Journal of Agriculture and Rural Development in the Tropics and Subtropics
Vol. 121 No. 2 (2020) 207–217
https://doi.org/10.17170/kobra-202010191969 ISSN: 2363-6033 (online); 1612-9830 (print) – website: www.jarts.info

Drivers of farmers market participation in southeast Nigeria

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Abstract

The objective of this paper was to investigate the drivers of farmers' participation in the output market for yellow pepper using a sample of 420 randomly selected producers from 8,500 farmers in selected markets in southeast Nigeria. The heterogeneity of smallholder market participation was modelled with quantile regression. The variables that affected all the quantiles (*i.e.* for subsistence, semi-subsistence, intermediate, semi-commercial and commercially oriented farms) are the distance to the trading centre and the level of poultry manure applied. The estimated coefficients of poultry manure were statistically significant and directly related to commercialisation of pepper, while the distance to market was negatively correlated. The estimated coefficients for land size, age of household head, fertiliser and agrochemicals use, were positive and significant while income from other sources and asphalt road were negative and significant. It could be deduced from the results that specialisation and commercialisation in yellow pepper production in southeast Nigeria triggers the production of other commercial crops (*i.e.* cassava, maize, tomatoes, and garden eggs, groundnut, okra, fluted pumpkin, amaranth, and sweet potatoes). The findings showed that volume of pepper sold and total farm production and consumption were indicators for household food security and income. These suggest that smallholder market participation in West Africa could be driven by policies aimed at improving the commercial crops that are highly marketable, rural road infrastructure, market information systems, asset accumulation, human capital and promotion of farmer organisations.

Keywords: Yellow pepper, transaction costs, subsistence, commercialisation, quantile regression

1 Introduction

Integrating smallholder farmers into the agricultural market offers a means of livelihood to several households in Africa. In southeast Nigeria, yellow pepper *Capsicum annuum* (L.) which is a unique species of pepper is widely cultivated as a commercial vegetable, thereby triggering market participation and transformation towards the alleviation of poverty and food insecurity. Its cultivation forms the major and sometimes the only agricultural activity of rural women in Nsukka Agricultural Zone (Onwubuya *et al.*, 2009). This crop (in combination with other crops) offers a source of food and income security to farmers, providing trade and employment to about 70 % of the local population in the region (Onwubuya *et al.*, 2009; Odetola & Etumnu, 2013; Dagnoko *et al.*, 2013; World Bank, 2017). Large scale production of crops offers farmers an opportunity to move from subsistence agriculture into more specialised, market-oriented systems rather than migrate out of the agricultural sector. Although much evidence demonstrates the need to promote smallholders' market participation, there is little consensus on how to integrate farmers into the market (Alemu, 2015; Wickramasinghe, 2015; Ahamad *et al.*, 2017; Bernard *et al.*, 2017; Ebata *et al.*, 2017). This study attempted to contribute to strengthening our understanding of the relationship between technology, institution, market access, and other factors that might explain the observed behaviour towards commercialisation with respect to the southeast Nigeria context and the link between pepper production specialisation and market participation.

The problems with participating in food marketing are failure of farmers to meet transaction costs. These costs are whole array of costs associated with acquisition of inputs and technology, buying and selling and transferring ownership of goods and services, etc. (Renkow *et al.*, 2004; Alemu, 2015; Bernard *et al.*, 2017; Ebata & Hernandez,

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Published online: 29 October 2020 – Received: 22 July 2019 – Accepted: 15 October 2020

2017; Opata, 2018). The classical policy prescription would be for government to provide an appropriate institutions for easy access to inputs, output, insurance, credits, land, labour and other agro-services markets (Andersson *et al.*, 2015; Burke *et al.*, 2015; Montalbano *et al.*, 2018; Renkow *et al.*, 2004; Zanello, 2012). However, both government and these institutions failed to improve market systems and therefore the need for addressing the institutional failure to achieve more market participation in southeast Nigeria. The overarching aim was to unravel the entry point for transitioning from subsistence to commercially oriented farming through market participation drivers in Nigeria. As such the interplay of some confluence of factors in the context of farm-to-market linkages was investigated across a range of quantiles covering the continuum from zero to 100 % share of sales in the output of pepper. The paper thus investigates the effect of transaction costs on the persistence of different farmers (the subsistence, semi-subsistence, intermediate, semi-commercial and commercial farming) operating within the region's market systems. In sum, the paper advances discussions on the need to enhance income-generating opportunities by strengthening rural-urban market linkages for farmers by identifying factors influencing farmers' volume of supply. It contributes to debates on farm commercialisation, public agricultural service provision, market participation and searches for the transformation of West African agricultural economy.

