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Analysis of Integration among Smallholder Dairy Farmers in Lower Central Kenya

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Abstract:
In Kenya dairy farming accounts for four percent of the country's Gross Domestic Product (GDP) and fourteen percent of total value of agricultural output thus making it a significant economic activity. Market-oriented smallholder dairy farms in the country tend to be concentrated close to urban centres because the effects of market forces over-ride many production factors. Urbanization creates competition for alternative land uses thus leading to land fragmentation which has a potential negative impact on dairy farming especially in Lower Central Kenya. The resultant diminishing land sizes implies that peri-urban smallholder dairy farmers have to integrate vertically and horizontally. Integration leads to high gross margins, better choice of market channel and improved market participation thus encouraging commercialization of dairy smallholder farming. Multistage sampling technique was used in collecting data from 288 farmers in Kiambu County in 2012.'T' statistics was used to analyze the mean differences of the socio-economic characteristics that distinguish integrated and non-integrated smallholder dairy farmers. Dairy enterprise turnover, percentage of milk sold and external sourcing of milk reveal significant differences between vertically and non-vertically integrated dairy farmers. There are significant differences between horizontally and non-horizontally integrated smallholder dairy farmers in respect to: distance from markets, land parcel sizes, level of formal education, dairy herd size, training willingness to pay for information and cost of production. It is recommended that farmers should establish and strengthen existing associations and integrate vertically and horizontally on the basis of their spatial location and milk output

Keywords: Mean difference, Integration, Smallholder dairy farmer

1. Background

Dairy farming is a key economic activity among the developing countries. It fills the funding gap created by the inadequacies of the financial markets and low acceptance of insurance policies (Omole et al 2004). It ensures regular cash flows to the farmers as opposed to intermittent incomes from crop cultivation and other forms of livestock keeping (FAO, 2011).

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 hence making it asignificant economic activity, KNBS, 2009, Mutua-Kiio, J.M. and Muriuki, H.G. (2013). About 80% of the dairy output in Kenya emanates from small holders, many of whom are in the highlands thus making it a major contribution to the livelihoods of the rural population. (GoK 2010, Smallholder Dairy Project, 2008). It is estimated that in Kenya, 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 output creates 18 jobs in the informal sector and 13 fulltime jobs at the processing level (Staal et al. 2008).

During the pre-liberalization period, the challenges of the dairy industry in the country were addressed through the Kenya Co-operative Creameries (KCC); a private farmer's organization that heavily depended on government support and patronage (Ngigi,2005). With the liberalization of the dairy industry in 1992, new institutional arrangements in milk collection, processing and marketing emerged (Karanja, 2003). Nonetheless the culture of dairy farming among Kenyans has continued despite the decreasing household land sizes over time. However, only a few of the smallholder dairy farmers, community based organizations and cooperatives have expanded their enterprises to include value addition though processing of milk products (Ngigi, 2004)

Smallholder dairy farmers can enhance their growth and profitability by being involved in production, distribution and marketing coordination and governance at various levels in the food value chain thereby integrating vertically and horizontally.Vertical integration occurs where two or more stages in the process of production and marketing are effectively controlled by single

management (Rehber, 1998).Vertically integrated farmers maximize return on investments through value addition, complimenting own produce from other sources as well as offering diversified products from the same material inputs. When selling their products, such actors will use marketing channels that enable their produce to reach the market at least cost per unit of output. Horizontal integration occurs when a farmer gains control over other farmers performing similar activities at the same level in production and marketing (Onumah et al. 2007). By pooling skilled manpower, horizontally integrated farmers are able to minimize on transaction costs, access market information and adhere to government regulations more easily. This paper seeks to assess the differences between integrated and non-integrated small scale dairy farmers in Lower Central Kenya.

2. Review of Literature

Lieberman, (1991) while analysing oil sector found out oil companies with higher investment cost in the USA had a higher probability of vertically integrating. A firm is likely to be idled if it is unable to obtain supplies of its primary input and to avoid this lock in problem such firms integrate vertically. According to Moss and Schmitz, (2000) vertical integration emanates if there exists a small number of suppliers of an input required by a firm further in the production process. According to Lazonick, (1994) there is a high likelihood for firms to integrate vertically if they source some input supplies from independent small firms. The firms supplying the input may collude in order to fetch higher prices for their supplies halting the operations of the buying firm. Therefore, households that source milk from other households have a higher likelihood of integrating vertically.

