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The influence of prices on market participation decisions of indigenous poultry farmers in four districts of Eastern province, Kenya

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Abstract

Over 70% of the domesticated birds in Kenya are indigenous chicken (IC) providing meat and table eggs. They are frequently raised through the free range, backyard production system. Small flock sizes are characteristic of this production system and often, sales are mainly at the farmgate. Although IC production possesses enormous potential at livelihood improvement, marketing systems are undefined and variable. The influence of prices on market engagement has frequently been assumed. A study of 68 farmers conducted in Machakos, Kibwezi, Nzaui and Mwala District in 2008 revealed that 70% of all IC sales were conducted at the farmgate while only 19% of the sales were at the local market. This study also investigates the probability of market participation by employing a binary logistic regression model. The results suggests that while farmers complain of poor farm gate prices for indigenous chicken offered by middlemen, low volumes are an important drawback to market participation.

Keywords: Market, Price, Indigenous chicken, Farm-gate

Introduction

There are an estimated 29 million birds in Kenya with Indigenous Chicken (IC) being 70% of this number. Indigenous poultry production in Kenya is an important activity for 75% of the Kenyan population and these birds are mostly kept for domestic consumption and sale. The numbers kept vary with location but are largely reared under the free range system which is estimated to be more profitable (Menge, Kosgey & Kahi, 2007) than keeping indigenous poultry under confinement. However, these birds need extra feed to supplement that obtained from their scavenging activity (Kingori, Tuitoek, Muiruri, Wachira & Birech, 2007). Usually, these flocks are small and external inputs few (Okitoi, Udo, Mukisira, De Jong & Kwakkel, 2006). For instance, Sørensen (2007) puts the flock sizes in Makueni at between 20-30, while for Western province they are estimated as between 7-10 birds (Waithaka, Nyangaga, Staal, Wokabi, Njubi, Muriuki, et.al,. 2002) while Okitoi *et.al*., (2006) put this figure at 10-20 birds. These figures are against a national average of 13 birds per household (Nyaga, 2007). In Uganda, the size varies anywhere between 17-22 birds (Illango, Etoori, Olupot & Mabonga, 2002; Ssewannyana, Onyait, Ogwal & Masaba, 2006) while in Morocco, these are 11 chicken per household (Benabdeljelil, Arfaoui & Johnston, 2001) and between 15-20 birds in Botswana (Badubi, Rakereng & Marumo, 2006). IC in Nigeria, as in many parts of Africa are an important income source especially for rural women (Alabi, Esobhawan & Aruna, 2006, Akinola & George, 2008). Small flock sizes may however not be very attractive especially in terms of market efficiency as has been reported in Malawi where farmers' market participation decision is not significantly influenced by prices but is *ad hoc* depending on the farmers needs at any particular point in time (Gausi, Safalaoh, Banda & Ng'ong'ola, 2004).

The marketing system for indigenous birds in Kenya is described as unorganised, weak and indeterminate (Mathuva 2005, Munyasi, Nzioka, Kabiru, Wachira, Mwangi, Kaguthi et.al., 2009). In Uganda, many farmers do not assess market conditions before embarking on production (Alum, Kanzikwera & Sanginga, 2007) a scenario that is probably replicated in Kenya. This may partly explain why production is still low despite the existence of an unmet demand for poultry meat estimated at 12.4kg per adult equivalent in the urban areas (Gamba, Kariuki & Gathigi, 2005) and projected to grow to 29,600MT by 2014 (Muthee, 2006). It would be expected that with properly functioning markets, farmers should scale production and therefore supply, to reflect market trends.

However, supply will be responsive only after farmers make the decision to participate in the market, decisions conditioned by several factors. There are very few empirical studies showing the association between these indices and the decision to sell IC in particular since many farmers sell to avoid major losses from disease.

