ANALYSIS OF MILK CHAINS AND DETERMINANTS OF PARTICIPATION IN PROCESSED DAIRY CHAINS BY SMALLHOLDER DAIRY FARMERS IN MERU AND UASIN GISHU COUNTIES, KENYA

METTO CHEMUTAI VERONICA

A Thesis Submitted to the Graduate School in Fulfillment for the Requirements of the Award of Master of Science Degree in Agricultural and Applied Economics of Egerton University

EGERTON UNIVERSITY

OCTOBER, 2016

DECLARATION AND APPROVAL

Declaration

I hereby declare that this is my original work and has not been presented in this or any other University for the award of a degree.

Signature ……... Date……

METTO CHEMUTAI VERONICA

Registration Number: KM17/3007/11

Supervisors' Approval

This thesis has been prepared under our supervision and submitted with our approval as supervisors.

Signature……. Date……

Prof. Ngigi W. Margaret

Department of Agricultural Economics and Agribusiness Management, Egerton University

…… …….

Signature Date

Dr. Makokha N. Stella (PhD)

Kenya Agricultural and Livestock Research Organization (Nairobi)

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DEDICATION

This work is dedicated to my family and my children Andrew and Megan.

ACKNOWLEDGEMENT

I thank the Almighty God for enabling me reach this far. My sincere appreciation also goes to Egerton University for giving me an opportunity to pursue a Master's degree. I wish to also acknowledge with appreciation my University supervisors Prof. Margaret Ngigi and Dr. Stella Makokha, for their technical advice, guidance, patience and encouragement throughout the thesis writing period.

I also give my appreciation to the CMAAE secretariat and KALRO for funding and supporting my research. I am thankful to the smallholder dairy farmers from Meru and Uasin Gishu for their time and the information that guided my research. I acknowledge the staff of the Department of Agricultural Economics and Agribusiness Management for their support since I enrolled for my studies. I also give my gratitude to my course mates and my family for their financial support throughout my studies.

ABSTRACT

The dairy sub-sector in Kenya is of particular importance as it provides vital employment, income and nutrition, in an environment where job opportunities are scarce. The subsector markets about 55 percent of the total milk produced but the informal sector accounting for more than 75 percent of all the marketed milk. Large milk quantities are marketed through the informal sector raising questions over the safety and quality of milk products. In spite of the growth of value added milk chains in Kenya, unprocessed milk chains are still dominant. The major milk processors in the country face a challenge of low capacity utilization during dry seasons while during the rainy seasons milk is wasted due to limited capacity. This has led to the growth of small scale milk processors and milk handlers in the country. This study compared marketing margins along unprocessed and processed dairy chains and examined factors that influenced actors' decisions to upgrade processes, products as well as functions along selected dairy chains. The study employed Probit and Tobit econometric models as well as principle component analysis to answer the objectives. Using a sample of 273 respondents and farmer-based self-help groups, the results of the probit analysis showed that smallholder dairy farmers were more likely to add value to milk if they had value addition skills and if they were members in a value addition group. The results of Tobit analysis showed that participation by smallholder farmers in either the unprocessed or processed milk channel was significantly influenced by distance to the market, the herd size, total farm revenue as well as awareness of standard regulations. In the quest to upgrade the quality of milk, there is therefore need to improve on value addition skills through training and encouragement of participation in collective action. Furthermore, infrastructure in the form of roads, communication and electricity need to be improved to facilitate improvement in the quality of milk.

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LIST OF ACRONYMS AND ABBREVIATIONS

KDB – Kenya Dairy Board

GDP- Gross Domestic Product

SDP-Smallholder dairy Project

FAO-Food and Agricultural Organization

USAID- United States Agency for International Development

UNIDO-United Nations Industrial Development Organization

IFAD-International Fund for Agricultural Development

PCA- Principle Component Analysis

SPSS-Statistical Package for Social Sciences

KM-Kilometer

KES-Kenya shillings

CHAPTER ONE: INTRODUCTION

4.1 **Background Information**

Kenya's economy is largely agricultural. The agriculture sector accounts for 26 percent of the gross domestic product (GDP) and 60 percent of export earnings. The sector directly and indirectly employs more than 80 percent of the population (World Bank, 2009). There are over one million smallholder farmers who contribute up to 75 percent of the total agricultural output and 70 percent of the marketed agricultural output (SDP, 2005)

The dairy subsector in Kenya is rated as one of the fastest growing subsectors in Kenya, faster than even tea. It plays an important role in the national economy and in the socio-economic development of many rural households in Kenya. It contributes to about 14 percent of the agricultural GDP and 4 percent of Kenya's GDP as shown by statistics by the Kenya Dairy Board (KDB, 2014). Milk, which is a major product of the dairy sub sector, is valued by many families in Kenya due to its nutritional contribution especially to children. The subsector contributes more to livelihood of many Kenyans through employment, directly and indirectly, along its value chains and to nutrition. The subsector has had tremendous growth over the past years with research showing that for the periods between 2002 and 2010, volumes of milk processed have increased from 144 million litres to 516 million litres while milk production is estimated to be 4.1 billion litres per year (KDB, 2014). This shows that out of the total milk produced per year a very small percentage is processed. Annual per capita milk consumption in Kenya is estimated at 115 litres per individual which translates to an approximate of 5 billion litres per annum. This therefore means that there is limited surplus milk for exports (FAO 2007).

The Kenyan dairy sub-sector has had significant changes since the industry was liberalized in 1992 (Karanja, 2003).The subsector markets about 55 percent of the total milk produced with the informal sector accounting for more than 75 percent of all the marketed milk (FAO 2011). Since large milk quantities are handled by the informal sector which is unregulated, questions have been raised over the safety and quality of milk products with research showing milk products handled by traders in Kenya having high bacteria levels (Omore *et al.*, 2011).

Increased safety standards and consumer trusts as well as climate change continue to be a challenge in the dairy sub-sector. Production is costly and characterized by very low input use but this varies according to the degree of commercialization by a farmer. Muriuki (2011) showed that feed represented the largest part of the cost of milk production in Kenya and that there were

no effective mechanisms to assure farmers of the quality of feeds in the markets. Research done in Kenya shows that cows are generally underfed, causing low milk production per cow (FAO 2011).

Kenya's milk surplus is concentrated in regions where milk production is high and much of the milk not absorbed into informal and formal channels goes to waste for lack of storage facilities. According to 2009 statistics, there were 52 milk processors in Kenya of which only 34 were active (FAO 2011). The major milk processors face the challenge of capacity utilization of as low as 40 percent with most of the processors constantly looking for new milk sources to fill processing plants to capacity (Technoserve, 2008). Other actors involved in the marketing of milk are distributers and retailers.

A value chain perspective shifts focus of agriculture from production alone to a whole range of production activities from designing to marketing and consumption. Many policy makers have emphasized the need for developing a market oriented and market led opportunities along the entire value chain ((USAID, 2010), (IFAD, 2010), and (UNIDO, 2009a). Production driven by demand requires improved market literacy of producers as a prerequisite for access to niche markets e.g. supermarkets (Reardon, et al., 2004) but this remains a challenge for small scale farmers.

Upgraded value chains are characterized by high technological capabilities, skills and specialization. Dairy products from these chains are pasteurized and packaged before marketing thus tend to serve niche markets, such as supermarkets, which are characterized by stringent standards for quality. According to (Giuliani, Pietrobelli, & Rabelloti, 2005) traditional manufacturing industries are characterized by a low degree of technology use. Traditional processes such as boiling and fermentation of milk are some of the ways in which participants in the dairy value chain use to add value to the milk products (Makita *et al.*, 2011).

According to (UNIDO, 2009b) upgrading involves increasing technological know-how and management abilities of the involved parties so as to enable effective participation in value chains. Upgrading a value chain therefore means not only acquiring knowledge and technologies, but at a faster pace than other actors in competing chains so as to have a competitive edge. There is therefore a need to shift focus and study the unprocessed milk and processed dairy chains and ways of improving processes, products as well as functions. Traditional value addition have opportunities to increase volumes of milk marketed with less stringent standards (UNIDO,

2009b) and comprise of majority of smallholder farmer thus giving opportunities for broad-based rural development. It is therefore imperative to study the two value chains, compare marketing margins and characteristics and identify the key drivers of upgrading decisions along the dairy channels in terms of specific factors in each selected value chain.

1.2 Statement of the problem

Research shows that consumers are willing to pay for high quality and safe milk products, hence the reason for increased demand for value addition. Varieties of dairy products, to suit different needs by consumers, have emerged in the Kenyan market necessitated by changes in taste, increase in income and exposure. Despite this, unprocessed milk is still dominant in the market indicating minimal value addition is done.

The unprocessed milk and processed milk value chains may offer different opportunities for development and improvement of the overall dairy sub sector, however, little has been done in terms of characterizing and comparing the unprocessed milk value chains with the processed dairy value chains. It is not clear whether the marketing margins received by actors from unprocessed milk and processed marketing channels differ hence this research proposes to provide this information. There is no sufficient information on factors that influence upgrading and participation decisions by actors along unprocessed and processed dairy chains in Kenya; hence opportunities for efficiency and development that are available in the dairy value chains have not been sufficiently explored.

1.3 Objectives of the study

1.3.1 General objective

To contribute towards improved value addition and marketing of milk by smallholder dairy farmers and market agents

1.3.2 Specific Objectives

1. To characteristics processed dairy chains and unprocessed dairy chains in Meru and Uasin Gishu counties
2. To analyze the determinants of smallholder actor’s participation in unprocessed milk value chains and processed dairy chains in Meru and Uasin Gishu Counties
3. To compare the cost structures and marketing margins along processed and unprocessed milk marketing channels in Meru and Uasin Gishu Counties

4. To determine the factors that influence the decisions to upgrade by actors along the selected dairy chains in Meru and Uasin Gishu counties

1.4 Research questions

1. What are the characteristics of raw milk and value added milk chains in Meru and Uasin Gishu counties?
2. What are the determinants of smallholder farmer participation in unprocessed and value added dairy chains?
3. How do cost structures and gross margins vary along raw and value added milk marketing channels?
4. What are the factors that influence upgrading decisions by actors along raw and value added dairy chains in Meru and Uasin Gishu counties?

1.5 Justification of the study

Analyzing and examining factors influencing upgrading decisions in the dairy chain allows for identification of interventions along the chain likely to provide improved incomes in line to benefits to low-income households. The identification of information on actor participation, costs, gross margins and, markets, marketing opportunities and challenges can enable formulation of intervention pathways and policies for developing the dairy value chains. The two regions were selected because they had significant production on milk and had potential markets.