Empirical studies on horizontal integration have focussed on membership to groups and associations. Stefano (2010) using a probity model analysed factors influencing farmers' membership to a cooperative and market choices for their products in Germany. The study concluded that the probability of farmers being members of cooperatives greatly depended on the numbers of cooperatives relative to the number of private processors within the vicinity of the farmer. Settlement in an area where the local economy is predominantly agricultural also increased the likelihood of farmers joining cooperatives. This was probably due to cultural and socio-political reasons and the local cooperative market size or economic power. These results confirm that both agricultural and social related networking have a significant positive impact on horizontal integration decisions. The conclusion from this study is that wealthier households are less likely to join any farmer associations but if they do, they participate in group activities more than poor households. However, Stefano (2010) focused cooperative membership purpose of which was marketing issues and channel choices while the current paper focuses on the differences between integrated and non-integrated farmers with the farmer as the basis of analysis.

Batuhan (2009) using a probit model analysed factors affecting participation in forest cooperatives in Turkey. The study concluded that members' involvement, asset ownership and administration were important factors in explaining farmers joining forest based farmer associations. The current study is built on the findings of this study.Using a stepwise multiple regression, Bagher (2011) analysed the factors that affected participation of farmers in agricultural associations in Iran. The results of the study showed that membership history, income, amount of agricultural land, socio-cultural factors, the members' economical features, managerial factors, and members' psychological and communication factors had direct impact on their decision to join agricultural associations. This study focused on the level of participation in agricultural associations while the current study focuses on factors distinguishing horizontally and non- horizontally integrated smallholder farmers.

Fanaye T and Thomas (2012) used both a Tobit model to analyse the determinants of extent of women membership in agricultural associations and logit model to study the determinants of women membership in those associations in Ethiopia. The logit regression results showed that age and household size statistically influence women's participation in farmer associations. In another study to analyse the factors influencing active participation in cooperative entities, Saharkhiz (2009) used a probit model. The results showed that government support, training, access to information were crucial factors. Jenson (2010) evaluated the factors that influence the decision by dairy farmers to join farmer associations in Tennessee. The study found that the provision of quality services and assistance in marketing of dairy products attracted farmers to be members of farmer association.

Othman et al. (2012) analysed the factors that influence cooperative membership and increment in shares in Malaysian Cooperatives using a logit model. The results of that study showed that age, occupation, annual general meeting attendance and membership duration were important predictors in the model. Gender negatively influenced cooperative membership and that people in the older age group are more likely to become cooperative members.

3. Review of Explanatory Variables

3.1. The Study Was Premised on the Following Explanatory Variables

3.1.1. External Milk Sourcing (External Source)
This was a dummy taking a value of one if a household buys raw milk from its neighbours to sell and zero otherwise. It was hypothesized that a household that buys milk from its neighbours to sell is more likely to vertically integrate.

3.1.2. Percentage Milk Sale (%Milk Sale)
This was a continuous variable that depicted a percentage of milk sold as a fraction of total milk produced. This is derived from the demand variability models and according to Carlton model, integration is expected to be positively related to percentage milk sale (Carlton, 1979).

3.1.3. Enterprise Turnover (Turnover)

This was a continuous variable depicting the households' dairy enterprise turnover. It was hypothesized that the higher the enterprise turnover the higher the likelihood of vertical integration.

3.1.4. Education of Household Head

This was a continuous variable depicting the number of years spent in formal education by the household head who is the main decision maker concerning dairy production. At higher levels of education, farmers might have more awareness on the benefits and costs associated with the membership choice. Therefore, education is expected to have a positive influence on membership in farmer associations (Makhura, et al. 2001).

3.1.5. Number of Animals Kept

This was a continuous variable and a positive relationship was expected. Vijay *et al*. (2009) and Tsougiannis *et al.* (2008) noted herd size as a significant determinant in participation collective groups. This is because large producers get price incentives/ high price because of high bargaining power as well as lower transaction costs. 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. However, Vijay et al, (2009) noted for the case of cooperative, herd size had a negative impact. This because increase in the herd size which eventually leads to an increase in milk volumes that cause farmers to shift from cooperative to other channels. This is because farmers in cooperatives receive the same price (no price incentive) irrespective of quantity of milk supplied by individual farmers.