2 Materials and methods

2.1 Study area

The study area was southeast Nigeria, covering five states and located between latitude 6° N and 8° N and longitude 4° 30' E and 7° 30' E. The area is characterised by warm, humid forest areas where high annual rainfall and long wet season offer a conducive environment for optimum yield of crops. The region has a projected total population of about 16.4 million persons (World Meters, 2019), and spreads over a total area of 78,618 km^2, representing 8.5 % of the nation's total land area.

A multi-stage sampling procedure was employed in this study. In stage one, the study stratified each state within the region based on the intensity of supply or demand of yellow pepper. Stratum 1 (supply region) includes Enugu, Ebonyi and Imo states, while stratum 2 (deficit region) include Abia and Anambra states. The study selected one state from each stratum using a simple random sampling approach – Enugu and Anambra – from where markets and respondents were selected. To select markets (stage two), a purposive sampling approach was used to select areas with high trade of yellow pepper. Here, we choose three urban and three rural markets. The urban markets were Nsukka and Enugu market (in Enugu state), and Onitsha main market (in Anambra state), while the rural markets were Nkwo Ibagwa and Orie/Nkwo Opanda (in Enugu state), and Nkwo-Adazi Nnukwu (in Anambra state). In stage three, sample selections were done in two stages using a predetermined sampling frame drawn from the selected markets. Firstly, a census survey of the selected markets was carried out in 2017 to identify and stratify marketers into three groups. These lists comprised of (i) 8,500 producers, (ii) 3,600 wholesalers and (iii) 8,000 retailers and served as the sampling frame. Secondly, equal ratios of farmers in each group (5 %) were selected using Simple Random Sampling (SRS) technique. The number of producers, wholesalers, and retailers sampled in each market area is therefore specified through the use of an equal ratio of 5 % for each category of marketers identified. This gave a total of 420 producers, 180 wholesalers, and 400 retailers. The sampling percentages of 5 % (of each group) were chosen because of the intensity of survey and resource constraints. The pilot survey indicated that respondents were relatively homogenous and an intensive survey of a randomly selected sample can produce unbiased results (Opata, 2018). Data collection was undertaken during the 2017/18 cropping year, and primarily involved administration of three sets of different structured questionnaires to each category of respondents, including use of open-ended questionnaires for focus group discussions. The focus group discussions collected subjective data based on the perception of marketers to give more insight into factors influencing farmer market participation.

2.2 Analytical framework

Data were analysed using a quantile regression model which shows the heterogeneous effects of variables on response and allows for heteroskedasticity among the disturbances. The model explored how the conditional distribution of smallholder output market participation is driven by these variables. Quantile regressions not only allow modelling of the heterogeneous effects of covariates on the response variable but also allow for heteroskedasticity among the disturbance (Kostov & Davidova, 2013). Following these authors, the quantile regression used was given as:

$$y_i = X_i^T \beta_\tau + u_{\tau i} u_{\tau i} \sim H_{\tau i} \text{ subject to } H_{\tau i} 0 = \tau \qquad (1)$$

where the index i denotes the individual agent (producer), y_i is the regressand, and variable, X_i is the vector of the regressor for each variable i. β_τ represents the specific linear effects of the quantile, and $0 < \tau < 1$ is the given quantiles which are known (in this study we used 0.05th, 0.25th, 0.50th, 0.75th, and 0.95th quantiles). Quantile regression provides the capacity to view the effects of a regressor at different levels of quantile based on the Conditional Median Function. The quantile is therefore represented in (1) as an unknown function τ. The error term $u_{\tau i}$ is unknown and specified as $H_{\tau i}$. The linear quantile restriction leads to the following interpretation: the model describes the quantile function $Q_{yi}(\tau/X_i)$ of the response variable y_i conditional on a vector of response X_i at a given quantile. More specifically:

$$HH_{yi}^{-1}(\tau/X_i) = X_i^T\beta_\tau \tag{2}$$

where: $HH_{yi}^{-1}(\tau/X_i)$ = response variable y_i conditional on a vector of response X_i at a given quantile τ,
and $X_i^T\beta_\tau$ = vector of response X_i as regards to the specific linear effects of the quantile.

