ANALYSIS OF VERTICAL AND HORIZONTAL INTEGRATION AS DETERMINANTS OF MARKET CHANNEL CHOICE AMONG SMALLHOLDER DAIRY FARMERS IN LOWER CENTRAL KENYA

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DECLARATION

I, James Kuria Mutura declare that this thesis is my original work and has not been presented for the award of a degree in any other university or for any other award.

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DEDICATION

To my wife and friend Bernadetta Wanjiru Kuria who has been very supportive always, my children Edwin Mutura Kuria and Anthony Githua Kuria for being patient and understanding.

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ABSTRACT

Dairy farming is a significant economic activity in Kenya as it accounts for four percent of the country's Gross Domestic Product (GDP) and fourteen percent of total value of agricultural output. 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 intensify milk production by adopting cost minimizing strategies, value addition and marketing through integration. 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. Data management was carried out using SPSS version 20 while econometric analysis were carried out using STATA version 12. Descriptive statistics were used to characterize households while multinomial logit regression (MNL) was used to estimate the probability of households using different marketing channels. Logit regression model was used to determine the likelihood of a household to integrate vertically or horizontally in its dairy enterprise. Mean difference was used to distinguish integrated and non-integrated smallholder dairy farmers. Fixed investment cost, storage type, milk cost share, percentage of milk sold and dairy enterprise turnover explain a household likelihood to vertically integrate in its dairy sector. An increase in total fixed investments, turnover and volume of output increases the probability of household integrating horizontally. The gender of the household head, age, distance from markets, land parcel sizes, milk output and level of education have a significant relationship with horizontal integration. Level of education, training, milk output, and access to information and transaction costs significantly influences the choice of marketing channel. It is recommended that programmes relating to information on milk marketing be made accessible to farmers. There is need to profile farmers on the basis of production and education level and encourage them to use specific marketing channel. Policy makers should identify strategies for disseminating information. 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.

OPERATIONAL DEFINITION OF TERMS

Vertical integration: is a strategy used by firms/farms to gain control over the supply or distributors in order to increase its power in the marketplace, reduce costs and earn higher income. In this study it referred to practices of value addition and involvement in other activities along the milk value chain with a view of increasing farmers' market power and profits.

Horizontal integration in agriculture: is a process of establishing economic ties between farms producing agricultural products in the same category. This includes joint sales, marketing, joint input procuring and promotion. This is an effective manner of mitigating the market-related consequences of small-scale production and the high heterogeneity.

Sunk Costs: fixed investments that are difficult to recover in total amounts once the business is liquidated. This includes special milk cooling equipment and cow sheds.

Smallholder dairy farmer: farmers carrying out agricultural production on farms averaging 0.2–3 ha and have a herd size of not more than 20 cows.

Milk marketing channel: The means through which the farmer sells milk to final consumer.

LIST OF ABBREVIATIONS AND ACRONYMS

AIC	Akaike information criterion
BIC	Bayesian information criterion
BMC	Botswana Meat Commission
CAIS	Central Artificial Insemination Service
DDA	Dairy Development Authority
FAO	Food and Agriculture Organization
GDP	Kenya's Gross Domestic Product
GoK	Government of the Republic of Kenya
IIA	Independence from irrelevant alternatives
IIRR	International Institute of Rural Reconstruction
IO	Industrial Organisation
JKUAT	Jomo Kenyatta University of Agriculture and Technology.
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
KIPPRA	Kenya Institute for Public Policy and Research
KNBS	Kenya National Bureau of Statistics
KPLC	Kenya Power and Lighting Company Ltd
MCS	Milk Cost Share
MNL	Multinomial logit

MNP	Multinomial probit
MSE	Micro and Small Enterprises
NIE	New Institutional Economics
RBV	Resource Based Vertical Integration.
SDSHG	Smallholder Dairy Self-Help Groups
SPSS	Statistical package for social sciences
TCE	Transaction Cost Economics
UNIDO	United Nations Industrial Development Organization
USA	United State of America
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VIF	Variance Inflation Factor

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CHAPTER ONE: INTRODUCTION

1.1 Background

This first chapter presents the background to the study problem, the objectives of the study and the hypotheses. Also presented is the brief introduction to the importance of dairy farming in Kenya. Milk production trends are also presented as well as assumptions of the study.

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 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 total value of agricultural output (KNBS, 2009).

About 80% of the dairy output in Kenya emanates from small holders, many of whom are in the highlands (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). Out of 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, against a consumption of about 3 billion litres. In addition, new policies in the dairy sector are expected to lead to significant increases in dairy production.

According to FAO, (2014) and Mutua-Kiio and Muriuki, (2013), about thirty five percent of total milk produced is consumed on farm by the calves and the famer's family while the balance is available for sale. In the period 2005-2012, annual milk output exceeded quantity marketed through formal channels to consumers and processors. This resulted in surpluses against a background of economic growth with resultant increase in demand for milk and milk products (Mulu-Mutuku et al. 2009; GoK, 2010; KNBS, 2013). The excess milk output increased from 1383.5 million litres in 2005 to 1929.45 million litres in 2012, while simultaneously the quantity of imported skimmed milk powder increased from 452 tonnes to 2753 tonnes. Table 1.1 presents a summary of milk utilization between year 2005 and 2012.

Table 1.1: 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, GOK 2013.

The recurring unprocessed surplus milk and concurrent increase in the volume of imported skimmed milk may be attributed to inefficiency of processing plants, which hardly utilize fifty percent of the installed annual processing capacity of 985 million litres (KDB, 2013) and lack of appropriate or weak marketing channels. Nevertheless, milk processing appears to provide a

good investment for micro-entrepreneurs because there are market opportunities for value-added milk products (Mulu-Mutuku et al. 2009). This suggests that potential for business integration in the areas of milk processing and marketing exists.

The 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 infrastructure bottlenecks caused by poor road networks and lack of appropriate cooling and storage facilities, and poor road infrastructure in the small-scale production areas. During the glut periods of March to June, there is surplus milk that cannot be absorbed in the domestic market.

The more regular flow of income from 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 cattle, it is estimated that there are about 1.4 million smallholder dairy farmers in Kenya (Gok, 2013). Smallholder dairy farming as an informal family business mainly utilize family labour with one or two hired workers, thus making their operations Micro and Small Enterprises [M.S.E's] which hardly enjoy the economies of scale (Gok, 2012). Smallholder dairy farmers fulfill numerous functions in the agricultural economy. These functions include food security (Rosset, 1999), equitable distribution of income and creation of employment opportunities especially to the rural poor (Dorosh and Haggblade, 2003), thus making the sector an important economic driver.

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 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, they hardly individually graduate to processors (Muriuki et al. 2003). The 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 (Omiti et al. 2009).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 (Thorpe et al. 2000).

Until the 1950s, indigenous Kenyans were not permitted to engage in commercial agricultural activities, although in rural and pastoral areas smallholders kept cattle and consumed the milk they produced or sold the surplus to their neighbours. At independence many of the settlers left, with their cattle abandoned or redistributed to indigenous Kenyans (Muriuki et al., 2003) and land they previously controlled was subdivided and redistributed in line with the land reform movement. This process started the shift from a dairy industry dominated by large-scale producers to one dominated by smallholders. In 1964,the Government adopted the recommendations of a Commission of Inquiry on dairy development (The Kibaki Commission),

which included abolition of contracted milk quotas and opening up of KCC to all farmers so long as milk was of acceptable quality (GoK, 1965).

Through sessional paper No.4 of 1987, the government spelt out the need to encourage and assist dairy cooperatives to establish rural small-scale dairy processing plants (GoK, 1987). This was in addition to numerous laws that support the dairy industry such as ; The Dairy Industry Act (cap 336), The Standards Act (CAP 496), The Public Health Act (CAP 242), Food, Drugs and Chemical Substances Act (CAP 254), Animal Diseases Act (CAP 364), Veterinary Surgeons Act (CAP 366), Pharmacy and Poisons Act (CAP 244), The Fertilizer and Animal Food Stuff Act (CAP 345), The Agriculture Act (CAP 318), Cooperative Societies Act (CAP 490) Value Added Act (CAP 476), Factories Act (CAP 514), The Weight and Measures Act (CAP 513) and The Trade and Licensing Act (CAP 497) among others.

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. Majority of the smallholder dairy farmers produce for unidentified market 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 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 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 who are chain actors are able to minimize on 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 analysed. Similarly the importance of vertical and horizontal integrations

in determining the choice of marketing channels among the small holder dairy farmers in Kenya has not been investigated.

1.2 Statement of the Problem

In Kenya, market-oriented smallholder dairy farms tend to be concentrated close to urban centres because the effects of market forces over-ride many production factors. 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 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 collection, processing and marketing of milk and milk products thereby integrating activities vertically and horizontally. Additionally, they should choose the most efficient marketing channel since there exists great variation in the marketing efficiency of different milk markets (Sharma et al. 2007; Kanmony and Gnanadhas, 2004).

Most studies regarding the 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). However, there are gaps in literature on the analysis of determinants of vertical and horizontal integration among smallholder dairy farmers and how these integrations influence the choice of milk marketing channels. This study sought to analyse vertical and horizontal integration as determinants of choice of marketing channel among smallholder dairy farmers in Lower Central

Kenya. Research findings from the study will assist the small holder dairy farmers in addressing production and marketing challenges, the dairy industry and the Government in identifying and strengthening strategies for disseminating information on cost reduction, and revenue growth through strengthened farmers associations.

1.3 Research Objectives

The overall objective of this study was to analyse vertical and horizontal integration as determinants of market channel choice among small holder dairy farmers in Lower Central Kenya.

The specific objectives were:

i) To characterize small holder dairy farmers in Lower Central Kenya.

ii) To evaluate determinants of vertical and horizontal integration among smallholder dairy farmers in Lower Central Kenya

iii) To assess factors influencing choice of dairy marketing channel among smallholder dairy farmers in Lower Central Kenya.

iv) To assess the differences between integrated and non-integrated small scale dairy farmers in Lower Central Kenya.

1.4 Hypothesis

The first objective was qualitative and nature and no hypothesis was tested against this objective.

i) Fixed investment costs are not significant determinants of vertical integration among of smallholder dairy farmers in lower central Kenya

ii) Socio-economic characteristics of the farmers are not significant determinants of horizontal integration among smallholder farmers in lower central Kenya.

iii) Vertical and horizontal integration are not significant determinants of market choice channel among dairy farmers in lower central Kenya.

iv) There are no significant differences in household socio-economic factors between vertically and horizontally integrated households and those that are not.

1.5 Significance of the Study

The findings from this study will;

(i) Equip dairy farmers with skills of identifying strategies for integration and information necessary to position them better in the value chain.

(ii) Provide information to policy makers for policy formulation in regard to providing incentives and addressing the regulatory and other barriers to the upscaling of value addition by dairy farmers.

(iii) Be of interest to researchers as they will bring new insights on the importance of integration in addressing challenges faced by small holder farmers.

(iv) Contribute to the development of sustainable integration model for the dairy sector that would be of interest to financial institutions, investors and other dairy value chain actors.

1.6 Assumptions of the Study

The study was guided by the following assumptions;

i. There is no gender discrimination on the ownership of dairy enterprises.
ii. Dairy farmers are sufficiently knowledgeable on the benefits of existing marketing channels.
iii. Dairy farmers are capable of graduating to processors and marketers.
iv. There will be no epidemic affecting dairy cattle in the study area.
v. Dairy farmers in the study area participate in the milk dairy processing and marketing.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

The dairy sector involves milk production on farms and its industrial processing into consumer and intermediate products. The sector shares many characteristics with other agro-industrial branches (Mulu-Mutuku et al. 2006). Farm production of milk is spatially dispersed while processing takes place in centrally located factories. The delivery of farm milk to the processing factory is on daily basis. Milk is bulky and highly perishable and this imposes special requirements with regard to treatment before and during transportation to the processing factory and to consumers. Assembly costs, which are a function of logistic organization, milk handling and means of transport, tend to be high in dairy farming compared to other sectors.

2.1.0 Review of Dairy Farming

Dairy production ventures to achieve improved standards of living for both rural and urban citizens. It is a developmental pathway as it widens and sustains three major pathways out of poverty including securing the assets of the poor, improving smallholder and pastoral productivity, and increase market participation by the poor. In addition, the dairy sector is a key contributor to the agricultural gross domestic product in main developing countries.

2.1.1 Global Perspectives of Dairy Farming.

It is estimated that there are about 264 million dairy cows' worldwide, producing nearly 635 billion litres of milk per annum (FAO, 2012). The global annual per capita per dairy cow milk production is 2, 200 litres while Kenya's annual per capita per cow milk production is 898 litres. USA with an annual production of 87 billion litres is the leading world producer of milk while India has the highest population of dairy cattle with an estimated herd size of 43.6 million cows. When dairy cattle and cross breeds are taken into account, Kenya milk producing herd accounts

for 3.5 percent of the world total and ranks sixth globally(Compassion in World Farming, 2012).

2.1.2 Dairy Farming in East Africa

Dairy farming makes a major contribution to the people of East Africa. Milk is widely consumed in the region and makes a major contribution to food security, income generation and rural development. Due to a large population of about 89.3 million, there is a large local market for dairy products in East Africa. The region is endowed with abundant natural resources such as arable land and agro-climatic conditions favourable for dairying. This significantly lowers milk production costs giving the region a comparative advantage over other dairying regions in the Sub-Saharan Africa. For instance, Uganda has been argued of having the lowest milk production costs in the world (Wambugu et al. 2011).

Smallholder farmers dominate the dairy sector in the region and Kenya is the leading regional producer, processor and exporter of dairy products. The sector has experienced remarkable growth during the period 2005 to 2012. Between 2005 and 2012, recorded milk output increased from 2, 650 million litres to 3, 733 million litres in Kenya, 735million litres to 1,207million litres in Uganda and from 840million litres to 1,853millionlitres in Tanzania (AHDB, 2015). In terms of global ranking, Kenya moved from position 38 to 34, Uganda from position 74 to 63 and Tanzanian from position 66 to 51 out of 193 milk producing counties over the same period (AHDB, 2015). This growth in output is relatively higher than most countries in Sub-Saharan Africa The dairy sector in East Africa is facilitated and regulated by the national dairy institutions namely, Tanzania Dairy Board (TDB) the Dairy Development Authority (DDA) of Uganda and the Kenya Dairy Board (KDB) in Kenya.

2.1.3 Dairy Farming in Kenya

Kenya has been argued to having one of the largest dairy industries in sub-Saharan Africa. Regionally, it has the largest dairy sector among the Eastern Africa countries. The leading role of Kenya's dairy sector in the region is partly due to the favourable climatic conditions and the numerous legislations that facilitate the sector.

Milk production in Kenya is predominantly by small scale farmers who produce about 80 percent of the milk in the country. Their production systems are mostly influenced by the agro climatic characteristics of the area, land productivity potential and prevalence of animal diseases. Annual milk production from all the dairy animals combined is reported to be between 4 and 5 billion litres translating to daily milk production of 10 million litres from all species of which 60 percent emanates from the dairy cattle herd alone. About eighty percent of the milk output from dairy cattle is produced by the smallholder dairy producers, who are also the main suppliers of the marketed portion (FAO, 2013). There are 40 licensed processing plants, 123 mini dairies and 2833 milk bars all with a daily capacity of 3.4 million litres. (KDB, 2013)

2.1.3.1 Milk Supply Chains in Kenya

The milk supply system in Kenya is complex and in particular the size and organization of both the formal and informal supply chain. The informal milk supply chain controls an estimated 70 percent of the total milk marketed in Kenya (KDB, 2009; Gok 2006). Of the marketed production, some is supplied directly, unprocessed to the neighbourhood (about 40%), and a similar amount is supplied directly to consumers through cooperatives, shops and kiosks, totaling to about 80% of the milk supply that goes through a complex system of unprocessed milk pathway. The more formal processing pathway handles about 20% of the annual output (FAO, 2013).

In both the unprocessed and processed milk pathways, milk can at times pass through many intermediaries before reaching the consumer. The supply chain of both formal and informal market is fragmented with a large number of players at each step, and a low level of vertical integration. A major characteristic of the milk supply chain in Kenya has been (and still is in many areas) the low level of cold chain utilization, which lowers the quality of milk, affects the keeping quality of processed dairy products and limits the choices of dairy processing.

Most of the milk is marketed through Co-operatives, self-help groups or farmer based companies. Milk transport to the co-operative owned milk collection centres is arranged by farmers and involves milk bulking in collection points by the road side before the same is collected by a vehicle to the collection centre. **Figure 1.2** summarizes the movement of milk in terms of marketing and consumption from the point of production to the ultimate customer.

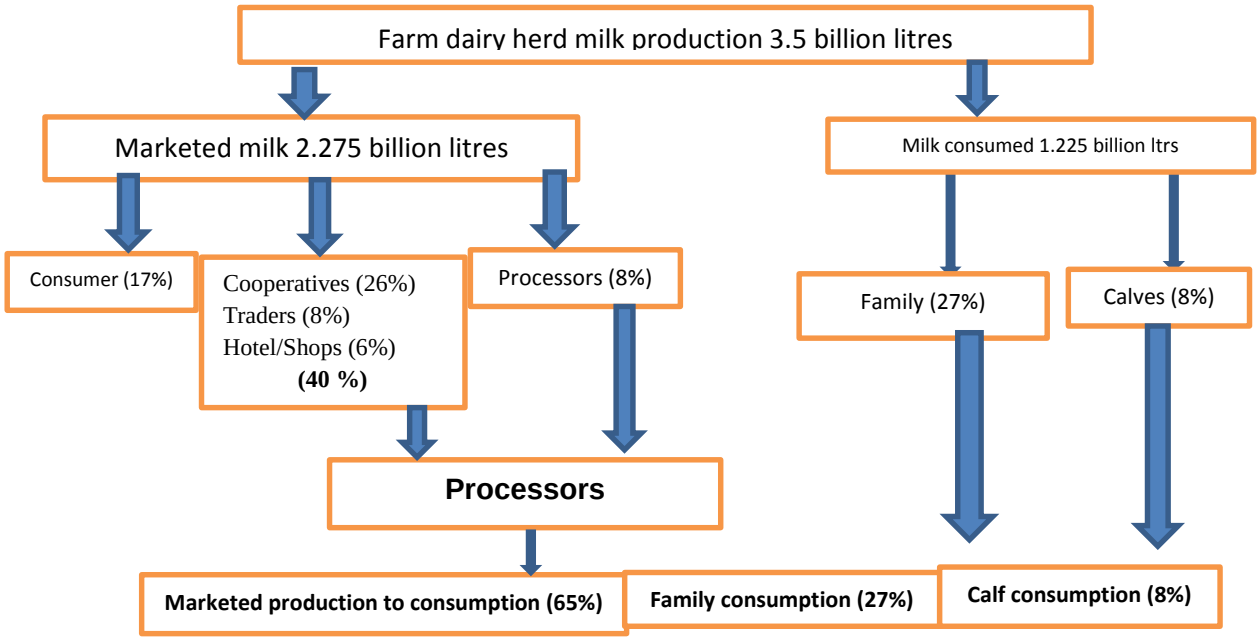

Figure 1.2: Farm to consumption milk supply

Adapted from Dairy Master Plan, 2010-2030, Ministry of Livestock Development, 2007

Of the total milk produced, 27 percent is for household consumption while 8 percent is fed to the calves. The remaining volume is sold using different channels as indicated in the **Figure 1.2.**

2.1.3.2 Challenges Facing Dairy Farming in Kenya

Kenya experiences low per capita milk output of 1,000 litres per cow per annum characterised with high cost of production as compared to world best practice of 8,000litres (Karanja, 2003, Mugambi et al 2014). Unavailability of fodder during dry periods, low quality fodder, access to quality veterinary services, inadequate extension services and high cost of credit are some of the key contributors to the high production costs. The country experiences challenges in milk processing mainly due to high cost of packaging materials and the low utilization of installed processing capacity.

