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TRANSPORTATION SYSTEM AND OUTPUT MARKET PARTICIPATION NEXUS AMONG YAM PRODUCERS IN SOUTHWEST REGION OF NIGERIA

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Abstract

The study assessed the nexus between the transportation system and output market participation among yam producers in Southwest region of Nigeria. A multistage sampling procedure was used to select 180 respondents for the study. Multinomial logit (MNL), Market Participation Index (MPI) and Double-hurdle Regression model were employed for the analysis of data. The MPI result showed that about 87% of the respondents participated in yam market in the area. The most commonly subscribed modes of transportation were pick-up van (55%), motor cycle (26%) and head porterage (7%). The results of the MNL showed that farming experience, extension services, distance, household size and market participation were the factors influencing the preference for the mode of transportation used by the farmers. Again, the results from the double-hurdle regression identified membership of cooperative society, farming experience, access to market information and mode of transportation as the factors that determine the decision to participate and the rate of participating in yam market. Therefore, the study concludes that there is a synergy between transportation system and output market participation which has significant impact on the production and availability of food (yam) in the market.

Key words**:** *double-hurdle, market, multinomial logit, transportation, yam, Nigeria*

INTRODUCTION

Nigeria is naturally favoured in the production of root and tuber crops which makes her the highest producer of cassava and yam in the world [13, 19]. After cassava, yam is the top agricultural product produced in Nigeria with about 47,532 thousand tonnes as at 2018 [19]. Africa produces most of the yam in the world with over 70% of the production from Nigeria [27]. Yam is mainly grown in the central and southern parts of Nigeria [13, 5], with average area of nearly 6 million hectares as at 2018. It is a staple food that has socio-cultural recognition in Nigeria and contains about 21% dietary fibre, rich in carbohydrate, vitamin C, and essential minerals [13, 34]. According to [11, 30], 100g of yam contain 494kj of energy, 27.9g of carbohydrate, and 4.1g of dietary fibre with nearly 200 calories of energy per day per capita. According to [44], yam production has significant relevance in Nigeria's economy in terms of food consumption, sources of earnings, and employment opportunities. Also, yam belongs to the family *Dioscorea* with over 600 species [26], out of which white yam (*Dioscorea rotundata*) is the most socially and economically valued species in most parts of Nigeria [44]. In attempt to convey agricultural products to the markets makes transportation system a key factor in production and marketing stages, most especially in root and tuber crops as a result of their bulkiness. The tasks of transportation and marketing are normally carried out by the farmers and traders [25, 44].

Again, transportation and logistics form integral part of the economy, and these two are the propelling forces upon which industries and societies all over the world function. Transportation is very crucial in trade and commerce and as well help in globalization. It also forms one of the factors that determine competitiveness, efficiency and effectiveness of the commodity pricing and market. Again, it is viewed by [8] as a requisite to economic development most especially in Nigeria and other developing countries. It is a major component of rural infrastructure which provides accessibility to market and other social amenities such as schools, health services, and institutions [47, 8]. According to [3], sustainable rural development is incomplete without transportation system which serves as a main link for the market of goods and services; movement of people; dissemination of information, and the advancement of rural economy in developing countries. Its importance in agriculture as in the other sectors of the economy cannot be over-emphasized. It is the only way by which input resources can be brought to the farm, and where food and other resources produced in the farm to the market, and various homes [39]. In agriculture, transport is the engine behind market formation most especially in the rural settlements, and also contributed immensely in connecting socio-cultural and geographical areas for economic activities [43, 39]. Again, [28, 4] opined that a good transportation system is not only provided cheap access to market for agricultural products but significantly reduced the cost of the products, and as well create sustainable livelihood to the people.

Moreso, transportation system plays indispensable role in all agricultural value chains, starting from production through processing and marketing to the final consumers. Therefore, market participation can be enhanced through a functioning transport system. Market participation allows producers (farmers) to sell their products thereby bringing the products to the end-users (consumers) and as well accrue better revenue [32]. According to [31, 32], market participation and extent of participation are determined by improved access to markets through good roads and means of transportation. [36] also affirmed that development of effective and efficient agribusiness value chain is a function of market orientation and participation most especially among agricultural producers including yam farmers. Nigeria and other developing countries are still known for the subsistence nature of agricultural production including yam. Most of them have not seen farming enterprise as a business rather as a routine of life. Market participation is pivotal to change farmers' orientation toward farming in the areas of production and marketing of their products. Also, participation in output and input markets will not only cause sustainable productivity and profitability but tremendously reduce rural poverty among the farming households [12, 1]. [32] opined that the overall goal of sustainable agriculture, food security, and poverty alleviation can be achieved through marketing of agricultural products especially among the yam producers being a crop that are highly demanded for in Nigeria.

