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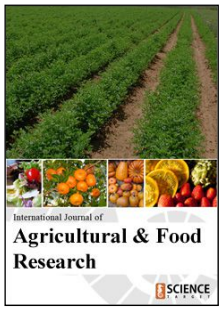

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Analysis of Determinants of Vertical and Horizontal Integration among Smallholder Dairy Farmers in Lower Central Kenya

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Abstract. This study sought to analyze the determinants of vertical and horizontal integration among smallholder dairy farmers in Lower Central Kenya. Integration leads to high gross margins, influences choice of marketing channel and improves market participation, encouraging commercialization of dairy smallholder farming. A logit regression model was used to determine the likelihood of a household to integrate vertically or horizontally in its dairy enterprise. A multistage sampling technique was used, and data was collected from 288 small holder dairy farmers in Kiambu County. Processing and analysis of the survey data was carried out using SPSS version 20 and STATA version 12. Fixed investment cost, storage type, milk cost share, percentage of milk sold and dairy enterprise turnover were hypothesized to be key factors in explaining a household's likelihood to vertically integrate in its dairy enterprise. An increase in total fixed investments, turnover and volume of output contribute to the probability of a household integrating vertically. Horizontally integrated farmers were willing to pay more for market information and had higher monthly margins. The paper recommends that farmers should establish and strengthen existing associations and integrate vertically and horizontally on the basis of their spatial location and milk output.

Keywords. *logit regression, integration, smallholder famers*

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Background

Dairy farming is a key economic activity in many developing countries. Income earned from this economic activity contributes to the alleviation of poverty. Further, it ensures regular cash flows to the farmers as opposed to intermittent incomes from crop cultivation and other forms of livestock keeping, such as bees and pigs (FAO, 2011). 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 creates 18 jobs in the informal sector and 13 fulltime jobs at the processing level (Staal et al., 2008). Dairy farming is a significant economic activity in Kenya, as it accounts for about four percent of the country's gross domestic product (GDP) and fourteen percent of the total value of agricultural output (KNBS, 2009). Nearly eighty percent of the dairy output in Kenya emanates from small holders, many of whom are in the highlands of Kenya (Smallholder Dairy Project, 2008). The dairy sector in Kenya recorded significant growth between 2005 and 2012, as evident from the increases of recorded milk production from 2.650 to 3.733 billion litres, dairy herd size growth from 3.5 million to 4.2 million and per capita per cow milk output increase from 757 to 898 litres over the same period (GoK, 2013; FAOSTAT, 2014). Due to such developments, Kenya is now self-sufficient in milk production (Wambugu et al. 2011). In 2005 for instance, the country produced approximately 3.5 billion litres of milk compared to a consumption of about 3 billion litres. In addition, new policies in

the dairy sector, such as rural infrastructure development, on-farm feed preservation and licencing of milk bars, are expected to lead to significant increases in dairy production.

Thirty five percent of total milk output is consumed on farms while the rest is marketed (FAO, 2014; Mutua-Kiio & Muriuki, 2013). Between 2005 and 2012, annual milk output exceeded the quantity marketed and was channelled to consumers and processors. This resulted in surpluses against a background of economic growth with a 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 1,929.45 million litres in 2012, while the quantity of imported skim milk powder increased from 452 tonnes to 2,753 tonnes. Table 1 presents a summary of milk utilization between year 2005 and 2012. This suggests that there is growth potential in the dairy sector through integration.

The recurring unprocessed surplus milk and concurrent increase in the volume of imported skim milk may be attributed to the inefficiency of processing plants, which hardly utilize fifty percent of the installed annual processing capacity of 985 million litres (KDB, 2013) and lack appropriate, or have weak, marketing channels. Nevertheless, milk processing appears to be 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 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). Despite the growth in milk marketing and productivity, the sector is faced by infra-structural bottlenecks caused by poor road networks, a lack of appropriate cooling and storage facilities and poor road infrastructure in the small-scale production areas. During the glut months of March to June, surplus milk cannot be absorbed in the domestic market.

