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Analysis of Determinants of Market Channel Choice among Smallholder Dairy Farmers in Lower Central Kenya

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Abstract:

This study sought to analyse determinants of market channel among smallholder dairy farmers in Lower Central Kenya. Multistage sampling technique was used and data was collected from 288 small holder dairy farmers Kiambu County. Multinomial logit regression model (MNL) was used to analyse factors influencing the choice of dairy market outlet by the small holder dairy farmer. Processing and analysis of the survey data was carried out using SPSS version 20 and STATA version 12. Level of education, milk output, access to information and transaction costs influenced the choice of marketing channel. There was a positive relationship between choice of farm gate over cooperative societies and farmers training. It is recommended that programmes relating to information on milk marketing be made accessible to farmers. There is need to profile farmers on the basis of production, spatial location and education level and encourage them to use specific marketing channel.

Keywords: Multinomial logit, Marketing channels, Smallholder dairy farmers.

1. Background

Dairy farming fills the funding gap created by the inadequacies of the financial markets and low acceptance of insurance policies in most developing countries as it ensures regular cash flows to the farmers as opposed to intermittent incomes from crop cultivation and other forms of livestock keeping (FAO, 2011, Omole et al 2004). In Kenya dairy farming accounts for about four percent of the country's Gross Domestic Product (GDP) and fourteen percent of total value of agricultural output (KNBS, 2009). About eighty percent of the dairy output in Kenya emanates from small holders, many of whom are situated in the central highlands (Smallholder Dairy Project, 2008). According to FAO, (2014) and Mutua-Kiio and Muriuki, (2013), about thirty five percent of total milk produced is consumed on farm by the calves and the farmer's family while the balance is available for sale. In the period 2005-2012, annual milk output exceeded quantity marketed through formal channels to consumers and processors. This resulted in surpluses against a background of economic growth with resultant increase in demand for milk and milk products (Mulu-Mutuku et al. 2009; GoK, 2010; KNBS, 2013). The excess milk output increased from 1383.5 million litres in 2005 to 1929.45 million litres in 2012, while simultaneously the quantity of imported skimmed milk powder increased from 452 tonnes to 2753 tonnes. The large quantity of milk available for sale implies that a significant number of households in Kenya are involved in the milk value chain either as producers, processors, marketers or consumers (Stevenson and St. Onge, 2006). The recurring unprocessed surplus milk and concurrent increase in the volume of imported skimmed milk may be attributed to inefficiency of processing plants, which hardly utilize fifty percent of the installed annual processing capacity of 985 million litres (KDB, 2013) and lack of appropriate or weak marketing channels. Nevertheless, milk processing appears to provide a good investment for micro-entrepreneurs because there are market opportunities for value-added milk products (Mulu-Mutuku et al. 2009). This suggests that potential for business integration in the areas of milk processing and marketing exists.

The regular flow of income from sale of milk and other dairy products, against a background of limited regulatory entry barriers has been a good impetus for farmers to venture into dairy farming. With an average herd size of three dairy cattle, it is estimated that there are about 1.4 million smallholder dairy farmers in Kenya (RoK, 2013). Smallholder dairy farming as an informal family business mainly utilize family labour with one or two hired workers, thus making their operations Micro and Small Enterprises [M.S.E's] which hardly enjoy the economies of scale (GoK, 2012). Smallholder dairy farmers fulfill numerous functions in the agricultural economy among them: food security (Rosset, 1999), equitable distribution of income and creation of employment

