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Determinants of small-scale mango farmers' market channel choices in Kenya: An application of the two-step Cragg's estimation procedure

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The study estimates small-scale mango farmers' choice of market channels using the Cragg's two-step procedure where the farmer decides on the channel in the first step and the proportion sold to the selected channel in the second step. Cross section data was collected from a sample of 224 mango farmers selected through multistage sampling just after the mango season. The study was carried out in Makueni County in Eastern Kenya. The county is leading in production of mangoes in Kenya, having produced over 146,000 tonnes valued at over 18 million US dollars, in 2015. The data was analyzed using Cragg's two step regression model. The first step assessed factors that determine choice of a particular channel, while the second step assessed factors that influence the proportion of produce sold to the channel. Results show that socio-economic factors significant in the first stage are not necessarily significant in the second stage. In some cases, the direction of effect reverses. Factors such as distance to tarmac road, number of mango trees in the farm, membership in producer marketing groups, training in mango agronomy, and access to extension services affect choice of export market channel. Only membership to mango marketing groups significantly influences proportion sold. Household income, distance to tarmac, number of trees, market information, and gender significantly affect choice of the direct market channel. The direct market channel earns farmers the largest margins, followed by the export channel. However, majority of farmers sell to brokers followed by export channel. It was found that despite being aware that they could fetch higher prices through direct selling, they lacked financial capacity, transport resources, and information on market locations and requirements. Policies need to enhance financial capacity of farmers, as well as expand efforts to disseminate timely and accurate market information.

Key words: Small-scale farmers, mango market channels, Kenya.

INTRODUCTION

Marketing plays a critical role both in stimulating production and accelerating the pace of economic development. In Kenya, marketing chains for agricultural commodities are generally not transparent and consist of

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many players, making them inefficient and unresponsive to producer needs (Government of Kenya, 2010). Despite recent urbanization and supermarket revolution which is creating market for horticulture farmers in Africa, Neven et al. (2009) found that majority of supermarket suppliers are not small scale poor farmers, but an emergent crop of educated farmers who own commercial medium sized farms. Olwande et al. (2015) found that market access in Kenya has improved over the last decade, but market participation has remained relatively stagnant in most sub-sectors, an evidence of subsistence agriculture.

There exist in literature a number of studies that analyze farmer choice of market channel. Bogiwe and Masuku, (2012) found that factors such as the age of the farmer, quantity produced, and education, significantly influenced choice of market channel among corn farmers in Swaziland. However, unlike the Swaziland market where the government is a player through the National Agricultural Marketing Board, the Kenyan mango market is fully liberalized, with the government only playing regulatory role. There exist mixed results on the impact of liberalization on access to markets by farmers (Kherallah et al., 2002), and thus not factual to generally apply the results.

In liberalized markets, individual farmers lose bargaining power, and thus are routinely exploited by buyers because they are price-takers in the absence of agreements (Koning and Anderson, 2007). It is on the basis of such that recent literature that support marking is biased towards farmer collective action to access high value markets for cash crops (Okello et al., 2007; Rao and Qaim, 2011; Fischer and Qaim, 2012). The possibility of accessing high value markets as a result of collective action is not universal; other factors significantly affect access to different markets.

The choice of channel to sell is not mutually exclusive; farmers sell to more than one channel within the same season for the same crop. Majority of the studies that assess market channel choice have one fundamental weakness in that they fail to acknowledge this common phenomenon of agricultural marketing in developing countries. Farmers would probably have a preferred main channel that they sell a larger proportion of the produce to. In such a case therefore, multinomial logit or tobit models commonly used would not be appropriate because they assume mutual exclusivity between the channels, and that the effect of the independent variables on choice of channel, and quantity of produce sold to the channel, is similar. This assumption is not true, as Katchova and Miranda (2004) found out, a variable that increases the probability of choosing a particular channel does not necessarily influence the quantity sold to that channel. In this study, we adopt a two-step procedure proposed by Katchova and Miranda (2004). The procedure captures farmer characteristics that influence choice of channel in a probit model in the first step, and characteristics that influence the quantity sold using a truncated regression model in the second step.