1.6 Scope of the study

The study will only be conducted in Meru and Uasin Gishu Counties along selected dairy value chains and only the actors within the selected dairy value chains and dairy farmers within the regions will be targeted in this research. The research will also be limited to cow's milk analysis. The two regions were selected because

1.7 Operational definitions of terms

Upgrading:

This means acquiring the technological, institutional and market capabilities that allow actors to improve their competitiveness and move into higher-value activities. Actions that upgrade or increase the competitiveness of a value chain can take many forms and include improving product quality through value addition, adding more operations to the value chain,

bringing value chain operations into a country from overseas, capturing a new market channel, and entering a separate value chain (new market) with a similar product

Value added dairy chains:

These are value chains that handle processed milk from which a wide range of dairy end products are obtained such as yoghurt, ghee and cheese. These processes could either be traditional or upgraded

Unprocessed milk value chains:

In this study, unprocessed milk value chain is a dairy chain that handles milk in its raw (fresh) form and no value addition has been made to change the form or taste of the product along the chain

Value addition:

Value addition refers to an innovation that enhances or improves an existing product or introduces new products or new product uses

A vulnerable group: It is a group whose membership includes women, youth, female headed households or HIV/AIDs affected

Small holder actors: they are actors along the dairy value chains including farmers who own less than 3 dairy cows, market agents and processors with limited capital investments

CHAPTER TWO: LITERATURE REVIEW

2.1 Value addition concept

A value chain is full range of activities which are required to bring a product or service from conception through different phases of production, processing and delivery to the final consumer and then finally to the disposal after use' (Kaplinsky, 2000:Kaplinsky *et al.*, 2001:Kaplinsky & Morris, 2000).Value chains include all of the vertically linked, interdependent processes that generate value for the consumer, as well as horizontal linkages to other value chains that provide intermediate goods and services (Webber & Labaste, 2010)

Agricultural value chains are divided into five stages which include production, distribution, processing, marketing and consumption. Value addition can be in form of product or process innovation such as new varieties, new formulations, new presentations, entirely new manufactured products. Improved technology in production or manufacturing practices, certification, traceability, identity preservation, or branding are another major way to add value (Webber & Labaste, 2010). Small holder dairy value chain on the other hand comprises a production stage, collection and bulking, cooling, processing, packaging, distribution, wholesale and retailing.

Value-chain analysis investigates the complexity of the actors involved and how they affect the production to consumption process. It incorporates production activities (cultivation, manufacturing and processing), non-production activities (design, finance, marketing and retailing), and governance (Bedford *et al*., 2001).

Value addition refers to an innovation that enhances or improves an existing product or introduces new products or new product uses (Fleming, 2005). It is the act of adding value(s) to a product to create form, place, and time utility which increase the customer value offered by a product or service. Value addition and diversifying food exports depends not only on changing production and processing systems, but also on linking to appropriate marketing networks

2.2 Value chain upgrading

According to (Humphrey & Schmitz, 2002), upgrading refers to a shift in activities by producers in an effort to increase their incomes in the face of globalization and competitive pressures. This can be through increasing the skill content of activities and/or moving into market niches which have entry barriers and are insulated to some extent from these pressures. Measures that result in cluster upgrading include credit access, research and development,

strengthening technological capacities, diffusion of knowledge and information, building trust among cluster members, support to contracting with suppliers and linking up with traders and access markets (UNIDO, 2009a)

(Humphrey & Schmitz, 2002), distinguished between different types of upgrading; Process upgrading: transforming inputs into outputs more efficiently by re-organizing the production system or introducing superior technology. Product upgrading: moving into more sophisticated product lines (which can be defined in terms of increased unit values). Functional upgrading: acquiring new functions (or abandoning existing functions) to increase the overall skill content of activities and inter-sector upgrading: firms of clusters move into new productive activities

Global coordination, according to (Humphrey, 2004), can affect possibilities for upgrading by agricultural and manufacturing producers and traders in developing countries through acquisition of technological capabilities, market access and also access to particular channels. He argued that entry into global value chains has a positive impact on technological capability and upgrading since it promotes learning and specialization in production by firms in developing countries. Furthermore, he suggested that the increasingly stringent requirements of global buyers in areas such as quality and delivery may offer firms opportunities to add value to products.

Horizontal coordination, according to (Mitchel, Coles, & Keane, 2009) is a prerequisite for other forms of upgrading because it allows producers to achieve economies of scale in supplies and to reduce transaction costs while vertical coordination is important because it can result in greater certainty about future revenue flows for poor participants. According to (Da Silva, 2005), entering into contracts facilitates vertical coordination in food and agriculture as explained by transaction cost economics where the increased adoption of contracting worldwide can be regarded as a rational response of supply chain actors seeking to minimize their transaction costs.

Membership in a credit organization affords farmers to make necessary investments in order to upgrade for quality and meet standards of a sustainable marketing channel (Angula, 2010) while finance availability can be an incentive for contracts that ensure supply, as well as provide working capital that producer needs to upgrade a product to meet a buyer's standards. Fries & Akin, (2004) proposed a value chain financing that is more on seasonal working capital

rather than longer term investment capital, is more likely to facilitate product upgrades than process upgrades.

According to a Probit analysis by (Sinja, et al., 2006), belonging to a group increases the probability of a trader being established in informal milk marketing since he/she incurs fewer milk loses in the business, is able to handle bigger volumes of milk and fetch higher prices for the milk and meets requirements by the regulatory institutions. This will more likely lead to an increase in the incomes of such type of traders than for those not in groups

Chain governance is likely to influence a firm's upgrading chances while quasi-hierarchical chain governance has been associated with fast process and product upgrading in developing country firms according to (Schmitz, 2005), mainly because global buyers need to ensure that the manufacturing capabilities of their suppliers comply with their exact requirements in an ever increasing global competitive environment (Giuliani *et al.*, 2005:Humphrey & Schmitz, 2002)

In studies done in Kenya and Madagascar, country specific factors such as wage and capital costs, reliability and cost of infrastructure, ease of logistics and factors affecting ease of business, the location of final markets as well as ownership were shown to influence the decisions to upgrade value chains (Kaplinsky & Wamae, 2010).

The degree of cumulativeness, appropriateness, of knowledge, codification and complexity of the knowledge base influences the capacity and ways in which firms upgrade as found in a likert scale quantification by Giuliani, et al., (2005). Specific knowledge is critical for upgrading products and processes while the upgrading opportunities of local enterprises differ according to the type of value chain they feed into that is, the way trade is organized matters according to (Schmitz, 2005).

According to (Navas-Aleman, 2011), firm size and age are not associated with product or process upgrading while there was evidence of a positive relationship between functional upgrading and the age of the firm while there is a potential for domestic and neighboring markets to influence industrial upgrading.

The above researchers have looked at different aspects of upgrading; however none have focused attention on factors that influence decisions to upgrade products, processes and functions along agricultural value chains and more specifically on small holder dairy farmers in Kenya.

Hence the question arises whether smallholder farmers will always be smallholders or can they to upgrade themselves to earn more?

2.3 Determinants of participation in value added channels

In a study on the extent of value addition in honey production, (Berem, Obare, & Owuor, , 2010)employed a Heckman two stage model and concluded that value addition in honey was significantly influenced by household heads' age, the amount of time spent in off farm activities, group membership, household education level, measured by the years of schooling, and household size

(Kumar, Staal, & Singh, 2011) used a logit model to identify drivers that could induce milk market agents' participation in processing in India and he found out that education, experience in milk trading and sole dependence on milk trading for livelihood influence positively the decision to participate in a milk value chain. He further argued that traders who solely depend on milk marketing have a higher propensity to adopt milk value addition to maximize their income, while age and household size influenced value addition decisions negatively.

According to a research done in Ethiopia, a Heckman two stage model was used to identify the determinants of participation and the level of participation in firm-level value addition. It was found out that milk yield, distance from urban centers, household demography (age and presence of a child), livestock extension services, the need to extend shelf life, consideration of milk products for social factors such as holidays and fasting, and availability of labor for milk value addition determined household's decision to add value to milk (Berhanu *et al*., 2011)

Findings by (Jari, 2009) showed that good storage facilities is positively correlated with value addition mainly because it reduces loss of produce and urgency of selling and while results from a Multinomial Logistic regression showed that institutional and technical factors such as access to market information, expertise on grades and standards, availability of contractual agreements, existence of extensive social capital, availability of good market infrastructure, group participation and reliance on tradition to influence market participation choice. Consumer demand, according to (Schipmann., 2006) is a determining factor for the kind, amount and quality of a wide range of products; therefore consumer's esteem of a certain product determines its possible price and the potential value adding to the net product within a chain

Market information, according to (Ruijs *et al.*, 2004), allows farmers to make informed marketing decisions that are related to supplying necessary goods, searching for potential buyers, negotiating, enforcing contracts and monitoring. Necessary information includes information on consumer preferences, quantity demanded, prices, produce quality, market requirements and opportunities. Lack of information on prices, lack of linkages between farmers and other market actors, credit constraints and other market imperfections lead peasants to sell their crops at the farm gate to intermediaries, often at a low price, and to not take advantage of market opportunities.

2.4 Determinants of participation in a channel

In the Kenyan maize subsector, a farm gate to consumer value chain analysis conducted by (Kirimi, et al., 2011) found that proximity to demand centers and access to markets are important determinants of smallholder farmers' ability to participate in markets, however limited land and capital are the primary constraints preventing the majority of smallholder farmers to enter into commercialized production.

Knowledge on grades and standards influences the possibility of smallholder farmers to get contracts to supply to certain channels that are governed by high quality standards (Benfica *et al.,* 2002).The legal environment, such as through licensing also influences decisions to participate in a marketing channel since it influence transaction costs. Effective legal institutions may improve the organization of the marketing channels and decrease marketing costs. Presence of institutional arrangements such as supply contracts also influences the farmers' decision to sell to a particular channel.

Staal *et al*., 2006, applied a conditional logit model to determine farmers' decision to participate in alternative milk markets in Gujarat, India, and found out that there was a continued preference for direct sales from producers to buyers in spite of the high transaction costs associated with this choice. The results further indicated that households were less likely to select channels that paid cash, or that took milk on informal credit. Conversely, channels that offered monthly payment or provided formalized credit terms were more likely to be selected.

Ohajianya & Ogochukwu , 2011, employed an ordered probit analysis to find out factors related to fixed and variable transaction costs that influenced decisions to participate in sweet potato markets in Nigeria. They found out that that marketing experience, farm size, membership

of cooperatives/social organizations, extension contact, farming experience and road conditions to the nearest town had a positive relationship with market participation

According to Gebremedhin & Jaleta, 2010, market orientation strongly translates into market participation however the determinants of market participation were shown to be different from the determinants of market orientation. The determinants of market participation include distance to the market and the degree of market orientation of the farmer and the value of produce while the determinants of the extent of market orientation are related to household characteristics, market access, and technical support by the extension service.

Collective action has also been shown to influence decisions to participate in a channel due to increased bargaining power and reduced transaction costs (Kherallah and Minot, 2001). Reduced marketing costs through improved organization of the marketing channels results in economies of scale, improve access to resources such as inputs, credit, training, transport and information, increase bargaining power and facilitate certification and labeling (Negassa, 2009)

High transaction costs has been shown to hinder market access hence significantly influencing the decisions to participate in a channel (Ruijs., 2004), (Kyeyamwa, 2007), (Ouma & Jagwe, 2010); while transaction costs related to the geographical location of a household, market information and distance to the nearest urban centre also influences participation decisions (Alene,*et a.*,, 2007)

Olwande & Mathenge, 2010, showed, by use of a double hurdle model, that there is a strong relationship between market participation and existing poverty among farmers dealing with selected commodities (maize, vegetables, fruits and dairy). He concluded that the poor have lower production volumes and thus lower market participation.