In contrast, the linear regression model describes the mean of the dependent variable (Koutsoyiannis, 1977). The fundamental difference is that the mean model assumes that the response variable is conditionally Gaussian, which means that the mean equation applies to all parts of the distribution. The quantile regression makes no such distributional assumptions, and hence, the conditional quantile function that is estimated can vary across quantiles. It would also be useful to clarify that in estimating any quantile, including the most extreme ones, the (linear) quantile regression uses all available observations.
The conditional quantile can be alternatively expressed as the following optimisation problem:

$$\underset{\beta\tau}{argmin} \sum_{i=1}^{n} \rho\tau(y_i - X_i^\tau\beta_\tau) \tag{3}$$

where β_τ (.) is called the 'check function', that is, $\rho_\tau(\mu) = \mu(\tau - I(\mu < 0))$ with I(.) denoting the indicator function. Solving (3) leads to the most popular linear quantile regression estimator, namely the linear programming estimator. The minimisation problem (3) can be recast as an equivalent maximum likelihood problem where the distribution of the response variable is the skewed asymmetric Laplace distribution.

2.3 Quantile regression

This study employed quantile regression to model the differing groups of farmers based on conditional market participation; five groups have been identified. The quantile regression model based on the conditional quantile function is implicitly specified as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}...X_{13}) + U \tag{4}$$

Where:
Q 0.05(Y): median, the first quantile, 5th percentile
Q 0.25(Y): median, the second quantile, 25th percentile
Q 0.50(Y): median, the third quantile, 50th percentile
Q 0.75(Y): median, the fourth quantile, 75th percentile
Q 0.95(Y): median, the fifth quantile, 95th percentile

The dependent variable (Y) shows the volume of yellow pepper marketed. The quantiles denote households and the volume of yellow pepper sold, indicating that they allocated those same quantiles to marketable crop i.e pepper. Market participation is a ratio taking values from 0 (no sales) to 1 (all produce is sold). For this reason, it is preferable to use a fractional response model. The most widely applied approach in modelling a fractional response variable is to transform the original variable in such a way that the interval restriction no longer holds. The latter can be expressed by applying the logit transform $y^* = log(y/1)y)$, where y is the original (interval-valued) fractional response variable, and build a model for the transformed variable $y*$. This can be more easily seen if one considers the opposite transform, that is, $y = exp(y^*)/[1 + exp(y^*)]$, showing that for any value of y^*, y is guaranteed to be in the (0,1) interval. The problem arises when the fractional variable is measured at the boundary of the unit interval (*i.e.* when it takes the value 0 or 1) because then the logit transform is undefined. It can be overcome by a preliminary 'scaling' of the fractional variable to map it from the [0,1] to the (0,1) interval. This can be achieved by replacing y by $(y + e1)/(1 + e2)$, where $e1$ and $e2$ are arbitrary small numbers, such that $e < e2$. Adding $e1$ moves y away from zero, while dividing by $(1 + e2)$ scales back its values and as long as $e < e2$ the scaled values will be lower than 1. Here, $e1 = 10^{32}$ and $e2 = 10^8$ are used following (Kostov & Davidova, 2013). To allow for an unrestricted dependent variable, the logit transform also preserves the ranking of the dependent variable, which is an important property, particularly when using quantile regression.

In addition to estimating a quantile regression for a range of quantiles, the interest in this study was also in determining which variables affected the corresponding conditional quantiles. The main problem in specifying quantile 'fixed effects' is that, as in any other non-linear model, the standard linear transformation approaches designed to deal with the issue of a large number of parameters are not applicable. This implies that the individual's fixed effects have to be estimated directly alongside the other quantile coefficients. Table 1 presents the measurements and expected signs of the variables used in the model.

The R^2 estimated measured the proportion of the total variation in the volume of pepper sold in kilograms (kg) that

Table 1: *Descriptive statistics and expected signs of the explanatory variables used for the model.*

Variables	*Measurements*	*Sign*
Dependent variable		
The volume of yellow pepper marketed (market participation)	Quantile regression; 0-1: Q = 0.05, Q = 0.25, Q = 0.50, Q = 0.75 and Q = 0.95	
Independent variables		
Human and asset capital		
Gender of head of household (GHH)	Dummy: 1 = male and 0 = female	
Age of household head (AHH)	Years	
Education of the household head (EDU)	Years	+
Land size (LS)	Hectares (ha)	+
Income from other sources as pepper	in 1000 Naira	-
Market		
Distance to market (MKD)	Kilometres	-
Presence of aroma	Dummy: 1 = yes and 0 = no	+
Technology		
Fertiliser applied (FERT)	Kilogrammes per ha	+
Poultry manure applied (PM)	Kilogrammes per ha	+
Other agrochemicals (insecticides, fungicides, and rodenticides) (AC)	Litres per ha	+
Institutional infrastructure and network		
Distance to asphalt road (RDD)	Kilometres	-
Farmers association (FA)	Dummy: 1 = yes and 0 = no	+
Contact with extension agent (EA)	Dummy: 1 = yes and 0 = no	+