For the IC sector, two market channels are available to farmers viz, at the farmgate, or at the market. IC prices are usually spot prices with prices varying by season, chicken sex, size and trader (Munyasi et.al, 2009), but rarely are the birds weighed just as reported for many African countries (Guèye, 2001). Traders usually buy IC from farmers in the rural markets and assemble these for subsequent sale in larger urban markets. A Value Chain analysis for IC in Kilifi and Kwale reports the main reasons cited for the decision by farmers to sell are the need to offload in anticipation of disease outbreaks and to earn some income to cater for household requirements. The major disease causing mortalities in flocks is New Castle Disease (NCD). In Western Kenya, reducing mortality in chicken through NCD vaccination by 1% was shown to increase offtake by 0.11% (Okitoi, et.al, 2006). In Uganda, IC flock sizes were shown to increase by 195% following crossbreeding and NCD vaccinations, the latter reducing mortalities by 86% (Ssewannyana, *et.al.,* 2006).

In Kenya, many IC farmers complain of low profits as they point an accusing finger towards exploitative middlemen (Nyange, 2000). Prices offered to IC farmers are low at about 18% of the terminal price in Coastal Kenya while in other countries IC farmers appear to receive fairly higher returns (see for instance Mlozi, Kakengi, Minga, Mtambo & Olsen, 2003, Gondwe, Wollny & Kaumbata, 2005).

Munyasi et.al. (2009) report disease and price fluctuations in the larger Machakos and Makueni districts to be the major challenges in the marketing of IC from the perspective of traders. With an uncertain price structure, it is not clear whether farmers on the other hand respond to market information. This paper therefore explores the prices offered farmers for IC and distance to markets and their influence on the decision to participate in the market by poultry farmers.

Materials and Methods

Data collection and general description of study area

To study these relationships, we use baseline M&E data collected from farmers; all members of IC common interest groups (CIGs) who received training from service providers on main aspects of poultry management viz; housing, feeding, disease control and marketing between August and September 2008. The farmers were located in 8 divisions of Machakos, Mwala, Nzaui and Kibwezi Districts (which were carved from the larger Machakos and Makueni districts) and they included Kalama, Kibwezi, Makindu, Matiliku, Mbitini, Mulala, Nguu and Yathui divisions. Farmers to be interviewed were selected randomly from their respective CIGs from membership lists provided that the CIGs had requested for IC technical services, had registration certificates and were composed of at least 20-50 members. At least 10% of the farmers from each CIG were interviewed. The groups had significantly fewer male members (mean of 5) compared to a mean of 22 female members and seven out of the 29 CIGs were solely made up of female members. The oldest CIG was registered in 1996 with the latest registrations being those of 2008. A questionnaire was designed to gather periodic data on IC management as well as sales of IC, data necessary to monitor post-training progress in IC management among this group of farmers. During the first week of December 2008, a total of 68 farmers were interviewed from where cross-sectional recall (3 month period in reference to September-November) data on IC sales and prices in addition to other IC management practices were gathered. The questionnaire requested farmers to recall how many birds they had sold, where this sale had occurred and prices received from the sales.

Theoretical and Empirical framework

Some theoretical and empirical contributions explaining market behaviour include Barnum & Squire (1979), Singh, Squire & Strauss (1986), Sadoulet and de Janvry (1995). These assume properly functioning factor and product markets. In semi-subsistence situations much of which characterize small scale producers, production and consumption decisions are not separable and market participation takes place when a household's shadow price is lower than the market price with an allowance for transaction costs. Similar approaches have focused on explaining such decision processes in technology adoption studies. In the market participation literature, the decision about market participation is a two-stage process, the first being the decision to participate while a related decision on how much market involvement comes next in that sequence. Some applications of these procedures in market participation analysis include Key, Sadoulet & de Janvry (2000), Bellemare & Barrett (2006). Studies have modelled this decision as being influenced by both on and off-farm level factors (Montshwe, Jooste & Alemu, 2004, Uchezuba, Moshabele & Digopo 2009). Recent studies have extended the approach to consider farmer preference for different aspects of the marketing systems themselves (Abdulai & Birachi, 2008, Blandon, Henson & Islam, 2009).