The study was carried out in Makueni County which is located in the semi-arid south eastern part of Kenya. The County experiences bi-modal rainfall, with the lower side receiving little rainfall ranging from 300 to 400 mm and the higher areas receiving. Similarly, the high altitude areas experience temperatures ranging from 20.2 to 24.6°C, while in the low-lying areas temperatures can exceed 30°. The Kenya Agriculture and Livestock Research Organization introduced improved mango varieties in in the area 15 years ago due to its climatic adaptability. Mangoes can thrive in low rainfall (500 to 1000 mm) and a wide range of temperatures (10 to 42°C) which makes it suitable even for the arid and semi-arid lands. Makueni County is one of the leading mango producing areas in Kenya, with an annual estimated value of Kshs. 1.2 billion (1USD$ = Kshs100 on average) (Agricultural Business Development, 2011).

The county however, has relatively high poverty levels at 64%, compared to a national average of approximately half of the population (Kenya National Bureau of Statistics, 2009). Improving market access for mango farmers is therefore critical to reducing poverty levels. Marketing of mangoes is not organized, it is estimated that margin to mango farmers is very low, at Kshs. 1.70 per fruit in some channels, while post-harvest losses could be up to 30%, which is a disincentive to production (Agricultural Business Development, 2011). The losses are exacerbated by the perishable nature of mangoes.

According to Tsourgiannisa et al. (2008), the marketing channel used has a bearing on the profit farmers may make. For most small scale farmers dealing with perishable products, a decision between selling to the most profitable channel, and having to sell to the easily available buyer to meet urgent financial needs or avoid post-harvest losses has to be made. It is not clear what drives the decisions on the choice of marketing channels and the economic implications for the farmers. The purpose of this study therefore was to evaluate the factors that influence the mango farmers' choice of market channel. This study contributes to the existing literature by providing new insights into how smallholder farmers decide on market channels and quantities sold in those channels, and how such decisions interact with factors such collective action, income, and perishability of agricultural produce.

MATERIALS AND METHODS

Sampling and data collection

Respondents were selected through multistage sampling techniques. In the first stage, 3 locations (Kilili, Mumbuni and Kilala) were selected purposively due to high volumes of mango produced. The villages, from which respondents were interviewed (Table 1), were selected based on two criteria; level of market organization and access to market, following Omiti et al. (2006).

The level of market organization was based on membership of

Table 1. Village selection matrix.

High organization and low access	No. of respondents	Location
Kathatu	13	Kilili
Kilumbu	20	Kilili
Kavuliloni	8	Kilili
Mulenyu	12	Kilili
Itaa	13	Mumbuni
Low organization and low access		
Kilanga	12	Mumbuni
Kisuu	12	Mumbuni
Kithiani	18	Mumbuni
Mboani	15	Kilili
Wee	20	Kilili
Low organization and high access		
Muselele	12	Kilala
Itangini	6	Kilala
Nduundune	12	Kilala
Kaseve	16	Mumbuni
High organization and high access		
Nzueni	16	Mumbuni
Kyumu	9	Kilala
Ngutw'a	13	Mumbuni

Source: Survey data (2014).

the farmers in marketing groups, while distance to the nearest tarmac road was used as a proxy for access to market. Villages were classified as high on low regarding market organization and market access. The number of farmers interviewed from each village was based on the estimated total number of mango farmers in the respective village. Respondents were selected through systematic random sampling. Logistic regressions require larger samples than linear regression. According to Schwab (2002), the minimum number of cases per independent variable required in logistic regression is 10; the current study used 20 cases to 1. With 11 independent variables, a minimum 220 cases were required, the study proposed 240 cases to cater for non-response and incomplete questionnaires. Following Kothari (2004), systematic sampling was used to select the respondents. The n^{th} farmer (where n = 3) was selected along the determined routes with a random start in each of the villages to give a total of 227 respondents as illustrated in Table 1. Data was collected using both qualitative and quantitative methods. Quantitative data was collected using both open and closed ended questionnaires administered by trained enumerators. Data was collected in the month of May, 2014, immediately after the peak mango harvesting season that spans December to March.