Problem Statement

Several studies in literature have established the complimentary relationship between transportation system and agricultural sector; yam production inclusive [10, 43, 2, 17, 30]. [42, 29] opined that mobility of agricultural products has been impeded by bad roads and lack of transportation facilities in Nigeria most especially in the rural areas. This has significant effect on the efficiency of the marketing system, productivity, income and level of poverty in these areas [38, 6, 43, 2]. According to [30], yam is a bulky semi-perishable good, and moving it from farm through farm gate to the rural and urban markets needs strong transportation system. Also, the distance to most of the yam farms coupled with rough roads has led to burdensome farm trips, increase in transaction cost, and damage of yam tubers, thereby making farmers to run at a loss [29, 43]. It was also reported by [29, 30] that most crops including yam remain un-harvested or become spoilt once harvested due to inadequate transportation system. The problems have escalated to poor prices, market price instability, consumers' price increase, and decrease returns to the yam farmers. Again, limited accessibility, inadequate rural roads and high transaction cost have constrained farmers from getting important input resources, new technologies, to expand the production scale and as well transport any excess after harvest [39]. Again, to the best of my knowledge, empirical studies on the nexus between transportation system and output market participation among yam producers appear to be scarce in Nigeria, especially in the Southwestern Nigeria in which Ondo State is inclusive as one of the top yam producers. However, past studies have separately established the relevance of transportation system and market participation in agriculture but little or none has investigated the relationship between the two subject matters particularly among yam producers in Nigeria. Also, most of the studies on market participation failed to investigate the two scenarios of decision-making process: the decision to participate in the market, and the rate or degree of participating in the market using double hurdle regression. Moreso, to the best knowledge of the author, no study has been found examining factors responsible for the choice of mode of transportation used by the farmers in conveying agricultural products to either local or urban markets. Therefore, it is against this background that the study investigates the nexus between transportation system and output market participation among the yam farmers in Ondo State, Nigeria. The specific objectives of the study are to: ascertain the types and condition of roads leading to the farms; examine the modes of transportation; determine factors influencing the choice of transportation modes used by the farmers; and determine the effect of transportation on the decision to market participation and the rate of market participation in the area.

Rationale for the Study

Examining the nexus between transportation system and output market participation is very crucial at a period Nigeria is advocating for a paradigm shift from the sole economy of crude oil. Due to the continual dwindling prices of crude oil in the world market, Nigeria has considered agriculture as the top option for economic diversification. The potential for root and tuber crops in Nigeria is not debatable given the numerous benefits most especially in terms of food consumption and food security. Specifically, yam has various value chains and it can be processed into different forms such as flour, paste, and as well serves as raw material for some industries. Therefore, improved access to market in yam production will open up more entrepreneurial activities and as well encourage more livelihoods. The study will also encourage the yam farmers to be market oriented and increase the proportion of yam supplied to the market. The demand for yam has always be on increase among the common food crops in Nigeria, improving transportation system and level of output market participation will significantly go beyond meeting domestic demand but accrue some foreign earnings as the value of exports is still low [19]. Since the future of yam is economically promising, it will be an eye opener to the policy makers on the best ways to increase farmers' participation in the market with appropriate transport facilities that could reduce damages and transaction costs in accessing markets. This study will also add to the literature by giving information on the factors influencing the choice of mode of transportation used by the farmers, and as well determine the factors responsible for the degree of market participation in the area.

MATERIALS AND METHODS

The study was carried out in one of the States (Ondo State) in the Southwest region of Nigeria. The region is about 32.5 million in population with a land mass area of 76,852 square kilometers. Ondo State was chosen because it is notable for yam production in the region. It is only State in the region that is blessed with the richest forest landscape and large crude oil deposit, therefore making it more economic viable. The State has over 3,441,024 people [48] with land area of nearly 14,793km^2. It lies between longitudes 4^0 30" and 6^0 00" East of the Greenwich Meridian and 5^0 45 and 8^0 15" of the North Equator. The region is an agrarian community which is known for two distinct seasons namely: the dry season which lasts from November to March, and the rainy season which lasts from April to October. The area is noted for both cash and food crops such as yam, cassava, maize, cocoa, oil palm and so on. Primary data on the respondents were collected for this study through a well-structured questionnaire and interview schedule. The survey was carried out in 2018/2019 production season. A three-stage sampling procedure was adopted as a framework to select respondents for the study. The first stage involved purposive sampling technique of three (3) Local Government Areas (LGAs) based on their preponderance in yam production and proximity to the market. In the second stage, simple random sampling technique was employed to select five (5) communities from the selected LGAs. The third stage involved random selection of 12 yam farmers from each selected community using a simple random sampling technique. Thus, a total of 180 respondents were selected and employed for the study.

Analytical Tools

Descriptive statistics, Multinomial logit (MNL) regression model, Market Participation Index (MPI) and Double Hurdle Regression model were employed for the analysis of data.

