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Determinants of Market Participation among Maize Producers in Oyo State, Nigeria

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Authors' contributions

This work was carried out in collaboration between all the authors. Author AIA designed the study, author IBO performed the statistical analysis, and author ROS assisted with literature search. Authors AIA and IBO were both involved in writing the first and final draft of the manuscript submitted for publication.

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ABSTRACT

Smallholder farmers constitute the largest share of farm households in Nigeria and many of them are poor. A way out of poverty for them is to address market related problems. In this paper, the market options available to these farmers, as well as market related factors that are problematic were investigated. Primary data were collected from 100 maize farmers in Saki Agricultural Zone of Oyo State, Nigeria. Seventy five maize farmers participate in the market while 25 farmers produce only for subsistence. The farmers are well experienced and cultivate about 5.6 hectares of land. About 90% do not have access to market while 64% do not have access to good roads. The study identified 4 market options and the most patronized was the farm gate market option. The censored tobit result, market price show that, member of a producer group, farm size, educational and total maize produced, road condition, primary occupation and transaction costs significantly affect farmers' market participation. Policy interventions that seek to improve these factors are very important to market participation.

Keywords: Maize farmers; market participation; tobit model; Nigeria.

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1. INTRODUCTION

Markets are prerequisites for enhancing agriculture-based economic growth and increasing rural incomes in the medium term particularly for the rural poor households. Subsistence food crop production cannot improve rural incomes without market-oriented production systems. These require the intensification of agricultural production systems, increased commercialization and specialization in higher-value crops. And these must be built upon the establishment of efficient and well-functioning markets and trade systems–ones that keep transaction costs low, minimize risk, extend information to all players and that do not either exclude or work contrary to the interests of the poor–especially those living in areas of marginal productivity and weak infrastructure.

Meanwhile, market participation has been defined differently by various authors. It is regarded as participation in any market related activity which promotes the sale of produce [1-3], as the individual household's economic transactions with others in cash or kind [4] or commercialization [5]. Although, there is a high potential for rural farmers to derive livelihood from market-oriented agriculture and improve their standard of living, they face difficulties in accessing markets where they can obtain agricultural inputs, consumer goods and sell their produce [6]. These difficulties include bad feeder roads, poor storage facilities, poor packaging of farm produce, high transaction costs, and lack of access to market information among others. The rural communities often rely on human transport which is inadequate and inefficient. [7] stated that agricultural markets are not well-developed in Nigeria and this has remained so for many years.

The emergence of private-sector market intermediaries ranging from small scale informal traders to large ones to fill the vacuum left by the abolition of marketing boards has generally been a disadvantage to farmers. As a result, farmers suffer from market failure in which case, they do not get economically optimal price for their produce. A major reason why some farmers who produce surplus remain trapped in the poverty cycle is the lack of access to profitable markets [8]. Also, farmers are forced to sell to the buyers of convenience at the buyer's price. They often lack business and negotiating experience and collective bargaining skill to give them the power needed to interact on equal terms with strong market intermediaries thus resulting in poor terms of exchange.

Maize production, marketing and consumption are crucial for both actors in agriculture and the industrial sectors. This paper therefore examines maize farmers' access and level of participation in agricultural markets.

Specifically the paper addresses the following objectives:

- Identify maize farmers' socioeconomic characteristics;
- Examine maize output market options available to farm households; and
- Assess the determinants of market participation.

2. THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 Theory of Utility

In economics, utility is a measure of relative satisfaction. Given this measure, one may speak meaningfully of increasing or decreasing utility, and thereby explain economic

behaviour in terms of attempts to increase one's utility. Utility is often modeled to be affected by consumption of various goods and services, possession of wealth and spending of leisure time. Farmers cultivate land so as to satisfy his physiological needs of feeding, and/or to acquire more wealth by commercializing his farming activities.

Utility functions give us a way to measure producer's preferences for wealth and the amount of risk they are willing to undertake in the hope of attaining greater wealth. Farm households make decisions about what crop to grow, how much to grow, when and where to sell the output and so on in such a manner that they get maximum satisfaction from their labour in term of returns. Following [3,9], we consider a farm household maximizing utility (u) by deciding on the consumption of k goods (c_k), production of k goods (q_k), and sales of k goods (s_k). That is, using i inputs for each product k (x_{ik}) the household can produce (q_k) which can either be sold (s_k) or consumed (c_k).