Theoretical framework

This study is based on the random utility model, which assumes that a decision maker, faced with a set of alternatives, will select the alternative that offers the highest utility (Greene, 2007). Suppose an individual *i* is faced with two choices *a* and *b* with utilities u_a and u_b respectively (Equation 1 and 2).

$$U_a = w'\beta_a + z_a'\gamma a + \varepsilon_a \quad (1)$$

$$U_b = w\beta_b + z_b'\gamma b + \varepsilon_b \quad (2)$$

Where, *w* represents the observable characteristics of the individual, such as age, income, and other demographics. The vector *z* denotes choice specific attributes of the two choices. The random terms, ε_a and ε_b, denote individual specific stochastic elements not be known to the researcher. If the individual's choice of alternative *a* is denoted by Y=1, then $u_a > u_b$, which follows:

$$\Pr ob[Y = 1 | w, z_a, z_b] = \Pr ob[u_a > u_b] \quad (3)$$

$$= \Pr ob[x'\beta + \varepsilon > 0 | X] \quad (4)$$

Where $x'\beta$ are the observable elements of the difference of the two utility functions and ε represents the difference between the two random elements.

The choice of channel to sell is not mutually exclusive; farmers sell to more than one channel within the same season for the same crop. Majority of the studies that assess market channel choice have one fundamental weakness in that they fail to acknowledge this common phenomenon of agricultural marketing in developing countries. Farmers would probably have a preferred main channel that they sell a larger proportion of the produce to. In such a case therefore, multinomial logit or tobit models commonly used would not be appropriate because they assume mutual exclusivity between the channels, and that the effect of the independent variables on choice of channel, and quantity of produce sold to the channel, is similar. This assumption is not true, as Katchova and Miranda (2004) found out, a variable that increases the probability

of choosing a particular channel does not necessarily influence the quantity sold to that channel. In this study, we adopt a two-step procedure proposed by Katchova and Miranda (2004). The procedure captures farmer characteristics that influence choice of channel in a probit model in the first step, and characteristics that influence the quantity sold using a truncated regression model in the second step. The study also applied the one step tobit model for comparison with the two step Cragg's procedure as discussed subsequently.

One-step Tobit model

Tobit model was used to analyze the effect of independent variables on the dependent variable as there were numerous zero occurrences and corner solutions where the respondent did not sell to a particular channel (Wooldridge, 2002). For a specific respondent therefore, given $E(y^*|x)$, the *y** is 0 if the farmer does not sell to that particular channel. Alternatively, if the farmer sells all produce to only one channel, then *y** is 1. The dependent variable is therefore censored from above (1) and below (0). Separate models were regressed for each channel.
Following Cogg (2000), the Tobit model is described as:

$$y_i^* = \begin{cases} a & if \quad y_i \le a \\ y_i & if \ a < y_i < b \\ b & if \quad y_i \ge b \end{cases} \tag{5}$$

Given that *a* and *b* are the lower and upper limits respectively, which in this study is 0 and 1, then y_i^* = 0 when y_i < 0; $y_i^* = y_i$ = when 0< y_i <1; and y_i^* =1 when y_i ≥1. The latent regression model can be expressed as $y = x\beta + \varepsilon$, whereby *y* is a continuous outcome variable and β is the change in the mean of the latent dependent variable, that is, $\beta = \partial E(y_i)/\partial x_i$. The Tobit model assumes that the error term is normally distributed and homoscedastic; $\varepsilon \approx N(0, \delta^2)$. The marginal effects are reported at the means of the independent variable, for dummy variables the marginal effects represent net effect on the dependent variable when the independent variable changes from 0 to 1. Since the $E(y|x)$ is linear in *x,* then the marginal effect of x_j on *y* is simply the corresponding β_j.

Two-step procedure

The study used the Cragg's "two-tier" alternative to Tobit for corner-solution models (Cragg, 1971). The model applies the probit model in the first stage and the truncated normal regression in the second stage. The probit regression models a discrete decision, probability of a farmer choosing any particular channel, whether or not *y* is *0* or positive:

$$\Pr ob(y > 0) = \Phi(x'\beta)$$

Whereby Φ is the symbol for normal distribution.