A truncated regression model was applied by (Omiti *et al.*, 2009) to find out the factors that influence the intensity of smallholder farmer participation in Kenya and results showed that farmers in peri-urban areas sold a higher proportion of their output and distance to the market was found to be significantly influencing the intensity of market participation

Shiimi *et al.*,, 2010 employed a Probit model in to determine the factors influencing the marketing decision of whether or not to sell through the formal market by smallholder cattle farmers in Namibia. He found out that transportation problems, improved productivity, accessibility to market-related information and access to new information technology, are some factors significantly affecting the decision of whether or not to sell through a formal market

Other studies have employed different approaches in analyzing and understanding smallholder farmer's decisions in terms of participation in groups and participation in value addition. This study contributes to literature on participation decisions by farmers by looking not only at household and farm characteristics but by also looking at transaction cost factors. This study recognizes that collective action plays an important role in reducing transaction costs, provision of information as well as markets and sometimes credit to farmers therefore upgrading these groups formed by farmers in terms of education and support could significantly increase value addition of milk which eventually could reduce milk spoilage thus farmers will have higher incomes. This study therefore not only looks at smallholder farmers' decisions but also incorporates decisions and activities of self- help groups within the farmers' localities in order to find out if upgrading the self-help group could eventually contribute towards improving milk prices, standards on the other hand increase farmer incomes.

2.5 Theoretical framework

This study will be based on utility maximization theory which states that an individual will select the alternative from his/her set of available alternatives that maximizes his or her utility. Further, the rule implies that there is a function containing attributes of alternatives and characteristics of individuals that describes an individual's utility valuation for each alternative

A discrete choice framework will be used to analyze the determinants of the upgrading by actors along a value chain. Discrete choice models are usually derived in a random utility model (RUM) framework in which decision makers are assumed to maximize their utility. The level of utility from a choice is known only to the decision maker and is observed through the choices made.

2.5 Probit model

When an individual's choice is discrete and there are only two choices involved, a binary choice model is selected. In this case the decision to upgrade or not, is discrete and binary therefore a logit or probit model may be applicable. A probit model will be used in the analysis. It is assumed that there is a potential for upgrading products, processes and functions along dairy value chains and that actors along the chain who exploit this potential get higher profit margins hence have a high utility. The decision on whether or not to upgrade is considered under the general framework of utility maximization (Gujarat, 2003). Within this framework, actors in a value chain will decide to upgrade if the perceived utility or net benefit from the option is

significantly greater than is the case without. Although utility is not directly observed, the actions of the actors are observed through their choices.

Suppose that U_j and U_k represents a value chain actor's utility for two choices, which are denoted by Y_j and Y_k respectively. The linear random utility model could then be specified as:

$U_j = \beta_j X_i + \varepsilon_j$

$U_k = \beta_k X_i + \varepsilon_k$……..…….. (1)

where $U_j$and U_k are perceived utilities of an value chain actor's choice *j* and *k* , respectively, X_i is the vector of explanatory variables that influence the perceived desirability of each choice, $\beta_j$andβ_k are utility shifters, and ε_j and ε_k are error terms assumed to be independently and identically distributed (Greene, 2002) .

If a chain actor decides to use option j, it follows that the perceived utility or benefit from option j is greater than the utility from other options (say *k*) depicted as:

$U_{ij}(\beta_j X_i + \varepsilon_j) > U_{ik}(\beta_k X_i + \varepsilon_k), \quad k \neq j \forall i$……..…… (2)

The probability that a chain actor will choose to upgrade, i.e. choose *j* instead of *k* could then be defined as:

$P(Y = 1|X) = P(U_{ij} > U_{ik})$

$P(\beta'_j X_i + \varepsilon_j - \beta'_k X_i - \varepsilon_k > 0|X)$

$P(\beta'_j X_i - \beta'_k X_i + \varepsilon_j - \varepsilon_k > 0|X)$

$P(X^* X_i + \varepsilon^* > 0|X) = F(\beta^* X_i)$…… (3)

Where$P$ is a probability function, U_{ij} , $U_{ik}$and X_i are as defined above,

$\varepsilon^* = \varepsilon_j - \varepsilon_k$is a random disturbance term,

$\beta^* = \beta'_j X_i - \beta'_k X_i$is a vector of unknown parameters that can be interpreted as a net influence of the vector of independent variables influencing choice, and $F(\beta^* X_i)$ is a cumulative distribution function ofε^* evaluated at $\beta^* X_i$. The exact distribution of F depends on the distribution of the random disturbance term, ε^*. Depending on the assumed distribution that the random disturbance term follows, several qualitative choice models can be estimated (Greene, 2002).

2.6 The Tobit model

The Tobit model is used in analysis of metric dependent variables when it is "limited" or observed if and only if it is above or below a cut off level. Conditional on the decision to

participate on the market, the factors influencing smallholder dairy farmers' participation in raw milk channel and value added channel in relation to the volume of milk sold in the channel can be modeled using Tobit or censored regression model.

The Tobit model was developed by Tobin (1958) for a situation where the dependent variable is censored from above, below, or both. It is indicated that in a situation where the dependent variable is censored the Ordinary Least Squares estimators are biased downwards and the use of Tobit regression model is recommended (Greene, 2002). In this case, the dependent variables, that is, amount of dairy and dairy products marketed in the selected chains involve lower limit censoring at zero for a significant fraction of the observations. Greene, 2002, argued that when the dependent variable is censored the conventional regression methods fail to account for the qualitative difference between limit (zero) observations and non-limit (continuous) observations. Therefore, the Tobit model is estimated using the maximum likelihood method and is given as follows.

$V^{*} = x'\beta + \varepsilon_1$

$V_{i=}V^{*}\ if\ V^{*} > 0$

$V_{i=}0\ if\ V^{*} \leq 0$…………………………..……………………………………………(4)

WhereV^{*}, is the latent variable representing the observed volume of milk sold to a dairy channel $if\ V^{*} \leq 0$ and unobserved otherwise.V is the quantity of a given dairy product sold and X is a vector of independent variables affecting participation in a channel. $\beta$the parameter to be estimated and $\varepsilon_1$is the error term.

Various studies on small holder participation have modeled participation decisions as a two-step process. This is based on the assumption two separate decisions are made; one involves the decision to participate or not and secondly the level of participation. These studies have used either the sample selection model of Heckman (1979) (Makhura et *al*, 2001; Alene et *al.*, 2007; Berem et *al*., 2010) or the double hurdle models (Omiti et *al*.,2009: Olwande & Mathenge, 2010: Reyes et *al*.,2010). The Heckman two stage model is used to model two decisions, one on participation which Probit model is used and the second on level of participation in which the Inverse mills ratio (IMR) is used. The double hurdle model on the other hand is also used to model two decisions, one involving participation and the other on intensity of participation. (Wooldridge, 2002). In this study therefore a Tobit model was applicable since actors already participating in either the unprocessed milk channel or a processed milk channel was selected

and used to determine the factors influencing their participation decision in terms of the quantity of dairy products supplied to a particular channel

2.7 Conceptual framework

In this study, actors along the chain are faced with decisions on whether to upgrade or not. These decisions are influenced by a number of factors which in this case are categorized under socioeconomic, institutional and technical factors as well as the characteristics of the actors. These factors can interact together to impede or enhance the decisions they choose. The study conceptualizes that those actors who are willing to upgrade are likely to improve their margins. Institutional and technical factors in this case therefore act as moderating variables to the decisions that actors make. In this study, it is conceptualized that characteristics will initially influence.

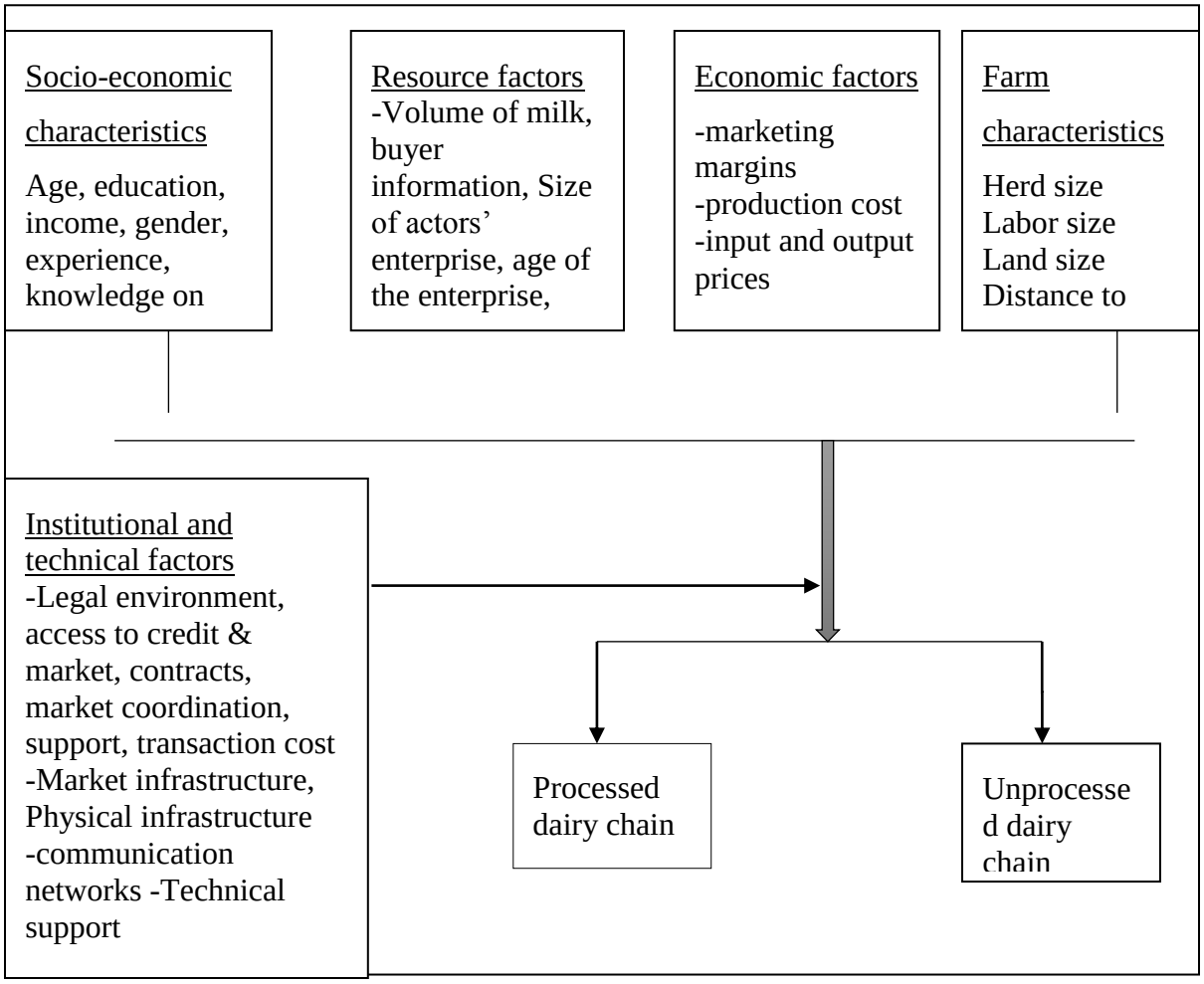

Figure 2:conceptual framework

Source: own conceptualization

CHAPTER THREE: METHODOLOGY

3.1 Study Areas

This study assessed the factors that influenced decisions by smallholder farmers and selected groups to add value to milk. It also analyzed group participation decisions by farmers. The selected regions for the study are in close proximities to major markets which imply good markets for milk and milk products. The study was conducted in Uasin Gishu and Meru counties of Kenya. The regions were selected basing on a baseline survey by Eastern Africa Agricultural Productivity Project Coordinating Unit, Kenya (EAAPP) in 2011 which showed enterprises for dairy production in the selected sites had competitive advantages and there was availability of suitable technologies that could be scaled up