Sales fits into the utility function through revenue generated from sales ($p_k s_k$), the sum of which is used to purchase other goods (represented by R_k). That is, the household will purchase an equivalent of R_k in other goods. The neo-classical subjective equilibrium for a commercializing (or market participating) household will then be given by the following:

$$\text{Max } L = U(C_k, R_k ; H_u) \tag{1}$$

Subject to:

$$\mu_k \left[\sum_{k=1}^{N} p_k (q_k - s_k) - R_k - p_k c_k + E \right] \tag{2}$$

$$\lambda \left[p_k (q_k - s_k) - p_k c_k - p_i X_{ik} + R_k + e_k \right] \tag{3}$$

$$+ \phi G(q_k, X_{ik} ; H_q) \tag{4}$$

Where;

H_u is a vector of the demographic characteristics that serve to move the area of the utility in the utility consumption-leisure space;

μ, λ and ϕ are the Lagrange multipliers associated with the full-income constraint, resource balance equilibria and technology constraint respectively. The household jointly makes its production, consumption and market participation decision subject to a number of constraints. The full income constraint (2) states that the equivalent of total expenditure on all purchases (or equivalent) must not exceed revenues from all sales and transfers. The resource equilibria (3) indicates that, for each k^{th} goods, the value of what is consumed, sold, and used as inputs should not exceed the value of what is produced, bought plus the endowment of the good k. The production technology (4) relates inputs (x_i) required to produce output (q_k) vis-à-vis the producers' demographic characteristics (H_q).

A farmer's choice as to whether or not to participate in crop markets as a seller depends on the utility derived from participation. Thus, we represent that choice by the indicator variable Y, which takes value one if the household enters the market for a crop, and zero otherwise.

Thus Y_s=1 if the household sells the maize crop and 0 if not. These choices will be guided by net returns to market participation.

Following [10], each household faces a market price for crop, and transactions costs and household-specific characteristics. Transaction costs depend on both public goods and services (e.g. radio broadcast of prices that affects search costs, extension service information on crop marketing strategies, distance to market) while household-specific characteristics include (e.g., educational attainment, gender, age, negotiating skills, its assets, and liquidity. The question is how does participation in crop sales markets varies with private assets, and public goods and services and institutional factors so as to address the core policy questions.

2.2 Econometric Approaches to Modeling Market Participation

Heckman sample selection models, double-hurdle models and Tobit models have been used to examine crop market participation. When sample selection is a problem, [11] can be followed as done in the work of [12-14]. Heckman's model employs a probit analysis to estimate the probability of market participation and the Inverse Mills Ratio computed from the probit regression is used with other explanatory variables to explain variation in the continuous, non-zero outcome variable (example sales volumes). Heckman model corrects for the fact that the non-selling group is not a random sub-sample of the population. The basic assumption of the Heckman model is that a certain value of the dependent variable is observed provided that it is higher than a certain threshold. Variables affecting the 'quantity decision' may affect the discrete participation decision while some factors (such as costs of market participation due to transport costs, display fees, license fee) that affect the discrete participation decision will in theory not affect the continuous outcome variable. The Tobit model contrasts the Heckman model as a single estimation which determines the choice between positive and zero sales, and the amount of sales given market participation. The Tobit model imposes the restriction that the same factors have the same effects upon the decisions to participate in the market and the quantity to be sold. Both Heckman model and the censored Tobit model described in Greene [15] were employed in this paper.

3. MATERIALS AND METHOD

3.1 Study Area and Sampling Method

The study was carried out in Saki East and Saki West Local Government Areas (LGAs) of Oyo State. These LGAs areas are part of the Oyo North Agricultural Zone of the State within the derived savanna. It is a major agricultural zone reputed for being the food basket of the state. Several arable crops are cultivated which include cassava, maize and yam. The study employed the use of primary data collected from a sample of 100 maize producers through a multistage sampling technique. The first stage is the selection of the two local government areas in the zone. In the second stage, two wards were selected out of the eleven wards in each LGA. The selection of wards was based on the number of farming households in the ward. Lastly, maize producers were randomly selected based on probability proportionate to size from each ward thereby giving a total of 100 maize producers from the four wards. Data were collected on socioeconomic characteristics of the farmers, farm characteristics, crop output and sales.