After a farmer makes a decision to sell to a particular channel, then he/she has to decide what quantity to sell to that particular channel, the quantity sold was used to calculate the proportion for each channel. The truncated normal regression was used to assess the factors that influence the proportion sold to that particular channel for the farmers who sold a positive quantity:

$$E(y|y > 0) = x'\beta + \delta\lambda\left(\frac{x'\beta}{\delta}\right) \tag{6}$$

The term $\frac{x'\beta}{\delta}$ is an adjustment factor because the respondents with zero values have been dropped in the truncated model. The 2-step procedure is better than the one stage tobit because the effect of an independent variable on the probability of choosing the channel, and effect of the quantity sold to the particular channel are determined in separate processes. We also test the one step tobit against the Cragg's 2-step procedure as found in Katchova and Miranda (2004):

$$\lambda = 2(\ln L_{probit} + \ln L_{truncatedegression} - \ln L_{Tobit}) \tag{7}$$

Whereby λ is distributed as chi-square with K degrees of freedom. The Cragg's 2-step model is preferred if λ is greater than chi-square critical value.

RESULTS AND DISCUSSION

Sample characteristics

Some important features of mango farming are presented in Table 2. The average number of years spent in school by mango farmers was 10.6, thus a majority of respondents had gone through primary school (8 years). Education is expected to influence a household's understanding of markets, and consequently decisions on where to sell. Previous studies have found that majority of supermarket suppliers are educated farmers who own commercial medium sized farms (Neven et al. 2009; Sebatta et al., 2014).

Majority of decision makers among mango farmers in the study area are male. This is more than proportion of households headed by females estimated by Kenya National Bureau of Statistics (2009). According to Agricultural Business Development (2011), the low number of women in mango farming is occasioned by the prevailing socio cultural factors where land and permanent crops are generally owned by men.

Only less than half of the farmers were members of any mango marketing groups. This shows a very disadvantaged position of the farmers considering the importance of collective action in marketing such as: Increasing farmers bargaining power, reducing transaction costs and improving information flows (Fafchamps and Hill 2005; Shiferaw et al., 2006; Kirsten et al., 2008).

Less than a quarter of the respondents had pre-agreed contracts with buyers, majority of whom sold to the export channel. Most of the contracts were agreed between groups and main buyer as opposed to individual farmers. Having a contract was however more of a consequence

Table 2. Summary of sample characteristics.

Variable (n=227)	Min	Max	Mean	Std. deviation
Number of years completed in school	0	18	10.06	3.72
Number of total family members	1	12	6.2	2.243
Distance to the nearest market center in km	0.1	22	4.933	5.36684
Distance to nearest tarmac road in km	0.1	27	11.324	7.58646
Total land size in acres owned	0.75	64	7.3427	8.34738
Land size in acres under mangoes per farmer	0.2	15	2.3379	2.1719
Age of the farmer in years	26	84	49.9	11.602
Years farmer has been growing mangoes	3	30	10.18	4.536
Total mango trees per farmer	12	1900	184.26	202.3
Percent of male respondents				86.8
Percent of farmers who had signed contract with buyers				12.8
Percent of farmers who are members of mango marketing group				45.8
Percent of farmers with access to market information				40.1
Percent of farmers visited by extension officer in last three years				47.1
Percent of farmers who have received training on mangoes				64.3

Source: Survey data (2014).

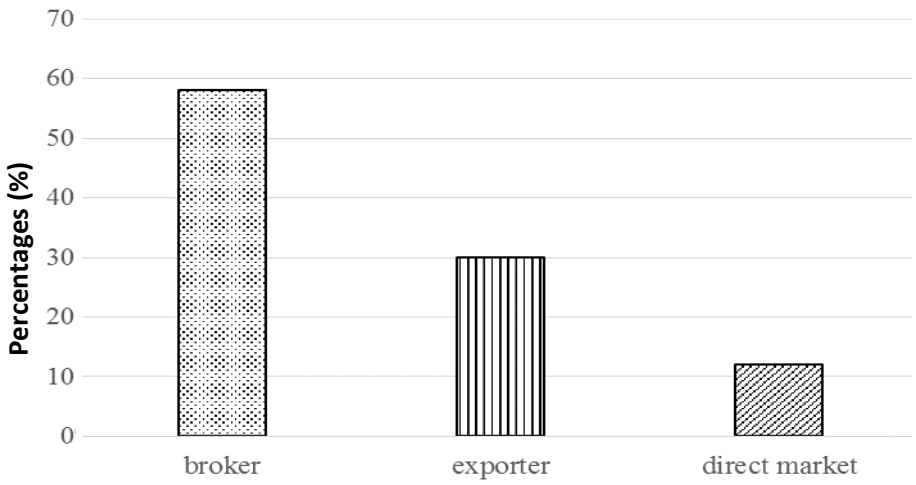

Figure 1. Distribution of farmers in market channels.Source: Survey data (2014).

of the channel selected rather than a determining factor. Furthermore, the contracts did not seem to be binding, as the buyers would occasionally change prices and other terms of the contracts.