3.2 Uasin Gishu County

Uasin Gishu County lies in the Midwest of the Rift Valley and borders six counties namely Elgeyo-Marakwet County to the East, Trans Nzoia to the North, Kericho to the South, Baringo to the South East, Nandi to the South West and Bungoma to the West. It covers an area of 3,345.2 Km^2 with temperatures ranging from a minimum of 8.4 ^0C to a maximum of 27 ^0C

Uasin Gishu county has two rainy seasons with average rainfall from 900mm to 1,200mm per annum. It has a population of 894,179 (KNBS: 2009) and a population density of 267 people per square kilometer. Statistics show that 50 percent of population lives below poverty line. The main agricultural activities in the county are Maize, Wheat, beef and dairy farming**.**

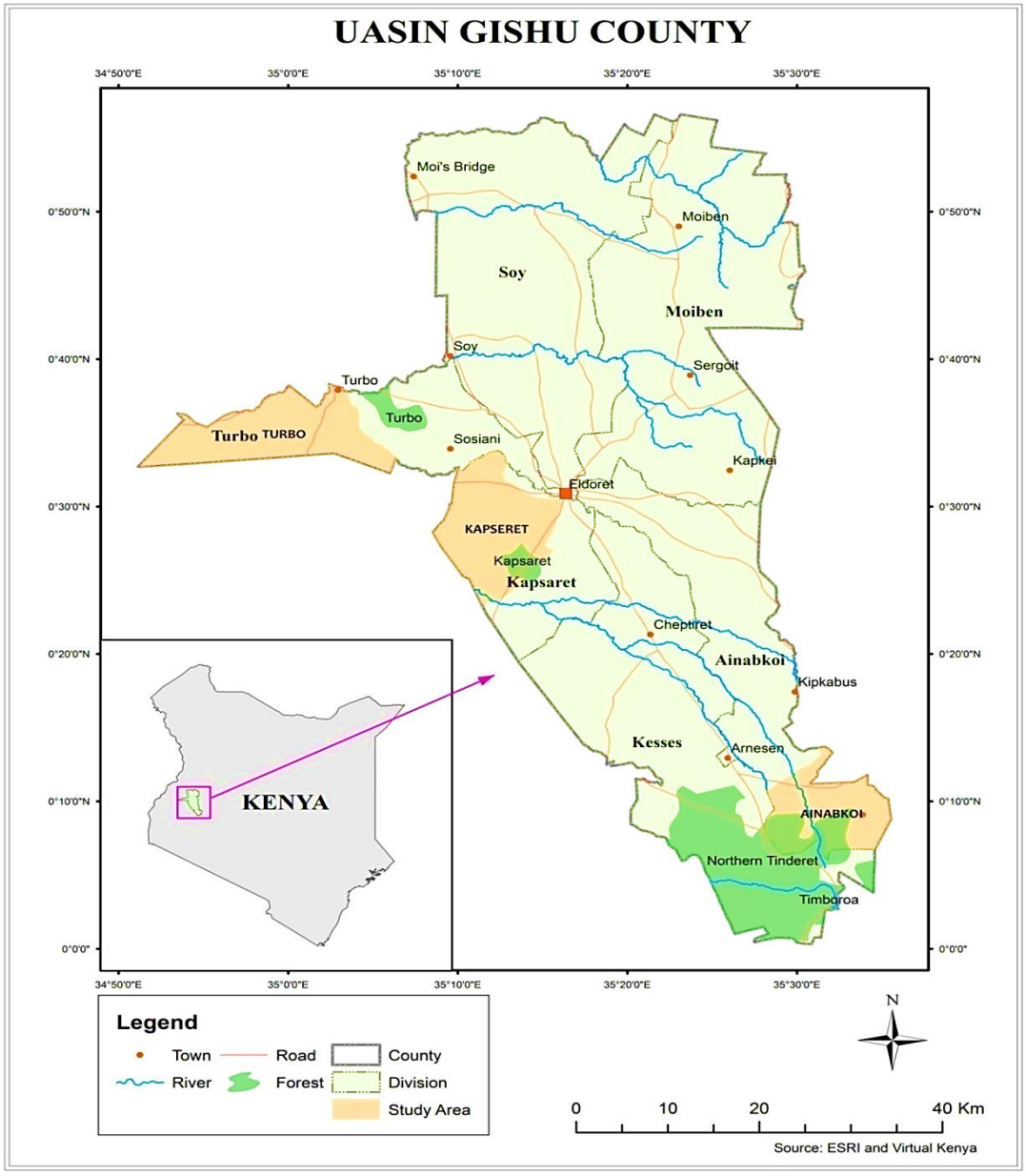

Figure 3 Map of Uasin Gishu County

Source: Karani (2014)

3.3 Meru County

Meru County is located along the eastern side of the Mt Kenya ring road. It borders Isiolo County to the North and North East, Tharaka County to the South, Nyeri County to the South West and Laikipia County to the West. The economy of Meru County is basically

agricultural with *Khat* being the most commonly grown in the south both for export and local consumption.

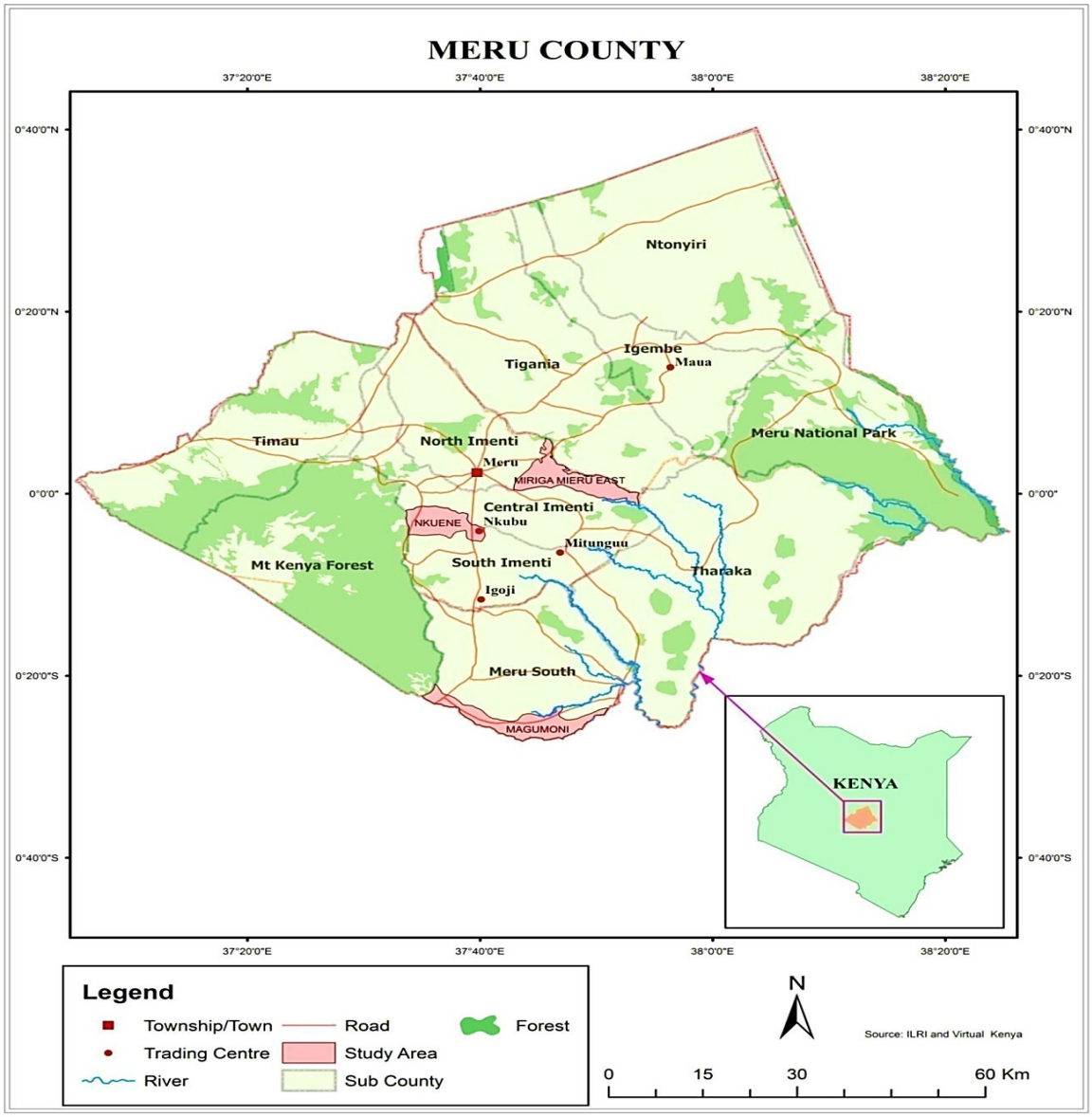

Figure 4: Map of Meru County

Source: Karani (2014)

The other major crop in is coffee as well as tea in some prime growing areas especially in areas near Mt Kenya. Meru is situated about five miles north of the equator, at an altitude of approximately 5,000 feet, Dairy farming also forms a huge part of Meru county's economy. The

rainfall pattern is bimodal with long periods of rain occurring from mid-March to May and short periods occurring from October to December. The mean annual rainfall is about 1,300 millimeters, ranging from 380 millimeters in lowland areas to 2,500 millimeters on the slopes of Mount Kenya

3.4 Sampling procedure

For the selection of groups, purposive sampling was employed: farmer groups that engaged in value adding activities to unprocessed milk were selected. The groups had to be operating legally and had to have good management and well defined future plans. Six groups were thus selected, three from each county and one from each selected district.