3.1.6. Training

This was a dummy variable taking value of 1 if a household received training concerning dairy production and 0 otherwise. It was hypothesized that increased access to training would increase household probability to horizontally integrate. Based on the innovation-diffusion literature, it is hypothesized that training exposes farmers to 'new information. However, some authors have also argued that what is important is not this contact but how farmers assess the relevance of the issues discussed (Zinnah et al. 1993).

3.1.7. Farm Size

Was a continuous variable indicating total land accessed by a household in acres. A positive relationship was expected in relation to likelihood of horizontal integration. A household with larger land size was expected to have a higher likelihood to join farmer association than households with small land sizes.

3.1.8. Distance

This was a continuous variable indicating how far a household was from the nearest market. A negative relationship was hypothesized where households far from the market were expected to join farmer associations to market their milk together.

3.1.9. Willing to Pay for Market Information

This was a continuous variable. The farmers were asked to indicate the amount of money they were willing to pay to access any market related information. It was expected that households within farmer associations would be willing to pay more for market information.

3.2. Diagnostic Tests

3.2.1.Test of Goodness of Fit

The significance of individual explanatory variables was tested using the t-test. This required a large sample size in order to rely on the asymptotic expressions for the standard errors, and the t-test statistic. The t-statistic followed approximately the standard normal distribution. The joint parameter restrictions were also tested using the Likelihood Ratio test with the null hypothesis that all coefficients (except the constant term) are zero (Heij et al. 2004)

The goodness of fit test can be done by either estimating the Pearson χ^2 test or the Hosmer- Lemeshow test. The Pearson χ^2 goodness-of-fit test is a test of the observed against expected number of responses using cells defined by the covariate patterns. The χ^2 statistic for the Hosmer-Lemeshow test may be unreliable if the response variable is grouped in fewer groups and the Pearson goodness-of-fit test is usually a better choice (Gujarati 2004). For both tests the probability χ^2 of a well fit model should not be significant. The results for vertical integration logit model indicated a Pearson Prob > chi2 of 0.702 meaning the model fitted the data.

For the logit model for horizontal integration, the Pearson χ^2 test results indicated a Pearson Prob > chi^2 of 0.902 meaning that the model fitted the data.

3.2.2. Model Specification Test

The link test is carried out for model specification after any single-equation estimation command such as logistic. According to the link test, for a well specified logit model the prediction squared should not have any explanatory power if the dependent variable is

regressed on the prediction and the prediction squared (Green 2002). Although link test is a test of the specification of the dependent variable, it is often interpreted as a test that, conditional on the specification, the independent variables are specified incorrectly. Therefore, the rule of thumb is that the P>|t| for hatsq should not be significant. The results for logit model for vertical integration showed that the P>|t| for hatsq was 0.702 indicating that the model was well specified. Likewise, for the logit model for horizontal integration, model specification test results showed that the P>|t| for hatsq was 0.507 indicating that the model was well specified

4. Results and Discussions

Factors influencing farmers' decision to integrate vertically in the dairy enterprise were analysed for farmers that were vertically integrated and those that were not. The variables used in the econometric model for vertical integration were used and included; storage, percentage milk sales, turnover, milk share cost of total production cost, external milk sourcing and total cost of production. The test results on differences between vertically and non-vertically integrated households in terms of these variables are presented in Table 1.

Variable	Vertically Integrated*	Non Vertically Integrated**	Mean diff	t- Value
Storage	0.09	0.11	-0.01	0.776
Monthly turnover (Kshs)	54, 857	32, 065	22,792	0.005***
The cost of production	14,568.97	15,995.19	-1,426.23	0.588
% milk sold to consumers	73.42	54.37	19.05	0.094*
MCS	0.62	0.66	-0.04	0.732
External Milk source	1.90	1.99	-0.09	0.028**

Table 1: Mean differences in socio economic household characteristics for vertically and non-vertically dairy enterprises
n=93 n= 195***

Out of the six analysed factors, monthly turnover, percentage milk sales and external sourcing of milk were significantly different between vertically integrated and non-vertically integrated households. Households which were vertically integrated had a higher monthly turnover of about Kshs 54,857 while those that were not had a turnover of Kshs 32,065. Though vertically integrated households had lower cost of production, the difference was not significant. On average, vertically integrated households sold over 73 percent of its total milk produced while non-vertically integrated households sold an average of 54 percent of milk produced. Vertically integrated households outsourced milk from other farmers more than non-vertically integrated households.