3.2 Models Specification

Following the work of [16], the Heckman model consists of a linear equation for quantity sold:

$$y_i^* = \beta_0 + X_{1i}\beta_1 + \varepsilon_{1i} \quad (5)$$

y_i^*=quantity of maize sold in kg. These quantities are observed only for those households that participate in the market.

β_{1i} =parameters to be estimated.
ε_{1i}=error term
X_i =vector of explanatory variables
X_1 =Age of the household head in years
X_2 =Educational status of the household head (Have formal education=1,0 otherwise)
X_3 =Primary occupation of the household head (Farming=1,0 otherwise)
X_4 =Total maize output last year in Kg
X_5 =Income from non-farm activities in Naira
X_6 =Membership of producer group (Yes=1,0 Otherwise)
X_7 =Distance to the market in Km
X_8 =Road condition to the market (Good=1,0 Otherwise)
X_9 =Farm size in hectare
X_{10}=Ownership of vehicle (Yes=1,0 Otherwise)
X_{11}=Dependency ratio
X_{12}=Transaction costs (transaction costs are proxied by the costs of transportation measured in Naira)
X_{13}=Access to extension agent (Yes=1,0 Otherwise)
X_{14}=Market price of maize per kilogram in Naira

The first step of the model is the standard Probit model and it describes the probability of market participation h_i;

$$h_i^* = X_{2i}\beta_2 + \varepsilon_{2i} \quad (6)$$

$$h_i = \begin{cases} 1 & if \quad h_i^* > 0 \\ 0 & if \quad h_i^* \leq 0 \end{cases}$$

Where h_i is the household's participation in the maize market. The sign and the magnitude of the coefficients for the same variable may be very different across the two scenarios as depicted in equations 5 and 6; however X_{1i} and X_{2i} should differ in order to achieve identification. This could be achieved by inclusion of extra variables in X_{2i} with respect to X_{1i} [16]. The conditional expected quantity sold given that the household is participating in the maize output market is:

$$E\{y_i / h_i = 1\} = X_{1i}\beta_1 + \sigma_{12}\frac{\phi(X_{2i}\beta_2)}{\varphi(X_{2i}\beta_2)} \quad (7)$$

Where σ_{12} is the covariance between the two error terms, the term $\frac{\phi(X_{2i}\beta_2)}{\varphi(X_{2i}\beta_2)}$ is the inverse mill's ratio called the Heckman's lambda. The second step of the model as developed by [11] is the OLS estimation corrected by the inclusion of Heckman's lambda among the regressors and is indicated as follow:

$$y_i = X_{1i}\beta_1 + \sigma_{12}\frac{\phi(X_{2i}\beta_2)}{\varphi(X_{2i}\beta_2)} + \eta_i \quad (8)$$

3.3 Tobit Model

[23] devised what became known as the Tobit model or censored normal regression model for situations in which *y* is observed for values greater than 0 but is not observed (i.e. It's censored) for values of zero or less.

The standard Tobit model is defined as:

$$y_i^* = \beta_0 + X_i\beta + \varepsilon_i \quad (9)$$

Where $\varepsilon_i \approx N(0,\sigma^2)$, y_i^* is a latent variable that is observed for values greater than 0 and censored otherwise. The observed y is defined by the following measurement equations:

$$y_i = 0 \qquad \text{if } y_i^* = \beta_0 + X_i\beta + \varepsilon_i \le 0 \quad (10)$$

$$y_i = X_i\beta + \varepsilon_i \qquad \text{if } y_i^* = \beta_0 + X_i\beta + \varepsilon_i > 0 \quad (11)$$

This can however be written as shown below if the data is censored at zero.

$$y_i = \begin{cases} y^* & if \quad y^* > 0 \\ 0 & if \quad y^* \le 0 \end{cases} \quad (12)$$

The y_i represents the volume of sales in kilogram while the X_i represents the explanatory variables as given above.