opportunities especially to the rural poor (Dorosh and Haggblade, 2003), thus making the sector an important economic driver. On average, for every 1000 litres of milk produced at the farm level, 73 fulltime and 3 casual jobs are created while a similar quantity of milk creates 18 jobs in the informal sector and 13 fulltime jobs at the processing level (Staal et al. 2008). Dairy farmers as agents of economic growth would be expected to graduate their operations to medium enterprises through expanded herd size, use of modern technology, advanced operating skills, diversified portfolio of dairy products brought about by processing activities, and use of appropriate marketing channels (Ortner et al. 2000). Jari (2009) argued that despite the fact that smallholder farmers face difficulties in marketing, they continue to produce and survive in the face of unfavorable conditions. The socio-economic factors that determine the choice of marketing channels among the small holder dairy farmers in Kenya has not been investigated. In Kenya, market-oriented smallholder dairy farms tend to be concentrated close to urban centres because the effects of market forces over-ride many production factors. As a strategy of maintaining competitive edge in the market, the peri-urban smallholder dairy farmers should establish elaborate governance structures and act collectively in collection, processing and marketing of milk and milk products. Studies regarding the dairy farming in Kenya have focused mainly on productivity, genetics, nutrition, and value chain development. This implies that there are gaps in literature on the analysis of determinants of market channel among smallholder dairy farmers. This paper seeks to analyse determinants of market channel choice among smallholder dairy farmers in Lower Central Kenya.

2. Review of Literature

Several approaches have been proposed in literature on the analysis of factors influencing the choice of market channel. Here there is a single decision among two or more alternatives. Hensher (1986) analyzed occupational choice among multiple alternatives while McFadden (1974), analyzed the travel mode of urban commuters whereas Terza (1985) studied the assignment of bond ratings to corporate bonds as a choice among multiple alternatives.

Mburu, et al., (2007) using a purposive multistage sampling procedure examined the determinants of smallholder dairy farmers' adoption of various milk marketing channels in Kenya highlands. The study used a logit model in analysing farmers' milk marketing channels choice either through itinerant traders (hawkers, neighbours and hotels) or through the dairy cooperative. The study found out that average milk price, total number of cows milked and farm acreage negatively influenced farmers' adoption of milk marketing through the dairy cooperative channel. Sikawa and Mugisha (2010) analysed the factors influencing south-western Uganda dairy farmers' choice of the milk marketing channel. The study categorized milk market choices in to a binary outcome of formal and informal market channels. Using a Heckman probit model was age of the dairy farmer, membership in cooperative, form of payment, volume of milk produced, level of education of the dairy farmer and marketing costs were found to influence the choice of milk marketing channel.

Kwakwa, et al (2013) used a logit model to identify the determinants of fuel choice type by respondents by running regression for each energy type namely electricity, firewood, charcoal, LPG and Kerosene. The study treated each dependent variable as having two outcomes only for each variable and therefore estimated five logit models. The major shortcoming with this study is that the researchers did not apply the econometric models used when the dependent choice variable is more than two which is well taken care of in this current study by using multinomial logit.

The difference between Mburu et al (2007) and Sikawa and Mugisha (2010) studies and the current study is that the former studies collapses all the market alternatives in to a binary outcome while the current study does not. Binomial logit and probit techniques are only suitable for problems involving the choice among two categories. The former studies combined several market outlets in order to make the dependent variable a binary outcome. For problems involving the choice among three or more categories, the multinomial logit technique is most often employed like the case in this study.

Staal et al., (2006) analysed the smallholder dairy farmer access to alternative milk market channels in Gujarat, India. The study used a two-step analysis first to explain milk market participation using probit model while in the second step the study used McFadden's choice model, using a conditional (fixed-effects) logit to model milk outlet choice, and their determinants. The study found out three major milk marketing channels including direct sales to individual consumers, informal private traders and sale through cooperatives and private dairy processors. The study established that the higher the number of adults in a household, the more likely the household is to sell through the private trader channel and cooperative/private processor channel than individual customers.

Households with external assistant in their dairy enterprise were more likely to select the private traders and dairy cooperatives/processor channels instead of the individual customer channel. Households with more land were found to be less likely to sell through either the private traders channel or the cooperative/private processor channel. Households keeping higher number of livestock were found to be likely to select both the private traders and dairy cooperative/processor channel as opposed to selecting the individual customer channel. The study found out that households were less likely to select channels that paid cash, or that took milk on informal credit as compared to channels that offered monthly payment or provided formalized credit terms in form of written contracts.