This significantly affects the competiveness of formal milk trade thereby fuelling the growth of informal milk trade, which though illegal, is generally tolerated by the regulators. Poor roads, low access to cooling facilities in milk surplus areas and lack of appropriate milk transport equipment have hampered the transportation of milk from milk surplus zones to the market. A significant number of small holder farmers with low milk output are not organised into efficient marketing systems and this leads to large unmarketable milk quantities.

2.1.4 Dairy Farming in Central Kenya

Central Kenya region has an average herd of 852,900 dairy cows making it the second dairy farming region in the country after the Rift Valley Region which has a dairy herd of 1,895,100 animals. The production per animal among smallholders is estimated to be 1,400 litres per annum which translates to 4 litres per animal per day. However, some studies indicate that close to 18% of the farmers in the region produce even less than 2 litres of milk per cow (Mbugua et

al. 2012). Although this compares well with India, at 1,000 kg / year per animal, it is fairly low since the average figures for the large scale farms in Kenya are over 8 litres per cow per day (Mugambi et al, 2014). However, central region has the highest level of milk productivity with estimated annual milk output per cow estimated at 2,035 litres against a national average of 1,344 litres annually per cow (Wambugu et al. 2011).

There are three types of dairy production systems that are practiced in the region, zero-grazing (intensive), semi-grazing (semi-intensive) and open range (extensive). Particular interest is the extent of peri-urban dairy farming in the region based on very intensive zero grazing systems with high production comparable to the large-scale farms. This makes the area a milk surplus region compared to other regions in the country. It is estimated that there are over 600,000 smallholder dairy farmers in the region keeping 1– 3 cows on an average of 1-4 acres of land thus making dairy sector a source of livelihood for over 1.2 million households. Current estimates indicate that the value of dairy produce in the region is close to Khs30 billion and this can easily be doubled if stability in the industry is maintained (Gok,2010).

2.1.4.1 Challenges Facing Smallholder Dairy in Central Kenya.

Despite the significant contribution of the dairy farming to the economy of the central Kenya region, the sector faces a number of technical, economic, and institutional problems. Famers receive low earnings from milk sales thus making the sector uncompetitive. Smallholder farmers are unable to attract premium prices for their milk due to low unmarketable milk volumes and lack of forward linkages with the processors and milk vendors. The situation is worsened by the low milk productivity at farm level. Although the average milk productivity per cow in central Kenya is above the national average of 1,344 litres per cow per annum, it is still low compared to the world best productivity of about 8,000 litres per cow per annum (Karanja, 2003; GoK, 2007). This is can be attributed to many challenges such as poor breeds,

low use of breeding improvement techniques like Artificial Insemination (AI), poor husbandry practices, disease epidemics and lack of business orientation among dairy farmers.

There are many actors in the dairy sector in central Kenya but dominated by dairy cooperatives. Co-operatives dominate the cooling and bulking segments of the milk value chain but are faced with governance and leadership challenges and this has negative impact on farmer incentives to produce milk. Due to limited processing activities the region has a low market share of processed milk products

2.1.4.2. Dairy Marketing Channels in Central Kenya

Milk marketing channels in the region have been identified as direct sales to consumers and milk bars, informal milk vendors, sales to cooperative societies, sales to smallholder dairy self-help groups (SDSHG), farmer federations and sales to the processing factories in the region. About 20- 40percent of marketed milk is processed while 60-80 percent is marketed through informal market channels and directly to consumers. Studies give varying data on the amount of milk marketed in the region and the existing marketing channels.

The informal milk marketing channel grew rapidly after the liberalization of Kenya's milk sector in 1992, which led to the near collapse of the state patronised Kenya Co-operative Creameries (KCC). Consequently, large numbers of small-scale milk vendors grew quickly to fill the gap but lots of concerns regarding the quality of their milk has been raised. This informal market is the greatest obstacle to the rapid growth of dairy processors. With their nominal overheads and lack of regulatory and sanitary oversight, informal market players are able to compete effectively on price basis, hence the large market for raw milk, particularly in urban areas. The introduction of cheaper packaging brand of milk in the market using poly pouch has

dramatically increased the demand for processed milk. Most processed milk is sold in Nairobi (56 percent) and the many urban centres in the area.

In order to effectively coordinate the dairy sector a number of dairy sector related associations have their foot print in Central Kenya. These include Kenya Livestock Breeders Association; Kenya Dairy Producers Association; Kenya Livestock Producers Association; Kenya Dairy Processors Association; and East and Southern Africa Dairy Association (ESADA)

2.2.0 Smallholder Dairy Farming.

Smallholder dairy farming involves rearing of dairy cattle in a small scale on a relatively small piece of land. It is one of the numerous forms of small holder farming activities that dominate the agricultural sector in Sub Saharan Africa (Masters et al. 2013). The features of small holder dairy farming are similar to those of other forms of small scale farming. This classification of farming which is also referred to as peasant farming or small scale farming involves production of agricultural goods by households on a relatively small piece of land. It is normally a direct operation by the farmer predominantly using family labour with occasional addition of temporary employees during peak production period. Compared with other types of farming, small holder farming heavily relies on labour than capital resulting production small units of output compared to large farms (Kristen and Van Zyl, 1998).

Under small holder farming the farmers derives a significant proportion of his earnings from the farm (Kristen and Van Zyl, 1998). However due to their vulnerability to economic shocks brought about by adverse weather conditions, small holder farmers tend to spread their risks by diversifying into farming activities with steady incomes such as dairy farming. Dairy farming unlike other forms of small holder farming activities enables the farmer to mitigate against effects of weather shocks on feed supply by way of storing feed as silage or using commercially

produced animal feeds. Alternatively, the small holder farmer may engage in off-farm activities for additional income streams.

Smallholder farming involves households producing agricultural yields on relatively small plots of land. It also involves direct operation by the farmer and makes use of family labour (manual and management), although they are sometimes supplemented by temporary employees. In addition, smallholder farming makes more use of labour (labour intensive) rather than capital, and results in production of small amounts when compared to large farms (Kirsten and van Zyl, 1998). Under smallholder farming, the family is dependent on the farm for a significant portion of their income. However, Kirsten and van Zyl (1998) clarify that due to their vulnerability to economic and climatic shocks in the agribusiness field, smallholder farmers tend to spread their risk by diversifying into off-farm activities for additional income. Smallholder farms are sometimes known as peasant farms, small-scale farms or family farms.

According to Kirsten and van Zyl (1998), a small farmer can be defined as 'one whose scale of operation is too small to attract the provision of the services one needs to be able to significantly increase one's productivity.' At this point, it is important to note that smallholder farmers differ between countries and agro-ecological zones, but land size should not be used as the only criterion. If land size is used alone, it can lead to misconceptions as whether some farmers can be regarded as smallholders or not. For instance, in favourable areas, smallholders may reap larger quantities of produce from cultivating less than one hectare of land compared to smallholder farmers in semi-arid areas cultivating more than 10 hectares.

There are some features common to all smallholder farmers, although definitions differ with different locations. These features include cultivation on relatively small pieces of land, use of less capital in production, as well as, use of less advanced technology, minimal access to

information on potential markets for farm produce and minimal access to information on technologies that can boost production (Kirsten and van Zyl, 1998).

2.2.1 Importance of Smallholder Farming

Despite the fact that smallholder farmers face difficulties in marketing, they continue to produce and survive in the face of unfavourable conditions. It is worth noting that smallholder farmers fulfil numerous functions in the agricultural economy. These functions make the sector important. Such functions include contribution towards food security equitable distribution of income and linkage creation for economic growth. Smallholder farmers have the advantage of flexible motivated family labour resources, which allows them to allocate labour to activities with higher marginal returns. Further, smallholder farmers can use resources efficiently. Moreover, smallholder farming has the potential to contribute towards income and employment generation to the rural poor (World Bank, 2006).

Although small holder farming faces a number of challenges, this sub sector of the agriculture contribute significantly to the agricultural economy. Small holder agriculture helps in poverty alleviation through employment creation and reduction of food prices at times of bumper harvest. By allowing own production of food by a large number of households, small holder farms assist in equitable distribution of incomes. Households producing own food are better off than those who exclusively purchase food.

It has been observed that areas dominated by efficient and successful small holder farms provide impetus for more business activities through backwards and forward linkages. Consequently, smallholder farming attracts other non-farm activities economic such as farm input supplies and marketing agencies thus accelerating economic development.

2.2.2 Challenges of Small holder Dairy Farming Enterprises.

Many poor people in most developing countries are employed in agriculture or small family owned firms which pay low and irregular salaries as Hazell et al. (2007) argue that smallholder agricultural development offers one of the main ways to reduce poverty, and they suggest that, at least in some relatively dynamic areas, smallholder agriculture can contribute significantly to economic growth. A similar viewpoint is echoed by Fan et al. (2013). Steady employment income at a relatively higher wage rate can help alleviate poverty. However the small and micro enterprises that employ the poor pay low and erratic wages and therefore do not help the poor out of poverty. Micro and small enterprises are predominant in the informal sector such as small scale agriculture.

There are contrasting schools of thought in regard to whether the small firms are established out of necessity rather than entrepreneurial ambition. Other concerns relate to the role of the government in contributing the state of the micro and small firms, many governments provide incentives for small firms to remain small thus restricting their growth and productivity. For instance, the tax and business licensing regimes in Kenya accord micro and small firms favourable regulatory requirements (Gok, 2012). This has led to the creation few and lowly paid jobs by the small firms that are preserve of the business owner and a few workers. This hampers the growth of small firms beyond certain limits. On the contrary formal and relatively large firms offer relatively higher and more stable wages thus securing high skilled labour which small firms are unable to attract (World Bank, 2006).

Micro and small enterprises are the major contributors to employment in developing countries but due to their inherent structural weakness their contribution to economic development less evident as they are less proactive than the large firms. Although the growth in the number of

small firms is significantly high, only a small proportion of the firms will achieve rapid growth and create more jobs. Small firms that grow beyond their peers face a number of challenges in regard to access to finance and human capital. These firms are too large for microfinance but too small for commercial banking and private equity investors. The resulting phenomenon is known as the missing middle manifests itself due to absence of middle sector actors to take care of the growing firm.

Steady employment income at a relatively higher wage rate can help alleviate poverty. However many poor people in most developing countries are mainly employed in agriculture or small family owned firms. The small and micro firms that employ the poor pay low and erratic wages and therefore do not help the poor out of poverty. The small firms are established out of necessity rather than entrepreneurial ambition. Small firms create few jobs that are lowly paid and in most cases create self-employment of the business owner and his relatives. This hampers their growth beyond certain limits. Relatively large and formal firms offer relatively higher and more stable wages. These jobs attract high skilled labour which small firms are unable to attract.

Thus majority of the poor in developing countries earn their livelihood in small scale and informal sector such as small scale agriculture. This has given rise to the view at pro-poor economic development involves raising incomes in these sectors (World Bank, 2006). Although micro and small enterprises are the major contributors to employment in developing countries, they are less proactive than the large firms. This makes their contribution to economic development less evident.

2.3 Analytical Review

2.3.1. Theoretical Perspectives of Vertical Integration

Transaction costs economics (TCE), Industrial organisation (IO) and Strategic management (SM) dominate 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, costs of transacting over market outweighs internal costs of management and this leads to elimination of inter-firm profit claims thus 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 (Medema, 1992).

Within the field of industrial organisation (IO) economics, the primary determinant of vertical integration is market structure or rather asymmetric market structures (Chatterjee, 1991). This school of thought has traditionally been preoccupied with vertical integration when focusing on barriers to entry raising rivals costs and foreclosure. According to this theoretical perspective vertical integration can constitute a valuable instrument to create competitive advantages by utilizing different economies. This is achieved through combination of operations, internal control and co-ordination, information and by reducing external uncertainty through securing supply of critical input (Porter,1980) Vertical integration should therefore lower the firm's risk in markets with demand and volume uncertainty, which consist of few actors, thus increasing the profits for those applying the vertical integration strategy.

The strategic management approach of analyzing vertical integration, also commonly referred to as resource-based vertical integration (RBV) of the firm is grounded on managerial and organisational practice. According to Chatterjee et al. (1992) strategic management has not been used as frequently as other theoretical approaches to analyzing vertical integration. Creation of heterogeneous, valuable and rare combinations of resources that are hard to imitate (Barney, 1991; Wernerfelt, 1984), and hence giving the firm competitive advantages have contributed to and understanding of the importance of strategic management in vertical integration. With no rules of the thumb on when, and how to apply vertical integration, the decision to vertically integrate requires thorough and detailed analysis of the actual situation and context.

Transaction cost economics has widely been used in analyzing vertical structuring of production (Shelanski and Klein, 1995). Small holder dairy farmers are essentially involved in production and this makes transaction cost economics (TCE) as the most ideal basis of analyzing their vertical integration process.

2.3.2. Transaction Costs Economics

Organization theory emphasizes the role of organizing information exchange and decisions making in reducing the cost of coordinating interdependent activities. Transaction costs focuses on transactional risks and their costs and on the organizational structures best suited to reduce these costs (Williamson, 1985). The transaction costs economics (TCE) which is a dominant approach in new institutional economics (NIE) argues that organizations have developed because markets are imperfect and therefore give the rise to transactional risks. High risks are implied when uncertainties is substantial and when one of the parties to the exchange has made transaction specific investments. Transaction costs can be reduced by choosing a proper governance structure. Shifting the transactions from markets governance to internal

governance, coordination costs and transactions risks can be significantly reduced because firms' benefits for coordination and control are superior to those of the market. Between the two extremes of market governance and the usual governance structures, is the hybrid governance model to which cooperatives are positioned.

The key transaction attributes determining which governance structure lead to efficient outcomes are asset specificity and uncertainty. The problem of safeguarding specific assets is particularly serious in the presence of local monopsonies. If farmers lack an alternative market for their produce, hold-up by processors or traders, possess considerable threats especially with perishable products such as milk. Consequently cooperatives may reduce the threat of opportunistic behavior of monopsonic sectors by processing perishable products into preserved products or by increasing the collective bargaining power of the members leading to a monopsony market structure. Marketing cooperatives are common among producers of perishable products where assets specificity is high and the produce need to be processed quickly or distributed to the consumer upon production.

2.3.2.1 Assumptions of the Transaction Cost Theory

It is assumed that bounded rationality and opportunism characterize TCE. Bounded rationality indicates that there are cognitive limits of individuals. Human actors would always like to act rationally but are limited in their ability to receive information that help them foresee all possible outcomes in a transaction thereby enabling them formulate responses to all future eventualities. This condition is known as bounded rationality and it makes the limited rationality a problem under conditions of uncertainty. This human specificity makes it difficult to fully specify the conditions surrounding an exchange and therefore gives rise to transaction costs (Williamson, 1985). Williamson (2000) also explains that contractual incompleteness creates

added problems if combined with the condition of opportunism. Williamson, (1985), while advancing the transaction cost theory asserts that transactions have three attributes, namely the frequency with which they occur, the uncertainty to which they are subject, and the degree of asset specificity. These variables determine whether transaction costs will be lowest in a market or in a hierarchy.

Low frequency transactions have very high protection costs and will therefore not attract new entrants. Unexpected changes in the circumstances lead to uncertainties that surround a transaction. Uncertainty can be brought about by environmental and behavioural factors. Environmental uncertainty refers to the unpredictability of the environment, technology, and demand volume and variety, while behavioural uncertainty arises due to the bounded rationality of human actors, information asymmetry problems and the opportunistic behaviour of an individual

Asset specificity has the highest impact on transaction costs with regard to institutional arrangements (Williamson, 1996) It refers to the transferability of assets that support a given transaction i.e the degree to which an asset can be redeployed to alternative uses or by alternative users without losing value. In this regard, highly asset-specific investments represent costs that have little or no value outside the exchange relation (Grover and Malhotra, 2003). The specificity of assets is assessed in terms of their physical location (site specific assets); physical value (physical specific investments), qualified labour (specific human assets); and other specific investments typical for the production itself (dedicated assets) (Williamson, 1985).

2.3.2.2. Measuring Transaction costs

Transaction costs have to be assessed in order to be reduced since good economic performance depends on low transaction costs. It has been observed that transaction costs are associated with information, negotiation, monitoring, coordination, and enforcement of contracts. The occurrence of transaction costs can be traced to observable attributes of transactions. According to Williamson (1985)), transaction costs can be presented as a function of the main attributes of the transaction, as follows:

$TC_i = f$ (F, U, AS), where

TC = transaction costs;

F = frequency;

U= uncertainty, and

AS = asset specificity.

This presentation of transaction costs was further adapted by Nilsson (2007) while analysing transaction costs of agri-environmental policy measures in Sweden.These variables combined with the human factors, such as bounded rationality and opportunism, affect to transaction cost height. Based on the Williamson's theory of TCE, three propositions on how the environmental and human factors influence the level of transactions, frequency, uncertainty and asset specificity, can be identified. Bounded rationality and opportunism give rise to transaction costs that are higher under conditions of high asset specificity and high uncertainty. Lower transaction costs favour markets, while higher transaction costs favour hierarchies. Thus most efficient governance mechanism (markets or hierarchy) needs to be chosen to organize economic activity.

Among the other practices, transaction costs economics can be applied to the process of choosing between marketing channels. According to the TCE framework, the choice of buyers is decided through minimization of the costs associated with the transaction occurrence, when given the transaction dimensions and the institutional environment. According to Boger at al. (2001), the choice of marketing channel is determined not only by the transaction cost level, but from the differences in prices between marketing nodes, socioeconomic characteristics, and transportation costs. Therefore, the function is composed as follows:

$M_i = f$ (TC, P, FC, TR), where

M_i = Choice of marketing channel;

TC = Transaction costs;

P = Farm-gate prices;

FC = Farm socioeconomic characteristics, and

TR = Transportation costs.

