agro-industrial uses (for example, starch, ethanol, adhesive, fructose/glucose syrup) (Akanbi, Adeboye, Togun, Ogunride, & Adeyeye, 2007; Iyagba, 2010; Ojeniyi, 2001; Sanni, Adebowale, Maziya-Dixon, & Dixon, 2008). The leaves are edible while the roots are a good source of ethanol and are rich in minerals, vitamins, starch, and protein (Adegbola, Awe, Ashaye, & Komolafe, 1978; Ravindran, 1992; Smith, 1992).

Although Nigeria is the largest cassava producer in the world, 90 percent of cassava production still goes to domestic consumption. To grapple with this situation, many development-oriented policies in the cassava sector have been implemented in Nigeria since independence. These policies include: the introduction of varieties resistant to cassava mosaic disease (CMD) and cassava bacterial blight (CBB) in the 1970s; the Presidential Initiative on Cassava, Rice, Vegetable Oil Development Program (VODEP) and Tree Crops introduced in 2003; and Maximizing Agricultural Revenue and Key Enterprises in Targeted Sites (MARKETS) in 2005. More recent policies are the National Investment Plan (NAIP) and the Presidential Agricultural Transformation Agenda having cassava as one of the main focus crops. The NAIP (2011–2014), provides for increased input supply and distribution by monitoring the quality/standard of fertilizers in the country (Asante-Pok, 2013). The Cassava Transformation under the Agricultural Transformation Agenda (2011–2015) was established to build on the aforementioned interventions. The overarching strategy of the cassava transformation is to make cassava production in Nigeria a major player in the local and international starch, sweetener, ethanol, HQCF, and dried chips industries by adopting improved production and processing technologies, and organizing producers and processors into efficient value-added chains (FMARD, 2011).

Despite all the efforts by successive Nigerian governments to increase the competitiveness of cassava, cassava production and profitability still vary widely. This could be due to various challenges experienced by cassava growers. The constraints to production include a wide range of technical, institutional and socioeconomic factors: pests and diseases, agronomic problems, land degradation, shortage of planting materials, access to markets, limited processing options, and an inefficient/ineffective extension delivery system (Asante-Pok, 2013). Cassava farmers may have to change the land portion allotted to cassava production if the effect of the constraints highlighted above becomes too severe. The majority of farmers have not been mainstreamed into the cassava transformation agenda and therefore have problems marketing their tubers which sometimes are left to rot in heaps due to their inability to get buyers promptly. Farmers who do not want to take such risks harvest the cassava tubers and frenetically scout for buyers who offer ridiculous prices based on their knowledge of the perishability of the tubers. This appalling situation is more vicious and pronounced during glut periods. Farmers who fall into this category may be compelled to reduce the area of land allotted to cassava production the next season or even become dissuaded from planting at all (somewhat following the cobweb theorem pattern). In contrast, farmers who are currently enjoying the benefits of the cassava transformation agenda or other favorable observed and unobserved factors may be incentivized to increase the area of land allotted to cassava production in subsequent seasons. As a sequel to the foregoing, a farmer may be faced with the decision of what farm area should be allotted to cassava in a given planting season. Therefore, this study sought to understand the dynamics of farmers cultivating different land sizes for cassava from year to year. Furthermore, it examined the factors which influence changes in farm size by cassava-based farmers.

Literature Review

The flagging number of farm families over the years has been an issue of social concern. At the same time, society benefits from having a highly productive farming system and low food prices that may come with increased consolidation (Ahearn & Yee, 2004). It is generally argued that small farmers in Nigeria, accounting for a large percentage of the farming area, use their limited resources and knowledge efficiently via their traditional farming systems. Among these limited resources, farm size plays an important role both in the level of their income and in their welfare (Semos, 1993). Because of policy interest in the size distribution of farms, understanding the causes of changing farm sizes has become a central issue.

Farm size varies from one country to another and is a phenomenon primarily determined by non-economic variables, such as laws of inheritance, social conditions, historical consequences, nature of the land, or government policies (Dillon & Hardaker, 1980). The causes of changes in farm size are complex and interrelated and include government policies, technological change, and changes in farm and nonfarm markets (Ahearn & Yee, 2004). In addition, it is recognized that farm size changes very slowly over many years under the influence of both political and social forces; however, the influence of economic factors should not be neglected (Bachman & Christensen, 1967).

