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Milk Marketing Channel Choices for Enhanced Competitiveness in The Kenya Dairy Supply Chain: A multinomial Logit Approach

Walter O. Moturi[1], Gideon A. Obare[1] and Alexander K. Kahi[1]*

[1]Egerton University

Abstract.

This paper uses data from a survey of one hundred and eighty four dairy households in two divisional administrative zones in the Kenya highlands to empirically analyze the factors that influence the choice of a milk marketing channel. Multinomial logit econometric estimation results show that distance to milk collection centre, education level, membership of the household head to farmers' group/organization, the number of cows owned by the household, and the coefficient of variation in prices significantly influenced the choice of a marketing channel. Private channel players are yet to focus on tapping the production potential of farmers with small herd sizes and encouraging group formation to exploit the social capital. The study demonstrates the need for the private sector to enhance milk collection at the unexplored areas to exploit the milk supply potentials. The implications for policy are provided.

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1. Introduction

The dairy industry is one of the most important agricultural subsectors in Kenya, where smallholder farmers account for nearly 70% of the total milk marketed (Government of Kenya, 2006). Export of milk and milk products amounts to less than 1% of the total amount of cattle milk produced which affirms the local market as by far the most important (Ynze, 2008). Smallholder dairy farming forms a crucial source of livelihood for many households in rural and peri-urban areas of Kenya (Wambugu *et al*., 2011).

Agricultural commercialization can be enhanced by promoting investments in it, more so developing marketing channels which is critical for poverty reduction (Geda *et al.*, 2001). When markets function fairly, poor households receive potential benefits of higher product prices and lower input prices due to commercialization (IFAD, 2001). In Kenya, recent studies show that legal framework to regulate the operations of informal milk marketing channels by licensing traders conditionally should be formalized to enhance market participation (Mburu *et al.*, 2007).

In recent years the cooperative milk marketing channel has been quite active in information dissemination in Kenya's liberalized milk market. Although the cooperatives offers the lowest price, they have significantly contributed to rural development in Kenya (Wambugu *et al*., 2011). They transport milk for members, provide inputs on credit and also enjoy significant economies of scale which are expected to minimize their operation costs. They, however, face stiff competition from alternative cash oriented marketing channels such as traditional channels (small scale milk vendors, large traders) and the organized private channels.

Opportunities for smallholder farmers may be realized from recent transformations in agri-food systems (particularly the rise of technological advances in developing countries' agriculture and supermarkets during the last decade) (McCullough *et al*., 2008). Policies and strategies should therefore be urgently instituted to counter population pressure, on-going global economic downturn and adverse effects of climate change that may suppress the above prospects. In order to support the process of sustained economic growth, there is need for a more robust and narrowed down analysis of vital issues that constrain farmers' market participation. Among them, socioeconomic and institutional factors have been ascertained as influencing participation

in studies such as Chirwa (2009), Gong *et al*. (2004) and Ouma *et al*. (2010). This study therefore depicts the importance of analysing the farm and farmer characteristics that influence dairy farmers' market choice and how the market characteristics shape marketing choice decisions.

2. The model

To determine factors that influence choice of milk marketing channel, Multinomial logit (MNL) model was used. The model was used to determine the empirical relationship between marketing channel and factors hypothesized to influence decision as used by Tsourgiannis *et al*. (2008). The model is aimed at how changes in the predictors translate into the probability of observing a particular categorical outcome. Multinomial logit is appropriate because it identifies statistically significant relationships between explanatory variables in this case, socio-economic, institutional, physical factors and a dependent variable (marketing channel). As opposed to other models like log-linear regression and discriminant analysis, MNL does not increase by a constant amount but approaches zero at a slower rate as the value of an explanatory variable gets smaller, it can also be used when there is a mixture of numerical and categorical variables. Considering the above information, the MNL model is specified, where market choice is given as:

