Heliyon 8 (2022) e10585

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Determinants of market participation and preference for production of pepper (*Capsicum* spp.) among farmers in southwest, Nigeria

Adewale Isaac Olutumise *

Department of Agricultural Economics, Adekunle Ajasin University, P.M.B 001, Akungba-Akoko, Ondo State, Nigeria

ARTICLE INFO

Keywords:
Cultivation
Multinomial logit
Nigeria
Tobit
Varieties
Vegetable

ABSTRACT

The growing population and demand for staple foods in Nigeria necessitate the promotion of smallholder market participation, particularly in the pepper industry. Therefore, pepper commercialization can only be achieved when harnessing the nexus between production preference and market participation. Thus, the study examined the determinants of market participation and preference for pepper production in Southwest, Nigeria. A multi-stage sampling procedure was used to select 500 respondents while the data were sourced using a well-structured questionnaire. Data were analysed using market participation index (MPI), Multinomial logit (MNL) and Tobit regression. The results of MPI indicated bell pepper was cultivated more (81.9%) for market purposes than cayenne (75.8%), scotch bonnets (68.8%) and birdeye (36.4%). The results of MNL indicated that education, experience, credit, market information and distance influenced preference for species cultivation while education, experience, income, market information and selected species were paramount in determining the level of market participation in the area using Tobit regression. The results established that production preference has a significant impact on market participation. Therefore, expected structural transformation in agriculture can be achieved through market participation if policies are guided by farmers' production preferences and improved economic status with a good market infrastructure.

1. Introduction

Amongst the available vegetables, pepper (*Capsicum* spp) is ranked third in the world after tomato and onion (FAOSTAT, 2012; Mustapha et al., 2021). It is one of the crucial classes of vegetables extensively cultivated in sub-Saharan Africa (SSA) countries (Baba et al., 2014; Obayelu et al., 2021). In Nigeria, pepper is the second most cultivated vegetable (Abu et al., 2020), which used to account for almost half of the African production (Ayo-John and Odedara, 2017; Mustapha et al., 2021), and its average consumption per person per day is about 20% (Ogunbo et al., 2015). In combination with other agricultural produces, almost 70% of the farmers and traders depend on pepper for food security, income generation and employment opportunities (World Bank, 2017; Opata et al., 2020). Due to the necessity of pepper in human life, attention has to be drawn to increasing the level of production with a functioning marketing system. According to Mohammed et al. (2015) and Bagshaw and Ogwu (2020), given the high population and demand for vegetables, and pepper, in particular, there is an urgent need for increased production and delivery of fresh pepper to the consumers.

Again, the dream of commercialized agriculture can only be achieved when farmers are encouraged to be business-oriented by participating in the market vis-à-vis transformed from smallholders that characterized Nigeria and SSA as a whole (Olwande et al., 2015). Going by the literature, agricultural commercialization is key to the development of low-income countries and also it has formed a central discussion on national issues. According to Owusu and Iscan (2020), commercialization will promote structural transformation in addition to increased productivity and farm income in SSA. Therefore, marketing has a stimulating impact on the production and distribution of agricultural products (Dessle et al., 2019; Olutumise, 2020). Thus, improving market participation will induce farm mechanization and greater investment in agriculture (Owusu and Iscan, 2020). In addition to this, market participation has a significant role to play in meeting the demand of consumers at the right time and at an appropriate price. However, agricultural output markets in Nigeria and other developing countries are mainly characterized by small numbers of traders, poor road networks, long market distance, a small quantity produced, high marketing costs, imperfect market information between buyers and sellers, weak bargaining power,

* Corresponding author.;
E-mail addresses: firstwalefat@yahoo.com, Adewale.olutumise@aaua.edu.ng.

https://doi.org/10.1016/j.heliyon.2022.e10585
Received 25 February 2022; Received in revised form 22 April 2022; Accepted 23 August 2022

and amongst other factors (Olutumise, 2020), these factors discourage farmers to produce more for market purpose.

Despite increase in production and high market price of pepper, the yield is at most 30% less in the developing countries compared to the developed countries (Ansa and Woke, 2018). According to FAOSTAT (2019), Nigeria has lost her position as one of the top producers of pepper in Africa. As also noted by Ikuemonisan et al. (2021), high output has not been translated into high yield vis-à-vis farmer market participation. There is a steady decline in the farmer's participation in pepper market in the region. Also, the absence of a market will not make farmers benefit from the increased production of pepper (Ansa and Woke, 2018). According to Joyce et al. (2019), the pepper sub-sector is characterised as smallholders and unorganized enterprises which faced challenges such as low quality, less value addition and irregularity in supply. The output market is also constrained by seasonal conditions and perishability which lead to the variation in the supply of pepper in the market. Previous studies on pepper in Nigeria (Joyce et al., 2019; Opata et al., 2020; Obayelu et al., 2021; Mustapha et al., 2021) identified poor market information and lack of infrastructure (transportation, quality control mechanisms, transition cost, storage facilities, price settings, etc.) as limiting factors towards market participation in Nigeria. Again, due to the perishability of the pepper and a lack of storage facilities, the supply side is also weak in price bargaining.

