Research article

What factors influence access to and the level of participation in high value mango markets by smallholder farmers in Ghana?

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A B S T R A C T

Market participation is critical to smallholder agricultural production because it stimulates increased productivity and enhances poverty alleviation. Accessibility to high value markets and participation by small-scale mango farmers in these markets in Southern Ghana are low and have received little attention on both policy and academic fronts. This study analyzed the factors that drive smallholder farmers in Ghana to participate in high value mango markets in Southern Ghana. A multistage random sampling technique was used to select 224 mango-producing households. A triple hurdle model was used in the study to capture a 3-step decision-making process. The results from the estimation of the triple hurdle model showed that participation in high value markets was influenced by education, household income, farming experience, ownership of a motorized transport (tricycle) and a radio, trust, distance to road, certification and access to credit. The level of participation in the export markets was determined by household size, household income, farming experience, distance to tarmacked roads and price. The study recommends intensive education and training to capacitate smallholder farmers to enable them to understand and meet the requirements of high value markets. Also, the farmers should be given access to credit and transaction-costs-reducing assets to enhance their participation in high value markets. Finally, certification should be duly encouraged among smallholder mango farmers to ease their access to and participation in high value mango markets.

1. Introduction

Horticultural marketing is critical in enhancing economic growth and development and this is manifested in its contribution to the Ghanaian economy. Horticulture remains an important component of agriculture in Ghana concerning its contribution to GDP, foreign exchange earnings and food and nutrition security (Joosten et al., 2015). For instance, in 2017, the horticultural export earnings of Ghana amounted to 86 percent of total agricultural earning (Ghana Export Promotion Authority, 2017). Further, the horticultural sector provides an avenue for achieving the Sustainable Development Goals (SDGs) Numbers 1 and 2 on "no poverty" and "zero hunger" by providing employment and income to smallholder farmers in the country.

In Ghana, horticultural products are intensively cultivated for domestic consumption and foreign trade (Agyei-Sasu et al., 2013). Of Ghana's horticultural products, pineapple is the leading commodity in terms of production and export value (Annor, 2017). However, mango has the potential of becoming Ghana's key non-traditional export

considering its local and global demand of over 1.37 million tons which rivals that of pineapple (Akurugu et al., 2016; Zakari, 2012).

After a recent fall in the pineapple subsector of Ghana, the mango subsector has experienced tremendous growth and is currently the leading horticultural crop under large-scale production (Grumiller et al., 2018). Despite the continued increase in mango production in Ghana, the production of the fruit is fraught with many challenges, including pests and diseases (such as anthracnose), inadequate access to and use of input (such as fertilizer and pesticides), and lack of skilled labor (Micah and Incoom, 2016). These challenges have reduced the competitiveness of small-scale mango farmers and have impeded the development of the subsector.

Mango production in Ghana is concentrated in southern Ghana and its marketing occurs at both local and international fronts with the major actors being producers, traders, industrial processors and exporters. On average, 90,000 tons of mangoes are produced in Ghana annually, of which 70,000 tons are sent to both local and international markets (Zakari, 2012). However, 80 percent of the marketed mangoes end up in the local markets. Yet Ghana has the potential to take full advantage of its

comparative advantage in mango exports due to its proximity to the European Union (EU) market (Grumiller et al., 2018; Okorley, 2014).

Farmers in Southern Ghana sell their mangoes to both low and high value markets. Low value markets are predominantly local open-air roadside markets while high value markets include domestic markets (such as industrial processors and supermarkets) and export markets. Low value markets account for 42 percent of volume of mangoes sold whereas high value markets account for 58 percent (Eghan, 2017). High value markets offer at least three times the unit price offered in low value markets (Baidoo-Williams, 2017). Thus, participation in high value markets by famers provides an opportunity for farmers to maximize farm income through the high profits accrued to the high prices offered by these markets. However, participation in high value markets by smallholder farmers in southern Ghana is low. This low participation in high value market chains implies a loss of opportunity for these smallholder farmers to maximize gains from mango production and marketing. It is, therefore, not clear what motivates or hinders smallholder farmers in Ghana to participate in high value mango markets. To this end, this paper sought to analyze the factors that influence participation and the level of participation in high value markets by smallholder mango farmers in Southern Ghana. Knowledge of these issues would help in crafting appropriate policies regarding institutional arrangements and creation of adequate market and infrastructure which could benefit a large mass of small and marginal landholders dwelling in rural areas of Ghana.

Having presented the introduction of the paper in Section 1, the rest of the paper continues in the following order: Section 2 presents a review of empirical literature. Section 3 presents the theoretical grounding of the study and empirical models used. Section 4 presents the results and discussion and Section 5 presents the conclusion and policy recommendations.