Model Specification for MNL

Unordered MNL was employed to determine factors influencing the choice of mode of transportation used by the yam producers in the area. The importance of this model is that it explains the choice of an alternative among a set of exclusive alternatives [33, 46], and also motivated by a random utility model. The idea is that for i[th] consumer faced with *J* choice, suppose satisfaction derived in *J* is: $U_{ij} = Z_{ij}\theta + \varepsilon_{ij}$

According to [22], if the yam farmer then makes choice *j* in particular, then it is assumed that U_{ij} is the maximum among the *J* satisfactions derived. This can now be statistically written as the probability that choice *j* is made: Prob ($U_{ij} > U_{ik}$) for all other $k \neq j$. Common mode of transportation used in the area was modeled as dependent variable which is denoted as Y_i following [16, 20]. It is assumed that Y_i is a random variable indicating the options chosen by the yam farmers which take on the values {0, 1, 2, …J}, where J is a positive integer, and let X_i represent the independent variables which were socio-economic characteristics, transport facilities and institutional factors. *Ceteris paribus*, the interest is on how changes in *X* will influence the chance of choosing *J* option.

$$P\left(y = {}^{j}/_{X}\right), \qquad j = 0, 1, 2, \dots, J \qquad \text{……………………. ....(1)}$$

Since the probabilities must be summed up to one, the P(y = 0/X) is determined once the probabilities for *j = 1, 2, …, J* are known.

Let *X* be a *1 x k* vector with first element unity. Therefore, the response probability for the MNL model will be:

$$P\left(y = \frac{j}{X}\right) = \frac{exp(X\beta_j)}{1 + \sum_{i=1}^{J} exp(X\beta_i)}, \qquad j = 1, 2, \dots, J \qquad \text{………………................... (2)}$$

Where β_j is *k x 1, j = 1, 2, …, J.*

Due to the unity of the probability's response, the equation becomes:

$$P\left(y = \frac{0}{X}\right) = \frac{1}{1 + \sum_{i=1}^{J} exp(X\beta_i)} \qquad \text{………………………….............. (3)}$$

When *J = 1*, β_i is the *k x 1* vector of unknown parameters. This gives the binary logit model. According to [46], the partial effects for this model are complicated. For continuous Xk, it can be written as:

$$\frac{\delta P\left(y = {}^{j}/_{X}\right)}{\delta X_k} = P\left(y = {}^{j}/_{X}\right)\left\{\beta_{jk} - \frac{\left[\sum_{i=1}^{J} \beta_{ik}\, exp(X\beta_i)\right]}{g(X,\beta)}\right\} \qquad \text{…………................................... (4)}$$

Where β_{ik} is the k[th] element of β_i and $g(X,\beta) = 1 + \sum_{i=1}^{J} exp(X\beta_i)$

Again, it is unveiled from the Equation (4) that β_{jk} do not totally determine the direction of the effect. This therefore, leads to the Equation (5) as:

$$\frac{P_j(X,\beta)}{P_0(X,\beta)} = exp(X\beta_j), \quad j = 1, 2, \dots, J \qquad \text{……………............................... (5)}$$

Where $P_j(X,\beta)$ represents the response probability in Equation (2). Thus, the change in $\frac{P_j(X,\beta)}{P_0(X,\beta)}$ is approximately $\beta_{jk}\, exp(X\beta_j)\, \Delta X_k$ for roughly continuous X_k.

It should also be noted that:

$$P\left(y = j \; or \; y = \frac{i}{X}\right) = P_j(X,\beta) + P_i(X,\beta),$$
$$P\left(y = \frac{j}{y} = j \; or \; y = i, X\right) = \frac{P_j(X,\beta)}{[P_i(X,\beta)]} = \forall[X(\beta_j - \beta_i)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

where $\forall(.)$ is the logistic function.
Also, the estimation of MNL model is best carried out by maximum likelihood provided the density is specified of Y given X [46]. Therefore, the likelihood can be written as:

$$\mu_i(\beta) = \sum_{j=0}^{J} 1[y_i = j] log[P_j(X_i,\beta)] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where the indicator function selects out the appropriate response probability for each observation i. Therefore, β is estimated by maximizing $\sum_{i=1}^{N} \mu_i(\beta)$.
As stated in [46], McFadden has shown the concavity of the log-likelihood function which makes the maximization problem straight forward.
The unbiased and consistent parameter estimates of the MNL model in Equation (2) require the assumption of independence of irrelevant alternatives (IIA) to hold. This means that the probability of using a certain mode of transportation by a respondent needs to be independent from the probability of choosing another mode of transportation. It implies that P_j/P_k is independent of the remaining probabilities, and the IIA assumption is the independent and homoscedastic disturbance terms of the basic model [22, 20].
The MNL coefficients are difficult to interpret, and associating the β_j with the jth outcome is tempting and misleading due to the curvilinear relationship between Yi and Xi. Therefore, marginal effects were derived to interpret the effects of independent variables on the response probabilities [22, 24]. The marginal effects measure the expected change in the probability of a particular choice being made with respect to a unit change in an independent variable [22]. The differential equation is stated as:

$$\Delta_j = \frac{\Delta P_j}{\Delta X_i} = P_j\left[\beta_j - \sum_{i=0}^{J} P_i\beta_i\right] = P_j(\beta_j - \bar{\beta}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

The explanatory variables and measurements were depicted in the Table 1.