Therefore, the above literature justifies the need to promote smallholder market participation, especially in pepper enterprise. But there is little consensus on how to integrate farmers into the market (Bernard et al., 2017; Opata et al., 2020). That is more reason why the study investigated the determinants of market participation and preference for pepper production in Southwest, Nigeria. The study further argues that production and distribution of goods stimulate market participation while producer preference induces more production. Following this, agricultural commercialization can only be achieved when harnessing the nexus between producer preference and market participation. Thus, the findings from this study would be of interest in the global debate on pepper production and African pepper commercialization. The new knowledge about preference for production with factors influencing the intensity of market participation of the smallholders would form a tripolar in policies that will change farmers' business orientation and also induce non-growers (Burke et al., 2015) especially when agriculture is currently within the scope of entrepreneurship in developing countries (Ebele et al., 2021). It is against this background that the study proffered answers to the following questions: What are the factors influencing pepper producers' preferences with respect to the species cultivated? What is the market share of pepper in the area? Does the producer's preference affect pepper market participation in the area?

2. Literature review and gaps in knowledge

The research on market participation is well established in the literature. Many studies have identified several factors affecting market participation. Ouma et al. (2010) reported that apart from the socioeconomic factors, transaction costs also influence market participation. Schipmann and Qaim (2010) confirmed the effect of spillover from the modern supply chains on the traditional market participation, while Burke et al. (2015) examined the nexus between productivity and market participation using a triple-hurdle model, recommending factors such as rural electricity, training, and better grazing techniques for market participation. Likewise, Olwande et al. (2015) compared agricultural marketing among three different products and also found similar factors except for productive assets, technology use, rainfall and expected prices as the main factors. Kostov and Davidova (2013) applied a quantile regression to analyse the effect of farmers' attitudes and perceptions on market participation. They found out that advisory services such as business advice and information on the markets and prices have a significant impact on market participation. Connecting market participation and access to information, Qin and Vania (2018) reported that internet access had a significant effect in addition to farm-level factors. Owusu and Iscan (2020) also identified farmers' access to resources as a driver connecting farm commercialization with market participation.

There is no doubt that the above authors and other researchers have worked on market participation in connection with diverse subjects that can influence it. However, there is still little or no research on how a producer's preference affects market participation. The nexus is necessary because there is emerging literature on how smallholder farmers can be linked with modern supply chains successfully (Schipmann and Qaim, 2010; Olutumise, 2020). Therefore, the study first contributes to the literature by determining the influence of producer's preference on the market participation with respect to pepper species in the case of this study.

In the case of pepper production in Nigeria, studies that have been conducted mostly focused on the yield, efficiency, performance, processing, and sales at the market points (Ogunbo et al., 2015; Adegunsoye and Mafimisebi, 2019; Omotade et al., 2019; Obayelu et al., 2021). Despite the literature has established four types of pepper species commonly cultivated in the region which include: *C. annuum* (scotch bonnet); *C. annuum* (bell pepper); *C. frutescens* (birdseye); and *C. frutescens* (cayenne). There is a paucity of research in the area of the preference of pepper species commonly produced in the region with the socioeconomic and market factors that might be responsible for farmers' decisions. The study's second intention is to fill this gap. Also, most of the studies in the literature conducted research on different single specie to make inferences on pepper production (Ansa and Woke, 2018; Adegunsoye and Mafimisebi, 2019; Joyce et al., 2019; Opata et al., 2020) but this study makes a difference by examining the major pepper species in a single study with the factors influencing producer's decisions for their production.

3. Materials and methods

3.1. Site description

The study was conducted in the Southwest region of Nigeria. The location of the study is central to the economy of Nigeria based on the market availability and potential for vegetable production. The region is one of the six (6) geo-political zones in Nigeria that comprises 6 States (Ekiti, Lagos, Ogun, Ondo, Osun and Oyo). The geographical location is longitude 4° 15′ and 6^0 00′ East of Greenwich meridian, and latitude 5° 45′ and 8° 15' North of the equator. The land area and estimated population are nearly 78,000km^2 and 33 million, respectively. The region has a tropical climate with distinct dry and wet seasons. The average rainfall ranges from 150mm to 3000mm while the average temperature is between 21 and 34 °C. Farming is the predominant occupation in the area, while others are engaged in trade, artisan and public services.

3.2. Data source and collection

The study used primary data source which was conducted in 2021 from June to September (4 months). A questionnaire supported by an interview schedule was used in capturing information from the pepper farmers concerning their production activities and market participation. The administration of the questionnaire was done through a well-trained enumerator from the state Agricultural Development Programme (SADP) after which the instruments have been thoroughly checked by the experts in the fields of Agricultural Economics, and Agronomy. The test-retest approach was used to determine the reliability of the instrument and a Cronbach's Alpha coefficient of 0.703 was gotten. Again, the consent of all participants (sampled respondents) was obtained for the survey.