Nearly two thirds of farmers had received training on various aspects of mango farm management comprising grafting, pruning, pest and disease control, marketing, post-harvest management and record keeping. Only about a quarter of farmers had been able to access credit; among the different channels. The low figure was attributed to lack of information on the sources and availability of credit, and fear of risk.

More than half of the respondents mainly sold to middlemen, commonly known as brokers, while only slightly more than ten percent sold directly to the market. Only channels used as the main outlets are presented here. Some farmers would sell most of the mangoes to these main outlets and the rest, which is a negligible quantity, to rural retailers or brokers. Figure 1 presents distribution of farmers based on market channels targeted.

High prices were however not tantamount to high profitability because of the difference in costs incurred in accessing the channels. One way Analysis of Variance (ANOVA) was used to test for differences between the net prices offered by the channels, results are presented in Table 3. With $p = 0.000 < 0.05$ (Table 3), the hypothesis that there is no difference in prices offered by the different channels was rejected.

Results for gross margins across channels are

Table 3. One way ANOVA results for average net prices between and within groups.

Group	Sum of squares	Df	Mean Square	F	P-value.
Between groups	82.862	33	2.511	16.482	
Within groups	29.402	193	0.152		0.000***
Total	112.264	226			

***, **, * significance levels at 1, 5 and 10%, respectively.

Table 4. Parameter estimates for the first-stage probit model

Variable	Export	Broker	Direct market
Formal education	-0.0004 (0.0340)	-0.0372 (0.0405)	0.0550 (0.0436)
Off-farm occupation (dummy)	0.2979 (0.2639)	-0.6202** (0.2959)	0.1726 (0.3235)
Household income	0.0608 (0.1145)	-0.0473 (0.1252)	0.3570** (0.1388)
Distance to tarmac road	0.0025*** (0.0005)	0.0004 (0.0007)	-0.0014* (0.0008)
Total mango trees	0.6423*** (0.1617)	-0.1424 (0.1654)	-0.3546* (0.1825)
Group membership (dummy)	0.4954** (0.2335)	-0.2537 (0.2698)	0.1666 (0.2889)
Market Information (dummy)	-0.4017 (0.2495)	-0.5035** (0.2540)	0.7907*** (0.2784)
Agronomy training	0.1095** (0.0553)	0.0263 (0.0702)	-0.0671 (0.0733)
Extension	0.3967*** (0.1164)	0.1988 (0.1270)	-0.1167 (0.1355)
Own Vehicle (dummy)	-0.0447 (0.3268)	-0.3029 (0.3157)	0.4160 (0.3315)
Experience	0.0380 (0.0256)	-0.0000 (0.0297)	-0.0218 (0.0354)
Gender (dummy)	-0.1098 (0.3719)	0.8680*** (0.3328)	-0.7806** (0.3476)
Cons	-5.6808*** (0.9124)	1.9528** (0.8135)	-0.2629 (1.8524)
Log likelihood	-87.16	-67.24	-57.17
LR Chi^2	106.99	34.31	54.45
Prob > Chi^2	0.0000	0.0006	0.0000

presented in Table 4. Farmers who sold to the direct channel earned the highest gross margins, while those selling to brokers earned the lowest gross margins. Farmers who sold directly to the market incurred very high marketing costs in transport and storage, the price they earned was however sufficient to cover the cost and earn the farmer a significant profit. Farmers who sold to brokers incurred the lowest costs because brokers moved around in the farms in search of mangoes. These farmers incurred very low costs of searching for buyers, entering contracts, being in groups, transport, and monitoring as compared to those who sold to exporters and direct market. Despite the apparent advantage of selling to the direct market, only a minority of the farmers sold to this channel.

Empirical results

Parameter estimates (marginal effects and coefficients) for the two-step Cragg's model is presented in Tables 4 to 6. The hypothesis for the log likelihood test for the Tobit versus the two-stage Cragg's model is rejected and thus the two stage model is preferred.