In our study, it is hypothesised that since farmers make sale decisions sequentially (Bellemare & Barrett, 2006), then they first make the decision to sell (SELL=1) after which the decision on where to sell and how many birds to sell (SOLD) given prices at the chosen market is made. In this paper, we are concerned with the first decision, that of market participation. The underlying determinants (x_i) of these separate decisions are assumed to be identical (Jha and Hojjati, 1994) and include the farmer's initial endowment (flock size), distance to the chosen market (a dimension of transaction cost) and the price of a bird at the market. As members of CIGs, it is assumed that these farmers are not autarkic and further, that market participation involves sales of IC and not purchases. Observed sale prices are somewhere above the reservation price since with spot markets such as those characterizing IC, sellers do not have an exact map of prices offered but may only have a reservation price below which a sale agreement is not made. Other factors, such as the overall incentive environment, aggregate demand situation that are likely to shift the market response curve are assumed fixed in the short run, and their effects cannot be deciphered from this data set. In sum therefore, only prices and market distance are available for analysis in this dataset. To estimate the influence of these variables on the decision of farmers to sell IC, the model;

$$\text{Prob (SELL=1)} = 1 - F(-\gamma X), \ldots\ldots\ldots \text{(i)}$$

for the probability of engaging in a sale (SELL=1) is estimated. Due to limitations in the dataset, in the absence of flock sizes [FZ_{t-1}] at period t-1 (i.e. when sale decision was made), we employ a rather contestable but simplifying assumption. A summation of reported sales (SOLD) and current flock size FZ_{t1} will yield the situation at t-1 when the sale decision was made i.e. (FZ_{t-1}= SOLD + FZ_t). This figure is what is used as the flock size in the regression. Further, prices (p) are assumed to be fixed in time i.e. $p_{t-1} = p_t$. In many applications, it is assumed that F is either the cumulative normal (probit model) or the cumulative logistic distribution function (logit model) but in practice, there usually is no prior knowledge to justify this distributional assumption (Gerfin, 1996). The logistic regression approach is a powerful, convenient and flexible technique that can be used to describe the relationship of several independent variables to a dichotomous dependent variable (in this case SELL). Due to its mathematical convenience, the logistic regression has been used extensively (Greene 2007). The probability of a result being in one of two responses is modeled as a function of the level of one or more explanatory variables. Thus, the probability of a farmer selling IC (probability SELL=1) is modeled as a function of prices and distance to the nearest market.

$$\log\left(\frac{\phi_i}{1-\phi_i}\right)=\alpha_0+\sum_{j=1}^{k}\beta_j x_{ij}+\varepsilon_i \text{……(ii)}$$

From equation ii above, the subscript *j* is the response category out of *k* categories (SELL=1 or SELL=0), *i* denotes individual farmers (1, 2, 3, 4…, n=68), ϕ is the conditional probability, α_o is the coefficient of the constant term, β_j is the coefficient of the independent variable, X_{ij} is a matrix of observed values and ε_i is a matrix of unobserved random effects.

$$\phi_i=\frac{e^{\alpha_0+\sum_{i=1}^{k}\beta_j x_{ij}}}{1+e^{\alpha_0+\sum_{i=1}^{k}\beta_j x_{ij}}} \text{…..(iii)}$$

Rearranging (ii) the logistic regression can be manipulated to calculate the conditional probabilities from (iii) above where e is the base of the natural logarithm (≈2.718).

Data analysis

These estimations are implemented by invoking the *proc logistic* procedure in SAS. For most applications with discrete data, *proc logistic* is the preferred choice and it fits binary response or proportional odds models, provides a number of model-selection methods for identifying important prognostic variables from a large number of candidate variables, and computes regression diagnostic statistics (So, 1999). Unlike in classical regression analysis, the parameters from the logistic regression are not easy to interpret. Hence, to compute marginal effects, one can evaluate the expressions at the sample means of the data or evaluate the marginal effects at every observation and use the sample average of the individual marginal effects (Greene, 2007). For a continuous explanatory variable, x, $e(\beta_x)$ represents the change in odds for a unit increase in x (Schlotzhauer, 1993). The estimated empirical model is of the form SELL = f(FZ, Distance, Price) and is estimated by maximum likelihood. One of the farmers was found to be reporting information regarding exotic broilers and this observation was dropped from subsequent analysis.