The results on differences in some socio economic characteristics for horizontally and non-horizontally dairy enterprises (Table 2.). Out of the twelve analyzed factors, nine variables were statistically different among horizontally and non-horizontally integrated households.

		Non-members*	Members**	
Variable	Unit	Mean value of variable		t- value
Education	Years	11.58	15.36	0.057*
Age	Years	56.61	57.51	0.112
Farm size	Acres	1.31	1.82	0.001***
No. of dairy cows	Heads	3.7	5.67	0.092*
Milk output/cow/day	Litres	8.07	8.21	0.375
% milk sales	Litres	58.56	63.53	0.079*
Experience	Years	19.43	19.29	0.232
Undergone training	Dummy	1.05	1.02	0.002**
Distance to market	Km	2.80	2.61	0.002**
WTP information	Kshs	205.00	265.00	0.027**
Monthly turnover	Kshs	30908.00	37050.00	0.000***
The cost of production	Kshs	18075.00	14683.78	0.004**

Table 2: Mean differences in socio economic household characteristics for horizontally and non-horizontally integrated dairyenterprises
n =121, n=167***

On average, horizontally integrated households had more years of formal education than non-horizontally integrated households. On average, they had larger land size than non-horizontally integrated households who had about 1.31 acres of land. Farmers who belonged to farmer associations had more cows than non-members. Similarly, they sold more of the milk (63.53%) produced than those not in farmers' association (58.56 %). Farmers within farmer associations received more training concerning dairy production than farmers who were not horizontally integrated.

Farmers who were horizontally integrated were found to a market (a distance of 2.61 km) as compared to non-horizontally integrated households (average distance of 2.8 km). Horizontally integrated farmers were on average willing to pay more than non-horizontally integrated households for market information at Kshs 265 and Kshs 205, respectively. The study showed that on average, horizontally

integrated households had a monthly turnover of Kshs 37,000 compared to Kshs 31,000 for non-horizontally integrated households. However, the cost of production in the dairy enterprise was higher among non-horizontally integrated households as compared to horizontally integrated households.

Smallholder farmers are likely to benefit from the establishment of production cooperation by integrating partially or totally in their farming activities. This horizontal integration consists of a farmers' union that jointly plans and executes the biological and mechanical processes required for agricultural production under the coordination of a common governance body. This may increase productivity through the attainment of economies of scale, enabling collective acquisition of technology and facilitation of use of common productive assets including machinery. Cooperation of small scale producers reduce transaction cost by enhancing access of information such that farmers need not to keep on experimenting new technologies (Arango et al. 2008). Farmer associations provide access and secure markets for the long term in addition to increasing technological and market efficiency. Farmer cooperation have been argued to decrease and internalize transaction costs by enabling better flow of information on consumer demand.

4.1. Education

As hypothesized, farmers within farmer associations were found to be statistically more educated than those that were not. This finding is consistent with findings of the study by Arayesh, (2011). While studying factors affecting the participation in agricultural associations in Iran, education was found to positively influence participation in agricultural related groups. The results of the current study are in concurrence with the findings of Woldu et al, (2013)research women participation in agricultural cooperatives in Ethiopia. Findings from the study indicate that Ethiopian women who were members of a cooperative were statistically more educated than non- members.According to Faturoti et al. (2006), education provides farmers with more information pathways. Higher level of formal education equips farmers with more knowledge and skills hence facilitate the awareness of the importance to work collectively.

4.2. Farm Size

The result shows that farmers within farmer associations had significantly larger land sizes than farmers that are not members of any association. This was inconsistent with the hypothesized scenario. It was expected that farmers who have large farm size could less likely join farmer associations as compared to the farmers with small farm sizes. This could be because small farmers may wish to benefit from cash, input subsidies, and services provided within the groups. These results were consistent with Mussie *et al.* (2001) and Gockowski and Ndoumbe (2004) found a negative relationship between farm size and decision to join or adopt farmer based organizations in Mbeya, Tanzania and Southern Cameroon respectively.