$$MKTCH_{ij} = \beta_j X_{ij} + \varepsilon_{ij} \quad (1)$$

where $MKTCH_{ij}$ is a vector of the 3 marketing channel choices namely: (j= 1,2,3) for traditional, private and cooperative respectively) of i^{th} farmer, β_j is a vector of channel-specific parameters. ε_{ij} is the error term assumed to have a distribution with mean 0 and variance 2, X_{ij} is a vector of the producer's characteristics that together reflect the incentive, risks, and capacity variables and other shifters influencing the producer's indirect utility. If the smallholder farmer chooses market j, then U_{ij} is the maximum among the j=1, 2, 3 utilities. It follows that if market j will be chosen by a farmer then:

$$PROB\,(U_{ij} > U_{ik}) \qquad \text{for all } k \neq j \quad (2)$$

Following Greene (2000), the probability for the choice of market *j* given x_i covariates is given as:

$$PROB(Y_i = j) = \frac{e^{\beta_j' x_i}}{1 + \sum_{i=1}^{i=n} e^{\beta_j' x_i}}, \qquad \forall j = 1, 2, 3 \tag{3}$$

where Y_i being the market choice j made among a total of three different channels by respondent i, x_i's are the household level and area specific factors of choice of household i, and β_i's are parameters to be estimated.

Specifically,

$$PROB(Y_i = 1) = \frac{1}{1 + \sum_{j=1}^{j=3} e^{\beta_j' x_i}} \tag{4}$$

The parameters can be estimated by the maximum likelihood procedure as:

$$ln\left[\frac{P_{ij}}{P_{i1}}\right] = \beta_j' x_i \tag{5}$$

where the dependent variable is the log odds that the farmer will choose market *j* relative to the base category. The marginal effects are then estimated to show the probability for the ranking of between 1 and 3 for a given marketing channel by:

$$\frac{\partial p}{\partial x_i} = \frac{\partial}{\partial x_i}\left[\exp(x'\beta)/(1 + \exp(x'\beta))\right] = p(1 - p)\frac{\partial x'\beta}{\partial x_i} \tag{6}$$

In estimating the econometric model, the traditional channel was chosen as the reference and coefficient estimates were calculated in relation to that category (see Long and Freese, 2006).

Note that the choice of the base outcome affects only the parameterization of the model, not the predicted probability of farmer *i* choosing channel *j*.

The empirical model to estimate the relation between marketing channel and factors influencing choice was specified as:

$$\begin{aligned} MKTCH_j = {} & \beta_0 + \beta_1 AGEHH + \beta_2 GENDHH + \beta_3 OCUPHH + \beta_4 EDUCHH \\ & + \beta_5 MEMBRSPHH + \beta_6 HERDSIZE + \beta_7 PRICRISK + \beta_8 ROAD + \\ & \beta_9 DNCOL + \beta_{10} DISTFRM + \beta_{11} REPBUY + \beta_{12} DISTPHONE + \beta_{13} OCUPHH + u_{ij} \end{aligned} \quad (7)$$

where the variables are defined in Table 1 and u_{ij} is the error term.

3. Study area, sampling and data

3.1. The study area

The sample unit for this study consisted of all smallholder dairy households in Nyandarua County. A multi-stage sampling procedure was used to select the sample households for the study. In the first stage, Nyandarua County was purposively selected because of the large number of small scale dairy producers. Within Nyandarua County, Nyandarua north district was then purposively selected because it is where small scale dairy farming is dominant and growing at the moment. Furthermore, it reflects significant differences in structure of the dairy marketing industry. The two wards (Mutanga and Ndaragwa) were then selected through stratified sampling. Finally, simple random sampling was used to select the sample villages and subsequently the sample milk producing households.

3.2. Sampling design and sample size

The required sample size was determined by proportionate to size sampling methodology (Anderson *et al*., 2013) as:

$$n = \frac{pqz^2}{E^2} \quad (8)$$

where n = sample size, p = proportion of the population containing the major interest, q = 1-p, z= confidence level (α = 0.05), E = acceptable/allowable error. Since the proportion of the population is not known, p=0.5, q = 1-0.5= 0.5, Z = 1.96 and E = 0.07. This gave a size of 196 respondents. The households which were found to use more than two channels were dropped from the sample, therefore out of the 196 households surveyed, 22 used multiple channels. This meant that the sample size was cut to 184.