The difference between Staal et al (2006) study and the current study is that the former used conditional logit model which is used when data consist of choice-specific attributes instead of individual-specific characteristics. Conditional logit model is limited in that it only gives direct information on which individuals make what choices does not allow testing hypotheses why those choices are made. Interpretation is based therefore on untested characteristics of alternatives available to particular individual (Hoffman and Duncan, 1988). The current study however utilizes the multinomial logit approach that analyses the choice of market on the premise of individual decision maker than the choice itself.

Shiferaw et al. (2006) employed descriptive statistics such as frequencies, cross-tabulations, means and ratios to analyse socio-economic assessment of legume production, farmer technology choice, market linkages, institutions and poverty in rural Ethiopia. The paper did not attempt to undertake detailed econometric modelling to test correlations and cause and effect relationships between different variables. The difference between this study and the current study is that the former used descriptive analysis

while this study used a more quantitative econometric analysis to estimate small holder farmers' choice of marketing channels. It is worth noting that although simple descriptive statistics provide important information on behavioural trends, they do not offer much insight into the underlying complex interrelationships and behaviours driving observed phenomena as quantitative analyses do, which is the case in this study

Murage (2010) examined the determinants of smallholder dairy farmers' use of breeding services in Nyandarua and Kiambu districts of Central Kenya. Considering three breeding services, artificial insemination (AI), natural bull service, and a combination of AI and bull services, the study used a multinomial logit econometric model. Ayuya, Waluse and Gido (2012) used both descriptive and multinomial logit to analyze small-scale farmers' choice of organic soil management practices in Bungoma County, Kenya. In some other work, Pundo and Fraser (2006) used multinomial logit model to investigate the factors that determine household cooking fuel choice between firewood, charcoal, and kerosene in Kisumu County. In a similar study in Eastern Cape Province, South Africa, Jari and Fraser (2009) used the multinomial regression model was used to investigate the factors that influence marketing choices among smallholder and emerging farmers. In another study, Yayar (2012) used multinomial logit procedure was used to investigate the socioeconomic and demographic characteristics of consumers that determine households' fluid milk consumption choices among packed, unpacked and both packed-unpacked milk consumption choices.

The relevance of Murage (2010), Ayuya et al (2012), Pundo and Fraser (2006), Jari and Fraser (2009) studies is that they all use the multinomial logit model approach in determining the determinants of choice. Multinomial logit model is the best approach for choices that are based on the attributes of the decision maker than the choice itself. Therefore these studies and the current share a common theoretical approach though the studies are analysing different choices.

2.1. Empirical Model

In this case, an individual is assumed to have preferences defined over a set of alternatives. The choice variable (dependent variable) has more than two unranked/unordered options while the independent variables can consist of features/attributes of the alternatives and characteristics of the respondent e.g., age, education, income. McFadden (1974) first introduced the multinomial logit model (MNL) to explain the choice of transportation modes of urban commuters with the random utility model. MNL continues to be a popular choice model because choice probabilities formula has a closed form and is readily interpretable.

The model was preferred since it permits the analysis of decision across more than two categories in the dependent variable therefore making it possible to determine choice probabilities of different channels. In addition, MNL is simpler to compute compared to multinomial probit which poses a challenge in computing multivariate normal probabilities for any dimensionality above 2 (Greene, 2002).

Assume the utility of household i choosing channel J is given by U_{ij} is a linear stochastic function of exogenous household characteristics X and endogenous household choices Z :

$$U_{ij} = \alpha X + \beta Z + \varepsilon$$

The parameter estimates of the MNL model only provide the direction of the effect of the independent variables on the dependent (choice) variable; thus the estimates represent neither the actual magnitude of change nor the probabilities. Marginal effects are used to measure the expected change in probability of a particular marketing choice being chosen with respect to a unit change in an independent variable from the mean (Greene, 2002).