has been accounted for by regressing the volume of pepper sold on the sets of variables. The estimated coefficients of each explanatory variable (β value) measured the marginal effects *i.e.* the response of the dependent variable to a unit change in independent variables, all other independent variables being constant. The sign of the coefficient shows the direction of influence of the variable on the volume of yellow pepper sold. The significant values (also known as the p-value) show whether a change in the independent variable significantly influences the volume of yellow pepper sold at a given level. In other words, the degree to which market participation in the output markets for yellow pepper can be explained by sets of variables grouped under human and asset capital, market characteristics, technological characteristics, institutional framework and network. In this study, the variables were tested at 1 %, 5 % and 10 % significant levels.

3 Results

3.1 Descriptive statistics

The total land size cultivated by the respondents (n=420) summed up to 800 ha with a pepper share representing 478.3 ha (59.7 %). Out of the 800 hectares, women cultivated 467 ha (59 %) while their male counterpart contributed 333 ha (41 %; Table 2). The descriptive statistics (Table 2) show that the farmers cultivated pepper in various crop combinations. Eighty point three ha was used for sole pepper production corresponding to 10 % of total land size. Forty point six ha of sole pepper was cultivated by women while 38.7 ha by men. The average yield of pepper was estimated at 496 kg ha^{-1}. Other crops cultivated together with pepper included cassava, maize, groundnut, garden egg, okra, fluted pumpkin, amaranth, tomatoes and sweet potatoes. Pepper fruits are one of the spices used for cooking food; however, each household used only a small part of their harvest (less than 2 %) for home consumption while over 98 % were sold over all quantiles.

The quantities sold (250 to over 2000 kg) were descriptively grouped to summarize the different level of engagement of farmers in pepper production and sale while the quantile regression model described relationship between a set of independent variables and the conditional market participation based on the five quantiles levels. Households who sold over 2,000 kg allocated 60 to 100 % of their cultivable land, fertiliser, manure, and agrochemicals to pepper production, transported to distance/urban markets, and incurred

Table 2: *Pepper and mixed pepper cropping systems in total area cultivated (in ha and as % of total), share by gender, and pepper proportion in each of the 12 crop mixtures.*

Cropping systems	*Total area cultivated (ha)*	*Area as % of total*	*Women share (ha)*	*Men share (ha)*	*Pepper share in cropping system (%)*
Sole pepper	80.3	10.0	41.6	38.4	100
Pepper/maize	61.0	7.6	34.8	26.2	52
Pepper/tomatoes/cassava	131.0	16.4	81.2	49.8	35
Pepper/cassava/groundnut	71.1	8.9	36.3	34.8	9
Pepper/maize/cassava	50.7	6.3	29.9	20.8	70
Pepper/garden egg/okra	60.5	7.7	42.4	18.1	75
Pepper/pumpkin/cassava	80.8	10.1	41.2	39.6	60
Pepper/pumpkin/amaranth	61.0	7.7	45.1	15.6	90
Pepper/tomatoes/potatoes	68.0	8.5	33.3	34.7	76
Pepper/tomatoes/maize	40.0	5.0	26.0	14.0	75
Pepper/garden egg/maize	41.1	5.5	27.0	14.0	53
Pepper/garden egg/cassava	54.5	6.8	29.0	25.5	50
Total	800 ha	100 %	59 % (467 ha)	41 % (333 ha)	478.3 ha

Table 3: *Classification of farmers by quantity of pepper sold and distribution of each group.*

Variable	*Subsistence*	*Semi-subsistence*	*intermediary*	*Semi-commercial*	*Commercial*
Quantity produced (kg)*	250 < 500	500 < 1,000	1,000 < 1,500	1500 < 2,000	> 2,000
Group (%)	26	27	33	9	5

* Over 98% of the produced pepper was sold over all farmer groups

transaction costs that excluded other farmers from attaining that quantile.

The mean and standard deviation of the independent variables used in the model are shown in Table 4. On the average female pepper growers outnumbered males. The average field size under peper was 1.9 ha on which the preference poultry manure was used as fertiliser. Distance to the next market was estimated at 8.1 km (SD 7.54).