3.3. Data type

General information of household and socioeconomic characteristics of the household head such as age, number of years of schooling, gender, group membership, distance to milk collection centre, distance to tarmac road, duration of repeated dealings between farmer and buyer, herd size, occupation of household head, distance from the major market, milk price risk and distance to phone service was collected. Respondents were asked questions using a semi structured questionnaire and responses were based on a 12 month period time frame i.e. (July 2012-June 2013). Farmers who participated in the dairy markets were categorized into three groups representing the marketing channels. These are: 1=Traditional channel, 2=Private channel, 3=Cooperative channel.

4. Results and discussion

4.1. Descriptive results

Table 2 and Table 3 give the descriptive statistics of variables used in this study where some variables showed significant mean differences between the three marketing channels that were used. The difference in means for gross dairy income (*GRINCOME*), net returns from enterprise (*NET_RETURNS*) and coefficient of variation in milk prices (*PRICRISK*) were significant at 10% while distance to nearest milk collection center (*DNCOL*) and total number of cows (*HERDSZE*) were significant at 1%. Number of years of schooling of household head (*EDUCHH*) was the only variable significant at 5%. However, age of household head (*AGEHH*), distance from major market (*DISTFRM*), distance to the nearest tarmac road (*ROAD*), distance from the nearest phone service (*DISTPHONE*), duration of repeated dealing between farmer and buyer (*REPBUY*), and percentage of pure/cross breed cows in the dairy herd (*TECHNOLOGY*) did not show significant mean differences between the three marketing channels. Descriptives

for occupation of household head (*OCCUPHH*), gender of household head (*GENDHH*) and membership to agricultural group/organization (*MEMBRSPHH*) are presented in Table 3.
Active members of the household that practice dairy farming were averagely aged between 54.2 to 56.9 years, results which are in line with Ouma *et al*. (2010). It is however clear that majority of farmers used the modern organized channels (private and cooperative) as opposed to those who used the traditional channel. Farmers who participated in the private channel were found to be more educated compared to those who participated in either traditional or cooperative channel. The average number of years spent in school (7.3) indicated high literacy levels in the study area. Wambugu *et al*. (2011) findings were in line with this study's results where households which participated in the private channels owned more cattle as compared to those who participated in either the traditional or cooperative. However a randomly selected household would own 5 cows.

Farmers who participated in the cooperative channel covered the longest distance to milk collection centers (3.8 Kilometres) as compared to those who used either private or traditional. This is in line with the fact that farmers using the traditional channel (0.5 km) covered the least distance to collection point because the buyers were composed of nearby villagers and neighbors. The distance a farmer covers to the major market does not vary much whether participating in traditional, private or cooperative channels. Affirming this is the fact that most small scale rural farmers in sub Saharan Africa share a common market for their agricultural produce within a given administrative zone (Government of Kenya, 2006). On the other hand, a farmer participating in traditional, private or cooperative channel would cover nearly the same distance to the nearest tarmac road. A farmer randomly drawn from the sampled milk producers was likely to be 2.4 Kilometers away from the nearest tarmac road.

There was a price risk involved for farmers who participated in the private channel (-2.5%) where as farmers who participated in the traditional and cooperative channels had none. The duration of time a farmer spent repeatedly dealing with the buyer of her produce did not vary much whether she participated in traditional, private or cooperative. Farmers who participated in

the private channel realized higher net returns i.e. KES (Kenya Shillings) 85,333.5 from the enterprise as compared to their counterparts in traditional and cooperative channels earning KES 32,951 and 78,420.4 respectively. The average gross dairy enterprise income was KES 56,614.2, 113,092.1 and 98,738.2 for traditional, private and cooperative channels respectively. In addition, there was a statistically significant mean difference in the average gross dairy incomes between the channels at 10%.