Table 1

Kenya's Milk Production and Consumption 2005-2012

Year	Production	Consumption			Imported
		On farm	Processed	Surplus	Milk powder
	(Million Ltrs)	(Million Ltrs)	(Million Ltrs)	(Million Ltrs)	(TONS)
2005	2,650	927.5	339	1,383.5	452
2006	3,500	1,225	360	1,915	1,335
2007	4,230	1,480.5	423	2,326.5	1,460
2008	3,990	1,396.5	398	2,195.5	1,091
2009	4,276	1,496.6	406	2,373.4	3,157
2010	4,642	1,624.7	516	2,501.3	3,351
2011	4,059	1,420.65	547	2,091.35	2,989
2012	3,733	1,306.55	497	1,929.45	2,753

Source, FAO Statistics, 2014, Kenya Dairy Board, 2013, GoK, 2013

The more the regular flow of income from the sale of milk and other dairy products against a background of limited regulatory entry barriers, the more smallholder dairy farmers are attracted. With an average herd size of three dairy cows, 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 utilizes family labor with one or two hired workers, making their operations Micro and Small Enterprises [M.S.E's], which hardly enjoy economies of scale (GoK, 2012). Smallholder dairy farmers fulfill numerous functions in the agricultural economy. These functions include food security, equitable distribution of income and creation of employment opportunities especially to the rural poor, making the sector an important economic driver.

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). Despite Kenya's dairy sector having a significant contribution to the national economy, there are a number of technical, economic and institutional problems concerning milk production, processing and marketing (Karanja, 2003). Therefore, the ability of the sector to participate and effectively compete in the domestic and regional markets is highly affected (Wambugu et al., 2011).

Although a significant proportion of milk production emanates from smallholder dairy farmers (Muriuki et al., 2003). The smallholder farmers, through the produce marketing cooperatives, invested significantly in construction of chilling plants, delivery vans and milking cans. These investments, in addition to stringent enforcement of the ban against sale of raw milk in urban centres, encouraged and sustained participation by more actors in the production, processing, distribution and sale of milk leading to vertical integration along the milk value chains. The government's policy of stimulating the growth of the dairy sector through community owned cattle dips and produce marketing cooperatives, each with elaborate governance structures, formed the basis of horizontal integration among small holder dairy farmers.

In the pre-liberalization period, the challenges of the dairy industry in the country were addressed through the Kenya Co-operative Creameries (KCC), an organization that heavily depended on government support and patronage. 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. The majority of the smallholder dairy farmers produce for unidentified markets, and this exposes their produce to market and price shocks. Farmers integrating their production with other activities along the value chain produce milk for an identified market in addition to seeking new market opportunities that offer higher returns (KIT, Faida MaLi and IIRR, 2006). 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.

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 in vertical and horizontal integrations. Vertical integration occurs where two or more stages in the process of production and marketing are effectively controlled by single management (Rehber, 1998). Such integration is motivated by the type and nature of fixed investments and products. Vertically integrated farmers maximize returns 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. By pooling skilled manpower, horizontally integrated farmers who are chain actors are able to minimize transaction costs, access market information and adhere to government regulations more easily. Horizontally integrated dairy farmers are able to take collective action on securing new markets, bargaining for better prices for milk and milk products and use of the most effective marketing channel. Such actions are taken against a background of strong associations by farmers who are trained and have a strong entrepreneurial orientation. The socio-economic factors that determine vertical and horizontal integration among smallholder dairy farmers have not been exhaustively analyzed.

Market-oriented smallholder dairy farms tend to be concentrated close to urban centers because the effects of market forces override many production factors. Urbanization creates competition for alternative land uses, leading to land fragmentation that has a potentially negative impact on dairy farming especially in Lower Central Kenya. The resultant diminishing land sizes implies that peri-urban smallholder dairy farmers have to intensify milk production by adopting cost minimizing strategies and value addition through processing in order to remain competitive. 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 the processing and marketing of milk and milk products, thereby integrating activities vertically and horizontally. However, studies regarding dairy farming in Kenya have focused mainly on productivity, genetics, nutrition and value chain development (Wambugu et al 2011, Kavoi et al 2010; Kahi et al., 2004; Gamba, 2006; Mugambi et al., 2014; Murage and Ilatsia, 2011 and Wambugu, 2000). There are gaps in literature on the determinants of vertical and horizontal integration among smallholder dairy farmers.

Review of Literature

Transaction costs economics (TCE), industrial organization (IO) and strategic management (SM) dominate the theoretical analysis of vertical integration (Dreyer et al., 2001). Each of the theories captures partly different approaches to explaining vertical integration. Occurrence of vertical integration on the basis of transaction costs economics (TCE) can be explained by asset specificity with significant transactions, specific sunk costs and uncertainty (Whyte, 1994). TCE also predicts that by organizing transactions internally, the costs of transacting over the market outweighs internal costs of management, and this leads to elimination of inter-firm profit claims, making the firm profitable (Frank and Henderson, 1992). This strategic decision is then a transaction-cost-minimizing response to the limited information and the cost of contracting.