Table 1 Description and Measurement of Explanatory Variables Employed for the MNL Model

Codes	Description of explanatory variables	Type and Measurement of variables	Expected sign
Y*	Mode of transportation	1= Head porterage; 2 = Motor cycle; 3 = *Pick-up* van; 4 = others	
X_1	Age of the respondents	Continuous: Measured in years	$\pm$
X_2	Membership of the cooperative society	Dummy: 1= Yes and 0, otherwise	+
X_3	Yam farming experience	Continuous: Measured in years	+
X_4	Access to extension service	Dummy: 1= access and 0, otherwise	+
X_5	Access to credit	Dummy: 1=access and 0, otherwise	+
X_6	Road connect from farm to urban market	Dummy: 1=tared and 0, otherwise	-
X_7	Distance to the farm from home	Continuous: Measured in kilometers	-
X_8	Household size	Continuous: Measured in numbers	$\pm$
X_9	Market participation index (MPI)	Continuous: see equation (9)	+

Source: Author 2019.

Measurement of Yam Output Market Participation Index (MPI):
Market participation is the annual sales share of the total yam produced by the farmer in the area. Following [14], market participation index (MPI) for the yam output is computed as:

$$MPI_i = \frac{\sum_{i=1}^{N} S_{qi}\bar{P}_i}{\sum_{i=1}^{N} Q_{qi}\bar{P}_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where $\bar{P}_i$ is the average price level in each community, S_{qi} is the quantity of yam output q sold by the respondent ith, Q_{qi} is the total quantity of yam output q produced by respondent i[th].

Again, it should be noted that most farmers in developing countries including Nigeria are smallholders with total farm size of less than five hectares in which some of them provide mainly for their family without producing for the market [17].

Double-Hurdle Model Specification: The tool was modeled to determine factors influencing decision to participate in the output market and rate of market participation among the yam farmers in the area. The assumption of this study is based on consumer behaviour where a rational yam farmer maximizes his/her utility given a budget line. The rationale behind the adoption of the approach is that yam farmer faces two hurdles in market participation: the decision to participate and the rate of market participation as also noted by [1]. These two decision-making processes allow the use of double hurdle model proposed by [15]. According to [15], double hurdle serves as an improvement over the Tobit regression model. This is because Tobit model is limited by assuming that the decisions to participate in the market and the actual degree or rate of participation are governed by the same process, which argued not to be the same by Cragg [35]. Therefore, the first hurdle is the decision made by the yam farmer on whether to participate in the market or not; while the second hurdle has to do with the rate of market participation. Again, the model distinguishes between the factors determining the decision to participate, and the rate or degree of market participation in sales of yam as two separate stages [9, 45, 7, 37, 1]. In estimating the model, the first hurdle (tier) using binary (probit) regression represents the equation on the decision to participate and presented as:

$$y_i^a = \beta X_i' + \varepsilon_i \quad \text{……………………………… (10)}$$

Where,

$$y_i^a = \begin{cases} 1, if\ y^a > 0 \\ 0, otherwise \end{cases}$$

y_i^a is a decision made by the yam farmers whether to participate or not in the market (yam producers that participate in the market are scored "1" and those that did not participate were scored "0").

The second hurdle (tier) is a truncated regression model on the degree or rate of yam market participation in the area. The equation is stated as:

$$y_i^b = r_i y_i^a = \beta X_i' + \omega_i \quad \text{………………………….... (11)}$$

Where,

y_i^b is the rate or degree of market participation by the yam producers. It is measured by MPI_i in equation (9). y_i^a are the yam producers that participated in the market and r_i stands for the rate or degree of market participation by the producers. ε_i and ω_i are error terms associated with the equations (10) and (11) respectively.

As also stated in [45, 7], if the two decisions are independently made by the individual yam producers, the error terms are assumed to be independently and normally distributed as shown in the above equations as:

$\varepsilon_i \sim N(0,1)\ and\ \omega_i \sim N(0, \delta^2)$, this implied that there is no correlation between the two error terms.

Again, the maximum log-likelihood function is used to estimate independent double-hurdle as modeled by [15]. This is the combination of the univariate probit model and the truncated regression model as stated earlier.

$$LogL = \sum_0 ln\left[1 - \varphi(x,\alpha)\varphi\left(\frac{\beta X_i'}{\sigma}\right)\right] + \sum_{+1} ln\left[\varphi(x,\alpha)\frac{1}{\alpha}\varphi\left(\frac{y_i^a - \beta X_i'}{\alpha}\right)\right]$$

If x, α = 1, it means no zero participation and then we have a Tobit model, which estimates the rate of market participation. X_i' is the vector of explanatory variables that determine the decision to participate or not, and as well as the degree of yam market participation in the area. β is the parameters to be estimated. Finally, the CRAGGIT command was used to carry out the analysis using STATA 13 software.

The explanatory variables and their measurements were defined and presented in Table 2.