Two sub-samples for individual farmers were collected for this study: one in which the actors were affiliated to selected value addition groups and the other that are not affiliated. For the affiliated, a source list was obtained from the collective action groups from which actors were selected randomly. For the non-affiliated actors, a sampling frame was constructed with the assistance of the area agricultural officer from which simple random sampling was used to obtain a sample of 300 respondents.

3.5 Data and Data Collection Methods

The research used both primary and secondary data. Though primary data was the main source of information, secondary data was used for literature review and to get information on the selected areas of study. Secondary data was obtained from government reports such as statistical abstracts and government national development plans and session papers, journals, computer databases and previous research studies. Interview schedules were used to obtain primary data from dairy farmers about their socio-demographic factors, group participation behavior and factors influencing their decisions. Data on selected groups was also obtained using interview schedules.

3.6 Data Analysis

The data collected was coded and entered using both Statistical Package for Social Scientists (SPSS), it was then cleaned and analysis was done using (SPSS) and STATA. After data cleaning a sample of 273 respondents was used for the purpose of analysis. The study Principle Component (PCA) and factor analysis to describe the variables in the data. Marketing margin analysis, Probit and a Tobit model was also used in the analysis of data.

3.7 Analytical framework

3.8 Principle component and cluster Analysis (PCA)

The PCA was used to characterize processed dairy chains and unprocessed dairy chains in the study areas. This included socio economic and demographic characteristics as well as constraints faced by participants in the selected dairy chains. Principal component analysis, (PCA) is a statistical technique used for data reduction. According to (Hamilton, 2006), PCA and factor analysis provide a method for simplification, combining many correlated variables into smaller number of underlying dimensions. The leading eigenvectors from the eigen decomposition of the correlation or covariance matrix of the variables describe a series of uncorrelated linear combinations of the variables that contain most of the variance. In addition to data reduction, the eigenvectors from a PCA are often inspected to learn more about the underlying structure of the data, (Madala, 1992)

The objective of PCA is to find unit-length linear combinations of the variables with the greatest variance. The first principal component has maximal overall variance. The second principal component has maximal variance among all unit length linear combinations that are uncorrelated to the first principal component, etc. The last principal component has the smallest variance among all unit length linear combinations of the variables. Experimenting with the PCA options can be able to tell us how stable a particular finding is or how much it depends on arbitrary choices about specific analytic technique (Hamilton, 2006).

The Cluster Analysis attempts to identify relatively homogeneous groups of cases based on selected characteristics, using an algorithm that starts with each case in a separate cluster and combines clusters until only one is left. The new variables created from principal component were then used in standard cluster analysis to obtain homogenous groups of farmers for gross margin and socio-economic characteristics comparison. It is assumed that each Y_i variable is linearly related to the various attributes. The number of factors may be determined by examining the proportion of total variance explained by each component or by cumulative proportion of total variance explained. The principal component model was represented in equation 6.

$$Y_i = \sum_{i=1}^{i} \beta_i X_i + \varepsilon_i \quad \text{……………………………………………………………………………6}$$

Where Y_i is standardized variable,

β_i are parameters also referred to as loadings for X_i variable factors

ε_i is the error (residual) term.

The assumptions of PCA model include: the model is linear, Y_i are measured as deviations from the mean (otherwise a constant should be included in the model) and ε_i is independent with 0 mean and have variance equal to 1. The strength of the factors is indicated by the loadings. Eigen values which are the variance of principal components (PCs) were obtained to indicate the extent to which factors explain management interventions and their attributes. Kaiser-Guttman criterion of retaining all PCs with Eigen value greater than one in further or subsequent analysis was applied. Factor loadings greater than or equal to ± 0.500 was interpreted.

3.9 Marketing margin (MM) analysis

Marketing margin analysis was used to answer objective two of the study. Marketing margin is the difference between prices at two market levels. Marketing margins was examined on the basis of data obtained on prices at different stages of the marketing chain. It can be calculated through computing the absolute margins or price spread, which is essentially the same as the difference between the price paid and received by each specific marketing actor. The total marketing margin is the difference between what the consumer pays and what the producer/farmer receives for his product. In other words, it is the difference between retail price and farm price The following formula will be used to compute percentage marketing margins as earned by each market intermediary in the marketing raw and value added dairy products.

$$MM = \frac{End\ buyer\ price - First\ seller\ price}{End\ buyer\ price}\ X\ 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (7)$$

Where. 'Mm' indicates the marketing margins earned by an actor.

To get the portion of the price paid by the consumer that goes to the dairy farmer. The producer’s margin is calculated as :

$$\mathrm{GMM} = \frac{(\mathrm{End\ buyer\ price} - \mathrm{Marketing\ costs})}{End\ buyer\ price} 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(8)$$

Descriptive statistics will be used to identify cost structures along the value chains; this will show adjustments in prices as value is added as well as costs incurred. A comparative analysis will then be done to compare upgraded value chains and traditional value chains in terms of gross margins and cost strictures using descriptive statistics

3.10 Probit model specification

A probit model was used to determine the factors influencing choice of whether to upgrade or not. By upgrading the milk products and processes such as increasing delivery speed, selling processed milk products, using standardized equipment and adopting measures to increase the quantity of milk sold, the dairy farmer is considered to have added value.

$$Prob(y_i = 1|X) = \int_{-\infty}^{X'\beta} \Phi(t)dt = \Phi(X'\beta) \quad \text{(9)}$$

Where y_i is an indicator variable equal to 1 if the value chain actor chooses to upgrade or otherwise.

$\Phi(.)$ Is the standard normal distribution function βs are the parameters that are estimated and Xs are the determinants of the dependent variable, that is, the choice of adding value to milk

$$Y(0,1) = \log({}^{p}/_{1-p}) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \ldots\ldots\ldots \beta_n X_n + \varepsilon_{ij} \quad \text{(10)}$$

Where:

Y is the probability of a chain actor to add value to milk and milk products

$\beta_0, \beta_1, \beta_2, \beta_3$ and β_4 are the parameters to be estimated

X_1 is a vector of socio economic factors

X_2 is a vector of institutional factors

$X_3$is a vector of economic factors

X_4 is a vector of resource factors

$\varepsilon_{ij}$is an error term that is independently and identically distributed

The Probit parameter estimate does not show by how much a particular variable increases or decreases the likelihood of choosing to upgrade milk. For this purpose we need to calculate the marginal effects of the independent variables on the probability of a chain actor to choose to add value to milk or to or the probability to upgrade. For continuous independent variables, the marginal effect of the probit model is calculated by multiplying the coefficient estimate ($\propto$) by the standard probability density function given above by holding the other independent variables attheir mean values:

$$\frac{\partial P(Y=1)}{\partial X_i} = \alpha\Phi(\beta_j X_i \quad \text{(11)}$$

On the other hand, the marginal effects of the dummy independent variables are analyzed by comparing the probabilities that result when the dummy variables take their two different values while holding all other independent variables at their sample mean values (Wooldridge,

2002). Finally, the log-likelihood function which is maximized to obtain the parameter estimates and the corresponding marginal effects for the probit model is given as:

$\ln L(\alpha|Y, X_i) = \sum_{y=1} \ln \Phi\left(\beta_j X_i\right) + \sum_{y=0} \ln(1-\Phi)\left(\beta_j X_i\right)$ ..... (12)

Probit model is then estimated using maximum likelihood estimation. The probit model uses a normal distribution and mathematically it involves the use of integrals.

3.11 The Tobit model specification

The Tobit model was used to analyze the determinants of participation in a dairy value chain. The tobit model allows for the analysis of censored data, originally applied to variables censored so that they could not fall below zero. In this study the presence of zeroes in the dependent variables of volume, is due to non-participation in raw or value added dairy chain and not from zero quantity of milk sold to the market. Therefore, by using a Tobit model, the zero observations are accounted for and the censored regression provides a more accurate estimation (Wooldridge, 2002)

The structural equation in the tobit model is given as:

$Y^* = X_i\beta + \varepsilon_i$ .....(13)

Where $\varepsilon_i$is an error term which is independently and identically distributed

$Y^*$is a latent variable that is observed for values greater than τ.The observed *Y*is defined by the following measurement equation

$$y_1 = \begin{cases} y^* if\ y^* > \tau \\ \tau_y\ if\ y^* \leq \tau \end{cases} \quad \text{..... (14)}$$

In the tobit model we assume that $\tau = 0$that is no data is censored at zero thus we have

$$y_1 = \begin{cases} y^* if\ y^* > 0 \\ 0\ if\ y^* \leq 0 \end{cases} \quad \text{..... (15)}$$

$$y^* = \beta_1 + \beta_2 x_2 + \cdots \ldots + \beta_k x_k + U$$

$y^*$is unobservable by $y_1 = \begin{cases} y^* if\ y^* > 0 \\ 0\ if\ y^* < 0 \end{cases}$

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 **Introduction**

This chapter is divided into two broad sub sections. Section 4.2 discusses descriptive results which include socio economic, demographic and institutional characteristics of smallholder dairy farmers and the value addition groups. Section **Error! Reference source not found.** presents empirical results of the Probit and Tobit econometric models. This section will also present findings of the market margin analysis and the principle component and factor analysis. The results were drawn from analysis of smallholder dairy farmers participating in selected collective action groups and those that did not participate. This section ends with discussion of the factors that would influence the smallholder farmers' choice to participate in a group that adds value to milk or not. Factors that influence the farmers' decisions to choose to upgrade the processes involved in handling of milk were also examined.

4.2 **Characteristics of dairy farmers**

The result in

Table 1 shows demographic characteristics of the respondents. There were more male respondents (59%) as compared to female (40%). Majority of the respondents (39.5%) had secondary education and a mean age of 43. The mean distance to the market was 5 km and farmers had an average of 14 years of experience in dairy farming. Majority of the roads used by the farmers in all the selected regions were earth roads (70%), hence a major sign that poor road infrastructure exists in the selected regions.

Farming was also shown to be the predominant activity in the selected regions since majority of the respondents depended on farming as their primary activity. The results significantly show that the farmers delivered milk to the market on foot as opposed to using vehicles. This implies that farmers take longer time to deliver products to the market.

The results also show that majority of the farmers did not own any motorized transport while they had an average of 3-5 cows in a household; farmers in Uasin Gishu County had a significantly higher number of cattle compared to Meru County

Table 1: Demographic characteristics of farmers

	Meru N=141	**Uasin gishu N=132**	**Significance Level**
Gender of household head (%)			0.326
Male%	55	56	
Female%	85	78	
Education level			**0.777**
No formal education	2	3	
Primary	52	42	
Secondary	53	54	
College	30	26	
University	4	6	
Age of respondent	48	40	0.000*
Dairy farming experience	17	11	0.000*
Distance to main road(km)	1.2	1.5	0.104
Distance to market(km)	2.5	7.7	0.000*
Primary Activity of household head			
Farmer	96	91	0.002*
Civil servant	20	14	
Businessman/woman	10	24	
Retired with pension	9	1	
Retired without pension	5	0	
Mode of transport to market			0.000*
Foot	104	36	
Bicycle	14	15	
Motor cycle	14	26	
Vehicle	8	53	
Total cattle	3	5	0.000*

Ownership of motor able transport			
No	113	76	0.000*
Yes	28	56	

Source: Own survey data 2013

Raw milk is generally perishable in nature and therefore needs to be processed or delivered to the markets fast or processed into a form that can be preserved. However, with a combination of long distance to the market (5km) as evidenced by the interviewed farmers and existence of earth roads in most areas and could imply that farmers incur high transaction costs in terms of the time and costs to deliver milk and milk products to the market.