2. Literature review

The importance of market participation has received attention from several researchers. Researchers began with modeling market participation as a single-step decision where the binary probit or logit models were used for binary choices and such models as the multinomial logit or multinomial probit models were used for a multiple choice outcome. Applying the binary logit model, Sumari et al. (2018) analyzed the participation of smallholder vegetable farmers in high value market chains in Tanzania and found that participation in high value market in Tanzania was influenced by income, distance from farm to main road, yield, irrigation, access to extension services, access to market information and distance to high value market. Other key determinants of participation in high value markets by smallholder vegetable farmers include age, education, farm size and membership if farmer groups or cooperatives (Maspaitella et al., 2018). Focusing on high value markets, Ngenoh et al. (2019) used a multivariate probit model to assess the determinants of the competitiveness of smallholder African indigenous vegetable farmers in high value agro-food chains in Kenya. The study found that the factors that influenced participation in high value market by smallholder farmers include access to information, location of the farm, the fertility of the soil and the type of irrigation used. Ngenoh et al. (2019) found that through group membership and access to extension services, certification can influence participation in high value markets since being members of farmer-based organization and also accessing extension services increase the likelihood of being a certified farmer.

Considering that most agricultural households are faced with a two-step decision regarding market participation, the double-hurdle model and the Heckman two stage model have been frequently used to model this decision-making process: the decision to participate in the market, and the level of participation. Using the double-hurdle model, Muthini et al. (2017) examined the determinants of smallholder farmers' choice of mango marketing channels in Kenya and found that distance to tarmac road, number of trees, group membership, access to training services,

access to extension services, income, market information access and gender influenced the choice of marketing channels, while only group membership significantly influenced the intensity of participation in the export market. Also applying the double-hurdle model, Musara et al. (2018) assessed market participation and marketing channel preferences by small-scale sorghum farmers in semi-arid Zimbabwe and found that choice of marketing channels was influenced by market price of sorghum, number of buyers in the market, distance to the market, dependency ratio, and household income. Using the Heckman two-stage selection model, Kyaw et al. (2018) assessed the drivers of smallholder rice farmers' participation in agricultural markets and found that the decision to participate in the rice market was influenced by age, education, household size, total produce of rice, price of rice, household income, ownership of livestock, membership of farmer organization, access to roads, distance to market, access to extension services, and market information.

Under some circumstances, agricultural households are faced with a three-step decision regarding market participation which thus cannot be modeled with the double-hurdle models. Based on this observation, some researchers have modeled this three-step decision with a triple-hurdle model. Applying the triple-hurdle model, Okoye et al. (2016) assessed the effect of transaction costs on market participation among smallholder cassava farmers in central Madagascar. The findings of Okoye et al. (2016) showed that group membership, being a native of the community, good road condition and farming experience positively influenced market participation. Age, distance to the nearest town and distance from farm to market negatively influenced market participation. Okoye et al. (2016) also found that ownership of means of transportation and marketing experience positively influenced the decision of a farmer to sell off-farm. High cost of transportation, distance to the nearest town, and distance from the farm to the market negatively influenced the decision to sell off-farm. On intensity, personal means of transportation, good road conditions and marketing experience increased the quantity of cassava sold. Distance to the nearest town, distance from farm to the market and high transportation costs decreased the quantity of cassava sold.

From the review of related literature on smallholder market participation, many approaches including the multinomial logit, the double hurdle and the triple-hurdle models have been used to study smallholder market participation. This review of related literature has revealed some of the determinants of smallholder farmer market participation. However, smallholder mango farmer market participation in Southern Ghana has received little attention from researchers. Virtually, no study specifically highlights the factors that influence participation as well as the level of participation in export markets as a case of high value mango markets by smallholder mango farmers in Southern Ghana.

3. Materials and methods

3.1. Theoretical framework

This study is anchored on the random utility theory. The theory posits that when a consumer is faced with a set of mutually exclusive choices, s/he will select the alternative that maximizes his or her utility (Greene, 2012). For practical purposes when undertaking a study of the marketing channel decisions, a farmer is just like a consumer. Therefore, in the case of mango marketing, a rational farmer will participate in a market outlet that gives him/her the highest utility, based on the profits obtained from that participation.

The utility, U, that the *ith* mango farmer would obtain from his/her participation in marketing outlet, j, can be expressed as a linear sum of two components; a deterministic part, V_{ij}, that captures the observable components of the utility function, and a random error term, ε_{ij}, that captures the unobservable components of the function including measurement errors as shown in Eq. (1).