3.3. Sampling design

The region was purposively selected based on the high demand for pepper, and the inability of the northern farmers to meet up with the

demand gaps in the area due to a bad road network and herdsmen clashing with the crop farmers. This has opened up vegetable production opportunities most especially pepper being an essential ingredient in food processing and consumption in the area. Four out of six states were randomly selected and they were: Ekiti, Ogun, Ondo and Oyo. One Local Government Area (LGA) was selected using a purposive sampling procedure from each state. The LGA from each state was selected based on the preponderance of vegetable producers in the area as reported by each State Agricultural Development Project (SADP). Furthermore, five communities were selected in each LGA using a simple random procedure, making 20 communities in all. Lastly, twenty-five pepper farmers were selected through a snowball sampling technique, making a total of 500 respondents. This was achieved through the help of farmer's groups available in each community. This also helped to interview the main pepper producers in the area. The valid copies of the questionnaire retrieved were 499.

3.4. Data analysis and model specification

The data emanating from the study were analysed using descriptive statistics, Multinomial logit (MNL) regression, Market Participation Index (MPI), and Tobit regression. Descriptive statistics such as mean, standard deviation, minimum and maximum values were used to ascertain the behaviour of the variables used for the regression models.

3.4.1. Multinomial logit (MNL) regression

The MNL was used to determine factors influencing pepper producers' preference with respect to the species cultivated in the area. MNL model is based on the utility theory of maximization. That is, the satisfaction derived as a result of profit accrued from a particular good (pepper species in this case) instead of the others, that could influence its production. Here, four species of pepper were identified in the study area, while the factors determining the preference for a particular species would be determined by the MNL. The 4 species which are the J sets of alternatives were modelled into MNL and formed the choices posed to the farmers. These alternatives are; scotch bonnets (J_1), bell pepper (J_2), birdeye (J_3), and cayenne (J_4). The reference point (base category) was J_3 being the highest frequency by default. It should be noted that some farmers do plant more than a species. To address that, the farmers were restricted to choose the main species planted in the last production season. Therefore, making the model not violate the Independent Irrelevant Alternative (IIA) assumptions of the MNL. MNL is widely used as it builds on the choices where there are more than two categorical dependent variables. Several studies (Abdalla, 2012; Clark et al., 2019; Benito et al., 2020; Olutumise et al., 2021) have justified MNL as the best alternative to modelling technique for categorical outcomes.

Therefore, the study deems it fit to use the MNL to determine the preference for the choice of a particular pepper species produced by the respondents owing to the fact that each pepper farmer is allowed to make a choice. It is assumed that farmers maximize their satisfaction by comparing the utility obtained in producing any of the species. This is also assumed to influence the decision of the farmers to cultivate a particular species instead of the other. The independent variables were the socioeconomic, farm-level and market factors of the respondents. The mathematical equations for the model are stated as:

$$Pr(Y_i = j) = \frac{I_i}{\left[1 + \sum_{k=1}^{j} I_j\right]} \tag{1}$$

Where;

$$I = exp(X\beta), \quad \beta_j = \mathrm{K} \times 1, \quad \mathrm{j} = 1, 2, 3, \ldots \mathrm{J}$$

The response probability can be written as $\Pr(\mathrm{Y_i} = \mathrm{j/X})$ and it must be summed up to 1.

For easy interpretation, Eq. (1) is differentiated in respect to the independent variables (X) to give the marginal effects (ME) of the variables (Eq. 2) as it influences the choices made by the farmers. As a function of probability, ME determines the expected change in the pepper species preference of the farmer with respect to changes in the predictor variables (Olutumise et al., 2021). The ME equation is written as:

$$\frac{\delta Y_j}{\delta X_k} = Y_j(\beta_{jk} - M) \tag{2}$$

Where $M = \sum_{j=i}^{j} Y_j \beta_{jk}$

The explicit function of the model is written in Eq. (3) below.

$$Y = \beta_0 + \beta_1 GEN_1 + \beta_2 EDU_2 + \beta_3 FMS_3 + \beta_4 AGE_4 + \beta_5 EXP_5 + \beta_6 FAS_6 + \beta_7 CRD_7 + \beta_8 MKI_8 + \beta_9 MAS_9 + \beta_{10} ASM_{10} + \beta_{11} LBC_{11} + \beta_{12} INC_{12} + \beta_{13} EXT_{13} + \beta_{14} MKD_{14} + \varepsilon_I \tag{3}$$

The description and the scale of measurement for the variables were stated in Table 1, while ε_I is the error term and β_i is the coefficient.

3.4.2. Market participation index (MPI)

The MPI was used to measure the degree of output market participation by the pepper producers. It ascertains the proportion of pepper output harvested for the market purpose and also helps to know how market-oriented the farmers are.

$$MPI = \frac{output\ sold\ in\ kg\ (S_{ik})}{total\ output\ harvested\ in\ kg\ (H_{ik})};\ S_{ik} > 0\ and\ 0 < MPI \leq 1. \tag{4}$$

According to Eq. (4), the *MPI* is the quantity produced for market purposes (market shares) and it takes values between 0 and 1, inclusive.