The results statistically showed that there was a significant difference between the mean ages of respondents in the selected regions. Meru County was shown to have older respondents compared to Uasin Gishu localities. There was a difference in distance to the market in the selected regions however it was not statistically significant. There was a significant difference in distance to the market between Meru and Uasin Gishu Counties. Farmers in Uasin Gishu were shown to be located further away from the market compared to Meru.

The result in the Table 2 below shows further characterization of respondents. Majority of the respondents (77%) were not aware of any international or national standards in dairy production and marketing of milk such as licensing by the Kenya Dairy Board and hygiene. This indicated the need for more sensitization, education and enforcements of existing standards in order to improve the quality of milk being traded in the market. Majority of the respondents (62%) participated in collective action.

The results further indicate that many households did not sell evening milk (56.57%). The main reason for this was because during rainy seasons, roads were impassable in the evenings in most regions and there was no ready market for evening milk. This presents opportunities to increase quantities of milk sold that have not been tapped yet. Out of the percentage who did not sell evening milk, 91% consumed the milk at home and the remaining 9% gave out to neighbors. Majority of the farmers in Uasin Gishu County did not sell evening milk compared to those in Meru County. This could be because the farmers in Meru County were located closer to the markets compared to those in Uasin Gishu County as shown by the results.

Majority of the respondents (69%) did not preserve milk using either traditional or modern methods of milk preservation. Preservation of milk reduces the urgency to sell milk by reducing

spoilage. Modern preservation of milk was not practiced by most households and this could be because electricity was not available in most households as well as in the self-help groups that bought milk from the farmers

Table 2: Socio economic characteristics of the respondents

	Meru N=139	**Uasin Gishu N=134**	**Significance level**
Awareness of milk standard			0.736
No	79.3	76.69	
Yes	20.7	23.31	
Participate in group			0.045**
No	34	41.04	
Yes	66	58.96	
Add value to milk			0.001***
Yes	6	20.15	
No	132	79.85	
Sell evening milk			0.010**
No	69	85	
Yes	72	47	
Preserve milk			0.561
No	60	70.15	
Yes	40	29.85	
Easy to find market			0.067*
Yes	28	16	
No	113	116	

Source: Own survey data 2013

This study therefore suggests facilitating and upgrading of these self-help groups that are closer to the farmers as a way of creating more markets for milk produced as well as reduce spoilage within dairy chains.

4.3 **Value addition by individual smallholder dairy farmers**

As indicated by the results in Table 3, majority of the farmers, 86% of the respondents sell their milk as unprocessed. None of the farmers interviewed processed milk into cheese citing that it was not liked by many buyers. This is consistent with a study done in the central region in Kenya which showed that only 3% of Kenya's milk is processed into cheese. (JKUAT; CAIS & KIPPRA, 2012). This implies that there are more opportunities for value addition which have not been exhausted in the dairy sector.

This result showed that most smallholder farmers in Kenya sold their milk individually as raw. Minimal Processing was done at the farm level and this could be because of inadequate equipment that can be used to add value. Most farmers who sold milk did not boil before selling the milk. Raw milk is highly perishable and in its raw form, it is more likely to get contaminated before it reaches the final consumer hence greater risks in health. Traditional value addition was minimally practiced for commercial purpose thus offering opportunities for value addition in the Dairy subsector

Table 3: Value addition by smallholder farmers

Value addition type ***	**Meru**	**Uasin Gishu**	**Percentage**
Raw	132	106	86.86%
Boiled	4	13	6.20%
Mala (Traditionally Fermented Milk)	1	5	2.19%
Yoghurt	1	0	0.36%
Ghee	0	1	0.36%
Raw & mala	2	0	0.73%
Raw & yoghurt	1	0	0.36%
Boiled& mala & yoghurt	0	5	1.82%
Mala& yoghurt &cheese	0	3	1.09%

Note: *Mala- Traditionally Fermented Milk*

Source: Survey data 2013

4.4 **Demographic and socio-economic comparison of farmers who add value to milk**

Table 4 shows summary statistics of variables that indicated demographic and socio economic characteristics of smallholder dairy farmers who added value to milk in comparison to those farmers who did not add value. The results indicated that small holder farmers who added value to milk were less educated as compared to those who did not add value to milk. The possible explanation for this could be that educated farmers probably depended on farming entirely for income generation therefore they would be more probable to try and maximize revenue from milk through value addition

The results also indicated that female respondents were more involved in value addition than their male counterparts. Majority of those farmers who added value did not own motorized as compared to those who added value to milk. Further results showed that the farmers who added value to milk were slightly younger compared to those who did not add value to milk. Farmers who added value to milk were also located closer to the market than those who did not add value to milk.

Table 4: Comparison of farmers who add value and those who do not

	Add value (N=35)	**Do not add value (N=238)**	**Significance level (Pearson chi-square)**
Variable			
Gender of household head			0.001***
Female	23	88	
Male	12	150	
Training on value addition			0.000***
Yes	21	229	
No	14	9	
Motor able transport			
Mode of transport			
Age	39	44	0.027**
Distance to market	3.6	5.1	0.045**
Education level			0.08*
No formal education	2	3	
Primary	14	80	
secondary	12	97	
College	4	51	
University	3	7	
Experience	9	14	0.004***
Total revenue			

Source: Survey data 2013

Farmers who added value to milk tended to have significantly had less experience compared to those who did not. In addition, also more farmers who added value to milk had primary education compared to those who added value had secondary education

4.5 **Challenges faced by dairy farmers**

Challenges faced by dairy farmer were identified using the PCA method. When the factors were subjected to PCA, three principle components with Eigen values greater than 1 were extracted according to the Kaiser rule as shown in **Error! Reference source not found.** .

An Eigen value is an index of strength of the component and the amount of variance it accounts for. The three components explained up to 50% variations in other factors while the determinant was more than 0.00001 thus indicating the absence of multi collinearity in the factors. There was a good fit of the data as indicated by the Bartlett's test of sphericity (p=0.000) and the KMO measure of sampling adequacy (0.731).

Table 5: Challenges faced by smallholder dairy farmers

Component	**Initial Eigenvalues**		
	Total	% of Variance	Cumulative %
1	2.999	24.995	24.995
2	1.827	15.225	40.220
3	1.201	10.009	50.228
4	.976	8.136	58.364
5	.933	7.776	66.140
6	.809	6.743	72.884
7	.708	5.898	78.782
8	.662	5.513	84.295
9	.560	4.671	88.966
10	.490	4.086	93.052
11	.463	3.861	96.913
12	.370	3.087	100.000

Kaiser-Meyer-Olkin Measure of Sampling Adequacy 0.731

Barlett test, Approx. Chi-Square=411.314, df= 66, Significance= 0.000

Source: Own Survey data 2013

The first component extracted explained 25% of the variations in other components. The factor loadings that were high in principle component 1 (PC1) were transportation (0.734), contractual arrangements (0.540), and standards in milk marketing (0.611), market access (0.754), and road networks (0.776) as shown in **Error! Reference source not found.** below.

According to Table 6: PCA analysis: Rotated component matrixTable 6 below, the factors that loaded heavily on PC2, which explained up to 15 % of the variations in other components, were lack of extension advice (0.617) and high incidences of diseases (0.716). The factors that loaded heavily on PC3 (10%), were milk prices (0.744) and high cost of animal feeds (0.603). The principle components were therefore named according to the cluster of factors that heavily loaded on the components, PC1=milk marketing, PC2=milk production and PC3= cost factors

Table 6: PCA analysis: Rotated component matrix

Rotated Component Matrix			
	Component		
	Milk marketing	**Milk production**	**Cost factors**
Milk demand	.271	-.241	-.070
Milk prices	.254	-.115	.744
Transportation	.734	.073	-.007
Contractual arrangements	.540	-.027	.426
Standards	.611	.100	.350
Market access	.754	.045	.138
Road networks	.776	.152	-.153
lack of extension advice	.134	.617	-.275
high cost of animal feed	-.124	.181	.603
high incidence of diseases	.015	.742	.061
inadequate animal husbandry skills	.280	.629	.265
inadequate credit	-.029	.716	.044
Rotation Method: Varimax with Kaiser Normalization.			

Source: Own survey data 2013

4.6 **Description of selected value addition groups**

Table 7: Descriptive analysis of selected groups

below shows results of six groups that were selected within the study regions. Each selected district had one value addition group that had been in operation for more than three years. Among the selected groups, Thuita SH group which was located in Meru south was the oldest (24) in terms of years in operation. Langas SH group was run by a group of disabled who collected milk from farmers within the regions and processed the milk for resale.

The main activities undertaken by the groups were bulking, processing, distribution, marketing as well as support depending on each group and the group's needs. The main reason for the formation of these groups was to be able to get better prices and market for their produces, to provide loans to members as well as improve the welfare of its members. All the selected groups required the members to contribute membership fee and contribution fee.

Table 7: Descriptive analysis of selected groups

	Uasin Gishu			**Meru**		
	Chepngoro r	*Langas disabled*	*Kapkawa Baitany*	*Thuita*	*Muchege Hort*	*Siombur u*
Age	3	4	7	24	9	6
Membership	56	42	21	150	18	20
Est. Value(Ksh)	300,000	58,000	50,000	800,000	800,000	60,000
Other income	None	None	None	None	sell feed	None
Road type to market	Earth road	Earth	Tarmac	Earth	tarmac	murram
Own motorable transport	No	No	No	No	No	No
Distance to market (km)	30	0	3	4	3	3

NB: S H= Self help

Source: Own Survey data 2013

4.7 **Upgrading activities of the farmer groups**

The Table 8:Upgrading decisions by farmer groups

presents results that showed the willingness of the selected farmer groups to upgrade. From the results, five groups out of the selected six had invested in new machinery and increased the number of products the groups supply to the market in the past few years. This, according to

(Trienekens, 2011) is a sign that the self-help groups are striving towards upgrading processes as well as products.

All the groups have in the past tried to minimize losses resulting from spoilage of milk by buying lactometers and some by pasteurizing milk. One group invested in a cooler hence upgrading the quality of milk as well as quantity since they could now buy evening milk from farmers.

Some groups had upgraded their processes through activities such as expansion of their market base as well as increasing delivery speed to the market. Most of the groups are yet to improve on technology usage.