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

For binary choices regarding market participation, Eq. (1) translates to a binary outcome equation for participation in high value markets as shown in Eq. (2):

$$y_i = x_i\beta_i + \varepsilon_i \tag{2}$$

where y_i is the market participation decision; X_i = regressors; β_i = parameter estimates; ε_i = stochastic error terms which are assumed to be iid (independently and identically distributed) with mean = 0 and variance = δ^2.

From Eq. (2), one can think of an underlying latent variable y^* with threshold τ below which the market participation decision is not observed and above which the market participation decision is observed.

$$y = 1 \, if \, y^* > \tau,$$

and

where y_i^* is the index variable that defines an underlying observable tendency. The censoring point is assumed to be zero.

The three-stage decision problem of mango farmers regarding participation in high value markets has three possible outcomes. Not participating in a high value market ($Y_i = 0$); participating in a high value market but not choosing the export market as a high value marketing channel ($E_i = 0 | Y_{1i} = 1$); and for those who sell to the export market, intensity or level of participation (Q_i).

Following Gebremedhin et al. (2017), the three decisions that mango farmers face are represented by Eq. (6), Eq. (7) and Eq. (8):

$$\Pr(Y_i = 0) = 1 - \Phi(X_{1i}\beta_1) \tag{6}$$

$$\Pr(E_i = 0 | Y_{1i} = 1) = \Phi(X_{1i}\beta_1) - \Phi(X_{1i}\beta_1, X_{2i}\beta_2) \tag{7}$$

$$E(Q_i) = E(volume \ of \ sales) = \Phi(X_{1i}\beta_1)\Phi(X_{1i}\beta_1, X_{2i}\beta_2) * exp\left(X_{3i}\beta_3 + \delta_3^2 / 2\right) \tag{8}$$

A likelihood function of the three possible outcomes is given by Eq.

$$l_i(\varnothing) = 1[Y_i = 0]log[1 - \Phi(X_{1i}\beta_1)] + 1[Y_i = 1]1[Q_i = 0]\{log[\Phi(X_{1i}\beta_1)] - log[\Phi(X_{1i}\beta_1, X_{2i}\beta_2)]\}$$
$$+ 1[Y_i = 1]1[E_i = 0]\left\{log[\Phi(X_{1i}\beta_1) + log[\Phi(X_{1i}\beta_1, X_{2i}\beta_2)] + log\left(\varnothing\left[\frac{log \ Q_i - X_{3i}\beta_3}{\delta_3}\right]\right) - log\delta_3\right\} \tag{9}$$

$$y = 0 \, if \, y^* < \tau$$

Therefore, a binary choice model whose dependent variable is bound between (0, 1) can be derived and specified as in the equations given hereafter.

For a probit model, the decision to participate can be represented by Eq. (3).

$$Prob(Y_i = 1 | x_i) = \Phi(x_i\beta_i) \tag{3}$$

where Φ represents the cumulative standard normal distribution function. Likewise, its complement is given by Eq. (4).

$$Prob(Y_i = 0 | x_i) = 1 - \Phi(x_i\beta_i) \tag{4}$$

Reformulating Eq. (2) as an index function yields a Tobit model which is used when the dependent variable has a mixture of zero and non-zero observations and is given by Eq. (5):

(9):

where, $\varnothing(.)$ is the standard normal density function, $\Phi(.)$ is the standard normal cumulative distribution function, βs are parameters on Xs and δ_3 represents the error variance parameter.

The nature of the likelihood function of the triple hurdle model allows for the separate estimation of the different components of the triple hurdle models. This study used a maximum likelihood method to jointly estimate the marginal effects associated with the three-step decisions made by mango farmers. Sekyi et al. (2017) argue that a simultaneous estimation of multiple equations gives efficient estimates and thus allows for the testing of the correlations between the error terms.

3.2. Empirical model

The specification of the empirical model draws from the theoretical framework on market participation. The probit model that was used in the first stage to capture the decision to participate in a low-value or a

$$P(y_i = 1) = \beta_0 + \beta_1 Age + \beta_2 Education + \beta_3 Hhsize + \beta_4 Income + \beta_5 Experience + \beta_6 Treedensity + \beta_7 OwnTrans + \beta_8 Trust + \beta_9 Distancetoroad + \beta_{10} Cert + \beta_{11} Radio$$
$$+ \beta_{12} Region \tag{10}$$

$$y_i^* = x_i\beta_i + \varepsilon_i \tag{5}$$

$$y_i = y_i^* \, if \, y_i^* > 0$$

$$y_i = 0 \, if \, y_i^* \leq 0$$

high-value market is given by Eq. (10):

Where $y_i = 1$ for participants of high-value markets and $y_i = 0$ for participants of low-value markets.