The probit model results show that household income is significantly linked with a higher probability of choosing the direct market channel. This could be attributed to the ability of relatively wealthy farmers to pay for the transport and storage costs associated with direct marketing, as well as the risk of incurring loss. Fafchamps and Hill (2005) found mixed results among coffee farmers in Uganda; that wealthy farmers were less likely to sell directly to the market, except when they have large quantities. The truncated regression model results appear to corroborate Fafchamps and Hill (2005), although not significant, the negative effect means that increasingly smaller quantities are sold through the direct channel as incomes increase for farmers that select the channel. For farmers who sell to brokers, the quantity sold increases as household income, which is expected as poor farmers lack ability to target alternative channels that pay premium prices.

Contrary to expectations, distance from tarmac road is positively associated with a higher likelihood of farmers selling to export market and lower likelihood of selling directly to the market. This may be because farmers farther from the tarmac road were more likely to have large farms which exporters prefer because of economies

Table 5. Parameter estimates for the second stage truncated regression model.

Variable	Export		Broker		Direct market	
	Truncated regression	Tobit	Truncated regression	Tobit	Truncated regression	Tobit
Formal education	0.0103 (0.0116)	0.0095 (0.0179)	0.0045 (0.0056)	-0.0079 (0.0196)	-0.0682* (0.0359)	0.0731 (0.0719)
Off-Farm occupation (dummy)	0.0371 (0.0876)	0.1542 (0.1343)	0.0158 (0.0440)	-0.2271 (1467)	0.0878 (0.1578)	0.4756 (0.5117)
Household Income	-0.0030 (0352)	0.0120 (0.0568)	-0.0620*** (0.0185)	-0.1375** (0.0629)	-0.0316 (0.0835)	0.4929** (0.2396)
Distance to tarmac road	0.0002 (0.0002)	0.0012*** (0.0003)	-0.0003*** (0.0000)	-0.0006* (0.0003)	-0.0010 (0.0006)	-0.0027* (0.0014)
Total Mango trees	0.0239 (0.0524)	0.3109*** (0.0814)	-0.0269 (0.0231)	-0.1061 (0.0809)	-0.0464 (0.1123)	-0.5234* (0.3038)
Group Membership (dummy)	0.1348 (0.0854)	0.1776 (0.1220)	-0.0062 (0.0380)	-0.1160 (0.1335)	0.1048 (0.1806)	0.2335 (0.4636)
Market Information (dummy)	0.1114 (0.0833)	-0.1376 (0.1241)	-0.0542 (0.0378)	-0.3217** (0.1314)	0.2073 (0.1998)	1.2669** (0.5204)
Agronomy training	0.0259 (0.0203)	0.0708** (0.0293)	-0.0205** (0.0094)	-0.0328 (0.0330)	-0.0458 (0.0492)	-0.1053 (0.1190)
Extension	-0.0074 (0.0401)	0.1327** (0.0580)	-0.0388** (0.0176)	-0.3011 (0.0622)	-0.2225*** (0.0852)	-0.2911 (0.2252)
Own Vehicle (dummy)	-0.0076 (0.1028)	-0.0832 (0.1614)	-0.0002 (0.0533)	-0.1876 (0.1745)	0.3545** (0.1812)	0.7076 (0.5426)
Experience	0.0066 (0.0077)	0.0262** (0.0128)	-0.0093** (0.0042)	-0.0131 (0.0144)	-0.0428* (0.0221)	-0.0530 (0.0585)
Gender (dummy)	-0.0657 (0.1164)	-0.0924 (0.1823)	-0.0020 (0.0620)	0.4680** (0.1938)	0.1453 (0.1805)	-1.1954** (0.6049)
Cons	-0.1722 (0.3113)	-2.90611*** 0.4880)	1.3257*** (0.1226)	2.2883*** (0.4301)	2.2296*** (0.5342)	-0.0560 (1.3787)
Log likelihood	-4.114	-122.20677	3.004	-181.34805	-1.9666	-74.64
Wald Chi2/LR Chi^2	11.75	101.42	92.32	68.50	15.75	56.4
Prob > Chi2	0.4663	0.0000	0.0000	0.0000	0.2030	0.0000
Log likelihood test for tobit vs truncated regression test	**38.816**		**100.059**		**23.525**	

Standard errors are shown in parenthesis.

of scale. Martey et al. (2012) found that farmers in Nigeria who were located far from the tarmac roads were more likely to participate in marketing cooperatives, which exporters prefer to buy from as opposed to individual farmers. A Pearson correlation test proved that there was a significant positive relationship between distance to tarmac road and membership to mango marketing group. Farmers close to the tarmac road were more likely to sell to direct market as expected. The direction of effect does not change for the truncated regression model. As distance from the tarmac increases, the quantity sold to brokers decreases, an indication that brokers venture only to a certain extent in the rural areas, possibly to reduce the associated transport and bulking costs.