4.3. Number of Dairy Cows

Households that were members of farmer associations kept statistically more cows than those that were not. This could be explained by the information they could be accessing on dairy cow's management from group dynamics. Additionally, it is likely that membership in farmer associations helped farmers to access market for their milk. This would be expected because households within farmer associations were found to have a relatively larger land size than those that were not.

4.4. Training

Households within farmer associations had more training as compared to those not in any association. This is consistent with the hypothesized scenario. Farmer groups are usually involved in job creation and are also responsible for the training its members in order to perform well and achieve the organization goal (Webster et al. 2012).

4.5. Percentage Milk Sales

This result was as hypothesized for both vertical and horizontal integration. Since association members are more educated, they are likely to adopt new production technologies that will enhance productivity. Adoption of technologies like zero grazing dairying has been argued to perform well under conditions of collective marketing, good linkage to markets and access to production information. It is evident that these farmers are producing more milk and with more market information, they sell more milk. Similarly, vertically integrated farmers are efficient in their operations and sell more of their milk output as valued added products (Mulu-Mutuku et al. 2009). Provision of training, feeds, and credit and extension services should have a beneficial impact on milk productivity.

4.6. Cost of Production

Households within farmer associations had lower production as compared to the households that did not belong to any association. This could be explained by the fact that farmers' associations have the potential to shorten the marketing chain by directly connecting small producers to markets; enhance a better coordinated production and marketing activities facilitate farmer to have access to production inputs at fair prices (Shiferaw et al. 2006). According to Barton (2000), farmers form associations with the goal to generate greater profits by obtaining inputs and services at lower costs than they could obtain elsewhere or that were not available, and by marketing the products at better prices or in markets that were previously not accessible.

4.7. Willingness to Pay for Information

Farmer training and better access to relevant information on dairy production through the extension system or the milk cooperatives will enhance profitability of the enterprise hence greater commercialization of the dairy sub-sector. This was consistent with Baltenweck and Staal (2000), who found that households in groups were more likely to pay more for information on new dairy

technologies. According to Motiram and Vakulabharanam (2007), farmers belonging to a farmer associations have more bargaining power, lower transaction costs in being advanced loans, and better access to information. This makes such households be willing to pay a premium to access any information that would benefit them in their dairy enterprise.

According to Elzo et al. (2010) farmers with higher education level may have superior ability to access and understand information and technology, and may be able to apply them more appropriately to their conditions than farmers with lower education hence pay a premium to access information. Since farmers in associations were more educated they are more likely to pay a higher premium to access any information.

4.8. Enterprise Turnover

These results imply that households in associations gain more income from their dairy enterprise than those households that are not members of the association. These results agree with those of Xaba and Masuku, (2013) who found that turnover on vegetable crops influenced the choice of marketing channel among farmers in Swaziland. The higher the turnover, the more likely were the farmers to sell their vegetables through the state marketing board compared to wholesalers. Vertically integrated small dairy farmers have a higher turnover than those who are not vertically integrated as a result of value addition.

5. Summary and Recommendations

Data on farm size, milk output, turnover, cost of production, the level of education, willingness to pay for information and estimated amounts as well as the estimated distance from the nearest market. All the variables among the determinants of vertical and horizontal integration were subjected to a 't' statistic to further evaluate the significant differences between integrated and non-integrated smallholder dairy farmers. Monthly turnover, percentage of milk sold to customers and the external source of milk revealed significant difference between vertically and non-vertically integrated dairy farmers. Education level, farm size, number of dairy cows, experience, training, monthly turnover, willingness to pay for information, cost of production and distance to the nearest market were found to be significant when analysing the mean difference between horizontally and non-horizontally integrated dairy farmers

There is need for the farmers to be organized in groups backed by recognized user rights that can then focus on innovation, technical extension services and research, including access to group credit. Policy makers should therefore come up with legislation that reduces barriers milk value addition without compromising hygiene and related health issues that might arise thereto.

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