The probit model that was used in the second stage to capture the decision to participate in a domestic or foreign (export) high-value market is given by Eq. (11):

$$P(y_i = 1) = \beta_0 + \beta_1 Education + \beta_2 Hhsize + \beta_3 Income + \beta_4 Experience + \beta_5 Treedensity + \beta_6 OwnTrans + \beta_7 Trust + \beta_8 Distancetoroad + \beta_9 Credit + \beta_{10} Radio$$
$$+ \beta_{11} Region \tag{11}$$

Where $y_i = 1$ for participants of foreign high-value markets (export market) and $y_i = 0$ for participants of domestic high-value markets.

The tobit model that was used in the third stage to capture the quantity sold to the export market is given by Eq. (12):

$$y_i = \beta_0 + \beta_1 Education + \beta_2 Hhsize + \beta_3 Income + \beta_4 Experience$$
$$+ \beta_5 Treedensity + \beta_6 OwnTrans + \beta_7 Distancetoroad + \beta_8 Credit + \beta_9 Radio$$
$$+ \beta_{11} Price + \beta_{10} Region \tag{12}$$

Where y_i represents the quantity of mangoes sold to the export market.

3.3. Study area and description of variables

3.3.1. Sampling

3.3.1.1. Sample size determination. The sample size for the study was determined using the following Cochran (1963) formula for unknown population size represented in Eq. (13):

$$n = \left[\frac{Z_{\alpha/2}\delta}{E}\right]^2 \tag{13}$$

where n is the sample size; $Z_{\alpha/2}$ is the critical Z-value equal to 1.96; σ is the population standard deviation; E is the expected margin of error, and α is the confidence level.

The desired confidence level for the study was 95 percent and a 5 percent level of precision. The variation among mango farmers in Southern Ghana was not known, so the study assumed a variance of 0.5. This level of maximum variability produced a more conservative sample size than the mean would calculate (Israel, 1992).

$$n = \left[\frac{(1.96)(0.5)}{0.05}\right]^2 = 384 \text{ respondents}$$

However, 224 mango farmers agreed to participate in the study.

3.3.1.2. Sample selection. The data used in the study were collected in three districts in Southern Ghana where mango is predominantly produced and marketed namely: the Shai Osudoku, Yilo Krobo and Manya Krobo Districts. A multistage sampling technique was used to select a total of 224 mango farmers. The first stage and second stages involved the use of purposive sampling techniques. In the first stage, the Greater Accra and the Eastern Regions were selected. In the second stage, the Shai Osudoku from Greater Accra; and Yilo Krobo and Manya Krobo Districts from Eastern region were selected. Within each of the selected districts, a list of farmers was drawn from high mango-producing districts. This list formed the sampling frame for the study. Random numbers were assigned to each farmer on the list using Microsoft Excel 2016 and the first 384 were selected for the interviews. However, only 224 out of the 384 farmers were willing to participate in the study. The sampled farmers consist of 122 participants of high-value markets and 102 non-participants of high-value markets.

The survey was conducted using a structured questionnaire where trained enumerators who were supervised by one of the authors administered the questionnaire to the mango farmers. The information captured by the survey included socio-economic characteristics of households, household resource endowment, farm characteristics, access to information and institutional and market services.

Table 1 presents the definition of variables that are expected to influence access to and the level of participation in high value mango markets by small-scale farmers in Southern Ghana.

4. Results and discussion

Table 2 presents the descriptive statistics of the variables that were expected to influence access to and the level of participation by small-scale mango farmers in Southern Ghana in high value markets.

Regarding household characteristics, the study found that participants in high value markets had received more formal education than non-participants. Education provides farmers with managerial competence and the ability to implement improved production, processing and marketing practices (Marenya and Barret, 2007). Education was thus expected to enhance participation in high value mango markets.

Table 1. Variables that influence access to and the level of participation in high value mango markets by small-scale farmers in Southern Ghana and the Expected Signs for Coefficients.