The share of pure/cross breed cows within the dairy herd in the traditional channel did not vary much from the one in private or cooperative channel. This meant that a farmer randomly drawn from the sample was likely to have 85.3% share of his/her dairy herd as pure/cross breed. More male headed households sold milk than female headed households accounting for (86%) of the total sample as opposed to (14%) of females (Table 3). Furthermore, majority of the male headed households sold milk to the private channel (46.3%) while majority of the females sold through the traditional channel (53.8%). Most of the milk producers in the region are farmers and not involved in off farm income generating activities. Majority of the farming sub population participated in the traditional channel accounting for (44.9%) closely followed by those who participated in the private channel who accounted for (43.4%), the cooperative at (11.6%). A higher percentage of the business people and salaried employees used the private channel accounting for (58.3%) and (52.6%) respectively. Majority of the casual labourers used the traditional channel where (50%) of the sub population participated

Out of the sample population, (24%) comprised of household heads that were members of agricultural groups as opposed to (76%) who were not (Table 3). Amongst the sub population that was in agricultural groups, (72.7%) participated in the private marketing channel, (16%) in the traditional while (11.3%) were in the cooperative channel. On the other hand, majority of the non-group household heads were participants in the traditional channel accounting for (51%) of the sub population, whereas (37%) and (12%) participated in the private and cooperative channels respectively.

4.2. Econometric Results

Table 4 presents two replicates of the predictor variables, representing the two models that were estimated; private and cooperative, all of them relative to the traditional channel. The impact of a unit change in one independent variable relative to the referent group (i.e. traditional channel) represented each parameter. Marginal effects were then evaluated using the means of all variables in the sample. Discreet change in probability was also used for dummy variable.

The distance to milk collection centre significantly determined the probability of farmer participation in the private and cooperative channels where it had a positive effect on both (i.e. Marginal effects (ME) =0.092 and ME=0.036 for private and cooperative respectively). Therefore, the likelihood of change of marketing channels from traditional to private increases with distance to the market or milk outlets, farmers shifted their supplies from the traditional channel to the modern channels. The possible explanation for this behaviour could be that farmers incurred an extra transaction cost in transporting their produce to a traditional channel sale point as well as looking for the possible buyer as compared to other channels. The results are consistent with findings by Dries and Swinnen (2004) where the proximity to milk collection point facilitated the preservation of the traditional way of selling milk. The farther the distance was the less likely that a farmer participated in it.

The age of household head was positively related to the participation of smallholder dairy farmers in the cooperative channel. Moreover, the marginal effects for the private channel (ME=-0.001) showed that a one year increase in age reduced the probability of participating in the private channel by 0.1% while increasing the chances of being in a cooperative channel by 0.13%. This was partly consistent with the study's postulation differing slightly on the effect the variable had on the cooperative channel. The results corroborate the findings by Sharma *et al*. (2007) study's results with (ME=-0.002) for the private channel affirming the fact that younger farmers tend to be enterprising. Further, they tend to have the capacity to adopt new managerial systems and technologies as opposed to older farmers who would opt for a traditional channel.

The more the number of years spent in school the higher the likelihood that a farmer participated in the cooperative channel, this is evidenced by the statistically significant coefficient (0.1). The marginal effects of the private channel (i.e. ME=0.022) showed that a one year increase in schooling increases the likelihood of a farmer selling milk through the private channel relative to the traditional by 2%. The findings are consistent with the fact that education levels considerably affect market information interpretation and hence, market participation levels of farmers by helping them analyse and exploit the best marketing strategies at their disposal (Jari, 2009; Park , 2009).

The household head variable (whether male or female) did not significantly affect the probability of participation in the private or cooperative marketing channel relative to the traditional one. This is reflected by the insignificant coefficients namely -0.463 and 0.912 for the private and cooperative channels respectively. Wambugu *et al*. (2011) contradict these results that, in Kenya male-headed households keep improved cows compared to their female counterparts which restricts them to using an established sustainable marketing channel that ensures profit gain.