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Table 2. Description and Measurement of Explanatory Variables Employed for the Double Hurdle Model

Codes	Description of explanatory variables	Type and Measurement of variables	Expected sign
Y*	Tier 1: Decisions for market participation	Dummy: 1= participated and 0, otherwise	
	Tier 2: Degree/Rate of market participation	Continuous: MPI in Equation (9)	
X_1	Age of the respondents	Continuous: Measured in years	±
X_2	Membership of cooperative society	Dummy: 1= Yes and 0, otherwise	+
X_3	Secondary occupation	Dummy: 1= Yes and 0, otherwise	+
X_4	Yam farming experience	Continuous: Measured in years	±
X_5	Access to extension service	Dummy: 1=access and 0, otherwise	+
X_6	Access to credit	Dummy: 1=access and 0, otherwise	+
X_7	Road connect from home to urban market	Dummy: 1= tared and 0, otherwise	±
X_8	Distance to the farm from home	Continuous: Measured in kilometers	-
X_9	Access to market information	Dummy: 1=access and 0, otherwise	+
X_{10}	Mode of transportation	Dummy: 1= *pick-up* van and 0, otherwise	±
X_{11}	Road connect from home to farm	Dummy: 1= footpath and 0, otherwise	-
X_{12}	Frequency of road maintenance	Discrete: Measured in numbers	+
X_{13}	Household size	Continuous: Measured in numbers	±

Source: Author 2019.

RESULTS AND DISCUSSIONS

Information on the Explanatory Variables Used in the Regression Models

Table 3 presents the characteristics of the yam farmers sampled for the study. Based on the Table, it was revealed that the farmers were still in their productive age given the average age of 49.63 years old.

Table 3. Descriptive Statistics of the Variables

Variable	Mean	SD	Min.	Max.
Age of the respondents	49.63	13.55	25	86
Sex (Male =1, and Female = 0)	0.79	0.41	0	1
Marital status (Married =1, and unmarried = 0)	0.78	0.41	0	1
Educational status (Educated =1, and uneducated = 0)	0.77	0.42	0	1
Membership of cooperative society	0.31	0.46	0	1
Secondary occupation	0.86	0.35	0	1
Yam farming experience	23.01	13.16	2	70
Access to extension service	0.68	0.47	0	1
Household size	5.66	3.25	1	23
Access to credit	0.46	0.50	0	1
Type of road connect to urban market	0.58	0.50	0	1
Distance to the farm from home	12.21	12.32	1	50
Access to market information	0.96	0.19	0	1
Mode of transportation	0.51	0.25	0	1
Type of road connect to farm	0.57	0.50	0	1
Road physical condition	0.68	0.50	0	1
Frequency of road maintenance	2.44	1.50	1	5
Market Participation Index (MPI)	0.67	0.25	0	1

Number of observations = 180; SD = standard deviation, Min. = minimum value; Max. = maximum value

Source: Field Survey, 2019.

The majority of them were male, married and educated with at least primary school education. Again, few (0.31) of them belong to cooperative society with an average yam farming experience of about 23 years.

Many (0.68) of them had access to extension services, while a few (0.46) of them had access to credit with an average household size of nearly 6 persons.

It should be noted that the average output market participation index (MPI) was 0.67 where about 13.3% of the sampled respondents were not participate in the marketing of yam, while 86.7% of them participated in yam marketing in the area. Again, it is important to mention that the variables on transportation system were recoded into dummy form for easy interpretation.

Examining the Transportation Facilities in the Study Area

Table 4 showed that many (53.3%) of the respondents reported that footpath was the main type of road connecting the farmer's farms from home or settlement, while nearly 24.2% of them reported that road connecting the farm was farm track.

The average distance from home to the farm was about 12.21km with many (34.5%) of them trekked a distance between 1 and 5km daily before they could get to their farms. Majority (57.2%) of the roads connecting to urban markets from home were tarred.

The roads connecting the farms of the yam farmers were mostly maintained once in a year (37.8%) by the farmers or the government depending on the road type. Again, the results in the Table also revealed that *pick-up* van was the most (55%) commonly used mode of transportation by the yam farmers.

It was further observed that motorcycle (25.5%), head-porterage (6.7%), minibus (6.1%), and truck (2.2%) were also used in transporting yam tubers to the market by the farmers.

The reason for the use of these modes of transportation is because of the bad condition of the roads leading to the farms.

Table 4. Distribution of the Respondents based on Transport Facilities

Variable	Frequency (n = 180)	Percent
Road connects to farm from home		
Footpath	96	53.3
Farm track	43	23.9
Feeder road	39	21.7
Tarred road	2	1.1
Road connects to nearest urban Market from home		
Tarred	103	57.2
Untarred	77	42.8
Farm distance(km)		
1-5	51	28.3
6-10	45	25.0
11-15	62	34.5
16-20	7	3.9
Above 20	15	8.3
Frequency of road maintenance		
Once in a year	68	37.8
Twice a year	45	25.0
Once in 2years	17	9.4
Once in 3 years	19	10.6
Once in 4 years	31	17.2
Mode of transportation	Frequency	Percent
Head porterage	12	6.7
Motor cycle (*Okada*)	46	25.5
Bicycle	3	1.7
Tricycle	2	1.1
Taxi/Minibus	11	6.1
Truck	4	2.2
Pick-up van	99	55.0
Hilux	3	1.7
Total	180	100.0

Source: Field Survey 2019.