Kislev and Peterson (1982) approached farm size structural issues from the perspective that the price ratio of capital and labor was the major determining factor of farm structure. Thus, as the price of capital decreases relative to labor, capital is substituted for labor and farm size increases. Similarly, Ahearn and Yee (2004) in their study established that a decrease in the farm machinery price and hired farm labor wage ratio leads to an increase in farm size. A decrease in this ratio makes farm machinery cheaper relative to farm labor. Purchase of farm machinery generally entails a high fixed cost, which the farmer wants to spread over a higher level of output. An increase in the share of a state's land in non-metropolitan areas increases farm size. This indicates that with less competition for land for urban uses, farm sizes are larger. Increased specialization and the use of production contracting were not significant in explaining farm size.

Previous research has shown that off-farm work is one of the most important determinants of farm growth (Ahituv & Kimhi, 2006; Upton & Haworth, 1987; Weiss, 1999). Increased off-work is associated with a smaller farm size, as more time spent working off-farm means less time available for working on the farm (Ahearn & Yee, 2004). Where part time and full time nonfarm employment opportunities are growing, a small farm structure tends to be strong. This suggests that farm-related earnings may be declining in relative importance to the nonfarm earnings of family members. As a result, where there are few nonfarm employment opportunities, farm producers are forced to expand farm operations to earn comparable earnings. This perspective of the opportunity cost of farm labor stresses the reduced pressure for farm earnings if other family earning potential is high (Atwood, Helmers, & Shaik, 2002).

As revealed by Ahearn and Yee (2004), key determinants of farm size are technological factors, public policies (such as research and development, extension, and commodity payments), farm organizational characteristics, operator demographic characteristics (including engagement in off-farm work), and urban influence. Other factors affecting farm size as shown by Huang (1973) and Lianos and Parliarou (1986) are resource abundance, significance of agriculture, relative factor proportion, terms of trade, and institutional factors. Farm size determined by resource availability increases non-agricultural employment opportunities and changes in factor proportions over time.

Methodology

Data Requirements and Sources

Data required for the paper were mainly secondary. The data employed were: farm size; socio-demographic characteristics of cassava-based farmers; access to government support programs, credit, and extension services; household nonfarm income-generating activities; land ownership; and family and hired labor. The data were sourced from the Living Standards Measurement Study (LSMS), an integrated survey of agricultural data which was conducted in 2010/11 and 2015/16 covering all 36 states and the Federal Capital Territory. Information on 271 cassava-based farmers who were interviewed in the LSMS survey was used in the current study and only households represented in both survey periods (2010/11 and 2015/16) were used in the analysis. This was done by merging the two datasets using the unique household identification number as the matching variable.

Analytical Technique

The analytical methods used include descriptive statistics, Markov chain analysis, and a random effects Poisson model. The descriptive analysis involved the use of percentages, frequency distribution, and measures of central tendencies and dispersion.

Markov Chain Analysis

A Markov chain model was used to model changes in the size of farm allotted to cassava production by the sampled farmers. Weng (2001) defined a chain as a stochastic process having the property that the value of the process at time t, X_t, depends only on its value at time $t-1$, X_{t-1}, and not on the sequence of values X_{t-2}, X_{t-3}, …, X_0 that the process passed through in arriving at X_{t-1}. It can be expressed using Eq. (1):

$$P\{X_t = a_j | X_0 = a_0, X_1 = a_1, \ldots, X_{t-1} = a_i\} = P\{X_t = a_j | X_{t-1} = a_i\} \quad (1)$$

As shown by Weng (2001), Markov chain analysis is disaggregated as follows.

Regarding the change process as one which is discrete in time ($t = 0, 1, 2 \ldots$), the $P\{X_t = a_j | X_{t-1} = a_i\}$, known as the one-step transitional probability, gives the probability that the process makes the transition from state a_i to state a_j in one time period. When ℓ steps are needed to implement this transition, the $P\{X_t = a_j | X_{t-1} = a_i\}$ is then called the ℓ-step transition probability, $P_{ij}^{(\ell)}$. If the $P_{ij}^{(\ell)}$ is independent of times and dependent only upon states a_i, a_j and ℓ, then the Markov chain is said to be homogeneous. As modified and adopted from Ayantoye, Yusuf, Omonona, and Amao (2011), the treatment of Markov chains was limited to first-order homogeneous Markov chains (Table 1). The items in the transition matrix are converted into probability values of upgrading, downgrading or remaining on the same farm size by dividing each item by the corresponding row total to give the transition probability matrix below:

$$\begin{bmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{bmatrix}$$

The proportion of households that will be in each category in the periods of interest is given by:

$$P_{(K)} = P_{(0)} P_{ij}^{k}$$

where k is the time period, $P_{(o)}$ is the vector of initial probability, and P_{ij} is the probability of cassava-based farmers transitioning from *i* to *j* (one farm size category to the other).