3.4.3. Tobit regression model

Tobit regression was used to determine how the main pepper species produced by the farmers and other factors influence the degree of market participation in the area. The Tobit regression model is one of the censored regressions that is well and widely employed for a positive bounded dependent variable (Gujarati and Porter, 2009). Unlike truncated regression, it is bounded between 0 and 1 inclusive. This means that it cannot assume any value either less than 0 or greater than 1 in the model. It is also more appropriate than Ordinary Least Squares (OLS) because it is specifically designed to measure linear relationships in a situation where there is left-and-right censoring in the criterion variable. The model's dependent variable (MPI value) fell between 0 and 1, while species produced, socioeconomic and market factors formed the explanatory variables. Following Wooldridge (2002), the equations illustrating the model are stated as:

$$\text{Implicit function is } Y^* = \gamma_i X_i + \varepsilon_i \tag{5}$$

Where Y^* in Eq. (5) is the latent variable (MPI) which is censored at left hand-side by 0 and right hand-side by 1, the error term (ε_i) is N ($0,\theta^2$).

Therefore, the observed dependent variable measured as. $Y_i = 0 \leq MPI \leq 1$

The explicit function of the model is written in Eq. (6) below.

$$MPI = \gamma_0 + \gamma_1 EDU_1 + \gamma_2 FAS_2 + \gamma_3 EXP_3 + \gamma_4 MKD_4 + \gamma_5 INC_5 + \gamma_6 NFI_6 + \gamma_7 CRD_7 + \gamma_8 MKI_8 + \gamma_9 SPP_9 + \varepsilon_I \tag{6}$$

The description and the scale of measurement for the variables were stated in Table 1, while ε_I is the error term and γ_i is the coefficient. The summary of the variables used for the inferential statistics were also presented in Table 1.

Table 1. Summary of the regression variables.

Variable	Code	Measurement Scale	Mean	SD	Min	Max
Market Participation Index	MPI	Index	0.72	0.38	0.07	1.00
Age	AGE	Years	45.34	10.78	20	78
Gender	GEN	Dummy: Male = 1, and 0, otherwise	0.74.40	0.44	0	1
Farming experience	EXP	Years	23.78	12.75	2	57
Marital status	MAS	Dummy: Married = 1, and 0, otherwise	0.67	0.23	0	1
Family size	FMS	Numbers	6.50	2.33	1	16
Educational level	EDU	Years spent in school	7.73	4.57	0	32
Farm size	FAS	Hectares	0.47	0.29	0.1	3.01
Credit	CRD	Dummy: Access = 1, and 0, otherwise	0.26	0.44	0	1
Extension services	EXT	Dummy: Access = 1, and 0, otherwise	0.20	0.39	0	1
Membership of association	ASM	Dummy: member = 1, and 0, otherwise	0.57	0.41	0	1
Market source of information	MKI	Dummy: Access = 1, and 0, otherwise	0.39	0.57	0	1
Market distance	MKD	Measured in kilometres (km)	16.91	14.65	1	25
Labour cost	LBC	Cost of labour (N)	30,124.43	19,980.19	1901.10	98,019.09
Farm income	INC	Amount accrued from pepper production (N)	217,956.34	171,005.77	20,111.11	809,201.10
Non-farm income	NFI	Amount accrued from other sources apart from farm (N)	169,334.90	128,901.01	5,000.00	498,919.21

Note: $1 USD = N460.
Source: Computed from Field Survey (2021).

4. Results and discussion

4.1. Factors influencing the choice of main species cultivated in the area

Table 2 presented the results of the multinomial logit regression model that identifies the socioeconomic and market attributes that influence the choice of main species normally produced by the farmers in the region. To start with, the problems of multicollinearity were solved using variance inflation factor (VIF) for the continuous variables, and contingency coefficient (CC) for the dummy variables by running the linear model (Sadik-zada, 2020). The values gotten were less than 4.00 and 0.71 for VIF and CC, respectively, making the predictors desirable for the model. Again, the IIA assumption was not violated because the results of the Hausman test gave negative sign's coefficients with chi-square values less than zero, meaning appropriateness of the estimated model. The statistical significance of LR chi-square (42) value (327.40) at a 1% probability level with the negative sign of Log-likelihood indicated the model had the goodness of fit and also supported the combined relationship between predicted and predictor variables in the model (Abdalla, 2012). Therefore, the estimates in the results of this study are expected for the future forecast.

The marginal effects of the MNL regression coefficients were presented in the Table because the distribution functions of the MNL regression of the independent variables are nonlinear (Clark et al., 2019; Benito et al., 2020; Olutumise et al., 2021). The model made use of 14 explanatory variables out of which 7 variables were statistically significant in influencing the choice of species cultivated by the respondents. The number of years spent in school (education) is very paramount in predicting the preference for pepper species produced as it was negative in influencing the choice of producing scotch bonnets and birdeye peppers but positive in the case of the bell and cayenne peppers. It can be interpreted that a unit increase in years spent in schooling will increase the likelihood of producing scotch bonnets and birdeye peppers by 2% and 0.8%, respectively while it decreases the chance of producing bell and cayenne peppers by 2.1% and 1.5%, respectively, all things being equal. The negative association between education and pepper production does not follow *apriori* expectation but this could still amount to the peculiarity of the farmers in the area who see farming as the business of the poor and uneducated people. That is why it is crucial to change farmers' orientation by improving market participation and using improved technologies so that educated people can be more committed and dedicated to the farming business, especially in pepper production. The result disagreed with the findings of Adewusi and Adenegan (2020) who found a positive relationship between pepper production and years of schooling using two-stage probit least squares regression.