Factors Influencing Yam Producers' Preference for Mode of Transportation Used in the Area

The MNL results in the Table 5 present the factors that influence the choice of mode of transportation mainly employed by the yam farmers in the area. At this point, it is imperative to state that eight modes of transportation were first subjected into the model but failed to give desirable results in terms of significant level. Thus, restructured into 4 related groups to get a satisfactory result as depicted in the Table. Motor cycle, bicycle and tricycle were merged and named as "Motor cycle"; while truck, hilux, and taxi/minibus were merged and named as "Others". Therefore, the dependent variables set for the restructured MNL model were:

Head porterage, Motor cycle, *Pick-up* van and Others. Several variables both endogenous and exogenous were also included in the model but some were later dropped as a result of their undesirable behaviour with the dependent variable which was also observed in the studies of [23, 16, 20]. The parameter estimates of the MNL showed that the model exhibited a strong explanatory power giving the likelihood ratio statistics as indicated by the χ^2 value of 75.67 with a significant level of 1%. The coefficient of marginal effects of the MNL was used in the interpretation and discussion of this study. From the Table, it was unveiled that independent variables were statistically significant at different levels and magnitudes under each mode of transportation. Therefore, out of nine predictors incorporated into the model, 3, 5, 7 and 4 variables were significant under the head porterage, motor cycle, *pick-up* van and others, respectively as transportation modes.

Membership of cooperative society has a positive and significant association with the probability of using *pick-up* van mode at 10% level. This indicates that yam producers that belong to cooperative society are more likely prefer *pick-up* van mode to transport yam tuber to the market with a magnitude of 1.3%. The probable reason was that most of the *pick-up* van owners are members of the cooperatives therefore they encourage their members to patronize them. Again, some of the yam producers are smallholders that their output per harvest could only be accommodated by the pick-up, therefore, going for modes less or greater than *pick-up* van mode can lead to shortage in terms of cost incurred. The coefficient of yam farming experience was positive and significant at 5% and 1% levels in influencing motor cycle and *pick-up* van modes, respectively. This implies that a year increase in the farming experience by the yam producers will likely increase the likelihood of choosing motor cycle and *pick-up* van modes by 2% and 3% respectively. It can be deduced that experienced yam farmers would have more knowledge of the road terrain couple with the costs and benefits attached to the choice of mode of transportation used in transporting yam tubers to the market. Experienced farmers are expected to be aware of changes in weather, market behaviours, transportation system and quantity of production which will lead to accurate decision on the most efficient mode of transportation to be used [1]. The access to extension services had a negative and significant relationship with head porterage at 10% level but a positive and significant association with *pick-up* van and others modes of transportation at 5% and 10% levels, respectively. This shows that the more a yam farmer has access to extension services, the more the probability of choosing *pick-up* van and others means of transportation by 4.2% and 4.0%, respectively but reduce the chance of choosing head porterage by 1.1% in the area. The result is expected because extension agent will guide the farmers against drudgery and inefficient activities, but because of the size of the yam tubers, location, culture and poverty in the system, some farmers might still result in using head porterage in transporting yam to the market in the area. The coefficient of access to credit was positive and significant under motor cycle and other modes of transportation with a probability of 5% apiece. It can be interpreted that the more a farmer has access to credit, the more the likelihood of using motor cycle and other means in transporting yam tubers to the market by 7.7% and 7.4% respectively. Access to credit might encourage some of the yam farmers to have their own mode of transportation such as bicycle, motor cycle, tricycle, and mini-bus. This is because most farmers accessed their farms through motor cycle but not necessarily used to convey harvested yam to the market most especially for the farmers with large volume of output. The coefficient of the type of road connecting farms to urban markets was only positive and significant at 10% level with *pick-up* van mode. This shows that a tared road connecting farm to the urban market will increase the chance of choosing *pick-up* van to transport yam tubers by 6.4%. With the average quantity of yam that could be harvested per time and coupled with the labour involved, the size of *pick-up* van might likely be the best option to convey yam tubers to the market. This is because, apart from truck and hilux, *pick-up* van is the most common and roomy mode that can do the work effectively in the area. The distance from home to the farm has negative but statistically significant relationship with all the means of transportation in the area. It was shown that a kilometer increase in the distance from home to the yam farm will decrease the chance of choosing head porterage, motor cycle, *pick-up* van and other modes of transportation by 2.3%, 0.7%, 0.8% and 0.8% respectively in the area. The probable reason for the results is that urbanization and civilization have made farm land to be far away from the living areas. Other lands that are close to the living areas are over-used and not fertile to give optimal yield. Similarly, inherited and communal nature of land sharing has denied many of the yam farmers the opportunity to get a sizable farm land until they get to the far away areas. Apart from other modes of transportation, the coefficient of household size was positive and statistically significant in influencing all the transport options/choices in the model. This implies that increase in the numbers of family size will likely increase the probability of choosing head porterage, motor cycle and pick-up by 2.9%, 1.1% and 1.1% respectively in the area. Despite the ambiguity in the interpretation of household size in the literature [41, 21], it can still be deduced that household size as a proxy for labour availability may influence any of the options at the farmers' disposal since it reduces the labour constraints [18]. [1] argued that a larger family size increases the likelihood of participating in the market as they played a speedy role in the commercialization's process. The coefficient of market participation had a positive and significant relationship with the mode of transportation except under the head porterage mode. This implies that the more a yam farmer participates in the market, the more the chance of using motor cycle, *pick-up* van and other means of transportation by 17.5%, 22.7% and 20.8% respectively in the area. The volume of production could be the main reason for choosing the means of transportation in the area. A rational yam producer will want to be at margin by minimizing cost of transportation to the market. This study shares similar view with [36, 32, 30, 1] who argued that there is a positive relationship between mode of transportation and the market participation which could lead to increase in farmers' productivity and returns.