3.2 Model specification tests

Before interpretation of the estimation results various specification tests were performed. These tests showed the probability values for the goodness-of-fit and possible heterogeneous effects. The performed Wald test showed equality of slopes of the various quantiles. Tests results are shown in the supplement available on-line (Table S1 to S3).

3.3 Quantile regression results

Model results provided insights into the level of market participation proxied by volume of yellow pepper marketed. Each quantile in the regression was described as a group of households that produced and sold specific volume of yellow pepper. The 1st group or 0.05th quantile consisted of the subsistence-oriented farmers; the 2nd quantile at the 0.25th represented the semi-subsistence oriented farmers; the 3rd group at the 0.50th quantile the intermediate oriented farmers; the 4th group at the 0.75th quantiles the semi-commercial oriented farmers, and the 4th and 5th group represented the highly commercially oriented farmers sold at various distant and urban markets in the two states, Enugu in Enugu state and Onitsha in Anambra state. Further, the farm household at the lower three quantiles only sold at the farm gate and the three rural markets that were close to their farms.

The coefficients of the variables were estimated at different quantile levels. The result is presented at quantiles response or dependent variable volume of yellow pepper supplied. There are 13 covariates or explanatory variables retained by the models. These fall into four groups: human and asset capital; market; land assets technology; institution, infrastructure, and network as shown in Table 5.

Nine out of the thirteen variables affected the first quantile (0.05th), seven variables affected the second quantile (0.25th), three variables affected the middle quantile (0.50th), five variables affected the 4th quantiles (0.75th), while seven variables affected the 5th quantiles. The estimated coeffi-

Table 4: *Average statistics of variables (mean and standard deviation for the pooled sample; n = 420).*

Variables	*Mean*	*SD*
Dependent variable		
Volume of yellow pepper marketed (market participation) in kg	945	451
Independent variables		
Human and asset capital		
Gender of household head (dummy) male = 1, female = 0	0.41	0.04
Age of household head (AHH; years)	45. 2	7.26
Education of household head (EDU; years)	7.3	0.51
Land size (LS; ha)	1.9	2.32
None pepper income (1000 naira)	75.0	9.02
Market		
Distance to the next market (km)	8.1	7.54
Presence of aroma (dummy) yes = 1 and no = 0	0.89	0.934
Technology		
Fertiliser applied (FERT; kg ha^{-1})	54.6	28.45
Poultry manure applied (PM; kg ha^{-1})	956.3	682.12
Agrochemicals (insecticides, fungicides and rodenticides - AC; litres ha^{-1})	9.9	6.89
Institutional infrastructure and network		
Distance to asphalt road (RDD; km)	15.2	5.65
Farmers association (FA) (dummy, yes = 1 and no = 0)	0.48	0.05
Contact with extension agent (EA) (dummy, yes = 1 and no = 0)	0.21	0.075

Computed from field survey 2017/18; SD = standard deviation

cients of distance to the market were statistically significant and negative at for all quantiles.

4 Discussion

Discussion The probability of F-statistics showed a high level of significance ($p < 0.000$) and implies that an overall test of the explanatory variables has a significant influence on the volume of pepper sold. The level of market orientation in all the quantiles responded to two variables. The first was the distance to the market and the second the level of organic poultry manure used as fertiliser. As was anticipated, the level of significance of distance to the market was higher at the lower two quantiles as they were not participating in the distance and urban markets such as Enugu main market in Enugu state and Onitsha main market in Anambra state and only sold at farm gate and at the three rural markets. The coefficient of this variable is negative meaning that if the distance to the market increases by one km, the volume of pepper sold per quantile reduces by the respective coefficient (Table 5). The regression results confirm that those at the upper quantiles are less likely to be affected by a reduction in pepper sold by distance since the level of significance decreased at highly commercial oriented farms or 95th quantile. In this case, farmers at the lower quantiles were not competitive in the market and were constrained by transaction costs in accessing urban markets for yellow pepper in the two states. This suggests that farmers at the 0.05th and 25th quantiles were producing at subsistence level and lacking market power. This relationship is well established in the literature e.g. by Mmbando *et al.* (2015) and Ebata *et al.* (2017) who both found that greater distance from trading centres may proxy for prohibitively high transaction costs. Mmbando *et al.* (2015) obtained similar results on the negative and significant influence of proportional transaction costs (distance to market) on sale volume of maize and pigeon pea in Tanzania and contend that policies to support smallholders market orientation should target reducing transportation costs through the building of better accessible roads and mode of transportation. Similarly, Ebata *et al.* (2017) found that each additional minute of travel time reduced the farm gate price by 2.5 cents per quintal of beans produced in Nicaragua. The result further agrees with the evidence provided by other researchers on the negative influence of weak transportation systems in accessing output market by smallholders (Gliessman, 2016; Ume, 2017).

