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Determinants of smallholder indigenous chicken farmers' market participation decisions and value of sales in Gulu district

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Indigenous chicken play an important role in the livelihoods of the rural poor in developing countries. They not only act as a source of nutrition but also supplement household incomes. Despite the tremendous market opportunities available for the farmers, there are still low levels of market participation for indigenous chicken farmers in Gulu district and other parts of Uganda. In light of this, a research study was motivated to ascertain the drivers of smallholder indigenous chicken farmers' market participation in Gulu district. Using cross-sectional data from households in selected sub counties in Gulu district, a two-stage Heckman model was used to model the decision of the smallholder farmers to participate in the market and then determine the factors affecting the value of sales thereafter. Results from the descriptive statistics showed that there were 126 market participants and 24 non-participants. Both flock size and non-farm incomes differed significantly (5%) between market participants and non-participants. The participants had a larger flock size while non-participants had more income. The results of the probit model further revealed that the first stage of market participation was significantly affected by distance of the household to the market (1%), flock size (10%), and ownership of a bicycle (1%). In the second stage (outcome model), the OLS results revealed that flock size, distance to the market and market price of indigenous chicken significantly (1%) affected the indigenous chicken farmer's value of sales. In conclusion, creation of effective marketing systems that would help reduce transaction costs of the indigenous chicken, provision of extension and veterinary services will not only increase the flock sizes kept by the smallholder farmers but also the value of sales of indigenous chicken for the farmers that participate in the market.

Key words: Heckman model, smallholder farmers, indigenous chicken, market participation, Gulu district.

INTRODUCTION

Livestock farming in sub Saharan Africa (SSA) is considered a strategic way of reducing rural poverty and achieving higher incomes (NRI, 2002). This is because indigenous livestock can withstand a number of shocks

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therefore, are used by households as a form of saving and insurance mechanisms against production, and price uncertainties. The poultry sub sector is particularly important for agricultural growth and improvement of people's nutritional status in Uganda. Despite the tremendous expansion of the commercial poultry sector since the 90s, scavenging poultry have not been given much attention on improvement of the breed though still account for more than 90% of the total poultry production. Of the estimated 45.9 million birds present in Uganda, rural scavenging chicken represented 39.6 million (about 86.4%) of the total in 2012 (UBOS, 2013). The poultry sub-sector is crucially important in the context of agricultural growth and improvement of diets of people in Uganda. The sub-sector is particularly important in that it is a significant part of the household's nutritional intake. It is an attractive economic activity as well, especially to women and the rural poor. However, the indigenous chicken's potential has not been exploited in Uganda, as much as has been done in other African countries. This therefore creates a gap in not only marketing but also production aspects if the indigenous chicken.

Generally, the indigenous chickens (IC) are raised at a subsistence level with free-range system being more predominant and this has been found to be more profitable than keeping indigenous chicken under confinement (Menge et al., 2005). However, these birds need extra feed to supplement that obtained from their scavenging activity (King'ori et al., 2007). Usually, these flocks are small and external inputs few (Okitoi et al., 2006), flock sizes vary between 17 and 22 birds which composed of cocks, hens, pullets, cockerels, and chicks (Illango et al., 2002). Owing to the scavenging nature of these birds, a key farm-level problem is periodic pest and disease attacks, which at times wipes out the flocks to uneconomical production levels.

Farmers' failure to participate in the market can be influenced by a number of factors as illustrated by a number of studies (Gausi et al., 2004; Williamson, 1975, 1981; de Janvry et al., 1991; Goetz, 1992; Abeykoon et al., 2013; Jagwe et al., 2010) which are embedded in the theory of transaction costs.

IFAD (2003) and World Bank (2008) show that the intensification of agricultural production systems and increased commercialization must be built upon the establishment of efficient and well-functioning markets and trade systems that keep transactions costs low, minimize risks and extend information to all actors, particularly those living in marginal areas of productivity and weak infrastructure.