The long run equilibrium, which is attained when the total number of farmers entering a given farm category equals the number of farmers exiting, is expressed as follows:

$$eP = e$$

$$(e_1, e_2, e_3) \begin{bmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{bmatrix} = (e_1, e_2, e_3)$$

Table 1
First-order Markov model for farm size transitions

Period 1 (t)	Period 2 (t + 1)		
	Small scale	Medium scale	Large scale
Small scale	n_{11}	n_{12}	n_{13}
Medium scale	n_{21}	n_{22}	n_{23}
Large scale	n_{31}	n_{32}	n_{33}
Total	n_1	n_2	n_3

Source: Adapted from Ayantoye et al. (2011).

Solving the matrix above gives the values of e_1, e_2, e_3 which are the proportions of cassava farmers who will be producing on a small, medium, or large scale in the long run; e_1 represents the long term projection for small scale production, e_2 is the projection for production on a medium scale in the long run, e_3 is long run forecast for large scale production, and P_{ij} represents the transition probability matrix.

Random Effects Poisson Model

The random effects Poisson model was used to analyze the determinants of changes in farm size among cassava-based farmers in Nigeria. Panel data regression analysis was employed because it is best suited to study "dynamics of change and more complicated behavioral models, and has the capacity of enriching empirical analysis in ways that may not be possible for ordinary regression or multiple analysis" (Akintoye, 2008). However, this analysis was preceded by a Hausman test to decide between the fixed or random effects. The results from the Hausman test (where Prob > chi^2 was not significant) revealed the random effects model as the preferred model. The random effects Poisson model with intercept heterogeneity as developed by Hausman, Hall, and Griliches (1984) is given as:

$$\gamma_{it} = \exp\left(X'_{it}\beta + \varepsilon_i\right) \quad i = 1, \ldots N,\ t = 1, \ldots,\ d_i$$

where X'_{it} is row j of the model matrix X_i and β is a vector of unknown parameters.

As shown by Seco and Aubyn (2003), let

$$\varepsilon_i \sim P(u_i)$$

$$u_i > 0,$$

And independent for different *i's*.

Therefore $E(\varepsilon_i) = var(\varepsilon_i) = u_i, i = 1, \ldots, N.$

And according to Seco and Aubyn (2003), γ is the vector of all random variables and it is an D × 1 vector which is divided into N components γ_i, each representing a random d_i-vector, i = 1, …, N.

$$\gamma = \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \vdots \\ \gamma_N \end{bmatrix} = \begin{bmatrix} \gamma_{11} \\ \gamma_{12} \\ \vdots \\ \gamma_{1d1} \\ \gamma_{21} \\ \vdots \\ \gamma_{NdN} \end{bmatrix}$$

D represents the total number of observations, $D = \sum_{i=1}^{N} d_i$. Note that cov $(\gamma_{it}, \gamma_{ij}) \neq 0$, $t \neq j$. In other words, within the same group, γ_{it} for t − 1, …, d_i are not independent while they are independent for different *i's* as they represent separate groups. The study thus adopted the above model as follows:

$$\begin{aligned} FS_{it} &= \alpha_{it} + \alpha_1 GE_{it} + \alpha_2 AG_{it} + \alpha_3 HS_{it} + \alpha_4 AO_{it} + \alpha_5 CR_{it} \\ &+ \alpha_6 CI_{it} + \alpha_7 DR_{it} + \alpha_8 DM_{it} + \alpha_9 ES_{it} + \alpha_{10} HL_{it} \\ &+ \alpha_{11} FI_{it} + \alpha_{12} LO_{it} + \alpha_{14} SN_{it} + u_{it} + \varepsilon_{it} \end{aligned}$$

where α_i are parameters, t = 1, 2 is the time period, I = 1, 2 …, 272 is the cross-sectional units, u and ε are the between-entity and within-entity error terms, respectively, *FS*, the dependent variable, represents change in farm size from 2010/2011 to 2015/2016, And Gender (GE), Age (AG), Household size (HS), Asset Ownership (AO), Credit access (CR), Cassava income (CI), Distance to road (DR), Distance to market (DM), Extension service (ES) Hired labor (HL), Farm Income (FI), Land ownership (LO) and Safety nets (SN) are the explanatory variables.