The second variable that influenced all quantiles concerned the level of organic poultry manure used as fertiliser. Organic poultry manure is among the major input and technology constraint of smallholders. The variable shows a positive and significant relationship in all five quantiles, indicating that if the level of manure application increases by one kg, the volume of pepper sold per quantile increases by the respective coefficient (Table 5). If a high level of poultry manure is used, this would increase the level of fertility of the soil and increase pepper yield as well as the yield of the other crops in the mixture, and increase the market share of pepper. The finding compares favourably with that of Mariano *et al.* (2012) and Oyinbo *et al.* (2019) who showed that biophysical factors such as soil nutrient deficiencies are impediments to the yield of crops and market-oriented production of farmers. Oyinbo *et al.* (2019) showed that site-specific nutrient rates above the current application rate had a positive and significant influence on the yield and market orientation. The result from this work also suggests that policies aimed at improving yield for market participation

Table 5: *Regression estimates of the determinants of market participation among the pepper producers in the study area.*

	Q = 0.05		*Q = 0.25*		*Q = 0.50*		*Q = 0.75*		*Q = 0.95*	
Variables	*Coef.*	*P value*	*Coef.*	*P value*	*Coef.*	*P value*	*Coef.*	*P value*	*Coef.*	*P value*
GHH (gender)	0.39	0.03**	0.32	0.00***					0.44	0.06*
AHH (age)	0.44	0.00***	0.28	0.03**						
EDU (education)	0.38	0.04**	0.30	0.07*						
NFI (non farm income)	-0.29	0.02**	-0.36	0.01***						
LS (landsize)	0.28	0.01***	0.45	0.03**	0.24	0.02**			0.61	0.07*
MKD (market distance)	-0.34	0.02**	-0.32	0.00	-0.30	0.01***	-0.66	0.05***	-0.78	0.09*
PA (presence of aroma)							0.38	0.02**	0.23	0.00***
FERT(fertilisers)							0.40	0.02**	0.42	0.01***
PM (poultry manure)	0.42	0.01***	0.23	0.03**	0.31	0.02**	0.56	0.00***	0.62	0.02**
AC (agro-chemicals)									0.54	0.03**
RDD (distance to road)	-0.40	0.03**	-0.43	0.06*			-0.40	0.03**	-0.43	0.06*
FG (farmer groups)	0.19	0.01***					0.19	0.01***		
EA (extension contacts)	0.21	0.11							0.31	0.19
Constant	0.58	0.41	0.23	0.32	0.61	0.12	0.21	0.42	0.61	0.29
Pseudo R2		0.73		0.68		0.42		0.58		0.52
F(13, 420)	3.165						3.165			
Prob > F	0.00***						0.00***			

Computed from data field survey 2017/18; ***, **, * implies significant at 1 %, 5 % and 10 % probability level.

could enhance soil fertility management ability of farmers in SSA.

The cultivated area under pepper was a positive and significant factor determining commercialisation. This study, like other studies, found that land assets are an important determinant of market orientation and commercialisation and that the land variable is particularly important for pepper which as a spice is highly marketable; as a higher pepper production translate directly to more marketing, while other crops could be used primarily for home consumption and therefore do not necessarily translate to a higher marketing volume. The coefficients of land size were positive and significant at 0.05th, 0.25^{th} and 0.50thquantiles, indicating that if the land size cultivated under pepper increases by ha-1, the volume of pepper sold per quantile increases by the respective coefficient (Table 5). The land size was not significant at 0.75^{th} and 0.95th.

Most of the other empirically selected variables are consonant to previous studies regarding unravelling the entry point for transitioning from subsistence to market and commercially oriented farming in developing countries of SSA (Alemu, 2015; Bernard *et al.*, 2017). As the study identified five groups of quantiles, the remaining variables only affected some quantiles and not others. The interpretation below is structured according to the cluster of effects either in the lower or upper quantiles. A wider range of variables is associated with lower proneness to market participation suggesting that these factors are also important in shaping the market behaviour of subsistence-oriented households. These variables can be grouped into those with a positive effect on market orientation (age, education, and belonging to farmers association) and those with a negative effect (distance to the market, distance to the asphalt road, and non-farm income).