Another important issue regarding the TCE in the choice of buyers is the institutional arrangement between suppliers and buyers, particularly the contract arrangement. The contractual relationship between the buyers and the sellers may be difficult to enforce due to the opportunistic behaviour of the parties as envisaged by the agency theory.

2.4.0 Econometric Approaches used in Analysing integration

Different approaches have been used to evaluate factors that influence the small scale farmers' decision to horizontally 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 argued 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 as 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 decision to vertically integrate in 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.

Farmer organizations can achieve the necessary economies of scale and thus economize on external transaction costs, reduce information asymmetries, and build up countervailing market power. Farmer organizations may take over responsibilities for accessing agricultural extension, input provision and distribution, bulking, grading, selling, and even processing. The relevance of collective action may potentially increase with agricultural development, because more intensive use of purchased inputs and higher degrees of commercialization increase the number of market transactions. Moreover, modernizing supply chains are often associated with tighter product and process-related quality and food safety standards (Ngigi, 2005)

2.4.1. Linear Probability Model (LPM)

The Linear Probability Model (LPM) takes the form of a typical linear regression model, with a dummy variable as the dependent variable which can be used to analyse a choice process. The LPM poses several problems, such as non-normality of the disturbance terms, heteroscedastic variances of the disturbance term and questionable R^2 as a measure of goodness of fit (Aldrich, 1987).

2.4.2. Logit Model

Logit regression analysis is a multivariate technique which allows for the estimating of the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. However, the main limitation of the logit model is that the logistic regression does not make any assumptions of normality, linearity, and homogeneity of variance for the independent variables. The logit model uses the cumulative logistic function (Aldrich, 1984).

2.4.3. Probit Model

Probit analysis is based on the cumulative normal probability distribution. The Probit Model is a non-linear probabilistic model developed to address the shortcomings of the LPM. The Probit model has two categories in the dependent variable. The binary dependent variable takes on the values of zero and one (Liao, 1994). However, the choice between logit and probit model is minimal and preference for either is dependent on the choice of the researcher. Given the weaknesses of the LPM model described in this section in evaluating discrete choice phenomenon, the current study adopted the logit model to evaluate the factors influencing farmers' likelihood of horizontally or vertically integrate in its dairy enterprise in lower central region.

2.4.4 Mean Differences Approach

To compare the significant socioeconomic and technical characteristics of dairy cooperative members with non - members in England, Bravo-Ureta and Lee (1988) used the mean difference approach. In the study to analyse women's participation in agricultural cooperatives in Ethiopia, Woldu (2013), t-test was used to analyse differences between women members and women non-members in cooperatives. In this study, age, gender, literacy and education level were significant determinants of participation in group associations among women. The current study builds on the econometric approach of the above studies to study significant differences in farmer characteristics between vertically and horizontally integrated households and those that are not.

2.5.0 Approaches Used in the Analysis of Market Channel Choice

Several approaches have been proposed in literature to analyse the channel choices. Here there is a single decision among two or more alternatives. Hensher (1986) analysed occupational choice among multiple alternatives while McFadden (1974), analysed the travel mode of urban commuters whereas Terza (1985) studied the assignment of bond ratings to corporate bonds as a choice among multiple alternatives. The following are main econometric approaches that are employed in such analysis;

2.5.1. Multinomial Logit

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

utility model. MNL continues to be a popular choice model because choice probabilities formula has a closed form and is readily interpretable.

The major assumption of the multinomial logit model is the independence from irrelevant alternatives (IIA) which implies that the odds of choosing an alternative *i* relative to an alternative *j* are independent of the characteristics of or the availability of alternatives other than *i* and *j* (McFadden, 1973). The IIA assumption requires that if a new alternative is available, then prior probabilities adjust precisely to retain original odds among all pairs of outcomes. The MNL specification assumes a *Gumbel* (extreme value type I) distribution where the location parameter (mean) is zero and the error term, μ, is the scale parameter. In addition the model assumes homogeneity of tastes and preferences across respondents.

Through its assumption of independence from irrelevant alternatives, the MNL fails to account for varying levels of substitution between choice alternatives. The assumption of taste homogeneity ignores the fact that preferences are unobservable to the researcher and that they vary even among respondents with identical socio-demographics. MNL violates consumer axioms of transitivity and stability of choices by imposing independence of unobserved factors over time or across time e.g. in repeated choices. Ideally choice tasks are a learning process with experiences carried over across situations.

2.5.2. Multinomial Probit Model

The model was proposed by Aitchison and Bennet (1970) and has a significant advantage over the multinomial logit model since by relaxing the independence from irrelevant alternatives in MNL, it allows the modelling of correlated choices. The model introduces additional parameters in the covariance matrix of the error terms therefor increasing flexibility of the error structure. This allows any pattern of substitution in addition to enabling the model to handle

random taste variations. The model has been argued to be applicable when analysing panel choice data (Train, 2003).

The model assumes that the choice error terms have a multivariate normal distribution (Alvarez and Nagler, 1994; Long, 1997). In its flexibility enhancement property, high dimensional multivariate normal integrals for solving probabilities are evaluated which increases time before reaching convergence. This is a serious challenge especially if probability is close to zero or one (Cameron and Trivedi, 2005). This computational challenge makes multinomial probit less popular among researchers since any efforts to enhance computation from new algorithms lowers the model efficiency. Like MNL, the model assumes homogeneity of the preferences.

2.5.3. Conditional Logit

Conditional logit is used when data consist of choice-specific attributes instead of individual-specific characteristics. The model is otherwise essentially the same as the multinomial logit. More care is required in interpreting the parameters since the point of reference is the choice not the decision maker. This model like MNL assumes independence from irrelevant alternatives in addition to assuming homogeneity of preferences among decision makers. This model only gives direct information on which individuals make what choices but it does not allow testing hypotheses why those choices are made. Therefore, interpretation of conditional logit model is on untested characteristics of alternatives available to particular individual (Hoffman and Duncan, 1988).

2.5.4. Nested Logit

This is used as an alternative to MNL when the independence from irrelevant alternatives test fails (Greene, 2003). This model relaxes the homoscedasticity assumption in the conditional logit model and MNL by grouping the alternatives into subgroups that allow the variance to

differ across the groups while maintaining the IIA assumption within the groups (Greene, 2002). However, the model has computational complexities.

2.5.5. Random Parameter Logit

Random Parameter Logit (RPL) was introduced by Boyd and Mellman (1980) and Cardell and Dunbar (1980). It's an improvement to the MNL and the estimation of the model is by simulating the log-likelihood function rather than direct integration to compute the probabilities. In Random Parameter Logit, an individual's preferences are assumed to be heterogeneous and continuously distributed random variables for the whole population. RPL accounts for taste differences by allowing model coefficients of observed variables to vary randomly over individuals (Train, 1998) – this flexibility eliminates the restrictive IIA property of MNL and in conditional logit model. Though the RPL model enjoys a considerable advantage not available in any of the other forms suggested, one is likely to experience computational complexities and the results could not be any different from those of multinomial logit (Greene, 2002).

2.6.0 Analysis of Household Socio Economic Characteristics

In this analysis, mean differences for important household social economic characteristic were compared for the integrated households and non-integrated households. To achieve this objective, the study used tests of differences between the means. With a rich data set, descriptive statistics provide important information on behavioural trends and offer much insight into the underlying complex interrelationships and behaviours driving observed phenomena. Mean differences are the best analytical approach to explain whether differences in the observable characteristics of a household are significant or not and therefore policy recommendations can be done from such conclusions.

2.7.0 Empirical Review of Integration.

Integration involves combination of hierarchical and sequential activities into composite operations under a single coordinating function. Three main kinds of market integration are very common in the world including Vertical Integration, Horizontal Integration, and Circular Integration (Rehber, 1998). This study focused on Vertical and Horizontal integration as determinants of market choice channel among smallholder dairy farmers.

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, entrepreneurs have to integrate their products with other stakeholders in the same business line (Chartres, 1994; Ensminger, 2004; Maltsoglou and Tanyeri-Abur, 2005). Private sector improvement is very high effective in linking farmers to the dynamic trading process, but farmers themselves also must 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.

2.7.1 Farmers Characteristic in Market Integration

Different farmers have different perspectives in market integration. These perspectives have caused farmers to have different decisions in production and trading management. This section illustrates the theoretical issues of farmers' characteristic in market integration;

2.7.1.1 Farmers with Food Security Objective

Focusing on food security as the main objective is a major facet of farmers' characteristic. Farmers develop various strategies to secure the food and reduce marketing risk. They rely on diversification of agricultural production and/or diversification of income through off-farm activities. Farmers with this characteristic mainly produce staple food crop for self-

consumption while commercializing is only a part of their surplus. Farmers' endowment in such factors like land, labor, and capital determines strongly the capacity to produce, to earn income, and to cope with risk (Estelle et al. 2004).

2.7.1.2. Farmers with Production and Trading Management

These farmers offer a reasonable attractive product to the market which qualifies them to get reasonable prices from traders. They try to develop their own ability such as developing techniques, setting quality standards, delivering products in time, and negotiating prices, etc. These kind of farmers have good business concepts because they try to make their product attractive to the business partners so that the buyers can be willing to pay better prices, listen to their demands, and invest in them (KIT et al. 2006).

Small scale farmers combine their products with other farmers when selling to the entrepreneurs (Kaganzi et al. 2008). One farmers' group in south-western Uganda has successfully sustained sales of potatoes to a fast-food outlet in Kampala because they had learned new techniques for their potato production. They also have tried to build the strong relationship and leadership in their community through sharing techniques, skill, and market information. Market innovation and dynamic market actors connecting are also done in their community. They also tried to work together in making decisions in the trading process with restaurant and supermarket in Kampala. This characteristic made them very successful in their production and trading (Kaganzi et al. 2008).

2.7.2 The Benefits of Farmers in Market Integration

Whoever involves in market integration can get more or less benefits according to their involvement. Those gaining the most benefit from market integration include farmers, private sectors, and the state (Berdegué et al. 2001). Farmers are often regarded as the group that

benefits most from market integration, but this group may also experience negative consequences of market integration (Maltsoglou and Tanyeri-Abur, 2005). Farmers are a heterogeneous group and obviously, farmers can get benefits from market integration in several ways. Alam and Verna (2007), also mention that different profitability is due to differences in flexibility and involvement in markets by farmers. Farmers still can get profit from market integration through reducing the production costs and price isolation. Other authors and institutions also agree with what Alam and Verna (2007) have alluded as potential benefits to farmers arising from market integration. Among such benefits farmers can get job opportunities from industries, supermarkets and other entrepreneurships.

When market integration results in transferring and processing products, the demand for employment will also increase. So, farmers can reduce labor or time in their farms and work for those entrepreneurships to get more income. This system also leads to urbanization that attracts many migrants from rural areas. This could be beneficial in terms of employment accessing, so farmers can bring back remittance to their families in rural areas (Dhital, 2004; Samaratunga, 2006; Söderbom and Rijkers, 2009).

The integration of markets is a challenge to significant proportion of farmers due to low output and lack of information and this compels them to try learning new techniques in their production in order to integrate well in their cooperative or group. They will strive for higher benefits through quality control, quantity control, inputs control, and customer control. It means that their perspectives of farming will be broader when they start integrating their own production, community and markets (Berdegué et al. 2008; Kaganzi et al. 2008). Furthermore, in some cases farmers can get new techniques, production management, organization and financial management skills through training from an industry or other market agents. This is also another

opportunity that can build capacity empowerment of farmers effectively (Samaratunga, 2006; Warning and Hoo, 2000).

Social networks are also strengthened in their communities. To reach success in market integration, not only do farmers integrate their individual activities but also those carried out together with other members in their community and market actors. Such a chain can bring all members a very good relationship (Coulter et al. 1999; Moustier et al. 2007). This good relationship provides multiple benefits to all farmers. They can learn the new techniques and experiences in production from each other and can access market information easily (Wolz et al. 2008). According to Cai and Obara, 2009), horizontal integration leads to a larger market base for the merged firm, and thus helps reputation building with more effective punishments and better monitoring by eliminating idiosyncratic shocks of individual markets. However, it allows the merged firm to deviate only in a subset of markets, which hinders reputation building by making it more difficult for consumers to monitor its quality.

2.8.0 Determinants of Vertical Integration

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 emanate if there exists a small number of suppliers of an input required by a firm 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 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.

2.9.0 Determinants of Horizontal Integration

Empirical studies on horizontal integration have focussed on membership to groups and associations. Stefano (2010) using a probit 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 to be 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 the case probably due to cultural and socio-political reasons and due to local cooperative market or economic power.

Farms with more assets were found to less likely horizontally integrate through joining cooperative associations but if they joined they are 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 poor households. However, Stefano (2010) focused cooperative membership that were concerned with marketing issues and channel choices while the current study focused on the evaluation of the membership to any farmer association concerned with dairy production.

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 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 focused on factors affecting becoming members in agricultural association (Horizontal integration).

Thomas and Fanaye (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. (2009) 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.

2.10.0. Choice of Marketing Channels

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

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

The difference between Mburu et al (2007) and Sikawa and Mugisha (2010) studies and the current study is that the former studies collapse all the market alternatives in to a binary outcome

while the current study does not. Binomial logit and probit techniques are only suitable for problems involving the choice among two categories. The former studies combined several market outlets in order to make the dependent variable a binary outcome. For problems involving the choice among three or more categories, the multinomial logit technique just like in the case in this study is most often employed.

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

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

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

Shiferaw et al. (2006) employed descriptive statistics such as frequencies, cross-tabulations, means and ratios to analyse socio-economic assessment of legume production, farmer technology choice, market linkages, institutions and poverty in rural Ethiopia. The paper did not attempt to undertake detailed econometric modelling to test correlations and cause and effect relationships between different variables. The difference between this study and the current study is that the former used descriptive analysis while this study used a more quantitative econometric analysis to estimate small holder farmers' choice of marketing channels. It is worth noting that although simple descriptive statistics provide important information on behavioural trends, they do not offer much insight into the underlying complex interrelationships and behaviours driving observed phenomena as quantitative analyses do, which is the case in this study

Murage and Ilatsia (2010) examined the determinants of smallholder dairy farmers' use of breeding services in Nyandarua and Kiambu districts of Central Kenya. Considering three breeding services, artificial insemination (AI), natural bull service, and a combination of AI and bull services, the study used a multinomial logit econometric model. Ayuya, Waluse and Gido

(2012) used both descriptive and multinomial logit to analyse small-scale farmers' choice of organic soil management practices in Bungoma County, Kenya. In some other work, Pundo and Fraser (2006) used multinomial logit model to investigate the factors that determine household cooking fuel choice between firewood, charcoal, and kerosene in Kisumu County. In a similar study in Eastern Cape Province, South Africa, Jari and Fraser (2009) used the multinomial regression model to investigate the factors that influence marketing choices among smallholder and emerging farmers. In another study**,** Yayar (2012) used multinomial logit procedure to investigate the socioeconomic and demographic characteristics of consumers that determine households' fluid milk consumption choices among packed, unpacked and both packed-unpacked milk consumption choices.

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

Voors (2006) found that age of the sheep farmers and flock size positively and significantly influenced choice between large and small buyer channels in the dairy sheep farming in Macedonia. The increase in flock size led to increase in proportion of sheep sold to large buyer channels and the increase in age also led to increase in proportion sold through large buyer channel. It was further reported that the higher the level of education, the higher the probability to enter into an arrangement with a large dairy company since one is more capable to manage their farm and subsequently supply milk with higher levels (Voors, 2006). A study by Jari

(2009) provides an insight into the institutional and technical factors that influence agricultural marketing channel choices among smallholder and emerging farmers in Kat River Valley in South Africa. The institutional factors that influence agricultural marketing channel choices include transaction costs, market information flow and the institutional environment which encompasses formal and/or informal rules, the use of grades and standards, organization in the markets and the legal environment. An appropriate institutional environment reduces transaction costs for traders.

Knowledge of prices is an important factor which mainly arises due to imperfect information. Asymmetric information may give such actors an exploitable advantage in their dealings with other parties hence transaction costs arise (Klein et al. 1990). The speed of payment which is defined as the lag between the time when the product is sold and the time when the payment is received is also one of the important waiting costs. It was reported that higher speed of payment will increase the probability of farmers to participate in a particular channel (Nkhori, 2004; Gong et al. 2007). The significance of herd size can be attributed to the volume of milk that can be supplied focusing on same breed type. For farmers with small herd size, the transport costs per unit are relatively higher. As they deliver smaller quantities, there is a decreased interest of processors to collect the milk from the farm (Voors, 2006). Studies have shown that this has a significant influence on the marketing channel choice since it shows the farmer's bargaining power (Nkhori, 2004). In this case, large milk volumes might enable a farmer to allocate it into both channels as compared to those with small volumes.

Chen et al, (2006) recommends that transaction cost is a viable theory to explain the acquisition decision in marketing channels. Musemwa et al, (2008) explains that transaction costs are considered as barriers to the efficient participation of producers in different markets. Thus,

producers will not use a particular channel when value of using that channel is outweighed by the costs of using it (Musemwa et al, 2008). Transaction costs, which are distinct from physical marketing costs such as those for transport and storage, arise from the coordination of exchange among market actors (Eleni and Gabre-Madhin, 2001). De Bruyn et al, (2001) argue that market transactions do not occur in a frictionless environment.

According to Gong (2007) there are significant relationships between economic and social variables and marketing channel selection for cattle distribution in China. They argued that transaction cost has a significant impact on marketing channel selection. A study done in Nigeria on factors that influence the choice of market channel by cocoa farmers in Ila L.G.A. of Osun State, Nigeria, revealed that cocoa farmers make their choice of market channels for their produce on the basis time of payment, mode of payment, price of product, distance from farm, transportation cost and grading of product (Awotide, 2012).

2.10.1. Small Holder Dairy Farmers Marketing Channels

2.10.1.1. Farm Gate

Farm gate milk sales take place within the precincts of the farm and the farmer has direct contacts with the customers. Farmers producing low milk output prefer to use farm gate or direct marketing channel because they have better bargaining power and are able to set prices and hence more cash per transaction as compared to other channels. Use of other marketing channels reduces the rights to set prices to customers. Farmers use farm gate as a marketing channel when the distance to intermediaries is longer than to final end users and the transaction costs are very high.

2.10.1.2 Middlemen.

Dairy **f**armers producing significantly high quantities of milk in excess of effective demand within the neighbours of the farm are inclined to search for other markets. They are faced with the option of either using intermediacies or set their own marketing outlet as a strategy of selling their milk in other markets. Lack of information on new market horizons and the benefits of setting own distribution outlet motivates them to use middlemen as a marketing channel. Middlemen as intermediary marketing channels are relevant to some farmers as they characterized by quick returns and bulk purchases though at times under credit terms.