The choice of the explanatory variables was dictated by theoretical behavior hypotheses, empirical literature, and data availability. Socio-economic factors, farm organizational characteristics, technological factors, and operator demographic characteristics (including off-farm work) have been documented in several studies (Ahearn & Yee, 2004; Ahituv & Kimhi, 2006; Ohene-Yankyera, 2004; Upton & Haworth, 1987; Weiss, 1999) as pivotal factors that affect transition in farm size. An overview of the determinants and their expected signs with respect to the different transition probabilities is given in Table 2.

Results and Discussion

Descriptive Analysis of Socio-economic Demographics of Respondents

Table 3 presents the socioeconomic characteristics of the cassava-based farmers. The results revealed that majority of the households were headed by a male, aged 50 years and above, with 1–6 years of formal education. This indicates that a higher proportion of the sampled household heads had a low level of education and was not in their active and productive years. A low level of education affects negatively farmers' access to institutionally related services such as access to credit and extension services. Poorly educated farmers tend to be conservative and this therefore lowers their adoption of new technologies. The average

Table 2
Definition of variables used in empirical analysis

Variable	Measure	Expected sign
Sex of household head	Male = 1, Female = 0	±
Age of household head	Years	±
Household size	No. of individuals	±
Asset ownership	No. of asset owned	±
Educational level of household head	Years	±
Cassava income	Naira	+
Access to credit	Access = 1, otherwise = 0	+
Access to extension services	Access to extension services = 1, otherwise = 0	+
Distance to road	Km	−
Non-farm income	Naira	+
Hired labor	Mandays	+
Farm income	Naira	+
Land ownership	Purchased = 1 otherwise = 0	±
Access to safety nets	Access to safety net = 1, otherwise = 0	+

Source: Authors' compilation

Table 3
Socioeconomic characteristics of sampled farmers

	Characteristic	Frequency	Percentage (%)
1.	Sex of household head		
	Male	236	87.08
	Female	35	12.92
2.	Age of household head (years)		
	≤30	2	0.74
	31–40	34	12.55
	41–50	63	23.25
	>50	172	63.47
	Average: 56.30		
	Standard deviation: 13.17		
3.	Years of formal education		
	0	1	0.45
	1–6	142	63.39
	7–12	61	27.23
	>12	20	8.93
	Average: 8.00		
	Standard deviation: 3.88		
4.	Household size		
	≤4	26	9.59
	5–10	216	79.70
	>10	29	10.70
	Average: 7.44		
	Standard deviation: 2.46		

Source: Authors' compilation

values for age and years of formal education were 56 years and 8 years, respectively.

Households with 5–10 members constituted about 80 percent of the sampled households while those with more than 10 members represented more than one-tenth of the sample. The average household size for cassava-based farmers was about 7 people. This indicated that household size across the sampled farmers was relatively large and this may enhance the release of more family labor provided that household members receive the right incentives.

Markov Chain Analysis of Transition in Farm Size

The movement of cassava-based farmers from one farm size category to another between two time periods (2010 and 2015) is reported in Table 4. Following LSMS (2012), farm size categories cultivated by the cassava farmers were grouped into three: small scale (0.01–1.45 acres), medium scale (1.46–3.57 acres) and large scale (>3.58 acres). The results showed that 237 cassava farmers who cultivated cassava on a small scale in 2010/11 remained in the same category in the second period (2015/16) while 8 farmers and 4 farmers upgraded from small scale to medium and large scales, respectively, in the subsequent period. The

Table 4
Transition matrix for farm sizes

Farm size category (acres) 2010	2015			
	Small scale	Medium scale	Large scale	Total
Small scale	237	8	4	249
Medium scale	9	4	1	14
Large scale	7	0	1	8
Total	253	12	6	271

Source: Authors' compilation

Table 5
Transition probability matrix for farm sizes

Farm size category (acres) 2010	2015		
	Small scale	Medium scale	Large scale
Small scale	0.952	0.032	0.016
Medium scale	0.643	0.286	0.071
Large scale	0.875	0.000	0.125

Source: Authors' compilation

second row shows the number of farmers who downgraded from medium scale to small scale (9), remained in the same category (4), and moved from medium to large scale (1) in the second period. The third row shows the number of farmers that downgraded from large scale to small scale (7) and those who maintained large scale production in the subsequent period (1). No respondents downgraded from large to medium scale production in 2015.