Smallholder producers normally face two critical decisions; the quest to meet food security requirements and the need for marketable surpluses. These farmers are not only known for their subsistence level of production but are also characterized by weak links to information systems outside the communities in which they stay. In Northern Uganda particularly Gulu district, there are a number of market opportunities for indigenous chicken. This is due to increasing demand for chicken and chicken products locally, regionally and from neighboring South Sudan due to not only the increasing population but also the increasing consumer awareness of the health benefit of white meat. A number of studies have been carried out to characterize the poultry sector within and out of the country but with more emphasis on production, management, pests, and diseases. It is upon this background that this study establishes the factors that affect market participation decision and value of sales of indigenous chicken.

METHODOLOGY

Study area

The study was conducted in Gulu district located in Uganda. Specifically, the study took place in Laroo division, Unyama, and Bobi sub-counties. Gulu receives an annual rainfall of 10 to 250 mm (www.weather) and temperatures of 17 to 30°C with an average elevation of 1070 m above sea level. Agriculture in this region is predominantly rain fed with non-farm activities and livestock rearing contributing to the people's livelihoods.

Model specification

In this paper, the factors that affect the indigenous chicken farmer's decision to participate in the market as well as the value of sales were investigated using the two stage Heckman's procedure to correct for self-selection of households into market participants and non-participants. A probit model that generates the inverse Mills ratios (IMR) for market participants and non-market participants is used. The IMR was used as an additional regressor in the Ordinary Least Squares (OLS) regression that uses value of chicken sales as the dependent variable in the outcomes model.

The smallholder farmers' market participation issues as investigated in this study involved a two-stage decision problem for the households. The first is a discrete decision of whether or not to participate in the poultry market, while the second is a continuous decision of income earned from poultry sales and conditional on a positive first decision. If unobserved preferences and characteristics affect both the discrete and continuous decisions involved, the error terms in the two respective equations are correlated. Moreover, the variables affecting the two decisions may not be the same. In such situations, the Heckman's two-step model becomes appropriate (Heckman, 1979; Abeykoon et al., 2013), as it corrects for the self-selection problem.

In the Heckman's two step model, first the equation on the discrete decision was estimated and second, the equation on value of poultry sales was estimated with the inverse Mill's ratio (λe) obtained from the first estimation included as an additional independent variable. The following are the procedures.

Selection model

Whether or not to participate in poultry market (stage 1) is modeled as:

$$Y^* = Z^1 \propto +\varepsilon_1$$

Y=1 if $Y^* > 0$

Y=0 if $Y^* \leq 0$ (1)

where Y^* = 1 if a household participates in the poultry market and equals to zero otherwise. $\propto$ is a vector of parameters to be estimated which measures the effect of explanatory variables on households decision. Z is the vector of explanatory variables. ε_1 is the error term which is normally distributed with zero mean and standard deviation of 1, that is, e~N (0,1).

Since the probit parameter estimates does not show by how much a particular parameter increases or decreases the likelihood of participating in the indigenous chicken market, marginal effects were calculated by multiplying coefficient estimate $\propto$ by standard probability density function while holding other independent variables at their mean variables. The marginal effect of dummy independent variables were analyzed by comparing probabilities of that result when dummy variables take their two different values, while holding all other independent variables at their mean values (Wooldridge, 2002). Finally, log likelihood function was then maximized to obtain parameter estimates and corresponding marginal effects as:

$$\mathrm{LnL}\left[\frac{\propto}{Y}, Z\right] = \sum y = 1 \; In[\phi(\mathrm{Z}^1 \propto)] + \sum y = 0 \; In(1 - \Phi(\mathrm{Z}^1 \propto)) \quad (2)$$

A number of post estimation tests were carried out, for example, the goodness of fit test and the *estatclassif* command. The results of these tests were satisfactory as the model attained acceptable prediction power and had the desired goodness of fit (These results are available upon request).