2.10.1.3 Marketing Cooperatives.

Cooperative is important in accelerating rural development as they strengthen small holders' market access. A cooperative is an association of members in the sociological and psychological sense and a joint commercial enterprise (Levis and Ravis, 2008).Social interaction among members is expected to play an important role in conditioning the performance of the enterprise including value main coordination as jointly.

Cooperatives as community owned enterprises have a dual character. The interaction between social and economic processes makes a cooperative an ideal institution for solving value main challenges. From the propositions and assumptions of transaction cost economics (TCE) (Williamson, 1991), cooperative can perform a marketing transaction more efficiently than alternative organization structures. The social structure theory upon which cooperative operate informs all social structures are an important factor for the success for collective action and for the efficiency of community governance (Hayami, 2009) and coordination in the managing of dependencies between activities. Such dependencies may either be pooled, sequential or reciprocal. Sequential inter- dependence is particularly relevant in value chain analysis, management discretion is one of the main conditions mechanisms found in sequential

interdependence. Coordinated value chains feature connectedness of one transaction to another. This connectedness implies that downstream transactions are aligned with upstream transactions to achieve mutual option outcomes.

Coordination entails gathering and processing of information making and communicating decisions among interdependent activities. Traditionally cooperatives are pooled interdependent organizations characterized by horizontal coordination mechanisms particularly on product quality. Organization theory poses that in value aims where sequential transactions are highly connected more centralized decision making is required. The process of moving to more value chain coordination can be considered an innovative process in which all actors are typically interdependent in a reciprocal manner.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

The study sought to analyse vertical and horizontal integration as determinates of market choice among small holder dairy farmers. This study can be identified as ex-post facto research because determinants were studied presumably after they have exerted their effect on choice of marketing channel. The underlining issues to be analysed had already occurred and hence research findings will only assist in developing new approaches to handling the problem under investigation (Gall et al. 2007).

3.1 Location of Study Area

The study area which is now part of the Kiambu County was previously Kiambu district in Central Province and shared its borders the former Nairobi province to the South, Muranga to the North and Thika to the East. This area enjoys a warm climate that has temperatures ranging between 12°C and 18.7°C and aggregate rainfall of 1000mm per annum. The favourable climate is conducive to crop production and livestock farming .The area experiences land fragmentation due to high population growth and this leads to smallholder dairy farming being a dominant land use system. The district is the second leading producer of milk in the country. The importance of smallholder dairy farming has further been reinforced by presence of numerous urban centres within Kiambu and proximity to Nairobi City County, all accounting for 33.2 % (4,155,845) of Kenya's urban population (GoK, 2009). Figure 3.1 shows the map of the study area.

3.2 Target Population

The study targeted all dairy farmers in lower central Kenya. The key focus was on smallholder dairy farmers who participate in the dairy market. However the accessible population was smallholder farmers who produced and sold milk in its raw or processed form.

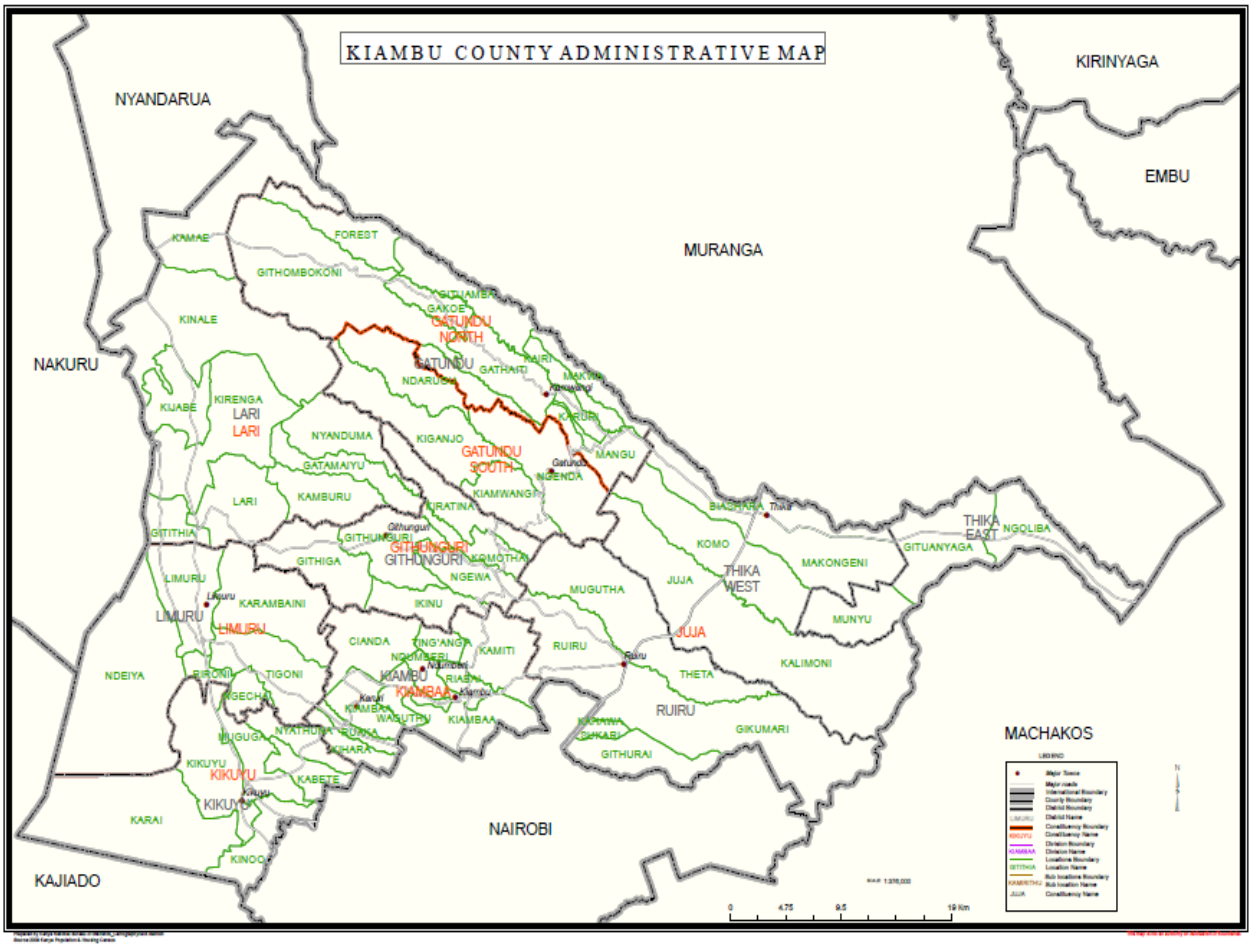

Figure 3.1: Map of Kiambu County showing the study areas.

3.3 Sampling Procedures.

Multistage sampling procedure was used during sampling. Lower Central Kenya was purposely selected because of the high number of dairy cattle and the volume of milk output. Five sub counties out of the ten sub counties in Kiambu County were selected. All the sub counties were listed and assigned numbers from one to ten. Then research randomizer software was commanded to select five random numbers from a maximum possible of ten. Then five sub counties assigned numbers corresponding to ones generated by the randomizer were selected. Consequently, Githunguri, Kiambu, Kikuyu, Limuru and Lari sub counties were identified as areas of study. Twelve locations were also randomly identified. Sampling for locations was done using probability proportional size approach such that more locations sub counties with

higher household population had more locations selected. Three locations each from Kikuyu and Kiambu sub counties were randomly selected. Githunguri, Limuru and Lari sub counties each had two locations randomly selected. With the help of county livestock production officers, village elders and local administration a list of all dairy farmers in the identified locations was generated. Twenty four farmers from each location were randomly selected, without replacement, to be interviewed. Table 3.1 presents the list of the sub counties in administrative units within Kiambu County.

Table 3.1 Kiambu County administrative units

Sub County	Area (km^2)	No. of Divisions	No. of Locations	No. of Sub-locations
Gatundu South	192.4	3	11	38
Gatundu North	286	2	8	28
Ruiru	291.9	2	4	9
Thika East	126.5	2	4	6
Thika West	327.1	2	5	12
Githunguri	173.5	3	7	20
Kiambu	189.1	4	16	39
Limuru	281.7	3	7	16
Kikuyu	236.1	4	14	28
Lari	439.2	4	19	40
TOTAL	**2,543.5**	**29**	**95**	**236**

Source Kiambu County Development Profile, 2013

3.3.1 Sample Size

A sample of 288 farmers was selected in the five sub counties. This sample was determined by Cochran (1977) formula specified as:

$$n = \frac{z^2 pq}{d^2} = \frac{1.96^2 (0.5)(0.5)}{0.0578^2} = 288$$

Where n = required sample size

z = Confidence interval at 95%

p = Proportion of households practicing dairy production (50%)

q = proportion of households not practicing dairy production (50%)

d = Confidence level (0.0578%)

The total number of respondents for this study was 288 smallholder dairy farmers who were selected for interview.

3.3.2 Data Collection Techniques

Primary data was collected from the dairy farmers using questionnaires and interview schedules. Questionnaires assisted the researcher in obtaining information from a large number of respondents (Mugenda and Mugenda, 1996). Research assistants were recruited and trained on how to undertake data collection. Data that was required for the purpose of this study was the farmer's socio economic characteristics, extent of vertical and horizontal integration and marketing channels. This data was collected from the farmers by the research assistants through the use of questionnaires and interview schedules. Published Government annual reports and empirical findings by scholars provided Secondary data.

3.4. Data Analysis and Presentation

All questionnaire data were captured in statistical packages for social sciences (SPSS) version 20 and STATA Version 12 for descriptive statistics. Descriptive statistics involving computation of means, independent sample t tests and frequencies were undertaken to characterize the respondent's socio-demographic attributes. Econometric analysis was undertaken to estimate a logit and a multinomial logit equations using STATA 12.

3.5 Conceptual framework

The study conceptualizes that a small holder dairy farmer choice of market is influenced by several factors. These include farmer social economic factors and the level of household horizontal and vertical integration. Horizontal integration involves mostly training, membership

in producer associations and their governance. There are transaction costs involved in this and many small holder farmers cannot afford producer association membership fee and other costs. However, horizontal integration may influence the households' social economic characteristics. It is conceptualized that if a farmer is a member of a dairy farming related association, she/he benefits from training and increased access to information and this is likely to lead to an increase in milk output. Therefore, there is a likelihood of interlinked causality between horizontal integration and household characteristics.

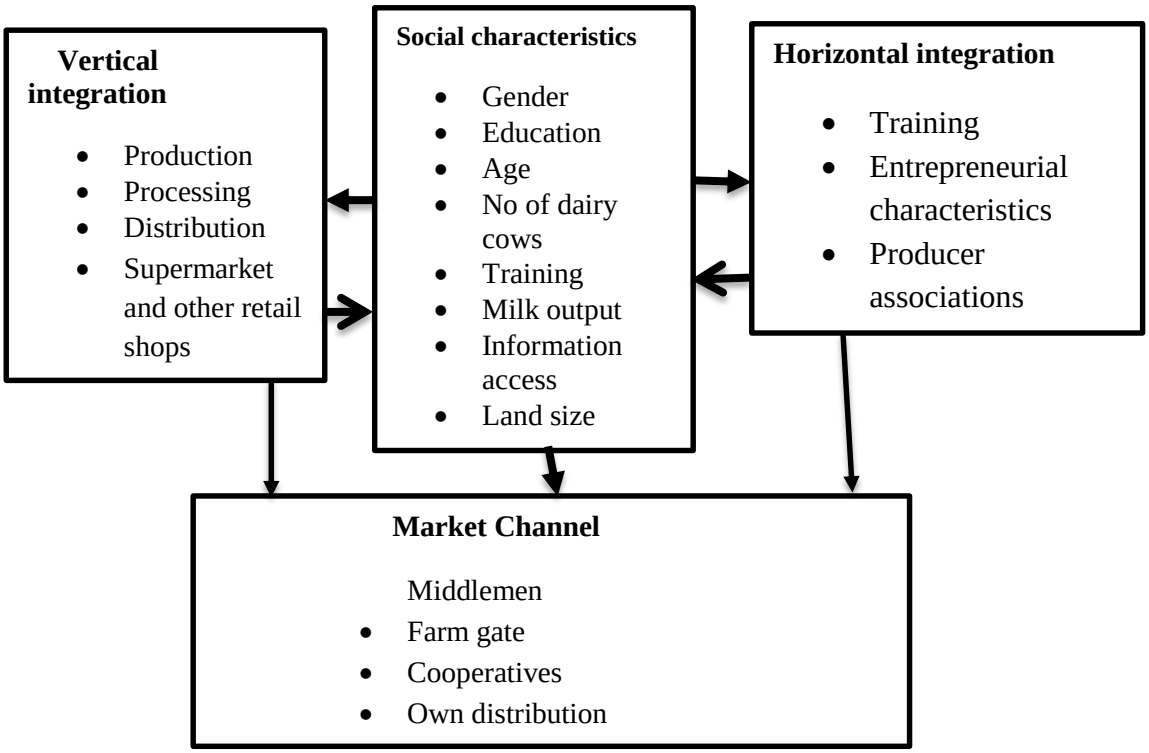

Figure 1.1: Conceptual framework, 2014
(Adapted from Lazzarini et al. 2001)

High transaction costs impede smallholder farmer linkage to formal markets while lack of producer membership to producer groups lowers bargaining power of the farmers. It conceptualized that households that are vertically integrated are likely to access better dairy markets than those not vertically integrated. However, there are inherent social economic

factors specific to a household that are conceptualized to influence the choice of a marketing channel.

A vast majority of smallholder dairy farmers lack vertical linkages in the marketing channels hence their exclusion from formal markets (Makhura, 2001; Wynne and Lyne, 2003). In other instances, smallholder farmers have weak financial and social capital therefore accessing formal markets individually is not an easy task (Fenwick and Lyne, 1999). Therefore most farmers remain trapped in poverty and are unable to access the more rewarding markets. Farmers prefer to use direct marketing channel because they have bargaining power and can set prices. Farmers also use direct channel when the distance to alternative market channels is long. Some farmers as well lack information on different market channels that are at their disposal. For small scale farmers, it has been argued that production only part of the challenge; the remaining challenge is due to market the produce. Farmers face difficulties in marketing even if they are integrated with the broader national or international markets (Shiferaw et al. 2006). Choice of a marketing channel by a smallholder farmer is preceded by costs consideration associated with transportation, profits, level of trust among the available middlemen and familiarity with markets, among other factors (Makhura, 2001). Farmers might market their produce through channels that sometimes offer even low prices because they either lack market knowledge or have difficulties in accessing markets that are more rewarding.

3.6. Theoretical Framework

3.6.1 Choice Theory

The study drew its theoretical basis on the choice theory. Choice theory which is also referred to as rational choice theory or rational action theory helps in understanding and modelling social, economic and individual behavour. Elster (1989) observes that the essence of rational

choice theory is that individuals usually do what they believe is likely to have the best overall outcome. In this regard an individual faced with a number of options acts in his best interest by balancing costs against benefits to arrive at the choice that maximizes his personal advantage. The basic assumptions of the rational choice theory are that choice made are anchored on individualism, optimality structures, self-interest and rationality (Abell, 2000). It has been observed that rationality is a building block for coalition building. The purpose of coalitions is to gain more influence and power which an individual or organization may find difficult to attain (Ogu, 2013).

Members joining a group or coalitions perceive free riding to be clearly in their interest, and therefore act rational within such groups. The group attract and retains its members through selective incentives whereby only members benefit from contracted joint negotiations thus making collective action possible. Collective action is one of the strategies of addressing the transaction cost problem.

Nearly all microeconomic analysis are premised on the decision making processes by individuals. In the decision making process, the individual makes rational choices by choosing the option that optimizes utility, (Tadenuma, 2002).The utility-maximization approach to choice has several characteristics that help account for its long and continuing dominance in economic analysis. In its earliest development, choice theory was associated with the principles of government making policy. Later on, choice theory was used in qualitative predictions based on empirical studies on choices made by individuals as they respond to a given phenomenon. Lately the choice theory has been used to analyse personal and household decisions on economic matters such as consumption, savings and business decisions.

Rational choice theory is anchored on the fact that individuals have preferences and chooses the option to take on the basis of the preferences. Whereas economic theories tend to begin by making assumptions about consumer's preferences and then making assumptions on what would happen, a reversal of the approach to analysing behaviour reveals that individuals first make decisions and then try to rationalize the choices made. The rationalization process emerges when the individual tries to establish whether the choices made are compatible with the optimization concept.

3.6.2 The Random Utility Theory

The choice of a milk marketing channel among small scale farmers is dependent upon the maximum utility derived from the chosen channel. Data on individual choices was provided by the random utility model where an individual's utility of two or more choices is estimated. We observe N independent observations on the multinomial vector, y_i, with p choice alternatives. For each choice occasion, a latent normal vector z_i (p x 1) is present. Choice alternative j is observed if the j^{th} component of z_i is larger than all other components.

The theory postulates that decision makers choose the alternative that maximizes the utility derived from their choices. A rational farmer would be expected to choose the marketing channel from which he derives the highest utility. This theory assumes that the utility function is composed of a systematic component dependent on hypothesized explanatory variables that can be attributed to the decision maker and/or alternative and a random term. The random term is due to unobservable factors and measurement errors that are not known to the researcher.

$$U_{in} = V_{in} + \varepsilon_i \qquad (3.1)$$

U_{in} is the utility for alternative i for individual n, V_{in} is the explained/systematic component and ε_i is a random term.

The choice process is formulated in terms of probability that if a given alternative is chosen then we have the following equation;

$$P_n(i) = P[U_{in} > MaxU_{jn}] = P[V_{in} + \varepsilon_i > MaxV_{jn} + \varepsilon_j] \quad \forall j \neq I \qquad (3.2)$$

The systematic component of the utility function is assumed to be linear in parameter combination (X_{in}) of the characteristics of the decision maker (S_n), the attributes of the alternative *i* as perceived by individual *n* (Z_{in}) and vector of parameters β.

$$V_{in} = h(S_n, Z_{in}) = \beta' X_{in} \qquad (3.3)$$

3.7. Empirical framework

3.7.0 Analysing the Determinants of Horizontal and Vertical Integration Among Small Scale Farmers

3.7.1 Modeling Binary Choices

In binary choices, the response variable can take only two values, 1 if the household is horizontally or vertically integrated and 0 if it is not. 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 the 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 $f(\varepsilon_i) = \frac{\exp(-\varepsilon_i^2/2)}{\sqrt{2\pi}}$ while in logit model they are assumed to be standard logistic $f(\varepsilon_i) = \frac{\exp(\varepsilon_i)}{[1+\exp(\varepsilon_i)]^2}$.