The number of mango trees is significantly associated with higher probability of selling to the export channel and less to direct market. Apart from being a perishable product, mangoes are very seasonal, buyers prefer unripe mangoes to avoid losses hence those with large quantities avoid transporting to the market because of their low capacity to sell at the market which is not as organized as farm-gate buyers. Martey et al. (2012) further explains that farmers who produce more prefer selling at their immediate market (farm gate) to avoid post-harvest loss, especially if the product is highly perishable, as is the case with mangoes. In addition, Shilpi and Umali-Deininger (2008) noted that farmers incur very high transaction cost selling to the market as compared to traders especially if the physical

Table 6. Marginal effects for the second-stage truncated regression model.

Variable	Export	Broker	Direct market
Formal education	0.0090 (0.0102)	0.0045 (0.0055)	-0.0605** (0.0311)
Off-farm occupation (dummy)	0.0325 (0.0767)	0.0157 (0.0438)	0.0779 (0.1404)
Household income	-0.0027 (0.0308)	-0.061*** (0.0184)	-0.0280 (0.0741)
Distance to tarmac road	0.0002 (0.0001)	-0.0003*** (0.0000)	-0.0009 (0.0006)
Total mango trees	0.0210 (0.0459)	-0.0268 (0.0230)	-0.0411 (0.0999)
Group membership (dummy)	-0.1181 (0.0745)	-0.0061 (0.0378)	0.0930 (0.1606)
Market Information (dummy)	0.0975 (0.0727)	-0.0539 (0.0376)	0.1839 (0.1762)
Agronomy training	0.0226 (0.0177)	-0.0204** (0.0094)	-0.0407 (0.0431)
Extension	-0.0065 (0.0350)	-0.0386** (0.0175)	-0.1974*** (0.0725)
Own vehicle (dummy)	-0.0067 (0.0900)	-0.0002 (0.0530)	0.3145** (0.1567)
Experience	0.0058 (0.0068)	-0.0092** (0.0042)	-0.0380** (0.0194)
Gender (dummy)	-0.0575 (0.1019)	-0.0020 (0.0616)	0.1289 (0.1594)

Standard errors are shown in parenthesis; ***, **, * significance levels at 1, 5 and 10%, respectively. Source: Survey data (2014).

market infrastructure is poor. Poor market infrastructure results in long waiting periods, which will affect farmers more negatively than traders who may have better access to facilities even in congested markets, thus farmers with large quantities may be discouraged to sell directly in the market. As found by this study, they will sell at the farm gate but they are more likely to sell to exporters at the farm gate and not brokers. Although not significant, the direction of the effect does not change for the truncated regression model.

Membership to a mango marketing group is associated with increased likelihood of a farmer selling to the export channel as opposed to the broker channel. The importance of collective action has been emphasized in the literature (Kirsten et al., 2008; Fischer and Qaim, 2012). Farmers in groups have the advantage of bulking hence gaining economies of scale. It is also easier and cheaper for exporters to enforce quality and grade requirements of the export market through reaching farmers in groups rather than individual farmers.

Access to market information is significantly associated with farmers selling to direct market channel. Conversely, farmers who lacked market information were more likely to sell to brokers. A significant proportion of farmers in the study area were found not to actively search for market and market information, and are thus price-takers. However, based on the results of the truncated regression model, access to market information does not affect the quantity sold to the direct market.

Having access to training is significantly associated with higher probability of selling to the export channel. As explained earlier, the export channel only buys grade one mangoes of high quality. Only farmers who had gone through training were able to attain these quality requirements. Similarly increased contact with extension service providers increased farmer's likelihood of selling to the export channel. The results from the two variables can be attributed to the farmer's ability to produce quality mangoes not damaged by pests and diseases. Similarly, lack of access to training and extension services significantly affected positively the quantity of produce sold to brokers.