3.4 Marginal Effect for Tobit Model

$$\frac{\partial E(y)}{\partial X_i} = \Phi\left(\frac{Xi\beta_i}{\sigma}\right)\beta_i \quad (13)$$

This indicates how a one unit change in an independent variable X_i affects observations.

4. RESULTS AND DISCUSSION

4.1 Socioeconomic Characteristics of Farm Households

Table 2 summarizes the distribution of maize farmers by socioeconomic characteristics. About 89% of the households are male-headed and 78% have farming as their primary occupation. The average age of the household head is 53 years which implies that an average farm household head is still productive and active. The average years of formal schooling of the household heads is 7 years which is slightly higher than the national average of 6 years. It then means that the average farmer has at least primary school education. This is consistent with the result found by [24] in Kwara State. Average household size of 8 persons per household obtained is quite a large number but this is typical of rural areas.

The average farm size is 5.6 hectares and is higher than the national average of 2 hectares, [24]. The average distance to the nearest market is about 10 km and is considered to be far due to bad road condition and poor transportation system. The average years of farming experience of approximately 26 years indicates that the farmers are well-experienced. The average transaction cost of maize is ₦9, 565.04 per ton of maize.

Also, 90% of the farmers lack access to market infrastructures like shops and storage facilities, 64% have no access to good roads while 58% lack access to electricity. Due to these factors, farmers have become price takers for their produce. Although the weather condition is considered to be good for cultivation, it also aids breeding and spread of pests and diseases because about 96% of the farmers reported cases of pest infestation on their farm and stores.

Table 1. A priori expectations regarding the behavior of the explanatory variables

Variable	Description	Expected Sign
Educational status	1 for formal education, 0 otherwise	+ [17]
Primary occupation	1 for farming, 0 for non-farm	+ [18]
Output	Total quantity produced (kg)	+ [19]
Non-farm income(NFI)	NFI as a proportion of total income	+ [3]
Membership of producer group	1 for being a member, 0 otherwise	+ [20]
Distance	Distance of farm to market (km)	- [3]
Road condition	1 for good and 0 otherwise	+ [21]
Farm size	Size of farm devoted to maize (ha)	+ [19]
Vehicle ownership	1 for yes, and 0 otherwise	+ [22]
Dependency ratio	Proxy for household size	+ [14]
Transaction cost	Proxy by transportation cost	- [9]
Access to extension	1 for access, 0 otherwise	+ [14]
Market place	Price per unit of output	+ [19]

Table 2. Socioeconomic characteristics of farm households

Variables		Mean	Std dev.
Age of household head in years		52.79	12.24
Years of formal education		7.1	6.017
Household size		8.47	3.283
Farm size in hectares		5.62	3.317
Market distance in Km		9.84	4.688
Years of farming experience		25.75	15.452
Transaction costs in Naira		9565.04	8783.58
		Frequency	**Percentage**
Gender of the household head	Female	11	11.0
	Male	89	89.0
Primary occupation of head	farming	78	78.0
	Non-farming	22	22.0
Have access to market facilities	Yes	10	10.0
	No	90	90.0
Road condition to the market	Good	36	36.0
	Bad	64	64.0
Have access to electricity	Yes	42	42.0
	No	58	58.0
Weather condition	Favourable	95	95.5
	Unfavourable	5	5.0
Pest infestation	Yes	96	96.0
	No	4	4.0

4.2 The Pattern of Market Access

Table 3 shows that only 75 percent of the farmers participated in the maize market while about 25 percent cultivated maize mainly for subsistence. The four market options available to the farmers include farm gate, local market/village market, contract sales and family and friend. The marketing channels taken by maize farmers revealed that more than half of them sell their produce at the farm gate. Although, the price offered is often not competitive, the farmers opt for this due to lack of storage facilities and high transaction cost. This is followed by those selling their produce to family and friends (representing about one-third of the farmers). Only 4 percent patronized the local markets while contract sales are not common. Considering the fact that the most commonly used sales outlet does not guarantee a competitive market price for the farmers, it could serve as a disincentive for market participation or increase in quantity of maize sold and this was also supported by [9] as indicated in Table 1.