The standard logistic distribution has a mean of zero and a variance of $\pi^2/3$. Estimation and inference for probit and logit models for binary choice models is usually based on maximum likelihood estimation.

This notwithstanding, the arbitrariness of the choice between probit or logit models is innocuous as long as the two models yield similar results (Cox, 1970; Maddala, 1983). This study adopted the logit model since logistic distribution and normal distribution are similar except that the latter has heavier tails (Greene, 2002) and the assumption is that the data were normally distributed. The logistic distribution tends to give larger probabilities to y = 0 when x'β is extremely small (and smaller probabilities to y = 0 when β'x is very large) than the normal distribution.

According to Amemiya (1985), logistic regression is preferred since it is more similar to normal distribution and has a simpler form. Even when the sample is response based, that is stratified on the discrete variable of the outcome, a special estimation procedure is not necessary for logit model, but a random sampling maximum likelihood procedure will still yield consistent and efficient results. This special property of the logistic model makes it to be categorized in the class of multiplicative intercept models (Hsiao, 1986).

A binary logistic model was therefore used in assessing determinants of household's horizontal and vertical integration in its dairy enterprise. Households that did any form of milk value addition were assigned the value of Y_i =1 and 0 otherwise. The model was specified as follows:

$$Y_i = \beta_0 + \beta_1 \text{ External Source} + \beta_2 \text{ SUNK} + \beta_3 \text{ Storage} + \beta_4 \text{ MCS} + \beta_5 \text{ \% Milk Sale} + \beta_6 \text{Turnover} + e_i \quad (3.4)$$

Where β_0, β_1, β_2, β_3, β_4, β_5, β_6 are parameters to be estimated; external source, SUNK, storage, MCS, % Milk sale and turnover are explanatory variables while e_i denotes the error term.

For households that belonged to any dairy related farmers association were as well 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

$$Y_i = \beta_0 + \beta_1 Education + \beta_2 Age + \beta_3 FarmSize + \beta_4 MilkOutput + \beta_5 Experience + \beta_6 MonthlyTurnover + \beta_7 No.DairyCows + \beta_8 Training + \beta_9 WTP\inf + \beta_{10} GrossMGN + \beta_{11} DistMkt + \varepsilon_i \quad (3.5)$$

Where: β_0, β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8, β_9, β_{10} and β_{11} are the parameters to be estimated while education, age, farm size, milk output, experience, monthly turnover, number of dairy cows, training, willing to pay for information, gross margin and distance to market are the explanatory variables.

Following Greene (2002), the probability that the i^{th} household will integrate in its dairy enterprise can be modelled as:

$$\text{Prob} = \left[Y_{ij} = 1\right] = \frac{\exp(\beta' X_i)}{1 + \exp \beta' X_i} = \wedge(\beta' X_i) \quad (3.6)$$

Equation (3.6) represents the reduced form of the binomial logit model, where X_i is a vector of explanatory variables and ε_i is non-observed variable is assumed to follow a distribution of logistic probability with a density function:

$$F'(\beta' X_i) = \wedge(\beta' X_i)[1 - \wedge(\beta' X_i)] \quad (3.7)$$

The probability that the i^{th} household will integrate horizontally or vertically in its dairy enterprise is estimated as:

$$\Pr(Y_i = 1) = \beta_i X_i + \varepsilon_i \qquad (3.8)$$

Where X_i is a vector of explanatory variables, β_i is a vector of parameters to be estimated while ε_i is the stochastic random term.

In computing marginal effects, the sample means of the data were evaluated at every observation using the sample average of the individual marginal effects. The functions were assumed to be continuous and at least once differentiable and the data are as well assumed to follow normal distribution. The study estimated the marginal effects for continuous variables as follows according to Greene (2002).

$$\beta m = \left[\frac{\partial(\beta_i X_i + \varepsilon_i)}{\partial \beta_i X_i} \right] \beta_i \qquad (3.9)$$

Where: m indicates the sub vector corresponding to the *M* variables.

However, the appropriate marginal effect estimation for dummy variables adopted equation 3.8

$$\beta m = \Pr[Y_i = 1] - \Pr[Y_i = 0] \qquad (3.10)$$

3.7.2 Description and Justification of Variables in the Vertical Integration Model

3.7.2.1 Dependent Variable

This variable is a dummy taking a value of 1 for a household that vertically integrates in its dairy enterprise. The measure was assumed to be equal to one if a household produced raw milk and added value before marketing. Value addition included pasteurization, packaging, branding and any form of milk processing. Households that produced and sold raw milk with no value

addition were assigned a measure of zero. Integration dummies have advantages over proxy measures used in other studies (Lieberman, 1991).

Explanatory Variables

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.

Fixed investment cost (SUNK): This was a continuous variable depicting a household's total fixed investment cost in dairy enterprise. This included the cost of animal shed and any processing equipment cost. If a household cease to produce milk or process milk, these investments will be idle. In addition, if a household was sourcing milk externally and they cease to supply, such a household will be operating under capacity. It is therefore hypothesized that the more the investment cost, the higher the likelihood a household to integrate vertically in its dairy enterprise.

Storage: This was a dummy variable taking a value of 1 if a household owns a cold room or cooling facilities for its milk and milk products and 0 if a household stores and transports its milk in normal metallic and plastic milk cans. The flexibility of storage and/or transport equipment helps avoid the problem of lock in. Milk cans are hypothesized to be more flexible than cold rooms which are argued to be more asset specific. It is therefore hypothesized that households that have invested in cold room assets are more likely to vertically integrate.

Milk cost share (MCS): It is argued that integration is more likely with the costs of inputs used in milk production account for a large fraction of the total cost (Lieberman, 1991). In this study, this was a continuous variable which was a percentage of total household milk produced divided

by total production cost. It was hypothesized that the higher the costs of milk production inputs the higher the probability of integration.

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).

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.

3.7.3. Variable Justification in Horizontal Integration Model

Independent Variables

Age of household head: This was a continuous variable defined as the farm household head's age at the time of interview, measured in years. Usually, it is the household who makes decisions in the farm regarding whether or not to be a member of any farmer association or whether to integrate horizontally or not. Age was hypothesized to have a positively influence on household likelihood of integrating horizontally, which is consistent with the findings of the studies conducted by Bagher (2011).

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.

Experience in dairy production: This was a continuous variable which defined the number of years of dairy production by the household head. The longer the number of years of active participation in dairy production it was hypothesized that the more experienced the farmer was assumed to be. In a study in Rwanda on coffee farming, more experienced farmers were found to be members of farmer associations compared to farmers with fewer years of coffee farming (Mugabekazi, 2012). Experienced farmers are better able to assess the returns associated with being an association member than less experienced farmers. Hence, farming experience is likely to influence positively the membership decision.

Milk output: This was a continuous variable defining the total milk output by a household. It was hypothesized that the higher the level to milk output the higher the likelihood of such a household to belong to a farmer association. This is because farmers with high milk volumes seek to reduce costs particularly on transport and could be keener on quality milk production (Vijay *et al*. 2009). In addition the farmers are likely join collective groups that could lower the cost of accessing some important factors of production.

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.

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).

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.

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.

Dairy enterprise gross margin: This was a continuous variable indicating the difference between total turnover and total variable cost in the dairy enterprise. It was hypothesized that households with larger gross margins in their dairy enterprises would more likely integrate horizontally.

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.

3.8 Analysing Choice of Dairy Marketing Channels among Small Scale Farmers

3.8.1 Multinomial Logit (MNL)

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

3.8.2 Model Assumptions

MNL's major assumption was the independence from irrelevant alternatives (IIA) which implies that the odds of choosing an alternative *i* relative to an alternative *j* were independent of the characteristics of or the availability of alternatives other than *i* and *j* (McFadden, 1974). The IIA assumption required that if a new alternative is available, then prior probabilities adjust precisely to retain original odds among all pairs of outcomes. The MNL specification assumes a *Gumbel* (extreme value type I) distribution where the location parameter (mean) is zero and the error term, μ, is the scale parameter. In addition the model assumes homogeneity of tastes and preferences across respondents.

From the previous discussion on weaknesses of the alternatives to MNL, the study used the Multinomial logit (MNL) approach to analyse the factors that influence the choice of a dairy marketing channel. The model was preferred since it permits the analysis of decision across more than two categories in the dependent variable therefore making it possible to determine choice probabilities of different channels. In addition, MNL is simpler to compute compared to

multinomial probit which poses a challenge in computing multivariate normal probabilities for any dimensionality above 2 (Greene, 2002).

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

$$U_{ij} = \alpha X + \beta Z + \varepsilon \qquad (3.11)$$

Assuming the errors ε_{ij} are independently and identically distributed with an extreme value distribution, the probability that alternative *j* is chosen from n alternatives can be represented by a mathematical model as formulated below;

$$\text{Prob}(Y_i = j|x_i) = \frac{e^{\beta_j' x_i}}{1+\sum_{k=1}^{J} e^{-\beta_k' x_i}} for j = 0, 2 \ldots, J, \beta_0 = 0 \qquad (3.12)$$

The above equation provides a set of probabilities for *J*+1 choices for a decision maker with characteristics x_i while Y denotes choices. Marketing channels x is a 1* k vector with first element unity and β_j is a k * 1 vector with j = 1, ….., J.

Prob (Y_i = j|x_i) is determined once the probabilities for all j = 1, 2, …., J are known and the probability must sum up to unity. For the parameter estimates to be consistent and unbiased, it requires that the probability of using one choice by a given farmer be independent of the probability of choosing another choice. This means p_j / p_k should be independent of the remaining probability which is referred to as independence from irrelevant alternatives (IIA).

The parameter estimates of the MNL model only provide the direction of the effect of the independent variables on the dependent (choice) variable; thus the estimates represent neither the actual magnitude of change nor the probabilities. Marginal effects are used to measure the

expected change in probability of a particular marketing choice being chosen with respect to a unit change in an independent variable from the mean (Greene, 2002).

The following model was specified for market channel choice analysis;

$$DMchoice = \beta_0 + \beta_1 Gender + \beta_2 Education + \beta_3 Age + \beta_4 LandSize + \beta_5 No.OfDairyCows + +\beta_6 \%Milksales + \beta_7 Training + \beta_8 MilkOutput + \beta_9 InformationAccess + \beta_{10} TransactionCost + \beta_{11} HI + \beta_{12} VI + \varepsilon_i \quad (3.13)$$

Where DM choice is the dairy market outlet used by the farmer (Farm gate direct sales, middlemen, own distribution and dairy cooperatives), while $\beta_1 \ldots\ldots \beta_{11}$ are coefficients associated with each explanatory variable and the ε_i is the error term. Several factors were hypothesized to influence the farmers' choice of financial provision mode. The description of these factors is presented in Table 3.2. The choice of these explanatory variables was mainly based on the general working hypothesis and partly on empirical findings from literature, and therefore, a positive or negative sign was assigned depending on the potential influence of a particular variable on choice of financial provision mode.

3.8.3. Variable Justification and Expected Signs

Some of the above variables have been found to affect market choice differently for various commodities in previous studies (Alene, et al. 2008; Vance and Geoghegan, 2004). Gender represents differences in market orientation between men and women heads of households. It is hypothesized that men headed households are more likely to prefer own distributions over cooperatives than female headed households. Prices offered at different market channels for a unit of milk is expected to have a positive influence on output sale and choice of that alternative. Papzan et al. (2008) also noted that the degree of innovation and information access affect rural entrepreneurship. Therefore, households with more information access are likely to distribute their own milk instead of other market alternatives.

Households with small farm sizes are expected to keep lesser milking animals and hence produce lesser milk volumes. Such households are expected to prefer middlemen or farm gate sales. However, this could not be the case where such households might keep more cows but vertically integrate their production and opt for own distribution where they are likely to fetch higher prices. In areas where households have relatively larger land holdings coupled with access to communal land, milking herds are larger. On the other hand, due to substitutability between land and capital, households with relatively smaller land holdings and limited access to grazing land can substitute capital for land to produce as much or even higher milk. The substitution is justifiable if the associated productivity or differential in milk market prices is large enough to offset the cost increases. Another argument could be that households with small land holdings may wish to benefit from cash, input subsidies, and other services that could be provided by the dairy cooperatives. In literature, there is mixed relationship of choice of market channel and farm size with some studies arguing that the probability of joining a cooperative decreases with the increase in the farm size (Karli, et al. 2006; Tursinbek and Karin, 2010) while other studies reported a negative relationship between farm size and decision to join farmer based organization (Mussie, et al. 2001; Gockowski and Ndoumbe, 2004). Therefore, the choice of market outlet for such a household is where they fetch the highest returns on their investments.

Education depicts the understanding of market dynamics by the household and therefore improves the decision about which market outlet to participate in (Makhura, et al. 2001). There exists a positive relation between access to information and the proportion of output sold (Omiti, et al. 2009). This is hypothesized to influence the choice of market by a household where a negative relation with farm gate direct sales and middle men is expected. Input use is

affected by the substitution of commercial high-value varieties with easily available and affordable though poor-yielding varieties. Consequently, through negative multiplier effects, implications for technology uptake and hence market choice are likely to be influenced. Households with small production costs are hypothesized to be more inclined to farm gate direct sales or middle men.

Table 3.2: Description of dependent and explanatory variables used in the multinomial logit model and their expected signs relative to choice of cooperatives

Variable	Description	Expected sign
Dependent variable		
DM Choice	Dairy market choice (j=1, 2, 3)	
Explanatory variables		
Gender	Sex of the household head 1 if male, 0 female	+
Age	Age of the household head (continuous)	±
Education	Household head years of formal education (continuous)	+
No. Of Dairy cows	Number of dairy cows owned by a household	+
% of Milk Sales	Percentage of milk sales	+
Training	1=Trained farmer, 0 = Otherwise	+
Milk Output	Annual milk production in litres	+
Information access	1= Access information, 0 = otherwise	+
Land Size	Total household land holding in acres	
Transaction Cost	Total annual dairy transaction cost in ksh '000'	±

Access to market information plays a key role in market participation among rural farmers. The choice of a marketing channel depends on the information of the channel available to the participants. Markets facilitate the exchange of commodities between producers and traders as

well as create linkage between local rural markets and urban markets. Small holder farmers mostly find it difficult to participate in markets because of numerous constraints and barriers which are mostly reflected in the hidden costs that make it difficult to access input and output markets.

Time and money can be saved by substituting travel to markets with telecommunications. Information is gathered through means such as radio, cell phones and computer networks. Information access is expected to reduce costs of connecting buyers and sellers and these savings, combined with quick access to information and instant communication with trade partners open new market possibilities. Improved telecommunications can lower the cost of acquiring information, lower risks and improve market efficiency. These services can offer previously unconnected farmers access to up-to-date price information and broaden market participants.

3:9 Diagnostic Tests

3.9.1 Diagnostic Tests for Logit Models

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. 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.

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. 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 (appendix 5)

3.8.2 Diagnostic Tests for Multinomial logit

Testing for Independence from Irrelevant Alternatives (IIA)

The assumption of independence is critical and leads to substantial computational difficulties involving the computation of multivariate integrals. The ratio of the choice probabilities for any two of the j alternatives (choices) depends only on the characteristics of those two alternatives. If there is a change in the characteristics of any other alternative in the choice set, this property

requires that the two probabilities must adjust precisely in order to preserve their initial ratio, that is, the percentage change in each probability should be equal.

A Hausman test was carried out using Hausman and McFadden (1984) logic that if independence from irrelevant alternatives is valid, parameters of the restricted model should be approximately the same to those of the choice set model (Fader et al. 1996). The Hausman test results showed no evidence that the study did not meet IIA assumption and therefore no need of using nested logit as an alternative.

Test for Multicollinearity

Potential multicollinearity among explanatory variables was also tested in a preliminary analysis where it was found not have any potential influence on estimates from the model. Pair-wise correlation among regressors revealed there was no problem of multicollinearity since the highest correlation was 0.4 whereas multicollinearity is a serious problem if pair-wise correlation among regressors is in excess of 0.5 (Gujarati, 2004). An analysis of variance inflation factor (VIF) which shows the increase in variance of variable x that can be attributed to non-orthogonality of that variable to other variables in the model did not show any problem of multicollinearity (Greene, 2002). As a rule of thumb, if the VIF of a variable exceeds 10, that variable is said to be highly collinear (see appendix 8).

Test for Heteroskedasticity

Bruesch-Pagan/ Cook-Weisberge test for heteroskedasticity was carried where large values of chi-square indicate presence of heteroskedasticity. Breusch–Pagan/Cook–Weisberge test assumes that the error terms are normally distributed under the null hypothesis which implies that the score test statistic is equal to the model sum of squares. However the tests results

indicated by a χ^2 (Chi^2) of 64.51 and Prob > χ^2 of 0.8633 indicating that heteroskedasticity was not a problem.

Test of Normality

A skewness and kurtosis test of normality was carried out where kurtosis represents the ratio of average of the power of the deviations from the mean to the square of the variance. A normally distribution has a skewness and kurtosis of 0. Greene (2002) argues that if a distribution has kurtosis values close to zero, and then it is likely to be normally distributed. However the overall model had a kurtosis probability of 0.0000 meaning in general the assumption of normal distribution was not violated.

Testing for Goodness of Fit

The test indicated a maximum likelihood R^2 of 0.646 indicating that the model fits well. Further, the probability of Pearson χ^2 (Chi^2) of 0.738 and that of Deviance χ^2 of 1.000 confirmed the model fits the data well

CHAPTER FOUR: RESULTS

4.1 Smallholder Dairy Farmers Socio- Economic Characteristics

Analysis of the general demographic and socio-economic characteristics showed that 76.4% of the households interviewed were male headed while 23.6 were female headed. The average age of the respondents was between 45-54 years. About half of the respondents had attained secondary level of education, a quarter finished primary school and only 7.7% were university graduates.

On average, each household owned between 4 - 6 dairy cows with Friesian being kept by over 80% of the households. Ayrshire was reared by 5.1 % of the households while jersey was the least common animal breed. A few farmers reared more than one breed of cattle. Around half (54.9%) of the sample households were involved in other farming as their other source of livelihood apart from dairy farming, while approximately 16.9% of the sample households were pensioners, 11.3% were civil servants while 2.6 % worked in financial institutions. The study found out that the average monthly household income was about Kshs. 15, 000 - 20, 000 while the average farm size was between 1-2 acres. Source of energy was mainly from KPLC (80 %) other sources included solar and fire wood as indicated in Table 3.3.

About 49 percent of the households that had land of less than one acre and reared a herd size of 1-3 cows. Additionally, 26% kept a herd size of about 4-6 cows while 9% kept between 6 and 10 cows. Only 2% of households with land size of 1-2 acres kept more than ten cows. For the households that owned a land size of between 1-2 acres, 18% reared between 1-3 cows, 23% reared a herd size of 4-6 cows while 22% about 6-10 cows while about 4% keep more than 10 cows.