The selection model that was used in the first stage is:

$$\Pr(\mathrm{Y_1}) = \mathrm{f}(\mathrm{x_1}, \; \mathrm{x_2}, \; _{\mathrm{elec}}\mathrm{x_{11}}, \mathrm{e}),$$

where Pr ($\mathrm{Y_1}$) is the probability of the farmer making a decision to sell poultry and poultry products in the market or not. $\mathrm{x_1} - \mathrm{x_{11}}$ are the variables affecting the decision of the farmer to participate in the market and e is the normally distributed error term.

Outcome model

Conditional on indigenous chicken market participation, variables affecting value of chicken and product sales were modeled in the second stage OLS (outcome model) regression as specified:

$$Z_i^* = W_i \propto + \varepsilon_2$$

where

$$Z_i = Z_1^* \text{ If } Z_i^* > 0$$
$$Z_i = 0 \text{ If } Z_i^* \leq 0 \quad (3)$$

Z_1^* is the latent variable representing the value of poultry and poultry products sold which is observed if $Z_1^* > 0$ and unobserved otherwise. Z_i is the value of poultry and poultry products sold. W_i is the vector of covariates for unit *i* for selection equation which is a subset of Z^*. $\propto$ is the vector of coefficients for selection equation. ε_2 is the random disturbance for unit of selection equation.

One problem with the two Equations (1 and 3) is that the second stage decision-making processes are not separable due to unmeasured household variables affecting both discrete and continuous decision thereby leading to correlation between errors of the equations. If the two errors are correlated, the estimated parameter values on variables affecting volume of sales are biased (Wooldridge, 2002). Thus, the model that corrects for selectivity bias while estimating factors affecting value of poultry sales has to be specified. For this purpose, in the first step the inverse mills ratio (IMR) was generated using predicted probability values obtained from the first stage probit regressions of factors affecting indigenous chicken market participation. Then in the second stage the IMR was included as one of the independent variables in the value of poultry and poultry products sales regression. Thus, the value of sales equation with correction of sample selection bias becomes:

$$V = w_i \propto + \lambda \left[\frac{\phi(w_i \propto)}{\Phi(w_i \propto)}\right] + e_3$$

where $\phi(.)/\Phi(.)$ is the mills ratio, λ is the coefficient on the mills ratio, ϕ denotes standard normal probability density function. ε_3 is not correlated with $\varepsilon_1 \text{and} \varepsilon_2$ and other independent variables. Under the null hypothesis of no sample selection bias λ was not significantly different from zero. V is the value of sales (UGX).

In the second stage of the Heckman model, OLS estimation was used to test the effect of the hypothesized factors on the level of participation. The model was stated as:

$$\mathrm{S_n} = \mathrm{f}(\mathrm{y_1}, \mathrm{y_{2,(e \bmod y_{13}}}, \mathrm{e})$$

where $\mathrm{S_n}$ is the value of indigenous chicken and indigenous chicken products sold annually in the market. $\mathrm{y_1} - \mathrm{y_{13}}$ are the variables that were hypothesized to affect the value of indigenous chicken and indigenous chicken products sold by the farmer in the market. While in this equation, e is the error term.

Sampling and data collection

A multi-stage sampling procedure was done at three levels, first a purposive selection of Laroo division, Unyama; Bobi sub-counties was done. Secondly, farmers engaged in the attachment program in Laroo division and Unyama sub-county were purposively selected because they received training and information from the university. Thirdly, random selection of farmers from the primary sampling unit (farmers in Laroo and Unyama involved in the farmer's attachment program) and those in Bobi farmers association was done. This association at the time had 6 groups. These groups were divided according to how far they were from the road and from this, two groups a sample that is representative of those that are near the main road and those far away were selected. The actual households interviewed were randomly selected.

The overall sample size was 150 households. This was calculated using Sloven's formula (Yamane, 1967) for determining

sample size for a finite population and with a confidence coefficient of 95%.