Table 3. Farmers' major maize market outlets

Market outlet	Frequency	Percentage
Farm gate	42	56
Local Market	3	4
Contract sales	2	3
Friends and Family	28	37
Total	75	100

5. DETERMINANTS OF MARKET PARTICIPATION

The result presented in Table 4 shows the output of the three models (OLS, Heckman two-step and the tobit models) estimated. The diagnostic statistics of the results from the Heckman estimation revealed that the rho (0.23) indicates absence of correlation between the error terms and the quantity of maize sold but the lambda is insignificant as reflected by t-value (0.30). This implies absence of selection bias in the sample. However, some variables were dropped in the estimation.

The OLS estimated result showed a good fit with R^2 of 0.77 and F-ratio that is significant at 1% level. This implies that the explanatory variables jointly explained about 77% of the variation in the dependent variable. However, only four of the variables (regressors) were significant. The explanatory power of the specified variables as reflected by Pseudo R^2 value (11.72%) of the censored tobit seems to be very low, but this is not uncommon in empirical studies as this Pseudo R^2 cannot be compared and interpreted the same way as R^2 or the adjusted R^2 [15]. Other studies with comparable coefficient of determination include [25] and [26].

Primary occupation refers to the main occupation of the head of a farm household and maize output represents the total maize crop produced last year. The estimated coefficient showed positive relationship with the market participation decision and are statistically different from zero at 5%. It means that those that take farming as their main occupation participate more in the market than any other group. Also, as the output level increases, the higher the level of market participation [19] as indicated in Table 1. This finding is consistent with the work of [16]. The marginal effect of a shift from non-farm jobs to a full-time maize farming will increase the farmer's sales' volume by 722 kg. A unit increase in maize output leads to 37% increase in the likelihood of market participation.

On the effect of farmers' educational status, the estimated coefficient showed a positive relationship with market participation and is significant at 5%. The implication is that, farmers with formal education are more market-oriented, knowledgeable about the prevailing market situations [17] and therefore produce to take advantage of the market environment. Meanwhile, the estimated coefficient for farm size is positive and has significant relationship with market participation. The larger the farm size, the larger the area allocated to maize production thereby increasing the quantity of produce available for sale. A hectare increase in farm size increases the quantity sold by 185.6kg.

However, road condition had a positive influence on market participation decisions, and it is statistically significant at 10% level. It means that an improvement on the condition of rural access roads influences farmers' participation in the market positively [21]. Farmers would be willing to practice commercial farming if road networks are good in the rural areas through which they can move their produce to the market. Good road networks facilitate easy evacuation of farm produce from farms to the points of sale, thus preventing wastages and/or spoilage due to road accident and inability of vehicles to reach farm locations due to bad roads. Again, estimated coefficient for membership of a producer society was positive and significant at 5 percent. This suggests that being a member of producer group motivate farmers to participate in the market through networking and provision of up-to-date information to members. This agrees with the findings of [27].