Age and education exert a positive influence, which were observed at the 0.05^{th} and 0.25^{th} quantiles, meaning that if age, the level of education, and belonging to farmers association increases by one unit, the volume of pepper sold at 0.05^{th} and 0.25^{th} quantile increases by the respective coefficient (Table 5). Concerning age, an argument has been made for both a positive and negative impact on market orientation and commercialisation, and there is little consistency in empirical findings (Mmbando *et al.*, 2015; Snoxell & Lyne, 2019). Age denotes more experience and skills, on the other hand, younger farmers may be more energetic to acquire technical input and other transaction variables needed to supply more output of yellow pepper and more market orientation. The positive and statistically significant influence of education on market orientation and commercialisation was found in other studies (Mmbando *et al.*, 2015; Olwande *et al.*, 2015).

Gender is generally found to be significant (Woldeyohanes *et al.*, 2016), with male-headed household more likely to participate in the market, but the result varies between regions and products. For instance, Masamha *et al.* (2017) found that 21.5 % of men engaged in more commercial oriented farms and generated 1.5 million Tanzanian shillings while 7.3 % of women are in this category. They attributed this to overriding factors of cultural practices, customary laws and subordination of women in social, political and economic life. Gender exert a positive influence, which was observed at the 0.05th, 0.25th, and 95^{th} quantiles, showing that if one unit of the gender of household increases by one man instead of one woman, the volume of pepper sold at 0.05th, 0.25th, and 95^{th} quantile increases by the respective coefficient (Table 5). Pepper production was formally a female culture, however, due to its market orientation both men and women now engaged in yellow pepper and other share crops in mixture such as tomatoes, fluted pumpkin leaves, cassava for income. These findings were against the findings of De la O Campos *et al.* (2016) and Peterman *et al.* (2011) who used Oaxaca decomposition to show that women were more productive in agriculture and engaged in value chains, although they faced daunting constraints to their productivity, arising from limited access to productive assets from physical, human capital and other social issues such as child dependency ratio which placed a constraint on production and marketing activities.

Nonfarm income refers to other income earned that did not arise from agricultural activities. The estimated coefficient shows a negative and significant influence at the two lower quantiles (0.05^{th} and 0.25^{th}) (*i.e.* for subsistence and -semi-subsistence-oriented oriented households). When farmers are more commercially oriented, they are less likely to engage in other nonfarm businesses, showing that the marginal effect of additional income from other businesses decreases with the increasing supply of yellow pepper at 5 % and 1 % probability level at the 0.05^{th} and 0.25^{th} quantiles.

High transaction costs in accessing input and technology requirement are captured in terms of households' demands for farm technology such as fertiliser, herbicides, pesticides, and poultry manure and other input. As expected, the level of fertilisers applied was positively and significantly related to commercialisation or more market orientation also associated with high transaction costs in accessing input and technology market. It influenced the 2 upper quantiles (0.75^{th} and 0.95^{th}) (i.e for semi-commercial and commercial oriented farmers). Other transaction cost variables that were positive and significant at 0.75^{th} and 0.95^{th} quantiles and reduced the likelihood of the smallholders from being market orientation were the use of agrochemicals such as insecticides, fungicides and rodenticides and the use of yellow pepper seed that had more aroma in the farms, meaning that if kg-1 of fertilizer, insecticides, fungicides or rodenticides and yellow pepper seed with more aroma were used, the volume of pepper sold at 0.75th, and 95^{th} quantile increases by the respective coefficient (Table 5). The degree of market orientation increases in the highest two quantile 0.75^{th} and 0.95^{th} with the use of fertiliser, agrochemicals and presence of aroma in pepper while the effect of these fertilizer, chemicals, and aroma disappeared in subsistence-oriented farms. This result is inconsonant with previous studies regarding the commercialisation of smallholders where transaction costs constrain adoption of agrochemical and fertiliser inputs by smallholder farmers in Punjab Province Pakistan (Bilal & Barkmann, 2019).