Different approaches have been used to evaluate factors that influence the small scale farmers' decision to integrate. In this study, horizontal integration is taken to mean farmers belonging to a group whose primary role could be to market, offer production training, input access or any other assistance related to dairy production. These farmer groups have been described as having a large contribution to rural dairy sector development in Kenya. Some offer milk transport services for members and also perform other services, such as provision of inputs on credit. Some groups require farmers to pay membership fees in addition to attending group meetings. For farmer associations that engage in milk marketing, they face competition from other marketing channels, such as small scale milk vendors, large traders, institutions and individual consumers, especially when the mode of payment is more favourable compared to the associations' mode of payment.

For vertical integration, dairy farmers are assumed to be vertically integrated if a household is engaged in any form of milk processing and value addition to raw milk. This model of vertical integration in dairy production confers a lot of benefits to farmers, enabling them to produce more profitably (Wambugu et al., 2011). Membership behaviour to a farmer association and/or a decision to vertically

integrate in one's own dairy enterprise is a discrete choice phenomenon, which, as a dependent variable, is of the type that elicits a yes or no response. According to Aldrich (1987), the most commonly used approaches in the estimate of such a model are the linear probability model, logit model and probit model.

Empirical Review

Integration involves a combination of hierarchical and sequential activities into composite operations under a single coordinating function. Three main kinds of market integration are very common—vertical, horizontal and circular integration (Rehber, 1998). High production is regarded as the core effect, leading to integration in commerce. Whenever people can get high productivity in their production, they start to learn the new norms for exchanging their products for maximum profits. To achieve this, people have to integrate their products with other stakeholders in trading fairness thinking (Maltsoglou & Tanyeri-Abur, 2005). Private sector improvement is very effective in linking farmers to the dynamic trading process, but farmers themselves must also prepare to act proactively in selling their output (Berdegué et al., 2008). However, we can simply say that market integration is bringing two or more market actors together into one system.

Stefano (2010), using a probit model, analyzed factors influencing farmer membership to a cooperative and market choices for their products in Germany. The study concluded that the probability of farmers becoming members of cooperatives greatly depended on the numbers of cooperatives relative to the number of private processors a farmer is close to. Settlement in an area where the local economy is predominantly agricultural also increased the likelihood of farmers joining cooperatives. This was probably the case due to cultural and socio-political reasons and due to local cooperative market or economic power.

Farms with more assets were found less likely to horizontally integrate through joining cooperative associations, but if they joined they were found more likely to participate in cooperative activities. These results confirm that both agricultural and social related networking have a significant positive impact on horizontal integration decisions. The conclusion in 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 poorer households. However, Stefano (2010) focused on membership to a cooperative as an avenue through which to access the market while the current study focused on the evaluation of the membership to any farmer association concerned with dairy production and benefits arising from resultant collective action.

Using a probit model, Batuhan (2009) analyzed factors affecting participation in forest cooperative's 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 built on the findings of this study. Using a stepwise multiple regression, Bagher (2011) analyzed the factors that affected the 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 a direct impact on their decision to join agricultural associations. This study focused on the level of participation in agricultural associations while the current study focused on factors affecting becoming members in agricultural association (horizontal integration).

Thomas and Fanaye (2012) used both a Tobit model, to analyze the determinants of extent of women's membership in agricultural associations, and a logit model, to study the determinants of women's 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 analyze the factors influencing active participation in cooperative entities, Saharkhiz (2009) used a probit model. The results showed that the government support, training and 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 a farmer association.

Othman et al. (2009) analyzed 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 people in the older age group were more likely to become cooperative members.

Determinants of Vertical Integration

While analyzing the oil sector, Lieberman, (1991) found that oil companies with higher investment costs 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. To avoid this lock-in problem, such firms integrate vertically. According to Moss and Schmitz, (2000) vertical integration emanates if a small number of suppliers of an input required by a firm further in the production process exists. As alluded to earlier, 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, as hypothesized, households that sourced milk from other households had a higher likelihood of integrating vertically.