Working off farm and having multiple farming enterprises had a negative effect on participation in the private channel (ME= -0.015). The opposite was true for those who participated in the cooperative channel (ME=0.012). The results implied that, farmers who had off farm income generating activities and other farming enterprises were likely to participate in the traditional channel as opposed to the private channel. On the other hand, the likelihood to participate in the cooperative relative to the traditional was positive, if a farmer engaged in off farm activities. This showed that as a farmer got engaged in other income generating activities other than the dairy enterprise, he/she was more likely to use the traditional channel to market his milk. The finding contradicts with results by Barrett *et al*. (2006) where farmers with off farm employment and other farm enterprises sold their produce to the modern channels which could accommodate their bulky produce and in turn accord them a chance for other activities. It seemed that in the study area, having other farming enterprises and employment increased farmers' exposure to opportunities for extra daily cash hence disposal of milk through traditional and cooperative channels.

Membership of the household head to a farmers' group/association had a statistically significant positive effect upon farmer participation in private and cooperative channels at 1% and 10% level of significance respectively. The likelihood to participate in a private or cooperative channel rose if a farmer was a member of an agricultural group/organization. In simpler terms, being a member of an agricultural organization or group increased the likelihood of a farmer participating in the private channel by 33.6% (ME=0.336) relative to participating in the traditional. This meant that if a farmer was a member of a farmer's group, he or she was less likely to participate in a traditional market. It may further be explained by the role of collective action in attaining greater bargaining power, greater economies of scale, as well as reducing transaction costs which corroborate with findings by Mburu *et al*. (2007), where group membership was used as a proxy for social capital and had a positive effect toward farmer participation in the cooperative channel. Furthermore the results confirm this study's postulation.

The distance to the major market which was proxy for access to alternative markets had a positive statistically significant effect upon farmer participation in the cooperative channel at 1% level of significance. The effect was also positive although not significant for the private channel. This means that with a one kilometre increase in distance to major market, there was 3% (ME=0.030) increase in the probability that a farmer would choose the cooperative relative to the traditional channel. In contrast, Sharma *et al*. (2007) found that farmers who have easy access to alternative markets with less transaction costs incurred, would prefer not to be contracted to either cooperative or private channels. These results are consistent with the fact that there may be an increasing number of players affiliated to the major cooperative (K.C.C) procuring milk directly from farmers through milk collection centres.

Distance to tarmac road had a negative effect on participation in the private and cooperative channels. The negative effect was however significant for participation in the cooperative channel alone at 5% level of significance. This meant that, with a one kilometre increase in distance to the tarmac road, there was a 4.1% (ME=0.041) likelihood of a farmer switching from the cooperative channel to the traditional channel. This showed that those milk producers who were located in areas with less road connectivity were disadvantaged from participating in cooperatives affirming assertions made by Mburu *et al*. (2007) study. Moreover, from

discussions with private market players, cooperatives had not yet set up milk collection centres in the rural areas but sometimes procured milk from the farm gate or at the nearest collection centre from the farm gate.

Distance to nearest phone service had a negative effect on farmer participation in the cooperative but was positive for the private channel. However the effect was statistically significant for neither of the channels. Although this study captured the distance to phone service as opposed to mobile phone ownership as other studies (Voors and Haese, 2010; Emmanuel and Charles, 2012), the insignificance contrast their findings. In the latter's study findings, mobile phone ownership increased the probability of participating in the traditional channel compared to either the cooperative or private. This may be premised on the fact that farmers who owned phones exploited the flexibility of prices in the informal markets because they had access to information on market prices.

Duration of repeated dealing between farmer and buyer had a negative effect for participation in either private or cooperative channel although it was not significant. The results are not in concurrence with most research findings like Sharma *et al*. (2007) where having a longer repeated dealing was deemed to increase trust and honesty between farmers and the modern marketing channels. The probable explanation for this unexpected finding may be due to the inflexibility of prices in all the modern marketing channels even in times of milk scarcity.

Total number of cows owned by the household had a positive significant effect upon farmer participation in the private and cooperative channels at 1% and 5% respectively. Furthermore, the marginal effects implied that increasing the dairy herd by one cow increased the probability of a farmer participating in the private and cooperative by 4.4% (ME=0.044) and 0.8% (ME=0.008) respectively relative to the traditional channel. Herd size being positively correlated to milk volume (D'Antoni *et al*., 2013), private and cooperative channels preferred large producers because of reduced transaction costs while the farmers obtained price incentives or higher prices because of rise in bargaining power. This is consistent with findings by Kumar *et al*. (2011) where farmers that produced higher volume of milk sought after channels that more easily accepted larger and possibly more variable quantities of milk.