The variables that were used to capture institutional factors, infrastructure and network were contact with extension agent, membership of farmers group and distance to the asphalt road. The coefficient of belonging to farmers association had a positive and significant impact but only at the lowest quantiles (0.05^{th}). The disappearance of this effect for the upper quantiles suggests that more market-oriented farmers already have market information that was provided by the farmers' group. It reflects the perceived need for subsistence-oriented farmers to access information by belonging to the farmers' group and through training by commercially oriented farmers. The estimated coefficient of extension contacts had no impact on the volume of yellow pepper sold. This shows that extension agents who should bridge between farmers and research are not doing so. This could be explained by the weak research-extension-farmers linkages in Nigeria. Several variables had a negative and significant effect on market orientation mainly at the lowest quantile. The first variable was the distance to the asphalt road, and this had a negative and statistically significant relationship at 5 % and 10 % probability levels at the two lower and upper quantiles 0.05^{th}, 0.25^{th}, 75^{th}, and 95^{th} quantiles, showing that if the distance to the asphalt increases by km-1, the volume of pepper sold per quantile reduces by the respective coefficient (Table 5). Further, the analysis also indicated that two other variables affected negatively commercialisation and market orientation of farmers (non-farm income and distance to market). The negative influence of nonfarm income suggests that subsistence-oriented farmers are constrained with access to steady income that will enable acquisition of all needed input and output market for more market participation thus nonfarm income reduces the degree of market orientation at the lower quantile. This is an important policy result as it demonstrates a market participation constraint for households who are both willing and able to participate in output markets for pepper but migrate out to engage in nonfarm income to sustain their families.

The fact that this variable does not affect more commercial oriented farmers suggests that they were not affected by transaction costs.

5 Conclusion

This study employed quantile regression to model the differing effect of explanatory variables on conditional market participation. It focused on determinants of proneness to commercialisation or subsistence by distinguishing between five levels of quantiles, based on their market orientation.

The results revealed that the degree of commercialisation or market orientation increases with both fixed and proportional transaction costs variables incorporated in this study as explanatory variables. The proportional transaction costs incorporated in this study, that were significant were transportation costs, organic poultry manure, fertilizers agrochemicals and pepper seed with special aroma while the fixed transaction costs were a land asset, search for information proxied by belonging to farmers group and infrastructure proxied by distance to the asphalt road. The significance of the fixed and proportional transaction costs demonstrate the impact on market orientation and commercialisation of smallholder farming showing the importance of policy measures, to effectively target these fixed and transaction cost variables, thereby increasing their capacity to increase production and access market. The results suggest a potential role for the advisory services (those commercially oriented farmers in a position to advise subsistence farmers) in facilitating market orientation of subsistence- and semi-subsistence-oriented farmers.

To unravel the entry points for achieving market orientation, we advocate three entry points in line with the findings for this study. First, since the main transaction costs that actual hinder farmers access to market borders on transportation cost (also as a result of distance to market and distance to asphalt road). Commercial farmers buy most of the pepper produced by subsistence farmers from the farm gate and rural market at a low price and sold at a higher price at distance market thus reducing the income of subsistence farmers. Secondly, we advocate the need for financial/ technical support and markets through private sector contracts farmers that will link suppliers to the consumers, through product buying at the farm gate at the current price in the distance market. The financial/technical support will reduce constraints in accessing input and technology (manure, fertiliser, agrochemicals and seed with the presence of aroma), and thirdly constraint imposed by fixed transaction such as (land size, search and bargaining cost proxied by being education or belonging to farmers group and infrastructure proxied by distance to asphalt road). Contract wholesalers at the private sector rather than the government can provide smallholder with financial and technical support to improve their market orientation. They also can ensure good prices for farmers comparable to the one obtained in the urban market than spot market in the rural market and farm gate. Second, since the distance to asphalt road negatively affects commercialisation, there is a need to invest in growth and rural infrastructure such as improving road networks that connect households to the market. The third advocacy is to build capacity, there is need for a policy that will enhance capacity building of subsistence-oriented farmers through education, belonging to farmers group and training by market-oriented farmers to overcome the constraints associated with search costs associated with locating a buyer of output, a seller of inputs, bargaining costs resulting from information asymmetries and costs associated with screening and monitoring of transaction and other necessary information.

The empirical results show the need for more targeted training, advice and capacity building through semi-commercially and commercially oriented farmers to train others, subsistence farmers, on the rudiments of application of technology and help to buy back the output for commercialisation. The associations between the explanatory variables and the degree of market orientation could be extrapolated to other West African countries. However, we cannot provide convincing and reliable interpretations of the implications of these associations for the transition from subsistence to commercial farming in southeast Nigeria and other West African countries. More research is needed including the development of a coherent and consistent theory of transition to explain these associations and rethinking smallholder market participation drivers in West Africa.

Supplement

The supplement related to this article is available online on the same landing page at: https://doi.org/10.17170/kobra-202010191969 .

Acknowledgements

This study was supported by the Department of Agricultural Economics, University of Nigeria Nsukka under the Departmental best project.

Conflict of interest

The authors declare that they have no conflict of interest.

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