Empirical Model / Modelling Binary Choices

In the analysis of binary response, logit and probit parametric models dominate. Between the two models, there is no theoretical justification for favoring one over the other, and choice is based on convenience. However, the two models employ different scales of normalization where the error terms in probit model is assumed to be standard normal Greene (2002).

$$f(\varepsilon_i) = \frac{\exp(-\varepsilon_i^2/2)}{\sqrt{2\pi}}$$

In logit model they are assumed to be standard logistic.

$$f(\varepsilon_i) = \frac{\exp(\varepsilon_i)}{[1+\exp(\varepsilon_i)]^2}$$

Binary logistic model was used to assess determinants of a household's horizontal and vertical integration in its dairy enterprise. Households that did any form of milk value addition were assigned the value of Yi =1 and were assigned 0 if not. The model was specified as follows:

$$Y_i = \beta_0 + \beta_1 \text{External Source} + \beta_2 \text{SUNK} + \beta_3 \text{Storage} + \beta_4 \text{MCS} + \beta_5 \text{\% Milk Sale} + \beta_6 \text{Turnover} + ei$$

Where β0, β1, β2, β3, β4, β5, β6 are parameters to be estimated; external source, SUNK, storage, MCS, % Milk sale and turnover are explanatory variables while ei denotes the error term.

Households belonging to any dairy related farmers association were also assigned a value of 1 while those who did not were assigned a value of 0. This was used in specification of horizontal integration model:

$$Y_i = \beta_0 + \beta_1 EDU + \beta_2 Age + \beta_3 FS + \beta_4 Output + \beta_5 EXP + \beta_6 MT + \beta_7 Herd + \beta_8 Train + \beta_9 WTP + \beta_{10} Gross + \beta_{11} DistMkt + \varepsilon_i$$

Where: β0, β1, β2, β3, β4, β5, β6, β7, β8, β9, β10 and β11 are the parameters to be estimated while education, age, farm size, milk output, experience, monthly turnover, number of dairy cows, training, willingness to pay for information, gross margin and distance to market are the explanatory variables.

Diagnostic Tests for Logit Models

Before fitting the logit model for vertical integration, two major econometric issues related to binary models were looked into. The link test indicated that the model was well specified where the results showed that the P>|t| for hatsq was 0.702, indicating that the model was well specified. The results of goodness of fit Pearson test indicated a Pearson Prob > chi2 of 0.702, meaning the model fit the data. Likewise for the horizontal integration model, the results showed

that the P>|t| for hatsq was 0.507, indicating that the model was well specified. In addition, a test for measure of goodness of fit was carried out using the Pearson χ^2 test where the results indicated a Pearson Prob > chi2 of 0.902, meaning that the model also fit the data.

Results and Discussion

The empirical results showed a positive relationship between total fixed investment incurred by a household in dairy farmers and the likelihood of that household integrating its dairy enterprise vertically. A 10 percent increase in the total cost in the dairy sector invested by a household in the dairy enterprise increases the probability of that household integrating vertically by 2.5 percent. These results provide strong support for the hypothesis that firms integrate vertically to avoid the problem of lock-in due to large sunk investments. The implication of these results is that the probability of integration was positively related to the total dairy enterprise cost. Table 2 provides the detailed results.

Table 2

Logistic regression result for determinants of vertical integration

Variables	dy/dx	Std. Err.	P value
SUNK	0.252	0.132	0.057**
Storage	-0.196	0.608	0.747
MCS	0.12	0.28	0.67
%Milk Sale	1.77	0.436	0.000***
Turnover	0.855	0.211	0.000***
External Source	1.857	0.766	0.015***

Source: Author, 2014, Asterisks denote the significance level * = 10%, **5% while *** 1%.

The empirical result for the dairy enterprise turnover was positive as predicted and highly significant at 1 percent. This implies that firms integrated vertically when they encountered variability in milk prices. A unit increase in monthly dairy enterprise turnover increases the probability of a household vertically integrating by 0.85 percent. As the income from milk sales increases, there is a high likelihood such a household will explore new opportunities by vertically integrating instead of selling just raw milk. This might be a means of fetching more returns from the dairy sector or as a precautionary strategy to evade the problem of lock-in.

As hypothesized, there was a positive relationship between volume of milk sold by a household and the probability of integrating vertically. A unit increase in the volume of milk sold by a household increases the likelihood of that household to add value to its milk, vertical integration, by 1.7 percent. Vertical integration is more likely among households with more milk sales. There was a positive relationship between a household decision to source milk from external sources and its likelihood to vertically integrate in its dairy enterprise. The results show that households that outsourced milk from neighbours had a 1.8 percent likelihood of integrating vertically compared to households that did not outsource milk. There was no significant relationship between investment in modern storage materials and milk share cost of the total investment in dairy enterprise by a household and the likelihood of vertically integrating.