The coefficient of variation in prices (*PRICRISK*) within the channels was another important impediment to market entry. It had a negative significant effect upon participation in the private channel at 1% level of significance. At the same level of significance, the effect was positive for the cooperative channel. The marginal effects further significantly showed that a 1% increase in the coefficient of variation in milk prices would decrease the probability of farmer participation in the private channel by 1.05%. Alternatively, a one percent increase in the price risk would increase the probability of farmer participation in the traditional channel by 0.95% relative to the other channels. The flexibility of prices in the traditional channel makes it a soft spot for most farmers when the modern channels have lower fixed prices. This is consistent with findings by Kumar and Staal (2011) where greater price risks, lower prices or both typically discouraged farmers from modern channel participation.

5. Conclusion

The results in this study indicated that smallholder dairy farmers were excluded from both the cooperative and private channels. There was evidence of distance to milk collection centre (*DNCOL*) for private and cooperative channels affecting the farmer's choices of selling their produce to either of the two.

The study has demonstrated the significant effect of information access to enhanced marketing channel choice decision. There is need therefore to promote access to extension service providers as a channel for increased access on existing marketing channels and their effects on smallholder milk market transactions. It is then likely for the farmers to easily identify the most effective marketing strategies essential to assist them in enhancing their marketing efforts and maintaining a long term commitment to the most profitable channel. In addition, the study has demonstrated the need for private channel players promote the production potential of farmers with small herd sizes by encouraging group formation and membership subscriptions plus participation. Furthermore, the modern marketing channels are more likely to overcome the hurdle of poor marketing infrastructure and costly transaction costs by establishing collection centres at the unexplored milk catchment areas in an effort to exploit the milk supply potentials from those areas.

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Table 1. Description and measurement of model variables

Variable Name	Variable description	Variable measurement	Variable type	Expected sign
MKTCH	Marketing channel	Dummies:1=traditional,2=private,3=cooperative,	Categorical	+/-
AGEHH	Age of household head	Years	Continuous	-
GENDHH	Gender of household head	Dummy: 1=Male, 0= Female	Dummy	+/-
OCCUPHH	Occupation of household head	1=Farming,2=business,3=employee,4=casual laborer,	Categorical	+/-
EDUCHH	Education of household head	Years of schooling	Continuous	-
MEMBRSPHH	Membership to Agricultural group/organization	1=Yes, 0=no	Dummy	+
HERDSZE	Herd size	Total number of cattle	Discreet	+
DNCOL	Distance to nearest milk collection centre	Kilometers	Continuous	+
DISTFRM	Distance from market	Kilometers	Continuous	-
ROAD	Distance to nearest tarmac road	Kilometers	Continuous	-
PRICRISK	Coefficient of variation in milk prices (%)	Percentage (%)	Continuous	-
DISTPHONE	Distance to phone service	Kilometers	Continuous	+/-
REPBUY	Duration of repeated dealings	Years	Continuous	+

Table 2: Descriptive statistics of farm, farmer and marketing channel characteristics

Variable	Pooled data	Traditional	Private	Cooperative	f-value
	N=184	N=78	N=84	N=22	
	Mean	Mean	Mean	Mean	
Age of household head	55.1(14.9)	56.9(15.8)	54.2(14.5)	54.2(14.1)	0.79
Number of years spent in schooling by household head	7.3(12.7)	3.8(19.0)	9.7(4.4)	8.5(3.8)	2.31**
Total number of cows owned by the household	5.2(3.7)	4.1(1.9)	6.1(4.5)	5.6(4.2)	3.56***
Distance to milk collection center	1.9(3.3)	0.5(1.2)	1.6(2.4)	3.8(7.9)	5.08***
Distance from the major market	3.8(3.3)	3.2(3.2)	3.1(3.7)	5.1(6.1)	1.81
Distance to the nearest tarmac road	2.4(2.8)	2.3(2.6)	2.4(2.9)	2.6(3.5)	0.57
Coefficient of variation in prices	0.8(12.1)	1.9(12.1)	-2.5(12.1)	1.4(11.2)	2.13*
Distance from the nearest phone service	0.1(0.4)	0.2(0.5)	0.1(0.5)	0.04(0.2)	0.65
Duration of repeated dealing between farmer and buyer	3.1(4.2)	3.2(5.8)	3.5(2.8)	2.6(3.6)	0.79
Net returns	65,568.3(125,716)	32,951(50,044.9)	85,333.5(177,706.7)	78,420.4(69,487)	2.07*
Gross income	89,481.5(124,908)	56,614.2(50,106)	113,092.1(176,457.9)	98,738.2(70,076)	2.17*
Percentage of pure/cross breed cows in the herd	85.3(33.3)	86(34.4)	84.3(34.7)	85.6(32.6)	0.58