Variable code	Factors	Measurement	Expected sign		
			Hurdle 1	Hurdle 2	Hurdle 3
Education	Education of respondent in years	Continuous	+	+	+
Hhsize	Number of household members	Continuous	+/-	+/-	+/-
Income	Average monthly income of household in GHS	Continuous	+/-	+	+
Experience	Number of years of farming mango	Continuous	+	+	+
Credit	Access to credit	Dummy: 1 = yes 0 = no		+	
OwnTrans	Ownership of means of transporting mangoes	Dummy: 1 = yes 0 = no	+	+	+
Distance	Distance to the nearest tarred road in km	Continuous	+/-	+/-	+/-
Treedensity	Total number of trees per acre	Continuous	-	-	-
Cert	Certification	Dummy: 1 = yes 0 = no	+		
Radio	Ownership of a working radio	Dummy: 1 = yes 0 = no	+	+	+
Trust	Trust level	Dummy: 1 = yes 0 = otherwise	+	+	+
Price	Price offered at channels	Continuous			+
Region	Location of farmer	Dummy: 1 = Eastern 0 = Greater Accra	-	-	-

Table 2. Selected household and farm characteristics comparing participants and non-participants of high-value mango markets.

Variables	Description of variables	High-value participants n = 122		Non-participants n = 102		t-test	
		Mean (A)	Standard deviation	Mean (B)	Standard deviation	Difference (A-B)	t-value
Household characteristics							
Head education	Education level of household head (years of schooling)	9.20	0.41	8.39	0.52	0.81	-1.24
Household size	Total family size (number)	4.96	0.19	5.48	0.24	-0.52	1.75 *
Resource endowment							
Household income	Total annual income of household (GH¢)	14221.38	1315.81	8637.33	977.53	5548.05	-3.30 ***
Credit access	Access to agricultural credit (1 = yes, 0 = no)	0.59	.04	0.08	.03	0.51	-9.36 ***
Farm characteristics							
Farming experience	Number of years of producing mango (years)	8.56	0.35	10	0.55	-1.44	2.28**
Tree density	Number of trees per acre of mango	38.85	0.91	39.10	1.16	-0.25	0.18
Access to information, institutional and market services							
Price	Current price of mango (GH¢)	2.06	0.063	1.07	0.0265	0.99	-13.64***
Tricycle	Ownership of a tricycle (1 = yes, 0 = no)	0.25	0.04	0.05	0.02	0.20	-4.18***
Trust level	Trust level between a farmer and a buyer (1 = high, 0 = low)	0.78	0.04	0.43	0.05	0.35	-5.68***
Distance to road	Distance to nearest tarmac road (Km)	9.91	0.90	9.61	1.19	0.3	-0.21
Certification	Whether a farmer has Globa lGAP certification (1 = yes, 0 = no)	0.78	0.04	0.16	0.04	0.62	-11.75 ***
Radio	Whether a farmer has a working radio (1 = yes, 0 = no)	0.84	0.03	0.89	0.03	-0.05	1.21
Region	Location of a farmer (1 = Eastern Region 0 = Greater Accra Region)	0.90	0.03	0.74	0.04	0.16	-3.34***

Note: *, ** and *** indicate 10%, 5% and 1% significance levels respectively.
Source: Survey data (2019)

Participants in high value markets in Ghana were found to have a relatively small family size as compared to non-participants. According to Muriithi and Matz (2015), large family size leads to an intensified cultivation of land for food crops relative to cash crops, thereby reducing quality and quantity of cash crops produced. However, large family size can enhance production of cash crops since there is the availability of household labor. The relationship between household size and participation in high value markets is therefore ambiguous.

Regarding household resource endowment, the study found that participants in high value markets had significantly high income and more access to credit. According to Abu (2015), the availability of resources enables farmers to cultivate larger land size and access improved inputs and technology that can enhance productivity and quality of outputs. Resource endowed households are thus expected to access high-value markets relative to less resource endowed households.

With regards to farm and farmer characteristics, the study found that participation in high value markets was significantly common among less experienced farmers. Mango production for exports and other high value market chains is a recent phenomenon in Ghana (Okorley, 2014); thus older farmers are likely to have established relationships with buyers from low value markets, reducing the likelihood of these farmers shifting to high value markets (Martey et al., 2012). Also, younger farmers are more receptive and are less risk averse as compared with older farmers. The study hypothesized an inverse relationship between participation in high value markets and farming experience.

Mango trees per acre of mango farmland were found to be slightly higher for non-participants in high value markets than participants. The study expected that a higher tree density increases competition among trees for nutrients which reduces the quality of fruits. Thus, a denser tree population reduces the propensity to participate in high value markets.

The distance to tarmac roads, Global GAP certification, level of trust between a farmer and a buyer, ownership of a tricycle and a working radio were used as proxies for access to information, institutional and market services. Participants in high value markets were slightly farther from tarmac roads than non-participants. Global GAP certification implies compliance with the Global GAP standards. Lee et al. (2012) argue that compliance with the standards enhances productivity and quality of farm produce and this increases a farmers' chance to participate in a high value market. The study found that more participants in high value markets were certified mango farmers as compared with non-participants. The study expected certification to positively influence access to and the level of participation in high value mango markets.