Results and Discussion

The average flock size (FZ_t) was 22 and birds offered for sale over three months were 9.3 (or roughly three birds each month), most of which (74%) were sold at the farmgate and 19% sold at the nearest market and the remainder sold at markets further away. This amounts to a total of 460 birds sold by these farmers within a span of three months (table 1). Seventy two percent of the farmers interviewed had sold birds in the previous 3 months preceding the interview and only one farmer had sold chicks. The differences are not however significant across the divisions. Mean number of birds sold was greatest in Nguu, followed by Matiliku and Makindu reporting a mean of 16.25, 12.80 and 12.63 birds sold per farmer. Farmers in all the other divisions sold less than the average of 9.3 birds during the 3 months. Generally, 65% percent of the farmers selling birds had sold at the farm gate while 34% sold at the nearest local market while 27% had sold birds in other market outlets.

In general, distance to the nearest market is 7.5km with a standard deviation of 7.2km while those markets further away are located 15km away with a standard deviation of 2.8km. A negative correlation actually exists between the number of chicken sold and distance to the market. Similarly, a positive correlation exists between prices received and market distance.

Table 1: Indigenous Chicken sales by division between September and December 2008

Division	No. of farmers	% farmers selling	Mean No. birds sold	Std. dev.	Total number of birds sold			
					Chicks	Growers	Hens	cocks
Kalama	11	73	7.88	9.43	0	11	49	3
Kibwezi	10	50	3.40	1.14	0	15	2	0
Makindu	10	80	12.63	10.34	0	50	33	18
Matiliku	7	63	12.80	11.34	0	27	15	22
Mbitini	5	80	8.00	4.97	0	23	9	0
Mulala	11	91	9.20	7.63	0	17	32	43
Nguu	6	67	16.25	9.29	10	14	30	11
Yathui	7	71	5.00	5.15	0	1	16	8
Total	67	72	9.37	8.52	10	158	186	105

Many farmers sell at the farmgate yet prices here are lower than they could get if selling at the local market (table 2). This may suggest that if farmers are responsive to price signals, then available prices do not provide sufficient markup to compensate for transaction costs. Interestingly, hens fetched more for these farmers within the period reported here despite cocks fetching more per bird than other categories. The price ranges also suggest greater price spread at the farm-gate compared to other markets. The average prices across the markets translate to shillings 180.94 for growers, 219.13 for hens and 255.84 for cocks. These prices appear to be within the range reported by Munyasi et.al, (2009) for 10 rural markets within the same divisions represented here.

Table 2: Average prices for chicken received between September-November 2008 (Ksh)

	Chicks	Growers	Hens	Cocks
Farmgate	75 (--)	183.3 (100-300)	218.4 (125-350)	250.6 (120-300)
Local market	--	195 (150-250)	210.6 (130-300)	277.5 (150-450)
Other	--	175 (170-180)	246.7 (240-250)	313.3 (240-350)
Total Income	750	28,590	40,760	26,864

NB: Figures in brackets are the price ranges for respective classes

From the regression, the signs of the parameters from regressing SELL against the exogeneous variables are as expected (table 3). The -2 Log Likelihood and the log likelihood estimates indicate chi-square is significant and that the variables used are significant predictors in the model. Parameter estimates, their respective standard errors and marginal probabilities are displayed on table 3. The predictive strength of the model, shows that 45 farmers out of the 67 used in this analysis were correctly predicted (which is 67% correct predictions) by the model. The Wald test was used to test for overall model fit and the null hypothesis that the joint coefficients of the parameter estimate are equal to zero was rejected at 5% level of significance. Two of the variables (flock size and prices) are significant (at 5%) predictors of market participation.

Examining the coefficients of interest in this paper reveals that prices have a positive relationship with the probability of a farmer engaging in a sale while the farmers' flock endowment also improves the chances they will engage in the market. This however cannot be said about distance to the local market since as shown above, most farmers sell at the farmgate (where distance=0) and therefore, sales can and do occur whether the farmer travels to the market or not. The negative sign however indicates that longer distances would negatively influence the decision to engage in selling poultry.

The inclusion of the variables market and stages does not alter the signs nor the magnitudes of other parameter estimates. They are themselves not significant determinants of market participation.