Table 4. Determinants of market participation

VAR.	OLS (t-value)	HECKMAN		TOBIT (t-value)
		1st; Coef (z-value)	2nd; Coef. (z-value)	
Age of household head	9.068	16.73	-.0477*	-8.300
	(0.86)	(0.94)	(1.78)	(0.59)
Primary occupation	602.15***	1093.08***	-.0682	722.317***
	(3.14)	(3.92)	(0.10)	(3.03)
Total maize output	0.435***	.627***	-.0007	0.367***
	(4.22)	(5.96)	(1.39)	(3.40)
Education status	625.409*	329.83	1.723*	937.556**
	(1.61)	(0.83)	(1.59)	(2.30)
Dependency ratio	-734.79	-1595.36*	1.589	-720.516
	(1.05)	(1.76)	(0.92)	(0.88)
Farm size	84.899	43.519	0.771**	185.612**
	(1.18)	(0.42)	(2.22)	(2.39)
Distance to market	40.592	-37.02	0.295**	12.398
	(1.23)	(0.76)	(2.24)	(0.31)
Road condition	426.255	713.58*	0.614	627.213*
	(1.39)	(1.92)	(0.62)	(1.81)
Membership of producer group	(507.81)	300.41	2.455**	1026.626**
	(1.30)	(0.50)	(2.08)	(2.18)
Revenue from non-farm activities	-.00067	-.00123*	2.27e-07	-0.00062
	(1.10)	(1.71)	(0.15)	(0.86)
Transaction cost	.0245	-.076	.00034**	0.0320*
	(1.23)	(0.83)	(2.57)	(1.57)
Access to extension	14.27	-	0.102	51.209
	(0.04)	-	(0.07)	(0.13)
Market price of maize	34.162***	-	-	65.349***
	(3.03)	-	-	(4.51)
Ownership of vehicles	21.807	-	-	611.537
	(0.05)	-	-	(1.13)
Constant	-2875.19***	-	-	-5104.29***
	(3.23)	-	-	(4.62)
Pro>F=0.000	Mill lambda : 315.978		No. obs.=100	
R2=0.7786	t-value=0.30		LR Chi2 (14)=172.7	
Adj. R2=0.7421	Rho=0.23300		Pro Chi2:0.000	
RME=1303	Sigma=1356.1427		Pseudo R2=0.1172	

*Levels of significance * =10%, ** = 5%, *** = 1%Obs. Summary: 25 left censored at qty=0; 75uncensored obs.*

Transaction cost has a positive relationship with the level of market participation and statistically significant at 10%. This seems counter intuitive and contradicts our a priori expectation. Meanwhile from theory, transaction cost could be fixed or proportional, it is fixed when the cost is invariant with the level of production, and proportional when it varies with the production level. Since only transportation cost was considered in estimating the transaction cost and it is proportional in nature therefore, the higher the volume of sales, the more the costs incurred. Therefore, a unit increase in the volume of sale had a marginal incremental cost of N3.00.

On the market price of maize, this was found to positively influence farm households' market participation decision. It is statistically significant at 1%. This positive relationship between the market price and market participation is consistent with the microeconomic theory of supply; the higher the price, the more the quantity the producers are willing to offer for sales at a particular time. This is also consistent with the findings of [19]. A unit increase in price would lead to a significant increase in quantity (about 65kg) offered for sale, an indication of increase in the level of market participation.

6. CONCLUSION

This study examined various characteristics of maize farmers in Saki Agricultural Zone of Oyo State, Nigeria. The status of rural infrastructure, farmers' accessibility to farm machines and implement, farm inputs and credit facility were investigated and found to be very low. Also, the various market options available to the farmers in the study area and the pattern of access were unraveled. In all, the most patronized market option among the four market options identified was the local market. The channels of distribution of maize output were discovered and that they were not unidirectional. This chain of distribution is considered very important for effective policy recommendations. The study also demonstrated when and where not to use OLS, Heckman and Tobit model. Though Heckman model has a more general applicability which gives a consistent but inefficient parameters estimates, and there is bound to be loss of information when its basic assumption are violated. Heckman model is designed to deal with sample selection bias and according to [28], it is not appropriate for exclusively non-negative data. Tobit model was however found appropriate and used in the paper.

The findings from this study indicated the need to increase yield, make farming more attractive and provide better market, pricing and good infrastructure, education and fostering development of producer groups.

Based on the study findings, some of the suggested policy recommendations include:

- The need to foster development of producer groups and cooperative societies in order to boost farmers' market participation. Government should encourage formation of local or community associations where farmers can have a common voice get information about market situation and assist one another via collective works.
- Effort should be geared at improving the status of rural infrastructures especially road networks. Investment in rural road infrastructure would lead to more traders penetrating the rural areas and this will increase competition and could benefit farmers through higher prices.
- There is the need to build capacity of these farmers through adult literacy programme and government should formulate appropriate policies and programmes that would mobilize and encourage the farmers to go to school. This will better enhance adoption of modern farming techniques that will invariably lead to increased output and incomes for the farmers.
- Incentives in the form of price support should be put in place to encourage the farmers to earn better returns for their effort.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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