On trust level, the study found that participants in high value markets had more trust in the high value markets than non-participants. Trust is a transaction-cost-reducing tool that reduces the time farmers take to enforce and monitor contracts with buyers (Maina et al., 2015). The tricycle is a popular means of transportation in mango production and marketing in Southern Ghana. The study found that more participants in high-value markets had a tricycle as compared with non-participants. This means of transportation reduces transport costs and can boost the volume of transport, hence the volume of sales (Sigei et al., 2014). Ownership of a working radio was used as a proxy for access to production and market information. Ownership of a working radio was found to be higher among non-participants in high value markets as compared to participants. Ownership of working radio reduces fixed transaction costs (Gebremedhin et al., 2017); thus the study hypothesized a positive relationship between ownership of a working radio and participation in high value markets.

On price received by farmers, the study found that participants in high value markets received a higher price than non-participants. According to the law of supply, a higher price is expected to drive an increased level of participation in high value mango markets. Thus, the study hypothesized a positive relationship between price and level of participation in high value mango markets.

Table 3 presents the maximum likelihood estimates of the factors that influence access to and the level of participation in export markets as a case of high value mango markets in Southern Ghana. A chi-square value of -169.6211, indicating that the likelihood ratio statistics are highly significant (P < 0.000), suggests that the overall model had a strong explanatory power. The results showed a correlation between the error terms of choice between high value markets (Hurdle 2) and quantity sold to the export market (Hurdle 3). This implies that estimating the choice between two domestic high value markets and export markets and the intensity of participation in export markets models separately is likely to yield results that are both biased and inconsistent.

Table 3. Maximum likelihood estimates of factors that influence access to and the level of participation in high-value mango markets.

Variable	Hurdle 1	Marginal effects	Hurdle 2	Marginal effects	Hurdle 3	Marginal effects
Years of schooling	-0.010	-0.002	0.160**	0.0316	0.0213	0.005
	(0.024)		(0.071)		(0.040)	
Household size	0.007	0.002	0.101	0.020	-0.063*	-0.015
	(0.050)		(0.080)		(0.035)	
Household income	0.374**	0.083	0.174	0.035	0.339***	0.079
	(0.150)		(0.224)		(0.096)	
Farming experience	-0.074***	-0.016	0.0172	0.003	0.054***	0.012
	(0.027)		(0.047)		(0.019)	
Tree density	-0.0007	-0.0001	-0.011	-0.002	-0.0003	-0.00008
	(0.010)		(0.015)		(0.009)	
Tricycle (Yes)	0.890**	0.199	-0.070	-0.014	0.196	0.046
	(0.380)		(0.347)		(0.174)	
Trust level (High)	0.324	0.072	1.601***	0.317	0.127	0.030
	(0.249)		(0.611)		(0.274)	
Distance to road	0.032***	0.007	-0.003	-0.0006	0.024**	0.006
	(0.011)		(0.023)		(0.012)	
Certification	1.968***	0.439				
	(0.277)					
Radio	-0.242	-0.054	0.746**	0.148	0.039	0.009
	(0.351)		(0.372)		(0.207)	
Credit access			1.689***	0.336		
			(0.487)			
Price					-0.571**	-0.132
					(0.276)	
Region	-0.562*	-0.125	-3.133***	-0.621	-0.665**	-0.154
	(0.320)		(0.839)		(0.299)	
Constant	-3.338**		-4.118*		-1.297	
	(1.342)		(2.489)		(1.196)	
Rho_12	0.193					
	(0.431)					
Rho_13	-0.081					
	(0.354)					
Rho_23	0.908**					
	(0.421)					
LRχ2 (23)	223.37***					
Log likelihood	-169.621					
Observations	224		122		50	

Note: *, ** and *** indicate 10%, 5% and 1% significance levels respectively. Standard errors in parentheses.
Source: Survey data (2019).

Hurdle 1 presents results of the factors that influence the decision of a farmer to participate in high value markets. As expected, household income significantly and directly influenced participation in a high value market (p = 0.013). Wealthy farmers can afford approved chemicals and inputs that are required to produce mangoes that meet the requirements of high value markets (Nyaga et al., 2016). Accordingly, a GH¢ 1 increase in household income would increase the probability of a farmer's participation in high value markets by 8.3 percent.