The data covered information necessary to make household level indices of social, economic, demographic, and institutional indicators comparable across different categories of households, thus continuous and discrete variables were identified based on economic theory and empirical studies.

RESULTS AND DISCUSSION

The market participants and non-market participants were characterized using a number of socio-economic factors shown in Table 1. Overall, 150 respondents participated in the study and by disaggregation, 126 respondents participated in marketing of indigenous chicken and chicken products, while 24 were non-market participants. Non-farm income and number of birds were significantly higher for indigenous chicken market participants than their non-participating counterparts (5%). This showed that farmers who were engaged in off-farm activities tended to have less time for farm activities, which could involve selling the indigenous chicken. Flock size significantly (5%) differed between market participants and non-participants.

The results of the probit model (Table 2) illustrated that age negatively affected the decision to participate by 10%. This could be due to its marginal diminishing effect on production as one's age rises, hence a confirmation to the lifecycle hypothesis (Randela et al., 2008; Enete and Igbokwe, 2009). The number of birds owned was found to be significant at 10% in influencing the farmers' decision to participate in the market. This is in line with Osmani and Hossain (2013). It was further observed that the probability of participating in the market increased by 19.1% for those who lived closer to the market. This finding is consistent with Gebremedhin et al. (2015) and Fletschner and Zepeda (2002) who reported that farmers with access to village market arrangements usually produce and sell more than their colleagues with no such opportunities to sell.

Ownership of a bicycle increased participation significantly at 1%. If a farmer owned bicycle, their probability of participating in the market was increased by 13.8%. The reason might have been the low transportation costs by the farmer in travelling to the market. This finding is consistent with the finding of Olwande and Mathenge (2010) who reported that ownership of transport equipment was significantly associated with agricultural market participation among poor rural households in Kenya.

Distance to the preferred marketing channel was negatively and significantly correlated to the probability of selling indigenous chicken. Hence, the partial effect of a unit increase in distance on the conditional probability of selling livestock was -0.02488. This means that with each unit increase (1 km) in distance, the probability to sell reduced by 19.1%. Thus, this finding suggested that households that are closer to market outlets are more likely to sell their indigenous chicken than those households living further away. The findings about the significant effect of distance to market in this study are in line with empirical findings of Bahta and Bauer (2007), Gebremedhin et al. (2015), and Fletschner and Zepeda (2002) who also observed that farmers with access to village market arrangements usually produce and sell more than their colleagues with no such opportunities to sell. In addition to this, the efficiency of both marketing and production of agricultural products can be improved by availability of physical sites like markets (Oppen et al., 1997).

The flock size was found to be significant ($P<0.1$) in influencing the farmers' decision to participate in the market. Output was expected to positively influence the probability and the intensity of market participation. The more the output the more the farmer is able to generate marketable surplus for participation. The result is consistent with the findings of Bellemare and Barret (2006) for the pastoral regions of Northern Kenya and Southern Ethiopia

Bobi dummy for sub-county was found to negatively and significantly affect participation (5%). Being in Bobi would reduce the farmers' probability of participating in the market by 14.5%.

Age was found to negatively affect the decision to participate (10%) due to its marginal diminishing effect on production as it rises hence giving a confirmation to the lifecycle hypothesis. An increase in age by one year reduced the probability of participating in the market by 3.9%. The older part of the population found it hard to move to the market due to the relatively long distances to the market place if these people did not have the means of transport so they would end up selling at the farm gate that offered very low prices and therefore this discouraged them. On the other hand, Enete and Igbokwe (2009) argued that younger heads were more dynamic with regards to adoption of innovations both in terms of those that would enhance their productivity and enhance their marketing at a reduced cost. Randela et al. (2008) also observed that younger farmers were expected to be progressive, more receptive to new ideas and to better understand the benefits of agricultural commercialization.