Table 3.3: Summary statistics of respondent (household) demographic and socio-economic Characteristics

Gender of the household head	Male	76.4
	Female	22.6
Respondent average age	Between 45-54yrs	
Literacy rate respondent (%)	Primary	23.6
	Secondary	52.3
	Technical College	6.7
	Teachers College	8.7
	University	7.7
Average Size of the farm	1-2 acres	
Average household income (Kshs/Month)	Shs. 15,000-20,000	
Other occupation apart from dairy farming (%)	Teacher	6.2
	Civil servants	16.4
	Financial institution employee	2.6
	Pensioner	16.9
	Other forms of farming	54.9
	Pensioner and Other forms of farming	1
Source of energy (%)	Own generator	0.5
	Electricity from National Grid(KPLC)	89.7
	Fuel wood	2.1
	Solar power	3.6
	Fuel wood and solar power	1
Average number of dairy cows owned	Between 4-6	
Type of cattle rearing system (%)	Ashyre	5.1
	Jersey	0.5
	Friesian	80
	Crossbreeds	3.1
	Ashyre and Friesian	7.7
	Friesian and crossbreeds	1.5
	Jersey and Friesian	0.5

Source; author, 2014[1]

For households with a land size of 2-5 acres, 6% of the households kept 1-3 cows while 9% kept a herd size of about 4-6 cows. About 4% of the households with an acreage of 2-5 acres

[1] In all the subsequent figures and tables, the author is the source unless otherwise stated

kept between 6-10 cows while 4% kept more than 10 cows. None of the households which had larger farm sizes kept less than three cows. A majority of them kept above six cows as indicated in **figure 4.1**. A correlation of the number of cows and the number of cows kept by a household was positive with a correlation coefficient of 0.45. Likewise, there was a weak but positive correlation between age of the household head and the number of dairy cows kept by a household with a correlation coefficient of 0.05.

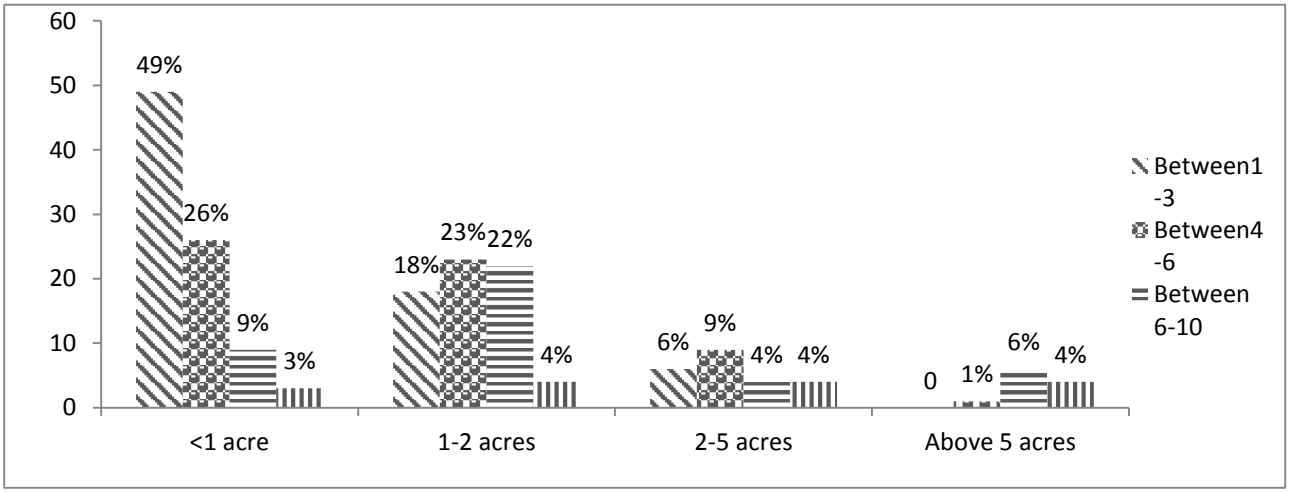

Figure 4.1: Relationship of land size and number of cows owned

4.1.1. Feed system and Production

The most dominant feeding system was zero grazing which was practiced by 91.3% of the respondents. A combination of zero grazing and open grazing was also practiced by 5.6% of the households while only 2.1% of the households practiced open grazing. Since year 2008, household milk production has been increasing with average increment of 200 litres. As indicated in **figure 4.2**, the average milk output in year 2008 was 700 litres while in the year 2012, the average milk production per cow was 900 litres. This is an indication that output per cow has been increasing overtime. It is unclear however what could be the likely cause of increase in production level. It is likely however to argue that per cow productivity has been improving overtime.

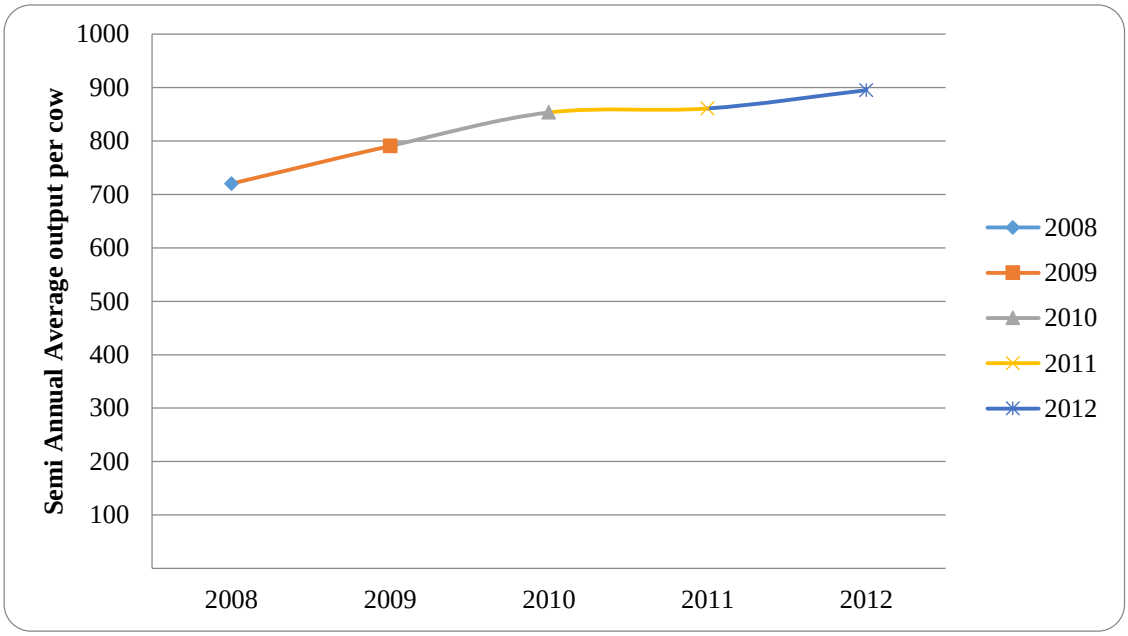

Figure 4.2: The trend in semi-annual milk production per cow (litres)

4.1.2. Households monthly Income

Most of the households had an average monthly income of 15,000-20,000 (38.2%) while 29% had an income range of Kshs. 20,000-40,000. Only 5.8% of the households had an income above Kshs. 40,000. However, the results showed that male headed households had a monthly average income of Kshs 21,962 as compared to female headed households which had an income of Kshs 17,830. Using a spearman correlation, there was a negative correlation (-0.1788) between income of a household and the income level.

Table 4.2: Distribution of Households monthly Income (total from all sources)

Total household income category	% of household
Shs. 5,000	11.0
Shs. 5,000-10,000	16.2
Shs. 15,000-20,000	38.2
Shs. 20,000-40,000	28.9
Shs. 40,000 and above	5.8

4.2 Determinants of Vertical Integration

This section presents the results of the logit model regression analysis for determinants of vertical integration among small holder dairy farmers in Lower Central. Before fitting the model, two major econometric issues related to binary models were checked. The link test indicated that the model was well specified. The results showed that the P>|t| for hatsq was 0.702 indicating that the model was well specified (appendix 2)

The measure of goodness of fit for binary models is the Pearson χ^2 test or the Hosmer-Lemeshow test. As a rule of thumb, the Prob > chi^2 should not be significant for a model to be well fit. The results of this model in this study indicated a Pearson Prob > chi^2 of 0.802 meaning the model fitted the data. **Table 4.3** provides the detailed results for the determinants of vertical integration (appendix 3)

Table 4.3: Logistic regression result for determinants of vertical integration among small-scale dairy farmers in Kiambu County

Variables	dy/dx	Std. Err.	P value
SUNK	0.252	0.132	0.057**
Storage	-0.196	0.608	0.747
MCS	0.120	0.280	0.670
%Milk Sale	1.770	0.436	0.000***
Turnover	0.855	0.211	0.000***
External Source	1.857	0.766	0.015***

Asterisks denote the significance level * = 10%, **5% while *** 1%.

The empirical results showed a positive relationship between total fixed investment incurred by a household in dairy farming 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. These results provide strong support to 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.

The influence of the dairy enterprise turnover on vertical integration was positive as predicted and highly significant at 1 percent. A unit increase in monthly dairy enterprise turnover increases the probability of a household vertically integrating by 0.85 percent. 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 for 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 as 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.

4.3 Determinants of Horizontal Integration

This section presents the logit regression model results for the determinants of horizontal integration. Among the eleven hypothesized factors likely to influence probability of a household to horizontally integrate in the dairy enterprise; six were found to be significant **(Table 4.4).**

Before fitting the model the link test for model specification was carried out. 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 > chi^2 of 0.902 meaning that the model fitted the data.

Table 4.4: Logit results for household likelihood to integrate horizontally in its dairy enterprise in lower Central Kenya

Log likelihood = -127.224			Prob > Chi^2 = 0.000
Dependent Variable: Membership to a farmer association			Psudo R^2 = 0.436
Variable	dy/dx	Std .Err.	P-Value
Education	0.103	0.733	0.088*
Age	0.890	1.384	0.519
Farm size	1.030	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	1.180	1.590	0.039**
WTP for information	2.991	1.293	0.020**
Gross Margin	-1.296	1.179	0.271
Distance	-2.530	1.880	0.178

As hypothesized, a significant positive relationship between education level of the household head and the likelihood of a household to integrate horizontally were determined. The results showed that more educated households were more likely to join 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 owning 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.

There was a positive relationship between household number of years a farmer had been practicing dairy farming and the likelihood of such a household to be horizontally integrated.

An increase in dairy farming by one year increased likelihood of integrating horizontally by 1.2 units. On the other hand however there was a negative relationship between household turnover in the dairy enterprise and the likelihood of integration horizontally. An increase in turnover of a household in dairy enterprise by Kshs 1, 000, reduces the likelihood of such a household to integrate horizontally 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 of the 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.

4.4 Results on Analysis of Factors Influencing Choice of Dairy Marketing Channel

Multinomial logit regression analysis was used to estimate the maximum likelihood of socio-economic factors that influence farmers' choice of milk marketing channel. Before fitting the model some tests were carried out. The test for multicollinearity results showed that Variance Inflation Factors (VIF) range from 1.47 to 1.04 and a mean of 1.26, hence absence of multicollinearity since VIF was less than 10 (See appendix 8). The Bruesch-Pagan/ Cook-Weisberge test for heteroskedasticity had a prob χ^2 of 0.8633 which shows the data were homoscedastic while the normality test showed a kurtosis probability of 0.0000 meaning that the data were normally distributed. The model as whole fitted well with a maximum likelihood R^2 of 0.646 and probability of Pearson χ^2 of 0.738 while that of Deviance χ^2 was 1.000. **Table 4.5** presents the MNL results;

Out of the 13 variables hypothesized to influence market choice, 11 variables were found to be significant. Education level of the household head was negatively related to a household choice of middlemen over cooperative in dairy marketing at 5 percent significance level.

Table 4.5: Multinomial Logistic regression result for determinants of milk market choice

Number of observations = 288; Log likelihood = - 85.17; Prob > chi = 0.000									
Market Channel Choice	1. Farm gate			2. Middlemen			3. Own distribution		
Variables	dy/dx	Std.Err.	P-value	dy/dx	Std.Err.	P-value	dy/dx	Std.Err.	P-value
Gender	0.026	0.549	0.435	-0.044	0.239	0.806	-0.742	1.804	0.996
Education	0.221	0.043	0.677	-0.784	0.412	0.047**	-0.232	0.9	0.548
Age	-0.244	0.413	0.577	0.772	0.39	0.436	0.773	1.742	0.277
No. Of Dairy Cows	-1.038	0.593	0.018**	-0.571	0.546	0.052**	-0.162	0.427	0.866
% Milk sales	-1.244	0.786	0.231	1.095	0.568	0.172	0.143	0.166	0.556
Training	1.163	0.975	0.172	-0.576	1.987	0.228	0.114	0.420	0.069*
Milk Output	-0.113	0.017	0.054*	-0.054	0.233	0.252	0.011	0.038	0.111
Information Access	-1.217	1.037	0.33 4	-1.344	1.728	0.665	0.730	0.987	0.092*
Land Size	0.228	1.005	0.073*	-0.878	0.876	0.851	0.615	0.779	0.548
Transaction Cost	0.140	0.731	0.024**	0.121	0.000	0.412	0.346	0.769	0.128
Vertical integration	-0.064	0.535	0.672	-0.445	0.677	0.859	0.123	0.091	0.061**
Horizontal Integration	-0.158	0.136	0.047**	-0.151	0.043	0.197	0.238	0.117	0.438

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

The more the educated a household head is, the lower the likelihood for that household to use middlemen. Households with more educated household heads were less likely to sell their milk through the middlemen as compared to through the dairy cooperatives.

The size of the farm owned by a household was positively related to choice of farm gate market channel over cooperatives at 10 percent level of significance. As the land size owned by household increases by one acre, the likelihood of that household selling its milk through farm gate compared to through dairy cooperatives increases by 22.8 percent

The results (**Table 4.5**) found a negative relationship between the number of cows a household owned and choice of farm gate and middlemen market channels at 5 percent significance level

respectively. A unit increase in the number of milking cows owned by a household reduced the probability of using farm gate market channel as compared to using cooperatives by 1.03 units. This is expected to be related with the number of milking cows owned by a household

The results (**Table 4.5**) shows that milk output has negative relationship between the choice of farm gate over cooperative societies as a marketing channel. An increase in total household milk output by 10 percent reduces the probability of that household selling its milk through farm gate as compared to through a cooperative by 11.3 percent. In addition, marketing costs significantly influenced the choice of milk marketing channel at 5 percent level of significance. A unit increase in transaction cost incurred by a household increases the likelihood for such a household to sell its milk through the farm gate over cooperative society by 14 percent.

There was a positive relationship between choice of farm gate market channel and access to information. Access to information increased the household likelihood of selling its milk through the farm gate over cooperative by 0.73 percent at significance level of 10 percent. A positive relationship existed between farmers opting to distribute their own milk rather than sell through the cooperatives and access to market information. Households that are vertically integrated were found to have a 12.3% likelihood of selling its milk and milk products through own distribution as compared to through cooperatives.

For horizontal integration, as a household becomes more horizontally integrated the likelihood of selling its dairy products through the farm gate reduces by 15.8 % as compared to selling through cooperatives. It can be concluded that vertically integrated households are likely to sell through their own distribution while horizontally integrated households sell through the cooperatives.

4.5 Comparison of Socio Economic Household Characteristics for Vertically and Non-Vertically Integrated Dairy Enterprises

This section presents results comparing socio-economic characteristics for households that were vertically integrated households and that are not. 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 4.6.**

Table 4.6: Mean differences in socio economic household characteristics for vertically and non-vertically dairy enterprises

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**

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.

4.6 Comparison of Socio Economic Household Characteristics for Horizontally and Non-Horizontally Integrated Dairy Enterprises

This section presents results on differences in some socio economic characteristics for horizontally and non-horizontally dairy enterprises (**Table 4.7**). Out of the twelve analysed factors, nine variables were statistically different among horizontally and non-horizontally integrated households.

Table 4.7: Mean differences in socio economic household characteristics for horizontally and non-horizontally integrated dairy enterprises

		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**

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.

CHAPTER FIVE: DISCUSSION

5.0. Introduction

This chapter presents discussions of the results of this study in line with objectives and hypotheses. The chapter logically discusses the findings and implications of the results as presented in Chapter Four (4).

5.1. Characteristics of Milk Producing Households

The average age of the household head was at middle age with more households being headed by men. This means that most of the farmers were in their productive ages. Literacy levels were high since majority of farmers had secondary education. This implies that farmers are well able to recognize the importance of improved dairy production compared to situations where the levels of education are relatively low. The low average acreage of land holding is important in explaining the intensity of dairy farming. However, in a study carried out in year 2006 by Murage and Ilatsia (2006), the average land size in Kiambu was reported to be around 3.5 acres. This may indicate that since then there has been more land subdivision in the County.

5.1.1. Types of Breeds of Cows Kept and the Feeding System

The results indicated that farmers in the study area have been able to maintain the pure breeds probably through predominance use of AI services. The main dairy breeds kept was Friesian which was kept by about 80% of the households, Ashyre by 5.1% while a combination of Friesian and Ashyre was kept by 7.7% of the households. In highland areas, farmers keep more of improved breeds than local breeds (Wambugu et al 2011). This result indicate that most farmers are using the best breed since the average productivity of Friesian is 7800 kg per lactation period compared to Ayrshire and jersey which has a productivity of 5400kg and 6800 kg per lactating period. The survey results showed that over 90% of the households were using the zero grazing feeding system. In a study in Uganda, farms which practised zero-grazing sold

more milk and operated closer to profit maximization in addition to being more efficient. Moreover, milk productivity is highest in zero grazing feeding systems than in other forms of feeding systems. This due to high feed conversion rate which translate to higher milk production consequently more volume of milk being sold (Baltenweck et al. 2007).

5.1.2. Herd Size per Household and Land Size

The average number of cows owned by households was different across the land holding of different households. Generally, households with bigger land parcels have the potential compared to those with lower land parcels to keep larger herd sizes. This means such households have larger grazing areas as compared to those that are land constraint. Households with smaller grazing areas must invest in commercial feeds if they are to sustain large herd sizes. Across different income, wealthier farmers kept more cows than poor farmers. This was consistent with Wambugu et al. (2011). The average of a herd size of 4 to 6 cows was in agreement with USAID study (2008) which found out that majority of the farmers concentrated in the Kiambu County and own 1-5 cows.