The following model was specified for market channel choice analysis;

$$DMchoice = \beta_0 + \beta_1 Gender + \beta_2 Education + \beta_3 Age + \beta_4 LandSize + \beta_5 No. Of Dairy Cows + \beta_6 Output Per Cow + \beta_7 \% Milk sales + \beta_8 Training + \beta_9 Milk Output + \beta_{10} Information Access + \beta_{11} Transaction Cost + \varepsilon_i$$

Where DM choice is the dairy market outlet used by the farmer (Farm gate direct sales, middlemen, own distribution and dairy cooperatives), while $\beta_1 \dots \dots \beta_{11}$ are coefficients associated with each explanatory variable and the ε_i is the error term. Several factors were hypothesized to influence the farmers' choice of financial provision mode. The choice of these explanatory variables was mainly based on the general working hypothesis and partly on empirical findings from literature, and therefore, a positive or negative sign was assigned depending on the potential influence of a particular variable on choice of financial provision mode.

2.2. Diagnostic Tests for Multinomial Logit

The assumption of independence is critical and leads to substantial computational difficulties involving the computation of multivariate integrals. If there is a change in the characteristics of any other alternative in the choice set, this property requires that the two probabilities must adjust precisely in order to preserve their initial ratio, that is, the percentage change in each probability should be equal. A Hausman test was carried out and showed no evidence that the study did not meet IIA assumption and therefore no need of using nested logit as an alternative

Potential multicollinearity among explanatory variables was also tested in a preliminary analysis where it was found not have any potential influence on estimates from the model. The highest pair-wise correlation was 0.4 whereas multicollinearity is a serious problem if pair-wise correlation among regressors is in excess of 0.5 (Gujarati, 2004). An analysis of variance inflation factor (VIF) did not show any problem since none of the VIF of a variable exceeded 8 (Greene, 2002). In addition a Bruesch-Pagan/

Cook-Weisberge test for heteroskedasticity which indicated a χ^2 (Chi2) of 64.51 and Prob $> \chi^2$ of 0.8633 indicating that heteroskedasticity was not a problem.

A skewness and kurtosis test of normality was carried out to test whether the data was normally distributed. Greene (2002) argues that if a distribution has kurtosis values close to zero, and then it is likely to be normally distributed. The overall model had a kurtosis probability of 0.0000 meaning in general the assumption of normal distribution was not violated. To test for goodness of

fit maximum likelihood R^2 was 0.646 indicating that the model fits well. Further, the probability of Pearson χ^2 (Chi2) of 0.738 and that of Deviance χ^2 of 1.000 confirmed the model fits the data well.

3. Results and Discussion

Multinomial logit regression analysis was used to estimate the maximum likelihood of socio-economic factors to influence farmers' choice of milk marketing channel. Before subjecting data for analysis several econometric issues needed to be addressed prior to estimation of the multinomial logit model. The Independence from Irrelevant Alternatives (IIA) assumption is most likely to be problematic when the alternatives are similar to one another, so that unobserved factors affecting one alternative may as well affect another alternative. If this property is not supported, the alternative could be estimation conditional probit model, which allows for multivariate normal correlated error terms. Table 1 presents the MNL results;

Number of observations = 288; Log likelihood = - 85.17; Prob > chi = 0.000									
Market Channel Choice	1. Farm gate			2. Middlemen			3. Own distribution		
Variables	dy/dx	Std.Err.	P-value	dy/dx	Std.Err.	P-value	dy/dx	Std.Err.	P-value
Gender	0.016	0.849	0.985	-0.084	0.709	0.906	-1.842	1.804	0.996
Education	0.34	0.376	0.367	-0.834	0.412	0.043**	-0.152	0.9	0.548
Age	-0.176	0.421	0.677	0.452	0.39	0.246	0.933	1.742	0.277
No. Of Dairy Cows	-1.788	0.813	0.028**	-0.941	0.486	0.053**	-0.072	0.427	0.866
Milk Output/Cow	0.756	0.71	0.287	-0.067	0.486	0.089*	12.889	0.893	0.994
% Milk sales	-1.134	0.867	0.191	1.285	0.808	0.112	9.763	0.386	0.996
Training	1.49	0.827	0.142	-3.57	1.657	0.528	0.214	1.72	0.099*
Milk Output	-0.03	0.017	0.063*	-0.011	0.013	0.392	0.027	0.03	0.361
Information Access	-2.847	2.037	0.294	-3.044	1.728	0.595	1.03	0.987	0.092*
Land Size	0.388	2.005	0.073*	-0.878	5.876	0.881	21.715	0.659	0.998
Transaction Cost	0.14	0.531	0.044**	0.001	0.000	0.412	0.001	0.000	0.448