Table 8:Upgrading decisions by farmer groups

	Uasin Gishu County			**Meru County**		
	Chepngoror cooperative society	Langas disabled SH	Kapkawa Baitany SH	Thuita SH	Muchege Hort milk SH	Siomburu SH
Invested in machinery	No	Yes	Yes	Yes	Yes	Yes
Increased products sold	No	Yes	Yes	Yes	Yes	Yes
Increased technology use	No	None	None	None	None	Yes
Increased delivery speed	Yes	None	Yes	None	None	None
Expanded market	Yes	Yes	Yes	None	Yes	Yes
Improved milk safety		Yes	Yes	Yes	Yes	Yes
Prevented losses	Yes	Yes	Yes	Yes	Yes	Yes

NB: S H= Self help

4.8 **Value addition activities by the farmer groups**

The results in This indicated the potential of these groups to undertake value addition. The groups were also aware of national and international standards on milk which is also a step toward improvement on the safety and quality of milk.

All the groups sampled in Meru County bought evening milk while those in Uasin Gishu County did not buy evening milk citing that evening milk was not available and poor road infrastructure was a hindrance. **Error! Reference source not found.** therefore gives a summary of the activities and services that the groups offered.

The results showed that inadequate processing equipment and milk spoilage were among the major challenges faced by the groups. In marketing, high cost of transportation, competition from milk hawkers and poor milk prices were among the major challenges

below shows that out of the selected six groups, five had at least trained a member or had a staff trained on value addition of milk. This indicated the potential of these groups to undertake value addition. The groups were also aware of national and international standards on milk which is also a step toward improvement on the safety and quality of milk.

All the groups sampled in Meru County bought evening milk while those in Uasin Gishu County did not buy evening milk citing that evening milk was not available and poor road infrastructure was a hindrance. **Error! Reference source not found.** therefore gives a summary of the activities and services that the groups offered.

The results showed that inadequate processing equipment and milk spoilage were among the major challenges faced by the groups. In marketing, high cost of transportation, competition from milk hawkers and poor milk prices were among the major challenges

Table 9: Descriptive analysis of groups

	Uasin Gishu			**Meru**		
	Chepngoror	**Langas disabled**	**Kapkawa Baitany**	**Thuita**	**Muchege Hort**	**Siombur u**
Value addition training	Yes	Yes	Yes	Yes	Yes	None
Training provider	College	College	MOA	NGO	MOA	
Standard awareness	Yes	Yes	Yes	Yes	Yes	Yes
Buys evening milk	No	No	No	Yes	Yes	Yes

Information source	MoA					
Marketing strategy	Pricing	Promotion	Quality	Product	Quality	Quality
Linkages with other institutions	Research	Credit	MoA	Credit	Credit	MoA
Services offered		Loans	Training	training	Loans	Feed & treatment
Has external support		Yes	No	Yes	Yes	Yes
Areas in need of support		Training	Credit	Electricity costs	Marketing	Training

MoA=Ministry of Agriculture

4.9 **Market margin analysis**

Table 10: Market margin Analysis of unprocessed channel

Average end buyer price/ltre	**35.99**
Average first seller price/ltre	32.76
Marketing margin (%)	**8.974715**
Average end buyer price/ltre	35.99
Transport cost	0.488492
Delivery cost	0.942877
Total costs	1.431368
End buyer price-Marketing costs	34.55863
Gross Market Margin	**0.960229**

Market margin analysis results showed that farmers had a bigger share of the retail prices in the market. However gross margin received by farmers is small due to higher transactions costs, marketing and production cost. Marketing margin is computed as the difference between the end buyer price and the first seller price divided by the end buyer price.

Results from **Error! Reference source not found.** show that producers received a bigger share of the market price (96%). The gross market margin shows the portion of the price paid by the consumer that goes to the dairy farmer. Since majority of the farmers sell milk in raw form, the value chain is shorter; a greater portion of price goes to the farmer. However, this does not imply that the farmer is making huge profits since farmers incur high production costs

4.10 **Relationship between value addition and market margin**

The results as shown in **Error! Reference source not found.** below shows that as more value addition is done the more market margin is accrued to trader. However, most respondents who added value did not have records showing the expenses incurred for processing such as electricity, water, labor, and flavor hence calculation of the gross marketing margin was not possible for this research

Table 11: Market Margin Analysis of processed dairy chain

	Mala	**Yoghurt**
Average end buyer price/ltre	60	140
Average first seller price/ltre	50	100
Marketing margin (%)	16.6%	28%

4.11 **Gross margin analysis of selected farmer groups**

The results in Figure 5 above shows the gross marketing margins received by the selected groups. Kapkawa Baitany SH group received the largest gross market margin when compared to the other groups. This was because value addition was done on milk to produce products such as pasteurized milk, mala, and yoghurt.

Chepngoror cooperative society had the least gross margins. This was because there was minimal processing in the group. Minimal processing by the group (chepngoror) could also be because of high transportation costs due to long distance to the markets and bad roads. The group was involved in bulking and selling the milk. This result showed that value addition increases margins received by the actors hence there is need to promote and encourage farmers and groups to sell value added dairy products

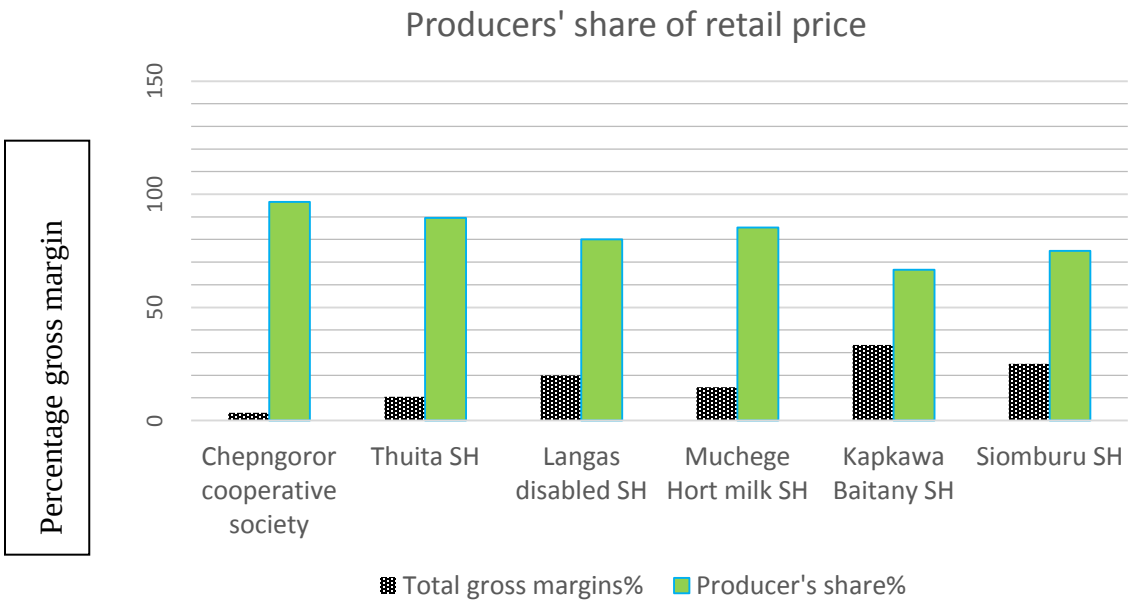

Figure 5:Gross market margin analysis of groups

4.12 Description of buyers

The results from **Error! Reference source not found.** below showed that most of the farmers sold their milk majorly to cooperative societies. Most farmers also sold to their neighbors', and few farmers sell directly to processing plants. The cooperative societies bulk the milk then sell to processing plants and in this way they are able to have bargaining power over their milk

Table 12: Description of buyers

Major milk buyer	**frequency**
Neighbor	83
Nearby schools	10
Local restaurants	15
Local shops	11
Self Help Groups	38
Cooperative Society	100
Processing company	10
Local Vendor	6
Total	273

Pearson chi2(7) = 31.5694 Pr = 0.000

4.13 Analysis of production cost

The results in ***Error! Reference source not found.*** shows that animal feed was considered by 82% of the farmers to be a major cost. There was a significant difference in the estimate for feed with Meru County having higher costs compared to Uasin Gishu. This could be because farmers in Meru County used the zero grazing systems while the farmers in Uasin Gishu County used the open grazing systems to feed the animals.

Table 13: Main cost factor in production

	Meru	**Uasin gishu**	**Meru**	**Uasin Gishu**	
main cost factor			**Main cost estimate per month per cow (KES)**		
Animal Feed	117	98	3070	2919	***
Salt	7	3	1555	678	***
Medicine	8	5			
Veterinary costs	0	1	2160	583	***
De worming	2	1	1412	1308	
Labour	7	24			
Total	141	132			
Pearson Chi-Square	.014**				
Likelihood Ratio	.009				

4.14 Factors influencing decision by smallholder dairy farmers to upgrade milk products

By choosing to add value to milk, farmers are considered to have upgraded milk products. This implies that more dairy products are sold to the market by farmers. However, farmers who sell only one product to the market, in this case unprocessed milk are considered not to have upgraded products. The decisions on whether or not to upgrade products have been modeled using the Probit model. Dairy farmers who sold their milk in an unprocessed form were given a value of 0 while for those farmers who sold milk products to the market in other forms, were given a value of 1 for modeling purposes.

The p-value for the overall model fit statistic was less than the conventional 0.05 hence showing evidence that at least one of the independent variables contributes to the prediction of

the outcome. The Mcfadden pseudo R2 showed that the variables explained at least 45% of the changes in the dependent variable.

The result in **Error! Reference source not found.** below gives the marginal effects after a probit analysis of the factors that influenced the decisions by smallholder dairy farmers to upgrade. The results indicate that the gender of the respondent had a negative and a statistically significant effect on the decision by smallholder farmers to add value to milk. This implies that a male headed household is less likely to upgrade milk products than the female counterparts. This is shown by a negative and significant coefficient and a marginal effect of 0.05.

Table 14: Probit Model results: Determinants of Upgrading

Add value	dy/dx	Standard error	z	P>z
Gender of household head	-0.0550281	0.02998	-1.84	0.066*
Age of house hold head	0.0003055	0.00079	0.39	0.697
Education	-0.0015983	0.00785	-0.2	0.839
Experience	-0.0023648	0.00137	-1.73	0.084*
Number of cows	0.0052094	0.00286	1.82	0.068
Milk price	0.0919561	0.05483	1.68	0.094*
Road network	0.0226077	0.02071	1.09	0.275
Value addition skills	0.2454437	0.1039	2.36	0.018**
Bargaining power	0.0196729	0.01851	1.06	0.288
Daily milk payment	0.0612548	0.04314	1.42	0.156
Group belonging	-0.0263058	0.02645	-0.99	0.32
Husbandry skills	-0.0263145	0.01795	-1.47	0.143
Cut down losses	0.0350342	0.0183	1.91	0.056*

Level of significance, * 10%, ** 5%, *** 1%.

Prob >chi2 = 0.0000 Log likelihood = -51.951719 Pseudo R2 = 0.4539

Further results show that at 1% significant level, if a farmer has value addition skill then the likelihood of adding value to milk also increases by up to 24%. This finding agrees Giuliani *et al.,* (2005) who found out that appropriateness of knowledge base influenced the capacity and ways in which firms upgrade. This result therefore implies the need to equip farmers with more specific skills on value addition in order to increase their ability to upgrade milk products to the market hence get more income.