Table 2. Results of the marginal effect of MNL model for pepper specie cultivation.

Explanatory variable	*C. annuum* (Scotch bonnets)	*C. annuum* (Bell peppers)	*C. frutescens* (Bird eye)	*C. frutescens* (Cayenne peppers)
	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)	Coefficient (P-value)
Gender	-0.037 (0.512)	-0.039 (0.468)	-0.067 (0.237)	-0.032 (0.232)
Education	-0.021*** (0.000)	0.020*** (0.000)	-0.015** (0.013)	0.008*** (0.002)
Family size	-0.015 (0.220)	-0.013 (0.274)	-0.011 (0.382)	-0.003 (0.557)
Age	-0.005 (0.095)	-0.005 (0.117)	-0.005 (0.119)	-0.002 (0.225)
Experience	0.012*** (0.000)	0.011*** (0.000)	0.012*** (0.000)	0.006*** (0.000)
Farm size	0.010** (0.014)	0.010 (0.211)	0.010** (0.014)	0.005 (0.108)
Credit	0.202** (0.013)	0.210*** (0.007)	0.337*** (0.000)	0.165*** (0.000)
Market information	0.302*** (0.000)	0.295*** (0.000)	0.335*** (0.000)	0.169*** (0.000)
Marital status	-0.017 (0.858)	-0.023 (0.795)	-0.011 (0.900)	-0.018 (0.679)
Association membership	-0.861 (0.978)	-0.875 (0.976)	-1.540 (0.979)	-0.702 (0.976)
Labour cost	-7.84e-10 (0.986)	-6.58e-09 (0.872)	-6.25e-09 (0.883)	-1.11e-08 (0.542)
Income	7.48e-08** (0.018)	7.09e-08 (0.448)	2.08e-08** (0.019)	2.01e-08 (0.640)
Extension	0.069 (0.319)	0.068 (0.290)	0.050 (0.474)	0.031 (0.333)
Market distance	-0.001** (0.040)	-0.004 (0.829)	-0.004** (0.031)	-0.006 (0.538)

Note: ***' **' significant at 1% and 5%, respectively; Number of observations = 499; LR chi-square (42) = 327.40***; Log likelihood = -395.984.
Source: Field Survey, 2021.

Also, the result of the relationship between pepper farming experience and the preference for the species produced is expected as it was strongly significant across the choices made by the farmers. *Ceteris paribus*, it was unveiled that a year increase in the farming experience will likely increase the probability of producing scotch bonnets, bell, birdeye and cayenne peppers by 1.2%, 1.1%, 1.2% and 0.6%, respectively. The influence of farm size on the choice of planting scotch bonnets and birdeye peppers in the area was statistically significant. It implies that the more the farm size, the more the chance of producing scotch bonnets and birdeye peppers by 1.0% apiece. This is in accordance with the survey's observation that scotch bonnets and birdeye peppers are produced in a large dimension of land compared with the bell and cayenne pepper species as also reported by Adegunsoye and Mafimisebi (2019).

The access to credit and market information had a significant relationship with the choice of pepper species produced by the farmers in the area. About 20.2%, 21.0%, 33.7% and 16.5% of scotch bonnets, bell, birdeye and cayenne peppers, respectively will be produced more if the farmers have access to credit while nearly 30.2%, 29.5%, 33.5% and 16.9% of scotch bonnets, bell, birdeye and cayenne peppers, respectively if the producers have access to adequate and timely market information. It means that a farmer who has access to credit and is also knowledgeable about the market behaviour per time will make the right choice of species that would accrue more income and as well better off their livelihood sustainability. The results shared similar views with the studies of Dessle et al. (2019) and Olutumise (2020). Farm household income also showed a significant association with the choice of producing scotch bonnets and birdeye peppers. All things being equal, a rational being will want to venture more into a business that operates at economies of scale especially if the marginal return is increased.

The distance to the nearest market showed a negative but significant relationship with the choice of either scotch bonnets or birdeye peppers in the study. The interpretation is that the longer the market to the producers, the less the likelihood of cultivating scotch bonnets and birdeye peppers by 0.1% and 0.4%, respectively. The negative relationship was also observed in the study of Olutumise (2020) carried out among yam farmers. The study revealed that the two species were produced in large quantity compared with other species, and long distances might hinder transportation to the market and therefore, discourage more production and market participation in the area. Therefore, going through the results, the educational curriculum needs to be restructured to accommodate practical and precise agriculture at all tiers of education, while policies on credit accessibility, land reform, group formation and market information should be reviewed to allow preferences for pepper species produced a vis-à-vis high level of market participation.