5.1.3. Education Level

The literacy levels in the study area were relatively high, as most farmers had at least attained primary level education. This implies that the farmers are able to recognize the importance of improved dairy farming as compared to farmers with no or low levels of education. This result was consistent with Murage and Ilatsia (2007) study who found out that farmers in Kiambu had at least acquired primary education.

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 on different milk marketing channels. Initially, lack of educated

members in farmer associations had been argued to limit their ability to negotiate profitable deals (Fischer and Qaim, 2011). The implication of these findings is that smallholder farmers get more education through members' education days and seminars and they are able to, pool individual efforts, acquire high bargaining power for inputs and markets for their produce using membership to the cooperative as their platform.

5.1.4. Milk Production and Productivity Growth

From secondary data, the study found out that there has been growth in dairy marketing sector in Kenya since 2005. Positive milk productivity growth may be attributed to factors such as improved animal husbandry practices and veterinary care, better quality feeds, and adoption of more intensive grazing systems and improved cow breeds. According to case study by Muriuki (2003), dairy farmers have improved milk production in Githunguri through improvement of animals and production of more milk per unit area.

These findings are consistent with Wambugu et al (2011) who established that a higher proportion of households in the higher potential agricultural areas compared to those in the lower potential areas keep improved cows and have larger herd sizes. The relatively higher productivity level can also be attributed to choice and intensity of the grazing system as well as the favourable climate for rearing dairy animals in Lower Central Kenya.

5.2. Determinants of Vertical Integration

5.2.1. Effect of Fixed Investment Cost on Vertical Integration

The positive and significant relationship between total fixed investment incurred by a household in dairy farming and the likelihood to vertically provide a strong support to the hypothesis that firms integrate vertically to avoid the problem of lock-in due to large sunk investments. In order to avoid this, households might integrate vertically to improve the rate of

return on fixed investment. Households with big fixed investment in the dairy enterprise are more likely to suffer from lock-in and this may explain why they integrate. The implication of these results is that the probability of integration was positively related to the total dairy enterprise cost. These results are consistent with Lieberman, (1991) who 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 Ouden et al. (1996) the major objective of vertical integration is to eliminate or reduce the costs incurred in production. According to Olasunkanmi et al. (2009) the rate of return on investment was highest for fully integrated poultry farms while the non-integrated poultry farms had the lowest return on capital.

5.2.2. Effect of Enterprise Turnover on Vertical Integration

Empirical result for the dairy enterprise turnover was positive as predicted and highly significant at 1 percent. This implies that farms integrate vertically when they encounter variability in milk prices. 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 as a means of fetching more returns from 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. Vijay et al. (2009) noted that, with vertical integration farmers are likely to reduce transaction costs. This is accelerated by the ability to produce quality produce with value addition facilitating access financial resources thus enabling farmers to venture into new innovations. According to Bamiro et al (2001), low

level of egg production made producers to vertically integrate and ensure that farmers can access quality feeds hence improve integration (Bamiro et al. 2001).

5.2.3. 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, 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 encouraged farmers to shift from cooperative to other channels where they are likely to receive better prices per milk unit.

5.2.4. Effect of Outsourcing Milk from External Sources on Vertical Integration

According to Moss and Schmitz, (2000) vertical integration emanate if there exists a small number of suppliers of an input required by a firm 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 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. 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.

Farmers' dependence on external markets for input acquisition and output selling risks their profit making capacity and increases their risks hence the need to integrate vertically. Given that farmers have little or no control over the demand and prices of the dairy products, due to the nature of the market which is more or less a perfectly competitive, the only plausible approach to increasing net return on investment to dairy enterprises farmers need to reduce the cost of production through vertical integration . With high fixed investment the risk on return on capital is minimized through vertical integration. Farmers who produce high volumes of milk and also buy milk from neighbours are likely to integrate vertically to minimize high transaction costs. With increased dairy turnover, vertical integration is important to ensure survival and continued growth in income of the enterprise (Aihonsu, 1999)

5.3. Determinants of Horizontal Integration

5.3.1. Effect of Education on 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 on 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 area of Indonesia.

The high level of education coupled with years of experience is expected to enhance productivity and efficiency in dairy enterprise since farmers are more exposed to information and more likely to understand the benefits of farmer associations (Xaba and Masuku, 2013). The high level of efficiency could be due to the fact that such farmers might be in other forms

of employment and join farmer associations where they can easily access market, more information on dairy production due to their busy days. It could also be due to their accessibility of funds and more sophisticated technology due to their exposure to new innovations at their places of work that consequently improve their dairy productivity. Since they are also committed to their formal jobs, they cannot outsource new market for their milk on their own due to time constraint. In such cases a milk marketing association is of importance to smallholder dairy farmers.

5.3.2. Effect of Farm Size on Horizontal Integration

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) who, using a probit model, found that farm size positively influenced participation in grass farmer associations in Switzerland. However, when analysing vertical integration and technical efficiency in poultry production in Nigeria, Bamiro et al. (2006) reported that it is important for farms not only to vertically integrate but also to horizontally integrate as a strategy of reducing risk in event of a major disease outbreak.

The implication here is that its likely households with large farms will have more cows and 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 group's coordination in dairy production confers a lot of benefits to farmers, enabling farmers to produce profitably.

5.3.3. Effect of Experience on Horizontal Integration

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 out that the longer the period of growing coffee, the more likely it is for the farmers to become members of a cooperative.

Farmer's experience has an effect on his managerial skills. According to Olasunkanmi (2009) in a study on integration of poultry enterprises in Nigeria, majority of young poultry farmers were involved in non-integrated poultry farming while old farmers operated partially and fully integrated poultry farmers. Correspondingly, old farmer are more experienced in farming and can easily analyse the benefits of belonging to a farmer association than younger farmers.

5.3.4. Effect of Training on Horizontal Integration

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 notwithstanding, could argued, that what is important is not the contact with training but how farmers applies the issues discussed in such farmer workshops for their actual production decisions (Zinnah et al.1993). It can concluded however that farmers in Lower Central Kenya attend training which in turn influence their operations in the dairy production.

5.3.5. Effect of Willingness to Pay for Marketing Cost on Horizontal Integration

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. Institutional innovations such as group membership help in mitigating against the costs of accessing markets (Manyong et al. (2008). The results of this study were consistent with Latvala and Jukka (2004) who found out that 59 % of consumers in Finland were willing to pay more to get information about safety and quality of beef products. It is expected that farmers within farmers' association 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.

5.3.6. Effect of Monthly Turnover on Horizontal Integration

There was a positive relationship between a household 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 turn over. This was expected since households with more milk output tended to take mutually beneficial collective actions leading to higher probability of horizontal integrating. In order to reduce the cost of production the 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 basis. In a study on integration of poultry production in Nigeria, Olasunkanmi et al. (2011) found out that farmer producing higher volume of eggs integrated horizontally than farmers who produced low volumes of eggs. In order to improve productivity farmers join associations as a means through which they reduce transaction costs resulting to higher gross margins.

5.4. Determinants of Choice of Marketing Channels

5.4.1. Influence of Household Land Size on Choice of Dairy Market

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

The results concur with a study of Karli et al. (2006) in the South Eastern Anatolian Region of Turkey which reported that the probability of the membership decreases with the increase in the farm size. These results are also in agreement with study of Tursinbek and Karin (2010) who found that farm size has greater impact on farmers' decision to join cooperatives in Zhejiang in China. Other studies by 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.

5.4.2 Influence of Number of Milking Cows on Choice of Dairy Market

The results found a negative relationship between the number of cows a household owned and choice of farm gate and through middlemen market channels at 5 percent significance level. A unit increase in the number of milking cows owned by a household reduced the probability of

using farm gate market channel as compared to using cooperatives for its milk by 1.79 units. Likewise, a unit increase in the number of milking cows owned by a household by one unit reduced the likelihood of that household using middlemen market channel over cooperative by 0.94 units. Other studies have reported herd size being a significant determinant in market channel participation for modern market channels (Tsougiannis et al. 2008).

As the herd size increases, farmers shift to more organized dairy channels hence the negative relationship with farm gate and middlemen which could be argued to be less organized. Large producers are likely to get price incentives or higher prices for their milk because of high bargaining power as well as lower transaction costs which could be achieved in more organized market channels like cooperative societies. Other farmers are usually contracted by hotels and other milk bar outlets in nearby towns thus drifting from farm gate. Large producers are likely to venture in to organized markets sometimes with contractual arrangements to assure them of a ready market. Farm gate marketing to neighbours and walk- in customers is not an assurance enough for large producers. In addition, the number of animals kept by the farmer determines the total production costs and therefore influencing the amount of working capital needed on the farm forcing farmers with a large herd size to prefer supplying their milk to channels that handle big volumes and pay the whole lump sum milk revenues for continuity running of their dairy operations. However these results are contrary to Vijay, et al. (2009) study who noted a negative relationship between herd size and choice of cooperative marketing channel among dairy farmers in India. This could be likely a case where farmers in cooperatives receive the same price like in other channels and in situations where there is no price incentive to farmers irrespective of quantity of milk they supply.

5.4.3 Influence of Total Milk Output on Choice of Dairy Market

The results of this study show a negative relationship of choice of farm gate marketing channel over cooperative societies. An increase in total household milk output by 10 percent reduces the probability of that household selling its milk through farm gate as compared to through a cooperative by 3 percent. These results are consistent with finding of Tsougiannis et al. (2008) study which established existence of a positive relationship between daily volume of milk produced and choice of cooperatives marketing channel by farmers in Greece. This could be due to the cost reduction to the dairy farmer especially on transport where the cooperative collects milk from its members from collection centres. Spatial distribution of small producers will have implications on the operating costs of the cooperative society. The implication of this result is that dairy farmers who produce fewer litres of milk could simply sell to vendors at the gate to avoid transport costs.

5.4.4 Influence of Marketing Cost on Choice of Dairy Market

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

5.4.5 Influence of Farmer Training, Access to Market Information and Farmer Education Level on Choice of Dairy Market

There was a positive relationship between choice own distribution marketing channel and access to information over marketing cooperatives. In essence, access to information increased the household likelihood of selling its milk through own distribution channel over cooperative by 21.4 percent at significance level of 10 percent. The implication of these results is that it is likely that the trainings attended by these farmers have impact or adds value on their milk marketing channel choices. Furthermore, in some cases farmers can get new techniques, production management, organization and financial management skills through training from different agents. This is an opportunity that can build capacity empowerment of farmers effectively (Samaratunga, 2006).

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

There was a negative relationship between the level of education and choice of middlemen as compared to cooperatives. Formal education enhances managerial competence and successful implementation of improved production, processing and marketing practices (Marenya and

Barret, 2006). Additionally, education has an implication on the ability to understand and interpret extension information received by an individual. Education levels affect market information interpretation and hence, market participation level of farmers (Jari, 2009). The more educated a farmer is the more they are likely to spend less time doing marketing activities hence would rather sell through cooperatives than middle men.

More educated farmers are likely to understand and interpret information shared in groups than less educated farmers. In the current use of information communication technology, educated farmers are more acquainted with different sources of information including internet.

5.4.6. Influence of Vertical Integration on Choice of Marketing Channel

Households that are vertically integrated have a 16.3% likelihood of selling its milk and milk products through own distribution as compared to through cooperatives. On the basis of reducing costs, risks and hence increase the profitability of an agricultural enterprise, vertical integration helps in elimination or reduction of the transaction costs incurred in marketing (Ouden et al. 1996).

5.4.7. Influence of Horizontal Integration on Choice of Marketing Channel

The study showed that for horizontal integration, as a household becomes horizontally integrated its likelihood of selling its dairy products through the farm gate reduces by 12.8 % as compared to selling through cooperatives. Association of farmers in dairy production, confers a lot of benefits to farmers, enabling them to produce profitably and especially through collective marketing. This result was consistent with those of Jenson (1990) who found that access to quality services was the main criteria for farmers choosing between becoming members or non-members in a dairy cooperative. Saharkhiz (2009) using a probit model to evaluate the mechanisms of attracting participation in the cooperative entities, found out that

supportive policies to members played important roles in influencing decision to join such associations. Promotions of scientific and technical assistance among cooperative members were also crucial factors in explaining farmers' likelihood to join farmer associations. Wambugu et al. (2011) who found out that farmers in Kenyan highlands were horizontally integrated in order to maximize on benefits including input supply stores (mainly feed), A.I. and credit services. It can be concluded that vertically integrated households are likely to sell through their own distribution while horizontally integrated households sell through the cooperatives

5.5. Differences between Horizontally and Non-Horizontally Integrated Small Scale Dairy Farmers

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. 2005). 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.

5.5.1. 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.

5.5.2. 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.

5.5.3. 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 cows 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.

5.5.4. 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).

5.5.5. Percentage Milk Sales

This result was as hypothesized. 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. Provision of training, feeds, and credit and extension services should have a beneficial impact on milk productivity.

5.5.6. 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.

5.5.7. 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.

5.5.8. 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.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction.

The study sought to analyse vertical and horizontal integration as determinants of market channel choice among small holder dairy farmers in Lower Central Kenya. A descriptive research design was used to collect data among randomly sampled smallholder dairy farmers. Econometric models were used in analysing determinants of vertical and horizontal integration, market channel choice and the mean differences between integrated and non-integrated smallholder dairy farmers.

6.2 Summary of Findings.

Data on farm size, farm tools, number and type of dairy cattle, milk output, choice of market channels. Turnover, and cost of production, age and gender of the farmer was collected. Other data collected was on the level of education, experience in dairy farming, willingness to pay for information and estimated amounts as well as the estimated distance from the nearest market.

Data on the farmers' socio-economic characteristics was analysed using SPSS Version 20 software to obtain descriptive statistics. Multinomial logit regression was used to analyse the choice of marketing channel while logit regression was used to evaluate determinants of vertical and horizontal integration. The mean difference between integrated and non-integrated smallholder dairy farmers was analysed using the't' statistic.

6.2.1 Small Holder Dairy Farmers Socio-economic Characteristics.

Majority of households were male headed households 76 percent with an average age of between 45-54 years for the household heads. The average land size per household was between 1-2 acres per household. On average, majority of household heads had at least secondary

education, 52.3 percent while for 23.6 percent of households had the only attained primary education with 15 percent having attained at least college education while a further 8 percent had attained university education. Over 80 percent of the households kept Friesian dairy breed while about 5 percent of households purely kept Ashyre breed while the remainder reared a combination of different dairy cattle breeds. Zero grazing was the most common dairy rearing system practiced by farmers. The dominance of zero grazing system could be attributed to better feed management and better cattle feeding practices associated with that system especially in presence of limited land sizes.

The mean average monthly household income from dairy was about Kshs 15,000-20,000. About 38 percent of the smallholder farm households had a monthly income range of Kshs. 15,000-20,000 which are the majority. About 29 percent had income ranges of Kshs. 20,000-40,000 while only 5.8 percent of the households had an income of above Kshs. 40,000 per month.

6.2.2. Determinants of Smallholder dairy farmers Integration

Monthly turnover cost of production, fixed investment, storage, percentage of milk sold, milk cost share and external sources of milk were hypothesised to be the determinants of vertical integration. Fixed investment, turnover, volume of milk sold and external source of milk had significant relationship to the probability of a dairy enterprise integrating. Of the eleven variables hypothesised as determinants of horizontal integration, six were found to be significant. Education level, farm size, milk output, experience, monthly turnover, number of dairy cows and distance to the nearest market has a significant likelihood of a household to integrate horizontally.

6.2.3. Choice of Dairy Marketing Channels

The analysis of the choice of market channel was anchored on four hypothesized channels namely: farm gate produce marketing cooperative, middlemen and farmers own outlet with the produce marketing cooperative as the base category for the analysis. Thirteen variables including vertical and horizontal integration were hypothesized to be determinants of market channel choice. Education, number of dairy cows, milk output, training, milk output per cow, information access, land size, transaction costs, vertical and horizontal integration were found to be determinants of market channel choice among the dairy farmers.

Households which had not received training on agricultural production were more likely to sell through farm gate as opposed to cooperatives. The results affirm the notion that extension officers mostly target households with large land holdings which was positively related with choice of farm gate over cooperatives. Households that were headed by more educated heads sold more through the cooperatives than through the middlemen. The lesser the number of dairy cows and the lesser the total milk volume that a household had, the more likely that household was to sell through the cooperatives than through the middlemen.

Similarly, households producing more milk volumes had a higher likelihood of selling through cooperatives as opposed to farm gate marketing option. Households with bigger land sizes were more likely to sell their milk at the farm gate as opposed to selling through the cooperatives. Unlike households that are land abundant, farmers with small land sizes benefit from cash, input subsidies, and service provided by the agricultural cooperatives. Such households in order to raise their productivity substitute capital for land. Households that had information of market prices preferred to sell on their own than to sell through the dairy cooperatives

6.2.4. Mean difference in Socio-economic Characteristics for Integrated and Non-integrated dairy farming enterprises.

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

6.3. Conclusion.

These results of this study affirm the need for integration and policy interventions to streamline that milk marketing channels. Farmers training and easy access to information are key to improved dairy production and marketing.

6.4. Recommendations

1) The evidence given in this study adds further weight on strategies towards enhancing dairy market competition and hence dairy marketing efficiency. The debate has initially revolved on different issues especially of whether sale of raw milk in urban areas should be legalised and encouraged. This will persuade dairy policy makers to accept and include raw milk in milk marketing statistics although it has been assumed away and not reflected in milk marketing statistics despite the fact that it has become one of the thriving activities in all urban areas.
2) Due to declining land parcels due to population pressure and competition from other investments like housing, policy makers need to focus on growth in agricultural

production based on enhanced productivity of land already under cultivation, and from capital investments that will transform marginal lands to zones of high-value agricultural production.

3) Further achievements will be attained through investments in genetic improvements of cows kept, provision of high quality animal feeds and improving feed management. This is already evident with some farmers in Ndumberi and Githunguri who have already adopted an elaborate dairy farming practice where they have constructed silages and other feed storage facilities to ensure regular feed supply. This explains why such farmers produce large volumes of milk in excess of 250 litres per day. Farmer training and better access to relevant information on dairy production through the extension system or the milk cooperatives will also be an important action point.
4) Provision of education and services to the farmers on different milk marketing channels will be key in accessing the best marketing channel.
5) 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. The effort of policy makers is therefore on designing better modes involving the farmer to enhance the appropriateness and adoption rates. Different farmer participatory methodologies need to be exploited. Similar efforts are underway in some parts of rural Kenya where ILRI has started a few dairy farmers' field schools on a pilot basis where farmers are encouraged to participate in screening available technologies, to identify those relevant and to make any necessary adaptation.

6.5. Suggestions for Further Study.

The study focused on vertical and horizontal integration as determinants of market channel choice among small holder farmers. Further research should be carried out on the extent to which large scale farmers who have vertically integrated can create horizontal integration with small holder farmers.