Although ownership of a vehicle is not significantly associated with a higher probability of selecting any of the market channels, it is positive and significant for the direct channel in the truncated regression model. Owning a vehicle increased the quantity sold directly sold to the market by 31 percent, which is substantial. Lack of transport to the market and the associated cost and risk even where available was a major deterrent in accessing the direct channel. As observed by Panda and Sreekumar (2012), farmers' own vehicles allow them to access marketing centers located far off at a lower cost and within a shorter period as compared to their colleagues who had no transport means.

The number of years that a farmer had been growing mangoes does not significantly affect choice of market channel. However, for farmers selling to brokers, less experience is associated with selling a larger proportion to brokers. This implies that these farmers who were presumably new in the sector had not created market networks with other buyers. The proportion of produce sold to brokers increased by 0.93% for every year of experience less.

Farmers with an off farm source of income were less likely to sell to brokers. This is because these farmers were probably not extremely cash-constrained and therefore could delay sales and seek for better prices from other channels. As discussed earlier, poor farmers sell to brokers at low prices to meet urgent financial needs. Female farmers were more likely to sell directly to the market and less likely to brokers. Women engaged

more in marketing activities of mangoes in markets, especially transporting to and selling small quantities to nearby markets. However, the direction of the effect reverses for the truncated regression model results, implying that quantities sold to this channel increased when the farmer was male.

The Wald chi-square, which is used to test the hypothesis that at least one of the predictors' regression coefficient is not equal to zero, is less than the degrees of freedom for the export channel. The Prob>chi^2 is not significant thus as a whole, the model is statistically not significant. In other terms all the coefficients in the model are equal to zero and so none of the independent variables influences proportion of produce sold to export channel.

CONCLUSIONS AND POLICY IMPLICATIONS

This study analyzed choice of market channel as occurring in two steps; the farmer first decides on the channel to sell to, and in the second stage decides on the quantity to sell to the particular channel. The log likelihood test indicates that the two-stage Cragg's is preferred over the one-stage Tobit model. The two-stage model shows that interaction of variables is different between the first stage binary choice of channel and second stage with continuous dependent variable. Socio-economic factors that affect the first-stage do not necessarily affect the second stage. In some instances the direction of effect reverses in the second stage. The results therefore contrast the results when choice of market channel is modelled as one step, and provides more insights into the decision process.

For instance, whereas factors such as distance to tarmac, number of trees, membership in producer marketing groups, training, and access to extension services affect choice of export market channel, only membership to mango marketing groups significantly influences proportion sold. Household income, distance to tarmac, number of trees, market information, and gender significantly affect choice of the direct market channel. Variables that were found to be significant for choice of brokers channel are off farm income, market information, and gender. The proportion of produce sold to brokers increases with lower household income and experience, poor access to training and extension services, and increasing distance to tarmac road. Ownership of a vehicle positively influences the proportion of produce sold directly to the market.

The study found that unlike recent bias for farmers to participate in groups, collective action has not enabled participation in the value chain through selling directly at the market. Rather, factors such as income, access to information, and ownership of a means of transport. The ability of farmer groups to fill the gaps in financing, information access, and bulking is intricate. Thus, for effective market access, the drive to have farmers participate in collective action should be combined with interventions that ensure the resulting producer marketing groups improve access to financial assistance, information, and common transport. In addition, access to the export market depends on capacity to attain the quality requirements of the market. It was found that access to training and extension services improve ability of farmers to meet quality requirements.

It is therefore clear that policies should focus on improving quality of produce, by increasing the geographical coverage of especially extension and training services to farmers. Market information for perishable horticultural products is not available to farmers, and therefore price discovery is biased against farmers. In addition to providing market information, facilitating farmers to acquire affordable means of transport would assist in reducing reliance on brokers and middlemen. Policy initiatives aimed at reducing costs of transport for farmers, as well as storage and export would enable farmers to participate in the value chain and earn higher margins.

This study is limited in that it focused more on the producer and discussions are based only on producer characteristics and needs. There is need for future research to focus on the whole value chain. Further research on the opportunities and constraints faced by buyers will help in coming up with broad based all-inclusive interventions.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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