The transition probability matrix corresponding to the transition matrix of Table 4 is shown in Table 5. The entries in the cells on the principal diagonal of Table 5 indicate the tendency for the farmers to remain within a given category of farm size. The entries showed that the probabilities of remaining on a small scale and downgrading were much higher among the cassava-based farmers, with 95 percent of the small scale farmers remaining in the small scale category while 64 percent and 88 percent moved to small scale from medium scale and large scale, respectively. The proportions of farmers that upgraded or remained at the medium scale and large scale in the second period were very low.

Further analysis of the transition probability matrix showed that in the short run, the probabilities that a farmer will produce cassava on a small, medium or large scale were 92 percent, 5 percent and 3 percent, respectively. At equilibrium, that is in the long run (using $eP = e$ to solve for long run changes), the percentage of cassava-based farmers producing on a small scale will be 95.5 percent while the percentages of those producing at medium and large scales will be 4.3 percent and 0.24 percent, respectively. In summary, the Markov chain analysis revealed that cassava-based farmers in Nigeria had a strong tendency toward maintaining a small scale level of cassava production and as there was little chance of moving to a higher category of farm size this may hamper the realization of the goals and objectives of the Cassava Transformation Program organized by the Federal Government.

Determinants of Farm Size Transition

The study estimated a random effects Poisson model to establish the factors influencing farm size transition among cassava farmers in Nigeria. The results in Table 6 show the effect of changes in the explanatory variables on the probabilities of transitioning to different farm sizes. The likelihood function of the model was −290.699. The model had a chi-square (χ^2) value of 183.10 and was statistically significant at $p < .001$. This indicated that the data had a good fit to the model. The model consisted of 14 explanatory variables and the results of the estimated equations

Table 6
Random effects Poisson model showing the determinants of changes in farm size

Variable	Coefficient	Standard error	t-value
Sex	1.325	0.6546	2.02**
Age	−0.0244	0.0077	−3.17***
Household size	0.1255	0.0463	2.71***
Asset ownership	−0.0198	0.0093	−2.12**
Education	−0.0765	0.0278	−2.75***
Cassava income	3.53e−06	5.90e−07	5.94***
Access to credit	−0.8201	0.4146	−1.98**
Access to extension service	0.2391	0.4340	0.55
Distance to road	−0.0853	0.0234	−3.65***
Non-farm income	−5.5e−07	7.97e−07	−0.70
Hired labor	0.0487	0.0098	4.96***
Farm income	−4.75e−07	4.87e−07	−0.98
Land ownership	−0.4585	0.5505	−0.83
Access to safety nets	−0.4507	1.3231	−0.34
Constant	−0.4852	0.8630	−0.56
Diagnostics			
Wald Chi square	182.97		
Prob > chi^2	.000		
Log likelihood	−288.225		
No of observation	226		

***, ** denote significant levels at 1% and 5%, respectively

are discussed in terms of the significance and signs of the parameters.

Out of the 14 exogenous variables considered in the study, nine postulated variables determined the probability of changing farm size. The results (Table 6) revealed significant gender differences in the probability of changing farm size among cassava-based farmers. As the proportion of male cassava-based farmers increased, the probability of changing farm size increased by over 100 percent. The age of the household head also had a negative, significant relationship with farm size. As farmers' advance in age, the probability of changing their farm size increased by 2.3 percent. This result was consistent with that of Katchova and Ahearn (2015) who examined farm expansion by age and found that younger farmers tended to expand over time in contrast to older farmers.