Note: figures in parenthesis are standard deviations associated with the means of the variables indicated.
***P < 0.01, **P < 0.05 and *P < 0.10 mean significant at 1%, 5% and 10% probability levels, respectively.
Source: Survey data, 2013.

Table 3: Distribution of farmers by gender, occupation and group membership

Variable	Percentage of total sample	Pooled data N=184	Traditional N=78	Private N=84	Cooperative N=22
Gender of the household head					
Male/percentage	86	158	64(40.5)	73(46.3)	21(13.3)
Female/percentage	14	26	14(53.8)	11(42.3)	1(3.85)
Occupation of household head					
Farming	70	129	58(44.9)	56(43.4)	15(11.6)
Business person	14	24	8(33.3)	14(58.3)	2(8.3)
Salaried	10	19	6(31.6)	10(52.6)	3(15.8)
Casual laborer	6	12	6(50)	4 (33.4)	2(16.6)
Membership of household head to an agricultural group/organization					
Yes	24	44	7(16)	32(72.7)	5(11.3)
No	76	140	71(51)	52(37)	17(12)

Note: Figures in parenthesis are percentages.
Source: Survey data, 2013

Table 4: Multinomial logit regression results on determining the factors that influence choice of a milk marketing channel

Independent variables	Mlogit Coefficient Estimates		Marginal Effects		
	Private	cooperative	Traditional	cooperative	Private
Constant	-2.167	-5.221	-	-	-
Distance to nearest milk collection center	0.553**(0.216)	0.672***(0.226)	-0.128*	0.036*	0.092*
Number of years spent in school	0.100*(0.052)	0.043(0.073)	-0.021	-0.001	0.022
Gender of household head	-0.463(0.563)	0.912(1.177)	0.064	0.089	-0.154
Occupation of household head	-0.040(0.179)	0.0974(0.250)	0.003	0.012	-0.015
Membership of household head to an Agricultural group/organization	1.868***(0.520)	1.279*(0.734)	-0.336***	-0.0007	0.336
Distance from major market (km)	0.047(0.090)	0.326***(0.108)	-0.022	0.031	-0.007
Distance to tarmac road (km)	-0.072(0.130)	-0.447**(0.184)	0.032	-0.041**	0.008
Distance to nearest phone service (km)	0.300(0.390)	-0.864(1.082)	-0.013	-0.103	0.140
Duration of Repeated dealing between farmer and buyer (years)	-0.022(0.046)	-0.045(0.081)	0.006***	-0.003	-0.002
Total number of cows owned by the household	0.232***(0.081)	0.223**(0.099)	-0.053	0.008	0.044
Age of household head (years)	-0.001(0.015)	0.012(0.022)	-0.0001*	0.001	-0.001
Coefficient of variation in prices	-0.046***(0.016)	-0.018(0.023)	0.009	0.0009	-0.010*
Log likelihood			-173.041		
LR χ^2 (48)			114.08		
Prob> χ^2			0.000		
Pseudo R^2			0.247		

Note: Figures in parentheses are the standard errors associated with the coefficient estimates

***P < 0.01, **P < 0.05 and *P < 0.10 mean significant at 1%, 5% and 10% probability levels, respectively.

Source: Survey data, 2013

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