Source: Author, 2014; Base category is the cooperative; Asterisks denote the level of significance * = 10%, **5% while ***is 1%.

Table 1: Multinomial Logistic regression result for determinants of milk market choice

3.1. Household Land Size

The size of the farm possessed by a household was positively related to choice of farm gate market channel over through cooperatives at 10 percent level of significance. As the land size owned by household increases by one acre, the likelihood of that household selling its milk through farm gate over through dairy cooperatives increases by 0.39 units. These explain that farmers who have large farm size were less likely to sell their milk through cooperatives as compared to the farmers with small farm sizes. This could be because farmers with small land sizes may wish to benefit from cash, input subsidies, and service provided by the agricultural cooperatives. Households with relatively smaller land holdings and limited access to grazing land can substitute capital for land to produce as much or even higher milk volumes as compared to those with land holding. To access such capital, such farmers are likely to join cooperatives where they are likely to get input subsidies.

The results concur with a study of Karli et al. (2006) in the South Eastern Anatolian Region of Turkey which reported that the probability of the membership decreases with the increase in the farm size. These results are also in agreement with that of Tursinbek & Karin (2010) who found that farm size has greater impact on farmers' decision to join cooperatives in Zhejiang in China. Other studies such as Mussie et al. (2001) and Gockowski & Ndoumbe (2004) found a negative relationship between farm size and decision to join or adopt farmer based organization.

3.2. Number of Milking Cows

The results found a negative relationship between the number of cows a household owned and choice of farm gate and through middlemen market channels at 5 percent significance level. A unit increase in the number of milking cows owned by a household reduced the probability of using farm gate market channel as compared to using cooperatives for its milk by 1.79 units. Likewise, a unit increase in the number of milking cows owned by a household by one unit reduced the likelihood of that household using middlemen market channel over cooperative by 0.94 units. Other studies have reported herd size being a significant determinant in market channel participation for modern market channels (Tsougiannis et al., 2008).

As the herd size increases, farmers' shift to more organized dairy channels hence the negative relationship with farm gate and middlemen which could be argued to be less organized. Large producers are likely to get price incentives or higher prices for their milk because of high bargaining power as well as lower transaction costs which could be achieved in more organized market channels like cooperative societies. In addition, the number of animals kept by the farmer determines the total production costs and therefore influencing the amount of working capital needed on the farm forcing farmers with a large herd size to prefer supplying their milk to channels that handle big volumes and pay the whole lump sum milk revenues for continuity running of their dairy operations. However these results are contrary to Vijay, et al. (2009) work who noted a negative relationship between herd size and choice of cooperative marketing channel among dairy farmers. This could be likely a case where farmers in cooperatives receive the same price like in other channels and in situations where there is no price incentive to farmers irrespective of quantity of milk they supply.

3.3. Total Milk Output

The results of this study show a negative relationship of choice of farm gate marketing channel over cooperative societies. An increase in total household milk output by 10 percent reduces the probability of that household selling its milk through farm gate as compared to through a cooperative by 3 percent. These results are consistent with Tsougiannis et al., (2008) study who reported a positively relationship between volume of milk produced by the farmer per day and choice of cooperatives marketing channel. This could be due to the cost reduction on the sides of cooperatives especially on transport where the cooperative collects milk from its members from collection centres. Spatial distribution of small producers will have implications of the cooperative society operating costs. Consequently, the quality of milk produced by big farmers having been argued to be of higher quality than small producers since big farmers have access to veterinary services (Vijay et al., 2009). The implication of these results is that dairy farmers who produce fewer litres of milk could simply sell to vendors at the gate to avoid transport costs.