Determinants of Horizontal Integration

Among the eleven hypothesized factors likely to influence a household probability to horizontally integrate in the dairy enterprise, six were found to be significant. Table 3 presents the results of the logit model. Table 3 shows the results in detail.

As hypothesized, a significant positive relationship between education level of the household head and the likelihood of a household to integrate horizontally was reported. The results showed that more educated households were more likely to belong to farmer associations. An extra year spent in formal education by the household head increased the likelihood of a household belonging to a farmers' association by 10 percent. The results also indicated that households with large farm sizes were more likely to be members of farmer associations. As the land holding by a household increased by one

acre, the likelihood of such a household to integrate horizontally increased by approximately 1 unit.

Table 3

Logit results for household likelihood to integrate horizontally in its dairy enterprise in Lower Central Kenya

Number of observations: 288	Prob > Chi2 = 0.000
Log likelihood = -127.224	Psudo R2 = 0.436

Dependent Variable: Membership to a farmer association

Variables	dy/dx	Std. Err.	P value
Education	0.103	0.733	0.088*
Age	0.89	1.384	0.519
Farm size	1.03	1.202	0.089*
Milk Output	1.366	0.036	0.502
Experience	1.188	1.114	0.046**
Monthly Turnover	-1.759	0.728	0.016**
Number of Dairy cows	0-.124	0.414	0.764
Training	1.18	1.59	0.039**
WTP for information	2.991	1.293	0.020**
Gross Margin	-1.296	1.179	0.271
Distance	-2.53	1.88	0.178

Source; Author, 2014

There was a positive relationship between household experience in dairy farming and the likelihood of such a household to be horizontally integrated. This was per expectations. An increase in dairy farming by one year increased the likelihood of integrating horizontally by 1.2 units. On the other hand, there was a negative relationship between household turnover in the dairy enterprise and the likelihood of integrating horizontally. An increase in turnover of a household in dairy enterprise by Kshs 1,000 increases the likelihood of such a household integrating horizontally reduced by about 1.8 units.

The results further indicated a positive relationship between training and willingness to pay for market information and the likelihood of a household to integrate horizontally in its dairy enterprise. Training to farmers increased the likelihood to integrate horizontally by around 1.2 units. Further, a unit increase in the amount of money that the household was willing to pay to access market information increased likelihood of such a household to horizontally integrate by approximately 3 units.

Determinants of Vertical Integration

The empirical results showed a positive relationship between total fixed investment incurred by a household in dairy farmers and the likelihood of that household integrating its dairy enterprise vertically. A 10 percent increase in the total cost in dairy sector invested by a household in the dairy enterprise increases the probability of that household integrating vertically by 2.5 percent.

Effect of Enterprise Turnover on Vertical Integration

The empirical result for the dairy enterprise turnover was positive as predicted and highly significant at 1 percent. This implies that firms integrated vertically when they encounter variability in milk prices. A unit increase in monthly dairy enterprise turnover increases the probability of a household vertically integrating by 0.85 percent. As the income from milk sales rise, there is a high likelihood such a household will explore new opportunities by vertically integrating instead of selling just raw milk. This might be a means of fetching more returns from the dairy sector or as a precautionary strategy to evade problem of lock-in.

Mburu et al. (2007) noted that vertically integrated farmers were likely to be more profitable through processing, marketing of milk and value added products. However, Vijay et al. (2009) noted that with vertical integration, farmers are likely to attain bargaining power, economies of scale and reduced transaction costs. This is accelerated by the ability to produce quality produce with value addition facilitating access to financial resources, enabling farmers to venture into new innovations.

Effect of Volume of Milk Produced on Vertical Integration

As hypothesized, there was a positive relationship between volume of milk sold by a household and the probability of integrating vertically. A unit increase in the volume of milk sold by a household increases the likelihood of that household to add value to its milk through vertical integration by 1.7 percent. Vertical integration is more likely among households with more milk sales. Large volumes of milk produced will lower transaction costs to the farmer even when they invest in any processing equipment individually or collectively. Likewise, Vijay et al, (2009) noted that increase in milk volumes that cause farmers' shift from cooperative to other channels of marketing where they are likely to receive better prices per milk unit.