The results of the OLS regression (Table 3) shows that the price of indigenous chicken (hens, cocks and pullets) was found to positively and significantly (1%) affect the value of poultry sales. The results showed that a unit increase in the number of hens, cocks and pullets caused the value of sales to increase by 2.41, 4.18, and 4.35 UGX, respectively. In a related study, Enete and Igbokwe (2009) found that price had an important influence on the level of farmers' market participation in cassava markets which is supported by economic theory that price induces increased supply. Omiti et al. (2009) also asserted that better output price and market information were key incentives for increased sales in the market, while household size and non-farm income significantly reduced the sales of vegetables in the market.

Table 1. Comparison of characteristics between indigenous chicken market participants and non-participants in Gulu district.

Variable name	Mean		Mean difference	Pooled (N=150)
	Market participants (n=126)	Non-participants (n=24)		
Nonfarm income (UGX)	130,793.7 (15145.4)	49,541.67 (16620.50)	-81,251.9 (35523.94)**	117,793.30 (13206.92)
Distance off farm (KM)	11.51 (7.9)	2.33 (1.58)	-9.18 (18.21)	10.05 (6.66)
Flock size	12.01 (0.60)	8.25 (1.58)	-3.75 (1.73) **	11.41 (0.64)
Trading experience (Years)	7.07 (0.60)	7.14 (2.40)	0.07 (1.84)	7.09 (0.67)
Education household head (Years)	6.14 (0.03)	5.74 (0.56)	-0.42 (0.78)	6.10 (0.29)
Household-size	6.71 (0.20)	6.38 (0.44)	-0.33 (0.63)	6.65 (0.23)
Age household head (Years)	40.73 (1.10)	38.60 (1.15)	-2.06 (2.97)	40.40 (1.08)

Numbers in parentheses are standard errors; **Imply significance at 5%.

Table 2. Results of the probit model for both market participants and non-participants in Gulu district.

Variable name	Probit coefficients (N=150)	Marginal effects
Bicycle ownership	1.923 (0.711)***	0.138 (0.511)***
Car ownership	0.845 (0.992)	0.096 (0.112)
Motorcycle ownership	1.472 (0.963)*	0.121 (0.069)*
Indigenous chicken trading experience	0.046 (0.027)*	0.006 (0.003)*
Flock size	-0.104 (0.064)	-0.013 (0.008)
In distance to market	1.549 (0.396)***	0.191 (0.073)***
Log flock size	-15.536 (7.487)*	-1.914 (1.042)*
Dummy Laroo	0.162 (0.882)	0.018 (0.088)
Dummy Bobi	-0.952 (0.429)**	-0.145 (0.076)**
Age	-0.039 (0.019)*	-0.005 (0.002)*
HH _Size	0.004 (0.071)	0.0003 (0.007)
Education of HH	-0.091 (0.065)	-0.008 (0.006)
Nonfarm	3.65e-06 (2.20e-06)*	3.40e-07 (0.000)*
Constant	33.013 (19.547)**	-
Log likelihood	-29.43	-
Wald chi-square	261.74***	-
Pseudo R^2	0.55	-
Prob.>Chi^2	0.0000	-

Numbers in parentheses are standard errors; ***, **, *Imply significance at 1, 5 and 10%, respectively; Na: Not applicable.

Table 3. Results from the OLS regression of value of sales for indigenous chicken farmers in Gulu district.