The results also showed a 12.6 percent increase in the area cultivated per household worker as the household size increased. This can be explained in terms of increased family labor which may create the need for farm expansion which can only be achieved when household members receive sufficient and higher incentives for working on family plots than participating in other household activities. However, this result differed from that of Shapiro (1990) who observed a decline in farm size as household size increased, Asset ownership has been used as a proxy for household income (Filmer & Pritchett, 2001), and hence a measure of household welfare (Tatwangire, 2011), so a positive relationship is expected between asset ownership and farm expansion. However, the results in Table 6 show a dissimilar relationship where asset ownership is seen to have a negative and significant relationship with farm size. Though not significant, similar relationships were also observed for farm income and non-farm income. The situation experienced in the study area may be that following an increase in access to physical assets, farmers divert resources to the production of other crops or their non-farm activities.

Farmers' education also had a negative and significant relationship with farm size. This suggested that as farmers acquire additional years of education, they tend to drift toward paid jobs which consequently reduce the amount of time available for farm activities. By implication, this imposes a downward trend on area of land cultivated as farmers tend to expand farm operations in cases where non-farm employment opportunities do not abound in order to earn comparable income.

As expected, cassava income was shown to be positively related to the probability of increasing farm size. As income from selling cassava increased, farmers were incentivized to increase the area allotted to cassava in the subsequent seasons. This finding was in concordance with the study conducted by Ben-Chendo, Korie, Essin, and Uhuegbulem (2014) where income was shown to have positive relationship with land holding size.

Other factors also influenced farm size. A unit increase in famers' access to credit was found to decrease farm size by approximately 82 percent. This inverse relationship can be explained by the absence of appropriate segmentation between the poor and rich farmers in the credit market. The cost and access to credit both have an inverse relationship with farm size as credit markets in many less-developed countries are characterized by undeveloped financial institutions (meaning local money lenders making high interest rate loans to small farmers, while lower interest rate, "institutional" credit goes to the richer peasants) (Cornia, 1985). As the household distance to major roads increased, the probability of expanding land holding size decreased by 8.5 percent. Increased distance to a road from farm sites affects accessibility to markets and given the perishability of cassava tubers, farmers are disincentivized and consequently this may prompt them to reduce the size allotted to cassava production rather than maintaining the same size category in subsequent planting periods.

The coefficient of hired labor was positively related to the farm size. Since it is expected that family labor will be relatively abundant on small farms (Newell, Pandya, & Symons, 1997), an increase in hired labor can only suggest farm expansion. However, the use of hired labor does not increase indefinitely, as hired labor can only be employed until its marginal product equates to the minimum wage. The positive relationship established between hired labor and farm size was further supported by Ohene-Yankyera (2004) who revealed that households with the ability to mobilize labor to fulfill the extra demand for labor imposed by weeding and other post-soil preparation activities can operate larger farms.

Conclusion and Recommendations

The study employed descriptive statistics, the Markov chain process, and a random effects Poisson model to analyze the socioeconomic characteristics of cassava-based farmers and revealed farm size transition between two time periods as well as establishing the determinants of changes in farm size. The Markov analysis revealed that cassava-based farmers in Nigeria are more likely to maintain a small scale level of cassava production or move to small scale from past medium scale or large scale production. Also, in the long run, the percentages of farmers producing at a small scale, medium and large scale will be 95.5 percent, 4.28 percent, and 0.24 percent, respectively. The low likelihood of moving to a higher category of farm size may hamper the realization of the goals and objectives of cassava transformation program organized by the Federal Government. Key determinants of transition in farm size were sex, age, household size, asset ownership, education, cassava income, distance to main road, and access to credit.

Due to the perishability and poor marketing of cassava in Nigeria, most farmers grow cassava on a small scale and are involved in panic selling. Efforts should be geared toward integrating more cassava farmers into the Cassava Transformation Program as they would then be able to link demand for cassava-based products in the industrial, export, and traditional food sectors to increase the reliable supply and thereby enhance commercial production of cassava. Owing to a reasonable degree of success recorded by the Presidential Initiative, the Cassava Transformation Program among others, consistency in agricultural policies and programs should be of the utmost importance. Therefore, successive governments should ensure continuity of on-going operational and result-oriented agricultural programs as these become important due to lack of consistency in Nigeria's agricultural policies with an overarching effect on the farmers. In the same vein, policies on land tenure in Nigeria should also be revised in favor of farmers, as most tenancy arrangements discourage their long term plans regarding agricultural production.

Conflict of Interest

There is no conflict of interest.

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