Milk Outsourcing and Vertical Integration

According to Moss and Schmitz, (2000) vertical integration emanate if a small number of suppliers of an input required by a firm exists further in the production process. As alluded to earlier, 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 secure higher prices for their supplies, halting the operations of the buying firm. Therefore, as hypothesized, households that sourced milk from other households had a higher likelihood of integrating vertically. Dairy farmers who produce fewer litres of milk could simply sell to other farmers who produce more milk in their farms at the farm gate to avoid transport costs. Huge volumes of milk can justify the transport costs incurred by the farmer (Vijay et al, 2009). Tsougiannis et al, (2008) in a study in Greece, noted that processing plants were more concerned by the volume of milk produced by the farmer per day.

Determinants of Horizontal integration

As hypothesized, there was a positive relationship between education and likelihood for horizontal integration. At higher levels of education, farmers might have more awareness of the benefits and costs associated with the membership choice. A study by Awotide (2012) revealed that experience and educational level attained were statistically significant factors in relation to women's participation in cooperative societies in Nigeria. These results are also consistent with Ernita et al., 2014 who found a positive correlation between participation in cooperatives and level of education in Sumatera in Indonesia.

There was a significant positive relationship between farm size and horizontal integration. Households with larger farm sizes were more likely to belong to farmer associations than those with small farms. These results were consistent with Jensen et al. (2011) where using a probit model found that farm size positively influenced participation in switch grass farmer associations. The implication here is that it's likely that households with large farms will have more cows. Therefore, they are more likely to be doing dairy farming as a business. Such a household will seek information on dairy farming from farmer associations. Likewise, farmer groups' coordination in dairy production confers a lot of benefits to farmers, enabling farmers to produce profitably.

The study found a positive relationship in years of farming experience and likelihood of horizontally integrating in dairy enterprise. The longer the period of dairy production, the more experienced farmers are assumed to be. More experienced farmers have more ideas on costs and returns associated with being a member of a farmer association. Hence, farming experience is likely to influence positively the membership decision. These results were consistent with Mugabekazi (2012) who found that the longer the period of growing coffee, the more likely it is for farmers to become member of a cooperative.

Farmers who have access to training were more likely to integrate horizontally in their dairy enterprise. Based on the innovation-diffusion literature, it is hypothesized that training and participation in workshops exposes farmers to new information (Adesina and Baidu-Forson, 1995). This withstanding, it could be argued that what is important is not the contact with training but how farmers assess the relevance of the issues discussed at such farmer workshops for

their actual production decisions (Zinnah et al., 1993.

There was a positive relationship between willingness to pay for information and likelihood to integrate horizontally. According to Manyong et al. (2008) and Artukoglu et al., (2008) farmers in groups were more willing to pay for market information than non-members. Potential benefits arising from institutional innovations emanating from group membership help in mitigating against the costs of accessing markets (Manyong et al., (2008). Results from the research were consistent with Latvala and Jukka (2004) who found that 59% of consumers in Finland were willing to pay more to get information about the safety and quality of beef products. It is expected that farmers within farmer associations access different information, and, depending on their assessment of the relevance of the information acquired on their actual production decisions, could be willing to pay more to access information that adds value to their dairy farming.

There was a positive relationship between a household's likelihood to integrate horizontally and dairy enterprise turnover. Households with higher turnover are therefore more likely to belong to farmer associations than farmers with low monthly turnover. This was expected since households with more milk output had a higher probability of horizontal integration. In order to reduce the cost of production, farmers join cooperatives where they can access production related services like animal feeds, breeding services and other farming inputs sometimes at a lower price and on credit. Wambugu et al., (2011) found that more farmers in Githunguri belonged to the Githunguri farmers' cooperative since the association offered some services to members at reasonable prices and sometimes on credit. The members also obtained additional benefits from the cooperative society such as the ability to obtain foodstuffs like maize flour on credit from the society's stores.

Conclusion and Recommendations

The foregoing results affirm the need for integration and policy interventions to streamline milk marketing channels. Farmer training and easy access to information are key to improved dairy production and marketing. Monthly turnover, production costs, fixed investment, storage, percentage of milk sold, milk cost share and external sources of milk were hypothesized to be the determinants of vertical integration. Fixed investment, turnover, volume of milk sold and external source of milk had a significant relationship to the probability of a dairy enterprise integrating. Only six of the eleven hypothesized determinants of horizontal integration were significant.

There is a 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. Therefore, the effort of policy makers is on designing better modes involving the farmer to enhance the appropriateness of integration and adoption rates. Different farmer participatory methodologies need to be exploited. Through support by ILRI, there are initiatives of educating farmers in rural Kenya on potential benefits on integrating vertically and horizontally. A number of dairy farmers field schools which are essentially model dairy farms have been established to execute this initiative.

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