4.2. Disaggregation of market participation index (MPI) by cultivated species

The results revealed that birdeye producers formed the majority (36.9%) of species produced in the area followed by scotch bonnets, cayenne and then bell pepper. According to the author's observations, the highest production of birdeye pepper was due to the fact that it can be consumed either fresh or dried unlike scotch bonnets and bell peppers that are mostly consumed fresh. Table 3 showed that about 97.2%, 100%, 81.5%, and 92.3% of the pepper producers took at least 50% of their products to the market. This implies that most sampled farmers in the region produce pepper for market purposes. Following the threshold of over 75% of MPI as reported by Egbetokun and Oyedokun (2019), it can be stated that bell pepper had the highest (81.9%) market participation followed by cayenne (75.8%), scotch bonnets (68.8%) and then birdeye (36.4%). Apart from the viability of the enterprise, the temperature of the region (20–30 °C) cum the soil properties also encourages the growth and production of pepper in the area. Despite that some of the farmers practice monocropping, most of them practice either intercropping or crop rotation which reduces risks in production, and pests and diseases. Again, the result is an indication that pepper farmers are fairly market-oriented. The probable reason might be due to the perishability of the pepper fruits since most farmers could not afford the modern method of preservation.

4.3. Effect of main cultivated pepper species on the degree of market participation in the area

The Tobit regression model's findings were provided in Table 4. The negative sign of log-likelihood and significance of the chi-square make the model behave well. The LR chi2 (11) value of 623.44 was strongly significant at the 1% level, meaning that the null hypothesis that the coefficients of all the variables are jointly equal to zero is rejected in favour of the alternative. The results further showed that a level increase in the educational status of the respondents lead to a decrease in the degree of market participation in the area by 0.52%, *ceteris paribus*. The result does not support the *apriori* expectations. It was observed that educated people always take agriculture as an alternative though they prefer white-collar jobs to farm in the area. This is a major reason why most farmers in the area are secondary school leavers. Therefore, the negative relationship might be because of the fact that educated farmers are not committed to pepper production as the case of other farming enterprises. Nwauwa et al. (2013) also reported a negative relationship between the level of education and efficiency of small-scale dry season fluted pumpkin farmers. In determining the rate of pepper market participation, the coefficient of pepper farming experience was positive and significant at a 5% level. It was noted that the more the year spent in pepper cultivation, the more the likelihood of being participated in the market by 0.1%. The result is expected because farmers are expected to have understood the nuances of the business and as well got more customers for uptake at a considerable price. The result concurs with the findings of Adewusi and Adenegan (2020) who reported that farming experience was positive and significant in any participation study.

Farm income accrued from the pepper production was also a significant determinant in participating in a market. A money increase in the income accrued from pepper production has a probability of increasing the rate of market participation, all things being equal. The positive farm income will be an encouragement to produce more for the market purpose. A rational being will want to operate at economies of scale by

Table 3. Distribution pepper species by the degree of market participation.

Market Participation	*C. annuum* (Scotch bonnets)		*C. annuum* (Bell peppers)		*C. frutescens* (Bird eye)		*C. frutescens* (Cayenne peppers)	
	Freq	%	Freq	%	Freq	%	Freq	%
≤0.25	-	-	-	-	15	8.2	-	-
0.26–0.50	4	2.8	-	-	19	10.3	7	7.7
0.51–0.75	40	28.4	15	18.1	83	45.1	15	16.5
0.76–1.00	97	68.8	68	81.9	67	36.4	69	75.8
Total	141	100.0	83	100.0	184	100.0	91	100.0
Pool (%)	28.3		16.6		36.9		18.2	100.0

Source: Field Survey, 2021.

Table 4. Results of the factors affecting the degree of market participation.

Explanatory variable	Coefficient	Std Err.	P-value
Education	-0.0052***	0.0011	0.000
Family size	0.0025	0.0022	0.239
Experience	0.0010**	0.0005	0.030
Market distance	-0.0011	0.0007	0.103
Farm Income	2.34e-08***	5.86e-09	0.000
Non-farm income	3.16e-08**	1.33e-08	0.018
Credit	0.0501***	0.0122	0.000
Market information	0.0239**	0.0114	0.036
Main species produced			
Scotch bonnets pepper	-0.0327	0.0201	0.105
Bell pepper	0.2497***	0.0110	0.000
Cayenne pepper	0.2696***	0.0142	0.000
Constant	0.6638	0.0209	0.000
Sigma	0.0876	0.0029	

Note: ***' **' significant at 1%, and 5% respectively; Number of observations = 449; Log likelihood = -456.3514; LR chi2 (11) = 623.44; Prob > chi2 = 0.0000. Source: Field Survey, 2021.

increasing output vis-à-vis the income. The non-farm income was also positive and significant at a 5% level in addressing the determinants of the degree of market participation. It means that a money increase in the income from non-farm sources will increase the degree of market participation in the area. The result shared the view of Olutumise (2020) that farmers also depend on non-farm income to support their enterprises in terms of capital formation. Access to credit depicted a highly significant factor in addressing pepper market participation in the area. It was noted that having access to credit will likely increase market participation by 5%. The coefficient of market information was positive and significant at a 5% level. This is an indication that having adequate access to market information most especially on prices and products demanded will likely increase the rate of market participants in the area by 2.4%. This study shared similar findings with the study of Egbetokun and Oyedokun (2019) that was carried out among vegetable farmers, that age, marital status, farm size, access to credit and forming group marketing are the main determinants of market participation.