Table 5. Results of Multinomial Logit Regression on the Modes of Transportation in the Area

Variable	**Head porterage**		**Motor cycle**		**Pick-up**		**Others**	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Age	0.008	0.129	0.003	0.126	0.003	0.126	0.003	0.162
Cooperatives	0.037	0.744	0.012	0.777	0.013*	0.075	0.014	0.732
Experience	-0.007	0.193	0.002**	0.042	0.003***	0.006	0.003	0.272
Extension	-0.109*	0.065	-0.040	0.225	0.042**	0.013	0.040*	0.087
Credit	-0.181	0.112	0.077**	0.018	-0.064	0.123	0.074**	0.050
Road connect to urban market	0.171	0.127	0.059	0.160	0.064*	0.098	0.064	0.134
Distance	-0.023**	0.036	-0.007*	0.097	-0.008**	0.014	-0.008**	0.020
Household size	0.029*	0.071	0.011**	0.050	0.011**	0.045	0.011	0.136
Market participation	0.587	0.208	0.175*	0.090	0.227**	0.039	0.208*	0.062

Log likelihood = -166.41; LR chi2 (27) = 75.67***; Number of observations = 180
*, **, *** means significance at 10%, 5% and 1% levels respectively
Source: Author's Computation, 2019.

Effect of Transportation System on the Decision for Output Market Participation and the Degree/Rate of Market Participation in the Area

The results of double-hurdle regression are presented in the Table 6. According to the parameter estimates, the sigma value of 0.008 was strongly significant at 1% probability level which indicates that the presence of heteroskedasticity was corrected for in the model, while the value of Wald χ^2 of 24.43 was also significant at 5% which implies that the model is well fitted given the variables used in the model. Thirteen explanatory variables gave desirable results in the Table, out of which nine were statistically significant and four of them were inclusively significant under the two hurdles.

First Hurdle: Decision to Participate in the Output Market

It was shown from the Table that membership of cooperative society, farming experience, market information, and modes of transportation had significant and positive association with the decision to participate in the market of yam business in the area. However, type of road connecting home to the nearest urban market, and distance to the farm had negative but significant relationship with the decision to participate in the market. Therefore, being a member of cooperative societies may likely increase the chance of participating in the market of yam by 182%. As also reported by [39], cooperative societies always buy agricultural products in large quantity including yam during the on season with the expectation of selling it during the off season. Added to this, some farmers do collect inputs from the cooperatives with the agreement of selling their yam tubers to them at the end of production year. Therefore, this might be the probable reason for participating in the market of yam business in the area. Farming experience in yam production influences the decision to participate in yam market at 10% level of significance. The result indicates that farmers with more years of yam production experience are more likely to participate in the market, *ceteris paribus*. It is expected that experienced farmers must have known the nitty-gritty of the business which could make them take a decision of participating in the market. This is consistent with the findings of [36] who also observed positive and significant association between experience and market participation among cassava farmers in Central Madagascar. Having access to right market information influenced decision to participate in yam market in the area by 3.3%. The likely reason might be because having access to rightful information most especially on the market prices will make the farmer to sell at the market that give the highest pay/revenue considering the cost incurred in transporting the yam tubers. *Ceteris paribus*, those farmers that choose *pick-up* van as a mode of transportation had the likelihood of participating in the market by 29%. Considering the smallholding capacity of the farmers, *pick-up* van is spacious enough to convey their products to the market per harvest. This is because the farmers always harvest yam either to eat or sell. Due to poor storage facilities, hardly will one see farmers harvesting for the purpose of storage; that is why the product always floods the market during the peak season. Again, not harvesting on time might endanger the products to pilferage, pests and diseases, and other post-harvest problems. On the other hand, the coefficient of type of road connecting home to the nearest urban market is negatively related to the probability of participating in the market at 1% level of significance. The reason might be because of the challenges of damages of tubers and hike transport fare experienced as a result of bad roads in the area. The coefficient of distance to the farm had a negative association with the participation in the market at 5% level of significance. This shows that a unit increase in the distance to the farm will decrease the likelihood of participating in the market by 4.2%. It can be deduced that farmers living far away from the farm might be facing difficulty in conveying both inputs into the farm and as well output out of the farm due to poor road condition in the study area. Thus, affecting their decision to participate in yam marketing negatively. This finding is in conformity with [39].