Farming experience negatively influenced participation in high value markets by mango farmers in Southern Ghana (0.007). An increase in farming experience by a year reduces the probability that a mango farmer in Southern Ghana would participate in high value markets by up to 2 percent.

As expected, ownership of motorized transport (tricycle) significantly and positively influenced participation in high value markets by mango farmers in Southern Ghana (p = 0.019). Ownership of a tricycle increases the probability of participating in high value markets by mango farmers by 20 percent.

Contrary to expectation, distance to a tarmacked road positively influenced participation in high-value mango markets by mango farmers in Southern Ghana (0.002). An increase in distance to a tarmacked road by 1km increases the probability of participation in high value markets by 7 percent.

Global GAP certification was found to significantly and positively influence access to high value markets among small-scale mango farmers in Southern Ghana (p = 0.000). Moving from "not being certified" to "being certified" increases the probability that a farmer will participate in a high value market by up to 44 percent.

Contingent on participation in high value markets, a farmer chooses a high value market (domestic or foreign high value market) in which to participate. Hurdle 2 presents results for factors that influence the choice of the export market as a high value marketing channel by mango farmers in Southern Ghana. As expected, years of schooling positively and significantly influenced participation in the export market by small-scale mango farmers in Southern Ghana (p = 0.025). An increase in the years of schooling of the household head by one year

increases the probability of participating in the export market by 3.2 percent.

The level of trust between a farmer and the export market significantly and positively influenced participation in the export market by mango farmers in Southern Ghana (p = 0.009). Transitioning from a low level of trust to a high level of trust in the export market increases participation in the export market by up to 32 percent.

As expected, household ownership of a working radio increases participation in the export market (p = 0.065).

Access to credit positively influenced participation in the export market (p = 0.001). Access to agricultural credit increases the probability that a farmer will participate in the export market by up to 34 percent.

Contingent on choosing to participate in the export market, a farmer decides the quantity to sell to this market. Hurdle 3 presents results for factors influencing the level of participation in the export market. As expected, household income significantly and positively influenced the level of participation in the export market by mango farmers in Southern Ghana (p = 0.000). Relatively wealthy farmers can afford more productive inputs and technologies that can increase yield (Abu, 2015). Accordingly, an increase in household income by GH¢ 1 would increase the level of participation in the export market by up to 8 percent.

Farming experience was found to significantly and positively influence volumes sold to the export market (p = 0.000).

Contrary to expectation, distance to tarmacked road was found to positively and significantly influence the level of participation in the export market (p = 0.035). An increase in distance to tarmacked road by 1km increases the level of participation in the export market by 0.6 percent.

Contrary to expectation, price negatively influenced the level of participation in the export market by mango farmers in Southern Ghana (p = 0.038). This could be attributed to the inability of mango farmers to meet the high quality of mango demanded by buyers from the export market who offered relatively high prices. In such instances, farmers have a limited supply of quality mango, thereby reducing the quantity of mango available for sale as price increases. Thus, an increase in price by GH¢ 1 reduces the level of participation in the export market by 13 percent.

5. Discussion

The study found that wealthier farmers were more likely to participate in high value markets and also supplied more mangoes to the export markets. High value markets, especially the export markets, require farmers to use approved farm inputs which are expensive but could be relatively affordable to wealthy farmers. This finding is in line with the findings of Muthini et al. (2017) and Sumari et al. (2018) who found that wealthier mango farmers and vegetable farmers, respectively, were more likely to participate in high value markets. Muthini et al. (2017) argue that wealthy farmers can incur transaction and transportation costs associated with participating in remunerative markets. Further, high value markets require a constant supply of quality products which are associated with high costs (Sumari et al., 2018). This is also true for farmers who have access to credit. This institutional support service increases the resource endowment of mango farmers, thereby capacitating them to access approved inputs that are necessary for enhancing the quality of farm produce which are preferred by export markets (Ngenoh et al., 2019). This finding reinforces the need for interventions that can increase the resource endowment of farmers to enhance their access to approved inputs, thereby increasing their participation and level of participation in high value markets.

The results revealed that more educated farmers were more likely to choose the export markets over domestic high value markets. Highly educated farmers have a better understanding of production processes, market dynamics as well as supply requirements which can enhance their access to the export market. This is in line with the findings of Bobojonov et al. (2016) and Maspaitella et al. (2018) who found that highly

educated vegetable farmers are more likely to shift from traditional markets to high value markets and export markets. In the case of the export market, more educated farmers are likely to understand international standards which can enhance their access to such remunerative markets. Thus, there is the need to build the capacity of farmers and educate them on supply requirements.