This study used the farmer as the point of analysis. Researchers can carry out further studies on what choice attributes could influence farmers' choice of marketing channel.

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Appendices

Appendix 1: Questionnaire

Analysis of vertical and horizontal integration as determinants of market channel choices among smallholder dairy farmers in Lower Central Kenya

Greetings!

We are carrying out a research on smallholder dairy farming enterprises and you have been identified as one of the resource person (respondent) for this study. The information gathered from this study will be helpful in understanding of the prevailing nature of the dairy sector and the possible interventions which are critical for improving smallholder dairy production. The purpose of this study is to gather information that can be used to inform government and other stakeholders about the interventions necessary in order improve productivity and economic welfare of smallholder dairy farmers. All the information given will be treated with utmost confidentiality and your cooperation is highly appreciated.

Thank you

Kindly respond to the following questions as truthfully as possible

1. IDENTIFICATION AND INTERVIEW BACKGROUND

	DD/MM/YYYY	Name:		code
Date of interview		Interviewer		
Time started		Time ended in 24 hrs		
Date checked		Checked by;		

Variable	**Response**	**Code**
County		
District		
Division		
Location		
Sub-location		
Village		
Respondent name		
Mobile phone number		
Dairy farming experience (yrs.)		

2. GPS MAPPING

Way point (mm.ddddd)	**N:**..... **E:** ..... **ALTITUDE:** ……..

3. CURRENT HOUSEHOLD COMPOSITION

Household member; *- people who live together and eat together from the same pot including hired labourers, students and spouse living and working away. Exclude visitors.*

Member code	Name of the household member (start with the respondent)	Sex **(Code A)**	Marital status (**Code B)**	Age (yrs)	Relation to the household head (Code D)	Education (yrs) **(Code C)**	Number of months a household member has lived in the household for the last 12 months
1							
2							
3							
4							
5							

Code A	**Code B**	**Code C**	**Code D**	
1 : Male	1. Married living with spouse	0 : Illiterate	1.House hold head	7. Hired laborer
2 : Female	2. Married but spouse away	1 : Adult education	2.Spouse	8. Nephew/Niece
	3. Divorced/ Separated	Others give in yrs	3.Son/Daughter	9. Grand parent
	4. Widow/ Widower		4. Sister/ Brother	10.Grand child
	5. Single		5. Parent	11. Brother/sister in law
	6. Other		6. Son/Daughter in law	12. Other specify..

(To the Enumerator indicate the age range of the household head below.)

	Age category
Tick which age category is household is (Refer from above)	1 = Below 25 yrs
	2 = Between 25-34yrs

	3 = Between 35-44yrs
	4 = Between 45-54yrs
	5 = Above 55yrs

4. SOCIAL CAPITAL AND NETWORKING

Does any house hold member currently a member of any group? **1 = Yes, 2 = No**. If yes fill the table below						
Member code	Type of the group **(Code A)**	Three most important group functions **(Code B)**			Yr joined YYYY	Role in group **(Code C)**

Codes A	**Codes B**	**Codes C**
1.Dairy producing Farmer association	1. Marketing	1. Official
2. Dairy marketing Farmer association	2. Input access	2. Ordinary member
3. Dairy input access Farmer association	3. Farmer research	3. Ex-officials
4. Dairy farming financial Farmer association	4. Savings and credit	

5. LIVESTOCK PRODUCTION AND MARKETING IN THE LAST 12 MONTHS

Livestock type	Number owned currently	How many did you sell	selling price/ unit	Ashyre	Jersey	Guernsey	Friesian	Crossbreeds
Daily cow								
Bulls								
Calves/Heifers								
Milk produced (ltr)								

6. Does the household buy milk from neighbours to supplement your own production? 1= Yes, 2 = NO

7. Milk marketing channel

a) Through what marketing channels do you sell your milk produced (List all the alternatives)

1.

2.

3.

4.

b) Out of the above channels which is your main channel?

(List only one here)

c) Why do you prefer the above mentioned channel***? (List all the reasons)***

1

2

3

4

8. Dairy production and facilities

What is the most common storage facility for milk before sale to customers?	1= Fridge [ ]	
	2= Milk cans [ ]	
	3= Cold room [ ]	
	4=other specify [ ]	
Have you been a dairy farmer for more than one year	Yes = 1 [ ] No = 2 [ ]	
If yes in **above**, indicate average daily milk production	**Milk production per day** 2008 =…… litres, 2009 = ……. litres 2010 = ……. litres 2011= ……. litres 2012= ……. litres	
What would be the most likely cause of increase in milk output? (Rank in order of priority)	**Reason**	**Rank**
	a)	
	b)	
	c)	
	d)	
	e)	

9. Energy source

What is the households' primary of energy?	1 = Own generator [ ]
	2= Electricity [ ]
	3 = Fuel wood [ ]
	4 = Solar power [ ]

	5 = Other specify ……

10. HOUSEHOLD INCOME SOURCES FOR THE LAST 12 MONTHS

	Income type	Does this household earn from? Yes = 1, No = 2. *If No go to the next row*	Average income/ unit		Total income
			Cash	In kind	
1	Agricultural labor				
2	Casual labor				
3	Salary				
4	Pension				
5	Rent				
9	Sale of wood or charcoal				
10	Sale of fruit				
11	Petty trade (shops, grocery)				
12	Transport				
13	Sale of crops				
14	Sale of crop residues				
15	Sale of animal fodder				
16	Livestock sale				
17	**Milk sale**				
18	Eggs sale				
19	Sale of other livestock products				
20	Rented out land				
22	Other specify				

11. Horizontal and Vertical integration

How do you participate in the management of the association?	General meetings =1 Delegates = 2 , A board member = 3, 4 = Others (specify)…….
What are the benefits of joining the association? Rank in order of importance	1 2 3 4
In what form do you mainly sell your milk	Fresh Raw milk = 1 Added Value = 2
If 2 in immediate above, what form of value addition?	1= Pasteurization 2 = Packaging 3 = Branding 4 = Other specify
How do you deliver the milk to the customer?	1= Wait for walk-in customers 2 = Through middlemen 3 = Contractual arrangements with retailers 4 = Appointed agents 5 = Own distribution firm/department 6= Dairy cooperative undertakes it
How far is your farm from the nearest all weather road.	……km.

12. Access to credit

What are your sources of finance for dairy enterprise expansion?	1= Savings from own salary income 2 = Credit from commercial banks 3 = Credit from dairy cooperative society 4 = Profit from other farming activities 5 = Profit from dairy farming
Do you occasionally use external funding	Yes =1, No = 2
If yes in immediate above indicate the source	1 = Loan from bank 2 = Loan from microfinance institution 3= Loan from cooperative 4 = Loan from association 5 = Loan from shylocks 6 = Loan from friends
What are the requirements for you to get credit from your financier	Collateral = 1,business plan =2 , deposit of percentage of loan = 3 , references from friends =4 , membership to a group = 5
If the lender requires collateral indicate the type	Dairy cow = 1, land title = 2, Business plan = 3, milk pay slip = 4, Processors guarantee = 5
Are you given the loan equal to amount applied	Yes =1, No =2
If NO in immediate above, indicate the most appropriate reason	Collateral not adequate = 1 , Collateral adequate but denied amount =2 Cash flow okay but denied amount =3 Membership to a group but denied

	amount = 4 , Unable to pay cost of processing loan =5
Do lenders deliberately deny amount applied?	Yes =1, No = 2
Explain your answer above	1)……. 2)……. 3)……
Which of the following factors would encourage processing of milk from your farm?	Availability of credit =1 , Availability of appropriate technology =2 Knowledge on milk processing =3, Government incentives on milk processing = 4
Which of the following benefits would accrue to a farmer involved in milk processing?	Agro-tourism=1 Training other farmers at a fee=2 Tax rebates from the government =3 Enhanced reputation =4

13. Dairy enterprise production cost

	item	monthly cost in Kshs	Annual costs
1	Commercial animal feeds		
2	Veterinary services		
3	Animal health drugs		
4	Water		
5	Hired Labour		
6	Family labour(man days		
7			
Wage rate per day			

14. LAND HOLDING IN ACRES IN THE LAST 12 MONTHS

Total land owned (acres).....Rented in/Borrowed in (acres)..... Rented out/Borrowed out (acres).....

	Long rains		**Short rains**	
Land category	Cultivated	Uncultivated; (Grazing and Homestead)	Cultivated	Uncultivated; (Grazing and Homestead)
Own land				
Rented in				
Rented out				
Borrowed out				
Borrowed in				

11. HOUSEHOLD ASSETS

	ASSET	Total number owned currently	Total value of the asset at their current condition
1	Forked jembe		
2	Hoe		
3	Spade		
4	Axe		
5	Knapsack sprayer		
6	Ox plough		
7	Water pump		
8	Tractor		
9	Chuff cutter		
10	Generator		
11	Solar panel		
13	Panga		
14	Mattock		
15	Ox cart		
16	Push cart		
17	Bicycle		
18	Motorbike		
19	Wheelbarrow		
20	Vehicle		
21	Radio		
22	Mobile phone		
23	T.V		
24	Computer		
27	Improved charcoal store		
28	Posho mill		
29	Sofa set		
30	Other (specify)		
31	Land owned (acres)		

15. DISTANCE TO SERVICES

	Issue	km	walking minutes	cost
1	Distance to the village market from residence			
2	Distance to the nearest input source (fertilizer, seeds)			
3	Distance to the nearest agricultural extension officer			
4	Distance to the nearest all weather road			

	Number
5. Number of contacts with extension services in the last 12 months	

16. Access to market information

Who are your customers?	Individuals =1, Businesses = 2, Schools and colleges =3, Government departments = 4, NGOS=5 Dairy cooperative = 6
Where are your customers located?	Urban centres =1, Rural areas=2, No definite location=3
Who are your competitors?	Other farmers =1, Soda vendors =2, Bottled water vendors=3 Packed juice vendors=4, Fresh Fruit vendors=5
Where are they located?	Same area =1, In trading centre=2, Large urban centre =3 No definite location=4
How is your milk product distributed?	Own shop =1, Middlemen=2, Own distribution = 3 Dairy cooperative =4
From what source do you receive information about consumer demand for milk and milk products	Government Agencies =1, Informal milk traders =2, Radio =3, Bulletins =4, Newspapers and magazines =5 Other farmers=6. Price determined by the dairy cooperative=7
How do you receive information on the market prices for milk and milk products?	Dairy cooperative=1, Radio =2, T.V =3, Public baraza =4, Other farmers =5, Informal milk traders= 6. Bulletins=7
Would you be interested in getting information on market prices and consumer demand	Yes =1, No=2
1. Does access to market information assist in increasing quantity of milk delivered to your cooperative?	Yes=1 No=2
2. If No in immediate above, explain your answer	
If Yes, in 1 above would you willing to pay for the information	Yes =1, No=2
If yes indicate how much you pay per week per lot of information on market prices and demand.	…….. Kshs.

17. Government intervention

Have you registered your business?	Yes=1 no=2
If yes in immediate above, Is registration for an individual or group business.	Individual=1, Group =2
Did you encounter obstacles/challenges in the registration process? Explain	
Indicate the number of employees in your dairy enterprise	<5 = 1, 10 = 2, 20 = 3, 30 = 4, 50 = 5 above 50 = 6
What is the cost of production?	
Is your profit margin able to sustain the dairy operations?	Yes=1, No= 2
Explain your answer in above	
Does the government offer incentives/ subsidies to cooperatives / farmers involved in milk processing?	Yes=1 No = 2
If Yes in immediate above, state the incentives provided	

18. Entrepreneurial orientation.

In a period of three years how often do you replace the dairy cows with other breeds?	Once = 1,Twice = 2, thrice =3
What prompts you to replace the cattle breeds	
Indicate the most ideal strategy of business survival and continuity(Rank in order of importance)	Frequent renewal of cattle breeds---- Diversification of farming activities- Enter into contract with the cooperative on quantity of milk to be delivered------- Start to process own milk------

Indicate the source of funds to meet running costs and capital expansion of your enterprise.	Savings from salary income =1, Credit from commercial banks=2 Credit from friends=3, Profit from other farming activities =4, Profit from dairy farming =5
Do you produce the same quantity of milk throughout the year?	Yes=1 No=2
Explain your answer if yes in immediate above	a) b) c)
Apart from your farm, do you have other sources of milk for sale to dairy cooperative/for your processing plant?	Yes = 1 , No =2
If your answer in immediate above is Yes, indicate the total number of farmers selling milk to your enterprise and weekly quantity of milk supplied.	Number of farmers……... Total weekly milk supplied……litres
Indicate the total number of milk traders who are not farmers who sell milk to your enterprise and quantity of milk supplied.	Number of non-farmer milk trader……... Total weekly milk supplied……litres/kilos
Briefly state the challenges you face while marketing your milk products.	
In a period of three years how often do you undergo training on dairy enterprise Management?	Once=1,twice=2 thrice=3, others(explain)
Do you allow your employees to make and execute decisions on when to dry and serve the cows?	Yes=1 No=2
If yes in immediate, explain why you allow the employees to make and execute the said decisions.	
Do you operate other related businesses alongside the dairy enterprise?	Yes=1 No=2
Indicate the percentage contribution of other enterprises indicated earlier to total income.	

Appendix 2: Link test for logit Vertical integration model specification test

	Coefficient	Std. Err.	z	P>z
_hat	1.052748	0.266144	3.96	0
_hatsq	0.05038	0.131641	0.38	0.702
_cons	-0.02431	0.19651	-0.12	0.902

Appendix 3: Logit model for vertical integration Pearson goodness of fit test

Logistic model Pearson Chi2 , goodness-of-fit test
Pearson chi2(288) = 126.80
Prob > chi2 = 0.7020

Appendix 4: Test for multicollinearity in the vertical integration logit model variables using Variance Inflation Factor

Variables	**VIF**	**1/VIF**
SUNK	1.476	0.678
Storage	0.589	1.698
MCS	2.442	0.410
%Milk Sale	2.269	0.441
Turnover	1.936	0.517
External Source	1.593	0.628
Mean VIF	**1.7175**	

Appendix 5: Link test for horizontal integration logit model specification test

	Coefficient	**Std. Err.**	**z**	**P>z**
_hat	1.1385	0.45844	4.06	0
_hatsq	0.0603	0.23941	0.48	0.802
_cons	-0.0463	0.20671	-0.18	0.802

Appendix 6: Test for multicollinearity in logit model variables for horizontal integration using variance inflation factor.

Variable	VIF	1/VIF
Education	1.347	0.742
Age	1.853	0.540
Farm size	1.858	0.538
Milk Output	2.281	0.438
Experience	1.994	0.502

Monthly Turnover	1.063	0.941
Number of Dairy cows	2.851	0.351
Training	1.264	0.791
WTP for information	2.447	0.409
Gross Margin	1.751	0.571
Distance	1.947	0.514
Mean	**1.878**	

Appendix 7: Logit model for horizontal integration Pearson goodness of fit test

Logistic model Pearson Chi2 , goodness-of-fit test
Pearson chi2(288) = 154.80
Prob > chi2 = 0.8020

Appendix 8: Test of multicollinearity for variables in market choice model using variance inflation factor

Variable	**VIF**	**1/VIF**
Gender	1.09	0.92
Education	1.23	0.81
Age	1.12	0.89
No. Of Dairy Cows	3.14	0.32
% Milk sales	1.42	0.70
Training	1.15	0.87

Milk Output	2.77	0.36
Information Access	1.07	0.93
Land Size	1.17	0.85
Transaction Cost	2.39	0.42
Horizontal integration	2.44	0.41
Vertical integration	1.99	0.50
Mean VIF	**1.73**	

Appendix 9: Test for Normality for multinomial logit model variables in the choice of market channel using the Skewness and kurtosis test for normality

Variable	Pr(Skewness)	Pr(Kurtosis)	chi2(2)	Joint Prob>chi2
Gender	0	0.444	63.05	0
Education	0	0.876	36.71	0
Age	0	0.426	25.22	0
No. Of Dairy Cows	0	0	54.61	0
% Milk sales	0	0.232	29.91	0
Training	0	0	165.41	0
Milk Output	0	0	408.32	0
Information Access	0	0	321.79	0
Land Size	0	0	295.56	0
Transaction Cost	0	0	288.2	0
Horizontal integration	0	0	124.53	0
Vertical integration	0	0	146.37	0

Appendix 10: Pairwise correlation matrix to test multicollinearity among variables in the market choice model

Variable	Gender	Education	Age	Land Size	No. Of Dairy Cows	% Milk sales
Gender	1					
Education	-0.056	1				

Age	-0.027	-0.09	1			
No. Of Dairy Cows	-0.06	0.262	0.213	1		
% Milk sales	-0.158	0.324	-0.078	0.2	0.242	
Training	-0.117	0.23	-0.088	0.032	0.138	1
Milk Output	0.133	-0.099	0.042	-0.065	-0.048	-0.108
Information Access	0.121	-0.114	0.045	-0.012	-0.058	-0.194
Land Size	-0.048	0.326	0.019	0.246	0.475	0.188
Transaction Cost	-0.075	0.251	0.051	0.246	0.446	0.182
Horizontal integration	-0.247	0.254	0.375	0.057	0.047	0.238
Vertical integration	-0.475	0.149	0.348	0.024	0.086	0.432

	Info Access	**Training**	**Milk Output**	**Transaction Cost**	Horizontal Integration	Vertical Integration
Information Access	1					
Training	0.1376	1				
Milk Output	-0.0615	-0.1064	1			
Transaction Cost	-0.0598	-0.0721	0.4706	1		
Horizontal integration	0.038	0.027	0.075	0.086	1	
Vertical integration	0.237	0.273	0.436	0.073	-0.347	1

Appendix 11: test for heteroskedasticity for Multinomial logit model for choice of dairy marketing channel

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

Ho: Constant variance

$chi^2(1) = 64.51$

$Prob > chi^2 = 0.8633$

Appendix 12: Test for goodness of fit for MNL Model

Log-Lik intercept only	-170.014	Log-Like full model	-199.758
D (133)	239.517	LR(28)	100.510
McFadden's R^2	0.300	Prob > LR	0.000
ML (Cox - Shell) R^2	0.460	McFaddens Adj R^2	0.119
Maximum Likelihood R^2	0.646	Cragg-Uhler (Nagelkerke)R^2	0.525
Count R^2	0.693	Adj Count R^2:	0.479
AIC	1.838	AIC*n	299.517

Appendix 13 Additional Measures of goodness of fit for MNL

Omitted		**Evidence**
Cooperative	0.860	For H0
Farm gate	0.750	For H0
Own distribution	0.630	For H0
Middlemen	0.748	For H0

	χ^2	df	Sig.
Pearson	432.008	462	0.738
Deviance	280.949	462	1.000

Appendix 14: Hausman Test for Independence from Irrelevant Alternatives (IIA)