3.4. Marketing Cost

Marketing costs significantly influenced the choice of milk marketing channel at 5 percent level of significance. A unit increase in transaction cost incurred by a household increases the likelihood for such a household selling its milk through the farm gate over cooperative society by 14 percent. The longer the distance, the higher the transportation costs. The channel which is associated with higher transport costs reduces farmers' gross margins. This research finding is consistent with the results of Otieno et al., (2009) who reported that high transport costs significantly reduced the percentage of milk supplied to the marketing channel because they reduced farmers' gross margins. More so, the higher the transaction cost incurred by dairy farmers, the less the interest of participation in the channel (Artukoglu, et al. (2008). These results are contrary to Manyong et al, (2008) who found out that institutional innovation such as group marketing mitigate the costs of accessing markets.

3.5. Farmer Training

There was a positive relationship between choice own distribution marketing channel and access to information over marketing cooperatives. Actually, access to information increased the household likelihood of selling its milk through own distribution channel over cooperative by 21.4 percent at significance level of 10 percent. The implication of these results is that it is likely that the trainings attended by these farmers has impact or adds value on their milk marketing channel choices.

3.6. Access to Market Information

The results indicated a positive relationship between farmers opting to distribute their own milk rather than sell through the cooperatives and access to market information. Access to marketing information encourages farmers to venture into new innovations (Fuller et al., 2004). However, it is farmers with higher education level that have been argued to have superior ability to access and understand information and technology therefore applying that information to venture in to new opportunities than farmers with lower education (Elzo et al., 2010). These results seems to affirm the notion that market information gotten by the farmer about a certain marketing channel increases a farmer willingness to participate in that channel hence and he is likely to increase his output sales through that market channel (Otieno, et al, 2009).

3.7. Level of Education

There was a negative relationship between the level of education and choice of middlemen as compared to cooperatives. A unit increase in level of education by the household head level of formal education reduced the likelihood of such a household to sell through middlemen as compared to through cooperatives by 0.8 units. Formal education enhances managerial competence and successful implementation of improved production, processing and marketing practices (Marenya and Barret, 2006). Additionally, education has an implication on the ability to understand and interpret extension information received by an individual. Education levels affect market information interpretation and hence, market participation level of farmers (Jari, 2009). The more educated a farmer is the more they are likely to spend less time doing marketing activities hence would rather sell through cooperatives than middle men.

3.8. Milk Output per Cow

A negative and significant relationship was found between farm gate channel choice and the amount of milk produced per cow. It was found that farmers were 3% less likely to sell through farm gate as opposed to cooperative. This could be because cooperatives are more likely to buy in bulk compared to small traders who buy at farm gate and so for farmers that wish to sell a lot milk might sell faster through cooperatives. This finding is in line with findings of Tsourgiannis and others who reported that volume of milk produced was highly significant in determining channel choice and that farmers who marketed their milk to big national / regional dairy firms were large scale farmers in terms of cultivated land, size of flock, volume of livestock and milk production (Tsourgiannis et.al, 2002)

4. Conclusions and Recommendations

The results of this study affirm that land size, number of dairy cows owned by a household, access to training, total milk output, access to market information, and household head education level were found to significantly influence choice of household dairy market outlet.

Households which received training on agricultural production were more likely to sell through farm gate as opposed to cooperatives. It results affirm the notion that extension offices mostly targets households with large land holdings which was positively related with choice of farm gate over cooperatives. Households that were headed by more educated heads sold more through the cooperatives than through the middlemen. Households producing more milk volumes had a higher likelihood of

selling through cooperatives as opposed to farm gate marketing option. Households that had information of market prices preferred to sell on their own than to sell through the dairy cooperatives.

Choice of appropriate milk marketing channel ensures high gross margins. Consequently provision of education and services to the farmers on different milking marketing channels will be key in accessing the best marketing channel.

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