Farming experience decreased the probability of participating in high value markets. However, more experienced farmers who participated in high value markets supplied more to the export markets. Given that more experienced farmers have longstanding relationships and contracts with buyers from low value markets and have built trust with them (Maspaitella et al., 2018), they are less likely to shift to high value markets which are relatively new marketing channels in Ghana's mango subsector. This is in line with the findings of Bobojonov et al. (2016), but contrary to the finding of Sumari et al. (2018) who found that more experienced farmers were more likely to supply to high value markets. This finding suggests that there is a need to educate older farmers on the benefit of participating in high value markets.

Farmers who owned motorized transport (tricycle) were more likely to participate in high value markets. Muthini et al. (2017) found that this variable transaction cost-reducing tool was functional in enhancing access to remunerative markets by mango farmers in Kenya. The tricycle facilitates the transport of mangoes from bulking points to both storage facilities and domestic high value markets in Ghana. However, distance to the nearest tarmacked road, which is a fixed transaction cost, was found to increase participation in high value markets and the intensity of participation in the export markets. Muthini et al. (2017) explain this relationship by arguing that farms that are farther away from tarmacked roads are mostly large farms that are preferred by buyers from high value markets. Also, based on the position of Muthini et al. (2017) on this relationship, it can be inferred that farmers who own such farms can supply more to the export markets since they have larger farms than those who are closer to tarmacked roads.

The results revealed that farmers who had a high level of trust in the export markets were more likely to participate in these markets. According to Maina et al. (2015), high levels of trust reduce transaction costs because farmers spend less time ensuring that contracts are enforced mostly regarding timely payments. In addition to the transaction-cost-reducing function of trust, it facilitates the circulation of reliable information about technology and market opportunities and also enhances the exclusion of unreliable agents for farmers (Lu et al., 2008). Considering that the export market is the most organized market, the agents are trustworthy and there is a relatively high level of transparency in their dealings with the farmers. Transparency being a positive signal increases the trust level of farmers (Granja and Wollni, 2019). This finding is in line with the findings of Shammah et al. (2017) who found that small-scale pineapple farmers in Ugandan households who had high trust were more likely to participate in the export market.

Ownership of a working radio increases participation in the export market. This is because owning a working radio increases access to production and market information and reduces fixed transaction costs (Gebremedhin et al., 2017). Thus, farmers who have a working radio are likely to have access to information about the requirements of the export market and are more likely to participate in this market. This result is in line with the findings of Zamasiya et al. (2014) and Nwafor et al. (2020) who found that ownership of radio positively influences market participation in Zimbabwe and South Africa, respectively, because farmers who own radio have access to information on rainfall and varieties and also increases farmers' propensity of receiving higher prices for their products.

The study found that certification enhance participation in high value markets. Buyers within high value markets prefer certified farmers because, as found by Lee et al. (2012), certified farmers employ good agricultural practices which positively influence their productivity and the quality of mangoes produced. This finding is in line with the findings of Ngenoh et al. (2019) who found that certified farmers have greater

access to high value markets because of greater productivity, high quality output, and bargaining power which can grant them secure or direct linkages with buyers. However, it is noteworthy that in the study area, certification is mostly facilitated by the farmer groups.

6. Conclusions and recommendations

This paper has presented the factors that influence access to and the level of participation in export markets as a case of high value mango markets in Southern Ghana. A triple hurdle model was used to analyze the three-step decision that small-scale mango farmers in Southern Ghana face regarding participation in high-value markets. The results showed that the challenges to participation in high value markets by small-scale mango farmers include large family size and farming experience owing to long-standing relationships between local traders and older farmers as these factors exhibited negative relationships with access to and the level of participation in high value mango markets. On the other hand, access to and the level of participation in high value mango markets were encouraged by education, household income, farming experience, ownership of a tricycle, trust level, distance to tarmacked roads, certification and judicious use of credit.

Given the roles of education and experience in enhancing smallholder farmers' participation in export markets, there is the need for capacity building through agronomic and value-chain training programmes. This will make small-scale mango farmers aware of the stringent requirements of high-value markets and get them educated on measures to meet these requirements. Also, since access to credit increases farmers' propensity to participate in export markets, there is the need for increased access to such institutional support services as well as the provision of financial literacy to ensure the judicious use of credit. This will ensure increased investment in mango farming to increase productivity and meet the quality requirements of high-value mango markets. Finally, the finding on certification reinforces the need for an increased awareness on the importance of certification as well as the provision of the necessary training to farmers which is required to enhance their participation in certification programmes.

Declarations

Author contribution statement

Rexford Akrong; Stephen G. Mbogoh; Patrick Irungu: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

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The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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