Variable name	OLS-Regression	OLS-Regression (Robust standard errors)
Flock size	2290.6 (728.9)***	777.78
Laroo Dummy	-25934.6 (18759.9)	19607.28
Bobi Dummy	-37029.5 (20912.6)*	20736.91
HH_Female Dummy	-8042.4 (12470.5)	13127.76
Sources_market info(radio)	-17085.4 (14170.2)	14458.14
Sources_market info(peers)	20607.8 (12029.9)*	11555.77
Sources_market info(traders)	3734.0 (10900.9)	10455.77
Extension2	16942.1 (11716.3)	10749.17
Distance to the market L	67142.1 (22099.9)***	23138.02
HH_Size LL	-71194.3 (82597.5)	79911.88
Price_Hens	2.41 (0.89)***	0.7422
Price_Cocks	4.18 (0.68)***	0.7420
Price_Growers	4.35 (1.31)***	1.448
Trading log	70250.01 (221968.8)	168029.2
IC Trading experience log	158485.4 (221968.8)	255019.2
Age of HH	-858.6 (511.5)*	425.68
Education of HH	704.4 (1617.2)	1594.2
HH_Size	2609.1 (4619.8)	3520.59
Nonfarm Income	-0.06 (0.39)	0.048
Market_dues	-6.1 (9.81)	9.743
Invmills	22140.5 (15376.9)	9793.89
Constant	-657445 (1037476)	-

Numbers in parentheses are standard errors; ***, **, *Imply significance at 1, 5 and 10%, respectively.

Flock size just like distance to the market was found to positively and significantly (1%) affect the value of poultry sales. That is for every unit increase in the flock size, the value of poultry sales increased by 2290.6 UGX. It was also observed that, the closer the distance to the market where the farmers sold their indigenous chicken the less the transport costs they will have to pay and hence the value of poultry sales increased by 67142 UGX. Point of sale is dummied and used as a proxy for transaction costs. Key et al. (2000) and Makhura et al. (2001) found that distance to the market negatively influences both the decision to participate in markets and the proportion of output sold. Therefore, when the point of sale is far, it will be expected to negatively associate with the intensity of participation to households who sold in market centers.

Location in Bobi was found to negatively and significantly (10%) affect the value of indigenous chicken sales. The value of sales of indigenous chicken for farmers in this sub county was reduced by 37029.5 UGX. This is because of the long distance to the main Gulu town market for those farmers located in Bobi sub-county. This long distance increases the transport costs and thus reduces the value of indigenous chicken sales.

Receiving information from the peer farmers positively and significantly (10%) increase the value of poultry sales 20607 UGX. While receiving information from traders though had a positive coefficient, did not significantly affect the value of poultry sales. This showed that the information received from fellow farmers could have been more accurate than that from traders and the radio.

Education, household size, experience in trading and extension though not significant had a positive coefficient on the value of sales of indigenous chicken as predicted by the a priori expectations.

CONCLUSIONS AND RECOMMENDATIONS

Indigenous chicken production could be a significant livelihood activity for smallholder rural poor farmers in Gulu district. Traditional management systems were predominant with low productivity. Hence, this production system can be categorized under low-input low output production system.

The results also show that market participation of indigenous chicken farmers is high with more than 80% of the population participating in the market. However, indigenous chicken production still remains low with very low numbers of birds kept by farmers because most farmers are not yet aware of its profitability and as a result of this, the farmers give it less attention.

Age variable is also significant in determining the decision of households to participate in the market, but this shows a negative relationship with the participation

decision and thus indicating diminishing marginal returns to participation. This is consistent with the life cycle hypothesis because as producers grow older, they experience increasing returns to participation because they establish contacts, gain experience, and cut down on search costs. However, as they grow older, and get past their active productive life, production reduces and so does market participation

Household income considered as wealth has a positive significant effect on the decision of smallholder indigenous chicken farmers to participate in markets. Wealth helps farmers in breaking market entry barriers, as households must be above a minimum income threshold to participate in a market.

Results also revealed that once a smallholder farmer decides to enter the market to sell, household characteristics, and farmer endowments are the key factors that influence how much to be sold into the market. Factors such as distance to the market, flock size, price of birds, and information from peers affected significantly the value of sales. While age and sub-county turned out to significantly in a negative way, influence the level of market participation in form of how much to sell. Therefore, this study recommends that farmers be assisted to boost productivity of their indigenous chicken; and since this serves as a great determinant in the value of sales, it would be highly necessary to investigate level of commercialization of this sector in this region.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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