The results of the influence of species produced on market participation showed that the probability of producing bell pepper and cayenne pepper for market participation instead of birdeye pepper was 24.97% and 26.96%, respectively, *ceteris paribus*. The results further showed that the likelihood of producing birdeye pepper for market purposes instead of scotch bonnets pepper was 3.27%, *ceteris paribus*. It was observed that birdeye pepper command less market compared to other species of pepper. The result is expected because it was observed on the field that farmers mainly produce bell, cayenne and scotch bonnets peppers for market purposes in the area. To encourage sustainable pepper commercialization, the government at all levels should come up with policies that will better off the socioeconomic status of the pepper producers, and also form an organized market with functioning market infrastructure that will abreast farmers on the current price information and good road network.

5. Conclusion

The study used cross-sectional data to examine the market participation and preference to production in the case of pepper farmers in Southwest, Nigeria. The study used multinomial logit, market participation index and Tobit regression to address the stated objectives. It was concluded from the findings that farmers' preference for the production of pepper species were influenced by some factors and as well depend on the market conduct obtainable in the area. The socioeconomic factors responsible for the significant influence for the farmers' choice of decisions were education, experience, access to credit and farm income, while access to market information and market distance are the significant market factors that determine the choices of species produce by the farmers. The farmers mostly produce pepper for market purpose going by the market shares depicted by MPI. It confirms that the core growers regard their work as a business rather than a way of life.

The study also concludes that production preference has significant influence on the market participation alongside the socioeconomic and market factors. Producing a particular species has great influences on the degree of market participation in pepper market. It has been established from the study that the degree of market participation can be increased and improved by production preference in addition with the socioeconomic, market and transaction cost factors that have already enlisted in the literature.

6. Limitations and further study

The use of Geographic Information System (GIS) remote sensing to capture the demographic characteristics and location-specific farm-level information would have formed robust qualitative and quantitative data. It would have also helped to compare results on farm and location basis. The further study should also explore hermeneutic tech. as suggested by one of the reviewers.

Declarations

Author contribution statement

Adewale Isaac Olutumise: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2022.e10585.

References

Abdalla, M.E., 2012. An application of multinomial logistic regression model. Pak. J. Statistics Oper. Res. 8 (2), 271–291. https://www.researchgate.net/publication/274394043.

Abu, N.E., Chimdi, G.O., Ojua, E.O., 2020. Nutritional and anti-nutritional evaluation of ten genotypes of pepper (*Capsicum annuum* L.) grown in a derived savanna ecology of Nigeria. Ethiop. J. Sci. & Technol. 13 (1), 17–30.

Adegunsoye, A.O., Mafimisebi, T.E., 2019. Gender differential in profitability of cultivating Scotch bonnet pepper. Int. J. Veg. Sci. 1–7.

Adewusi, O.A., Adenegan, K.O., 2020. Production of indigenous vegetables and livelihood of farmers in Nigeria–Canada vegetable project. Int. J. Veg. Sci. 1–10.

Ansa, J.E.O., Woke, C., 2018. Effect of spacing and poultry manure rates on growth, yield and quality of cayenne pepper (*Capsicum frutescens. L*) in Southern rain forest of Nigeria. Int. . Environ. Agric. Biotechnol. 3 (4), 1234–1240.

Ayo-John, E.I., Odedara, O.O., 2017. Serological detection of viruses infecting tomato and pepper in Southwest Nigeria and their distribution. Nigerian J. Biotechnol. 33, 78–82.