Second Hurdle: Degree of Output Market Participation

The second tier of the analysis revealed the factors influencing the rate or degree of market participation in the area. As presented in the Table, age of the farmers, membership of cooperative society, secondary occupation, yam farming experience, access to extension services, access to market information, and mode of transportation were the significant factors identified by the model. All things being equal, a year increase in the age of the farmers might likely reduce the rate of market participation by 0.2%. It might be that aged farmers might not be able to face the rigours of marketing considering the long distance of the farm to the market locations and the dilapidated conditions of roads connecting farms either to their homes or the markets. This study disagreed with the findings of [40, 1] who found out positive relationship between age of the farmers and rate of market participation, and as well stated that greater output comes from aged farmers. Again, the membership of cooperative society has positive relationship with the rate of participating in yam market. It implies that being a member of a cooperative society will increase the likelihood of the degree of participation in the marketing of yam by 3.6%, *ceteris paribus*. The ready market through cooperative societies might encourage the producers to sell a substantial portion of their produce into the market. Secondary occupation has a negative relationship with the rate of market participation. It indicates that having other occupations reduced the probability of the rate of market participation in the area. This can be explained that having other occupations might not allow full concentration in the market and can also make the producers easily relent in the business each time there is a challenge when compared with those that have yam business as a sole occupation. Farming experience has a positive association with the probability of the degree of market participation in the area. It means that the number of years engaged in the yam production will likely increase the chance of participating in the market by 0.2%. The long-stay in the business is an indication that the farmers have good knowledge of the business. All things being equal, increasing participation in the market might be as a result of higher returns earned which could enhance their decision making on the rate of market participation in the area. Access to extension services also has a positive relationship with the rate of market participation in the area. Farmers that have access to the extension services may likely participate more in the marketing of yam than those that do not have access in the area. The presence of extension agent might influence the rate of market participation.

Table 6. Results of Double Hurdle Model

Variable	**Tier 1: Decision for Market Participation**		**Tier 2: Rate of Market Participation**	
	Coefficient	P>/z/	Coefficient	P>/z/
Age	-0.015	0.401	-0.002***	0.003
Cooperatives	1.816***	0.000	0.036**	0.047
Secondary occupation	-6.833	0.970	-0.033*	0.091
Experience	0.031*	0.094	0.002*	0.057
Extension	0.241	0.502	0.031*	0.054
Credit	-0.431	0.288	-0.048	0.103
Road connect: home to urban market	-1.130***	0.005	-0.020	0.166
Distance (km)	-0.042**	0.018	0.001	0.347
Market information	0.033*	0.080	0.040**	0.020
Mode of transport	0.290***	0.001	-0.003**	0.027
Road connect: home to farm	0.224	0.593	0.059	0.001
Road maintenance	-0.130	0.307	-0.000	0.945
Household size	0.076	0.294	0.040	0.131
Constant	9.894	0.956	0.767	0.000
Sigma			0.008	0.000

Log Likelihood = -124.15239; Wald chi2 (13) = 24.43**; Number of observations = 180;
*, **, *** means significance at 10%, 5% and 1% levels respectively
Source: Author's Computation, 2019.

This is because it will allow the farmers to benefit from extension education and trainings on agribusiness and innovative information that could increase productivity, efficiency and market prices of the yam in the area. The positive relationship between access to market information and the rate of market participation caused a likelihood of about 3.1%.

This supported the assertion of [40] who stated that having access to current market information improves selling price and also helps producers to analyze the price difference among different marketing channels for optimal returns.

Therefore, having access to market information is one of the factors for business sustainability and continuity in the market as it might determine the proportion of yam in the market. Mode of transportation showed a positive and significant relationship with the rate of participating in the market. This implies that the use of *pick-up* van increases the probability of the rate of participating in the market by 0.3%. The reason might be because *pick-up* van is the most subscribed means of transportation and it is more accessible, rugged and adaptive to the condition of the roads compared with the other modes.

CONCLUSIONS

The study empirically assessed the nexus between transportation system and output market participation among yam producers in Ondo State, Nigeria. From the study, it was concluded that many of the farmers are young, married and educated with a better knowledge of yam production in the area. Most of the farms are linked either by footpath or farm track and farmers trek several kilometers before they could get to the farm. Tarred roads can only be found in some areas that are closed to the urban markets and road maintenance is mostly carried out once in the area. *Pick-up* van, motor cycle and head porterage are the common means of transporting yam tubers to the market and this has linked to the bad roads and poor transportation facilities in the area. It was also concluded that variables such as membership of cooperative society, farming experience, access to extension services, access to credit, road connecting urban markets, distance to the farm and market participation are the main significant factors responsible for the choice of means of transportation used by the producers to convey yam tubers to the market. Again, the study ascertained that most of the farmers participated in the market despite the challenges encountered as a result of transportation system. The study also established that membership of cooperative society, farming experience, access to market information and mode of transportation are very germane and vital in influencing the decision to participate and as well as the rate of participating in the yam market in the area. On this note, the study recommends that an urgent improvement in transportation system most especially means of transport and road conditions will cause a significant increase in yam production and in turn the rate of market participation. Government should train extension agents on how to disseminate market information to the farmers and probable create accessible markets close to the farm settlements. This will reduce spoilage, waste and transportation cost. Government should put the roads in good and motorable condition to help farmers convey inputs into the farm and output to the markets. This will surely bring positive change on farmers' productivity and income vis-à-vis their standard of living. Farmers should be encouraged to join cooperative societies so as to promote market participation and as well use the group to jointly repair and maintain the roads that lead to their farms.

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