Table 3: Maximum likelihood estimates for market participation

Variable	Parameter Estimate	Marginal probability	Wald chi	Pr > chi sq	Odds ratio
Intercept	0.2419 (0.1662)	0.044764	2.1197	0.1454	-
Distance	-0.023 (0.0162)	-0.00426	2.0065	0.1566	0.977
Flock size	0.0249** (0.00493)	0.004608	25.4917	<0.0001	1.025
Farm gate	-0.2373 (0.1425)	-0.04391	2.7732	0.0959	1vs3 0.667
Local market	0.0698 (0.1198)	0.012917	0.3389	0.5605	2vs3 0.907
Price	0.0191** (0.00594)	0.003534	10.3505	0.0013	1.019
Chicks	0.1257 (0.1387)	0.023261	0.8213	0.3648	1 vs 4 -1.199
Growers	-0.0204 (0.1412)	-0.00378	0.0208	0.8853	2 vs 4 1.036
Hens	-0.0496 (0.1428)	-0.00918	0.1205	0.7285	3 vs 4 1.006
Wald (df=8)			39.2097	<0.0001	
Log likelihood (df=8)			83.152	<0.0001	
% correct predictions			67		

Notes: Figures in parentheses are standard errors. -2 Log Likelihood (Intercept only) = 966.792; (with covariates)=883.639, correction factor = 0.185051

Despite some of the limitations of the data, it is possible to show that IC farmers in this sample respond to market signals (read prices) but distance can be a hindrance to the development of the market. Interestingly however, distance to the market does not appear to be a significant determinant in market participation. This might be due to the fact that quite a significant share of sales does occur even when distance is zero i.e. at the farmgate. Flock sizes appear to be significant determinants of actual market participation. Increases in prices offered will also increase market participation. A one unit increase in flock sizes increases log odds by 0.0249. This translates to an increase of about 2.5% in the odds of participation. If farmers doubled their flocks to 58 birds on average (as opposed to the average 22 birds), the odds of engaging in the market are 327%. Prices can also be used to determine the probability of market participation. An increase in prices by one shilling increases the log odds by 0.0191 which translates to an increase of 1.9% in the odds of market participation. Simulated prices reveal that doubling prices would improve the odds of participation by about 128%.

As is the case in Ethiopia, supply response to price is shown to be at best, modest. This is not explicit from this analysis however and it is necessary to investigate this further using a richer dataset that includes other variables that are supply shifters both in the short and long-term. We can only assume that the preference for the farmgate as an outlet is a reflection of low prices at other markets where margins do not allow sufficient markup to absorb transaction costs. Another weakness inherent in this dataset and worth investigating further is that seasonal changes in the market and their influence of market response may shift market participation decisions. These relate to seasons when farmers have the increased urgency to dispose off birds due to impending NCD outbreaks usually in the dry seasons. This reason for disposal is cited in some studies Mlozi *et.al.,* (2003)**,** Gondwe *et.al.,* (2005) and Alabi *et.al.,* (2006) for Tanzania, Malawi and Nigeria respectively. The results presented here should then be interpreted with these in mind.

Conclusion

The data used and presented here has a number of limitations and thus limits the strength and breadth of conclusions that can be reached. For instance, the spatial and temporal dimension of the IC market characterized above has not been described. The disposal of birds due to an impending disease outbreak (has a temporal/seasonal dimension) has not been explicitly modeled while in addition, medium and long-term changes of supply in response to the parameters cannot equally be ascertained. The direction of causality between prices and supply has been assumed. In addition, it has been assumed that both supply and demand interact seamlessly and prices offered are competitive. Since many product markets have been noted to exhibit short-term volatility, it is still not clear from this paper whether IC supply is elastic or not. Also unknown is the optimal flock size below which given prices and other farm level factors, farmers are bound to hold on to their flocks since as noted before, they do not sufficiently control the market prices on offer. Similarly, the advantages of group marketing should also be explored in order to transform such CIGs into marketing groups, capable of linking IC farmers to distant markets. Such institutions can also aid in the dissemination of simple IC technologies such NCD vaccination which would in turn improve on the standing flocks shown in this paper to be important in determining market participation. Studying the interest and ability of these farmers to engage with emerging supply chains which have rather stricter delivery schedules and quality standards would be a natural progression of this study.

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