Baba, M.D., Yelwa, J.M., Sanchi, I.D., 2014. Comparative profitability analysis of watermelon and pepper production in danko-wasagu local government area of kebbi state, Nigeria. Rev. Knowl. Econ. 1 (2), 39–47.
Bagshaw, K.B., Ogwu, K.R., 2020. Last milr logistics and on-time delivery of fresh fruit and vegetables in delta State and Rivers State, Nigeria. Nigerian J. Manag. Sci. 21 (1&2), 282–297.
Benito, U., Hanns, D.F., Claudio, E., Marisela, F., 2020. Multinomial logistic regression to estimate and predict the perceptions of individuals and companies in the face of the COVID-19 pandemic in the Nuble Region, Chile. Sustainability 12, 9553.
Bernard, T., De Jvanvry, A., Mbaye, S., Sadoulet, E., 2017. Expected product market reforms and technology adoption by Senegalese. Am. J. Agric. Econ. 99 (4), 1096–1115.
Burke, W.J., Myers, R.J., Jayne, T.S., 2015. A triple-hurdle model of production and market participation in Kenya's dairy market. Am. J. Agric. Econ. 97 (4), 1227–1246.
Clark, S., Coughenour, C., Bumgarner, K., De la Fuente-Mella Reynolds, C., Abelar, J., 2019. The impact of pedestrian crossing flags on driver yielding behaviour in Las Vegas, NV. Sustainability 11, 4741.
Dessle, A.B., Koye, T.D., Koye, A.D., Abltew, A.A., 2019. Analysis of red pepper marketing: evidence from northwest Ethiopia. J. Econ. Struct. 8 (24), 1–14.
Ebele, S.N., Ojukwu, E.V., Kalu, C.U., Metu, A.G., 2021. Effect of vegetable exports on Nigeria's economy. Int. J. Dev. Econ. Sustain. 9 (2), 23–38.
Egbetokun, O.A., Oyedokun, M.O., 2019. Determinants of level of market participation among vegetable farmers in Lagos State, Nigeria. Acta Horticulturae. Error! Hyperlink reference not valid.
FAOSTAT, 2012. Food and Agriculture Data. http://www.fao.org/faostat/en/#data/.
FAOSTAT, 2019. Food and Agriculture Data. http://www.fao.org/faostat/en/#data/.
Gujarati, D.N., Porter, D.C., 2009. Basic Econometrics, fifth ed. McGraw-HILL International Editions Economics Series, Singapore.
Ikuemonisan, E.S., Mafimisebi, T.E., Ajibefun, I., Adenegan, K., 2021. Cassava production in Nigeria: trends, instability and decomposition analysis (1970–2018). Heliyon 6 (10), e05089.
Joyce, M., David, J., Titus, J., 2019. Structure of red pepper marketing in Adamawa State, Nigeria. Int. J. Vet. Sci. Agric. Res. 1 (3), 16–21.
Kostov, P., Davidova, S., 2013. A quantile regression analysis of the effect of farmers' attitudes and perceptions on market participation. J. Agric. Econ. 64 (1), 112–132.
Mohammed, B., Ahmed, B., Abdulsalam, Z., 2015. Technical efficiency of chilli pepper production in kaduna state, Nigeria. Am. J. Exp. Agric. 9 (5), 1–9.
Mustapha, A.B., Felix, T., Tashiwa, M.C., Gworgwor, N.A., 2021. Effect of plant population density and methods of weed control on the yield of pepper (*Capsicum annum* L.) in Northeastern, Nigeria. J. Appl. Sci. Environ. Manag. 25 (2), 261–267.
Nwauwa, L.O.E., Rahji, M.A.Y., Adenegan, K.O., 2013. Determinants of profit efficiency of small-scale dry season fluted pumpkin farmers under tropical conditions: a profit function approach. Int. J. Veg. Sci. 19 (1), 13–20.
Obayelu, O.A., Adegboyega, O.M., Sowunmi, F.A., Idiaye, C.O., 2021. Factors explaining postharvest loss of hot pepper under tropical conditions. Int. J. Veg. Sci. 1–9.
Ogunbo, M.M., Ayinde, I.A., Afolami, C.A., Banmeke, T.O.A., 2015. Technical efficiency of pepper production under tropical conditions. Int. J. Veg. Sci. 21 (1), 21–27.
Olutumise, A.I., 2020. Transportation system and output market participation nexus among yam producers in Southwest region of Nigeria. Econ. Eng. Agricu. Rural Dev. 20 (4), 365–379.
Olutumise, A.I., Ajibefun, I.A., Omonijo, A.G., 2021. Effect of climate variability on healthcare expenditure of food crop farmers in Southwest, Nigeria. Int. J. Biometeorol. Epub ahead of print. PMID: 33474613.
Olwande, J., Smale, M., Mathenge, M.K., Place, F., Mithofer, D., 2015. Agricultural marketing by smallholders in Kenya: a comparison of maize, kale and dairy. Food Pol. 52, 22–32.
Omotade, I.F., Alatise, M.O., Olanrewaju, O.O., 2019. Growth and yield performance of hot pepper using aquaculture wastewater. Agric. Eng. Int.: The CIGR E-journal 21 (2), 18–25.
Opata, P.I., Ezeibe, A.B., Arua, R.N., 2020. Drivers of farmers market participation in Southeast Nigeria. J. Agric. Rural Dev. Tropics Subtropics 121 (2), 207–217.
Ouma, E., Jagwe, J., Obare, G.A., Abele, S., 2010. Determinants of smallholder farmers' participation in banana markets in Central Africa: the role of transaction costs. Agric. Econ. 41, 111–122.
Owusu, O., Iscan, T.B., 2020. Drivers of farm commercialization in Nigeria and Tanzania. Agric. Econ. 52, 265–299.
Qin, F., Vania, B.S.G., 2018. Information access and smallholder farmers' market participation in Peru. J. Agric. Econ. 69 (2), 476–494.
Sadik-zada, E.R., 2020. Natural resources, technological progress, and economic modernization. Rev. Dev. Econ. 25 (1), 381–404.
Schipmann, C., Qaim, M., 2010. Spillover from modern supply chains to traditional markets: product innovation and adoption by smallholders. Agric. Econ. 41, 361–371.
Wooldridge, J.M., 2002. Econometric Analysis of Cross Section and Panel Data. MIT Press, Cambridge, Mass.
World Bank, 2017. The World Bank Annual Report 2017. https://openknowledge.worldbank.org/handle/10986/27986.