At 10% significant level, the results show that farmers who considered milk prices to be favorable were more likely to add value to milk than those who did not. A unit change in the favorability of milk prices would increase the chances of adding value by up to 7% as indicated by the marginal effects. This result implies that prices have an effect on the farmers' decisions on whether to upgrade or not. In order to encourage more farmers to add value there is therefore a need to improve the prices offered to them in the market.

Experience had a negative influence on the decisions by farmers to add value to milk. A unit change in age would result decrease the probability of adding value to milk as indicated by the marginal effects. Experience as a proxy for age could imply that older farmers were less likely to add value than the younger farmer. This result could be because as people age, increase in responsibilities would demand for more cash requirements which the raw milk value chain offers. This result is contrary to (Sharma, Kumar, & Singh, 2009), who suggested that age enhances the skills and ability to meet quality requirements of the modern milk channels, better information utilization hence lower transaction costs thus have an impact to participation.

The results also indicate that farmers who had tried to cut down on losses were more likely to add value when compared to those who had not. This result was significant at 10% level. This could be because by cutting down on losses, farmers have more cash at their disposal hence this reduces the need to sell raw milk faster so as to meet their daily cash requirements.

Awareness of standards in milk by farmers and quality requirements by buyers was shown to have a negative influence on the decision to add value to milk. This result was however not significant at more than 10% confidence level. This could be because by adding value to milk and producing a variety of dairy products, requirements such as licensing and packaging could make farmers sell their milk in raw form which has lesser requirements.

4.15 Determinants of participation in a processed or unprocessed milk channel

The **Error! Reference source not found.** indicate the results of a Tobit analysis used to determine the factors that influence participation decision of dairy farmers in the unprocessed or processed dairy channel.

The results indicated that majority of the farmers (86.86%) sold milk in raw form. The Tobit result shows the factors that influences the farmers' decisions. The model was significant in estimation as indicated by p=0.000.

Table 15 Tobit Model results

Variable	dy/dx	Standard error	z	P>z
Household gender	0.4233	1.46045	0.29	0.772
Household age	0.02729	0.054	0.51	0.613
Education level	0.86822	0.78981	1.1	0.272
Distance to Main road	0.5477848	0.36533	1.5	0.134
Distance to market	0.2538857	0.1472	1.72	0.085*
Transport ownership	2.635057	1.66386	1.58	0.113
Quality requirements	-0.50791	1.78681	-0.28	0.776
Delivery time requirements	-0.69157	2.05354	-0.34	0.736
Reliability requirements	-1.1386	1.598	-0.71	0.476
Health standard requirements	3.4599	1.659	2.08	0.037**
Group belonging	2.5119	1.67543	1.5	0.134
Sell evening milk	1.0631	1.490	0.71	0.476
Preserves milk	4.2549	1.612	2.64	0.008***
Easy access to buyer	2.9717	1.9703	1.51	0.131
Add value	3.914552	2.53244	1.55	0.122
Favorable milk price	2.040369	1.90337	1.07	0.284
Favorable transportation	-3.298669	1.73661	-1.9	0.058*

Level of significance, * 10%, ** 5%, *** 1%.

LR chi2(16) = 54.92 Prob > chi2 = 0.0003

Log likelihood = -850.514 Pseudo R2 = 0.0312

Ownership of a motor able transport by a household is shown to have a positive influence on participation in the unprocessed milk channel, this results was not however statistically significant. Owning a motor able transport increases the chances of increasing the quantity of milk sold as unprocessed. This result was however not significant at less than 10%. A household that owns a motor able transport would be able to deliver fresh and unprocessed milk to the market faster than other households that do not have, hence they would find it easy to participate in the unprocessed milk channel.

Further results showed that farmers who considered transport networks to be favorable were less likely to sell more quantities of raw milk. This result was statistically significant at 1%

and this could imply that farmers who were located in areas with good road network were more likely to sell more quantities of value added milk

Participation in the unprocessed milk channel is also positively influenced by demand in health standards negatively and significantly influenced by the demand for quality by buyers. A unit change in the value for quality milk would result in decrease in the quantity of raw milk sold by up to 9.9%. This implies that farmers would choose to participate in the processed milk channel if there are demands for quality in the unprocessed milk channel.

Participation in the unprocessed milk channel is also influenced positively and significantly by whether a farmer preserved milk or not. This could be because when a farmer preserves milk when there is no market, especially evening milk, then the quantity delivered to the market will increase if he combines morning and evening milk.

Distance to the market also had a positive and significant influence on the quantity delivered to the market as unprocessed. A unit increase in distance would result in an increase in quantity sold as raw. This could be because most farmers who were located far from the markets sold their milk to did not deliver the milk themselves but depended on the buyer to collect. This increases the chances of selling the milk as unprocessed since the milk collected is bulked together with milk from other dairy farmers

4.16 **Determinants of participation in the selected value addition groups**

Within the selected regions, farmer groups that were involved in bulking, value addition and marketing of milk were also analyzed. The farmer groups were at close proximities to the smallholder farmers had good management practices and some offered varieties of support to the farmers who belonged to these groups. The selected groups were relevant for this study since these groups offered the farmers within the study regions a chance to upgrade milk and milk products through value addition and collective marketing. Some of the groups offered extra services to their members such as training on improved milk production as well as value addition. However, some farmers participated in these groups while others did not.

A probit model was used to determine the factors that influenced participation in a group. The significance of the model was shown by a p value of less than 1% and a pseudo R2 of 31.09%. **Error! Reference source not found.** presents the marginal effects of the probit analysis.

The variables hypothesized to influence participation decision by farmers in groups, nine were found to be significant at less than 5% level. Results also show that the age of the farmer significantly (at 10% level) and positively influenced decisions to participate in a group. If age is increased by a single unit, the probability of belonging to a farmer group also increases by up to 6.5%.

Table 16: Probit Model analysis. Determinants of participation in selected self help groups

Group belonging	Dy/dx	Standard error.	P>z
Buyer-processor	0.139	0.049	0.001***
Primary activity-business	0.051	0.039	0.251
No formal education	0.063	0.056	0.490
Gender of household head	0.042	0.041	0.290
Age	0.065	0.040	0.073*
Distance to market	-0.043	0.021	0.027**
Mode of transport-vehicle	-0.056	0.068	0.360
Value addition skills	0.112	0.036	0.012**
Sell to neighbor	-0.186	0.065	0.000***
Livestock-enterprise	-0.637	0.280	0.019**
Motorable-transport Ownership	0.083	0.037	0.038**
Total revenue	0.001	0.002	0.809
Favorable Milk price	-0.080	0.058	0.096*
Easy to find buyer	-0.048	0.037	0.261
Credit availability	0.358	0.047	0.000***
Bargaining power	0.060	0.042	0.119

Level of significance, * 10%, ** 5%, *** 1%.

Prob >chi2 = 0.0000 Log likelihood = -86.68 Pseudo R2 = 0.0.4507

Furthermore, the results show that farmers would choose to participate in a group if they had access to credit. The marginal effects indicate that a unit increase in the favorability of access to credit increases the probability of participation in a farmer group. From the study, all farmer groups that were sampled were able to give credit to their members. The marginal effects

show that a one unit change in the value for access to credit would result in an increase in group participation by 35%.

Distance to the market is also shown have a negative effect on participation in the selected groups and is significant at 5%. The results of the marginal effects show that a unit increase in distance to the market decreases participation in these groups by 4%. One explanation for this could be that distance presents higher transaction costs in terms of transport or milk loss in form of spoilage hence farmers would reduce participation in the groups if they are located far from the market.

Farmers who kept only livestock were less likely to participate in the groups according to the results. The marginal effects show that a unit increase in the value for livestock enterprise decreases participation in the groups by up to 63%.

When the buyer is a large scale processor, farmers were more likely to participate in a group as indicated by the results. This could be because the farmers would want to eliminate traders along the chain so that they can get better. On the other hand, if the buyers are neighbors the probability to participate in a group would decrease by up to 18%. This implies that farmers who sell to their neighbors were less likely to participate in groups.

Further, the results show that value addition skills influences positively and significantly the decision by famers to participate in the groups. If a farmer had value addition knowledge, probability of participation would increase by up to 11%. The explanation for this could be that farmers who have knowledge in value addition would participate in the groups since the group's offer them an opportunity to apply their skills.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

Minimal processing of milk was done at farm and products such as cheese were hardly known by farmers. In addition, traditional processing of milk was also minimally practiced. This results indicated that there were more opportunities for value addition in the dairy sector which could contribute to development of the agricultural sector in general.

Gross margins received by farmers who participated in the unprocessed dairy channel were low as compared to the margins received by farmers in the processed dairy chains. This showed that there was need to promote value addition by farmers and groups in order to improve their incomes.

Factors such as poor roads and longer distances to the markets played a major role in influencing decisions by farmers on whether sell to self-help groups that processed the milk. Some regions had roads which were impossible to pass during rainy seasons thus limiting the farmers market choices.

Participation in value addition was influenced positively by whether farmers had specific knowledge on value addition. This showed that for value addition to be practiced by farmers they needed to be trained and made aware of the various types of value addition that they could do.

Farmers who were able to preserve milk were also more likely to increase the quantities delivered to the market as unprocessed. The lack of electricity in some regions hindered the ability of farmers to preserve milk. Farmers were more likely to participate in groups if they were given incentives such as access to credit and inputs on credit.

5.2 Recommendation

Traditional processing as a form of value addition is minimally practiced for commercial purpose thus presenting opportunities for value addition in the Dairy subsector. Traditional methods of value addition are labor intensive and for these methods to be used for commercial purposes there is need to upgrade the processes in terms of commercialization and marketing. There is need to build technological and innovative capabilities of groups to encourage more value addition in the overall dairy subsector.

There is need to equip farmers with more skills on value addition in order to increase their ability to upgrade milk products going to the market hence get more income. This study therefore suggests facilitating and upgrading of self-help groups that are closer to the farmers as a way of creating more markets for milk produced as well as reduce spoilage within dairy chains.

Infrastructure was a major hindrance to value addition majorly poor roads and lack of electricity in the remote areas. This needs to be improved so as to realize more benefit from value addition.

5.3 Area for further research

More research could be done on production and marketing of evening milk. Majority of the farmers interviewed did not sell evening milk. Promoting the sale of evening milk could contribute to significant increase in quantities of milk sold to the markets. Further research also needs to be done in small scale dairy groups that were facing managerial challenges and how build capacity and capabilities for the self-help groups.

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APPENDIX

Appendix 1: Structured survey questionnaire

TARGET: SMALL HOLDER DAIRY FARMERS

DATE OF INTERVIEW _____NAME (Optional) _____

COUNTY OF RESPONDENT _____LOCATION_____

SUB-COUNTY_____ENUMERATOR NAME_____

1.0 **GENERAL INFORMATION**

1.1 Please provide the following information about the head of the household

Sex *1=male* *2=Female*	**Age (years)**	**Education level** 0=none 1=primary 2=secondary 3=college 4=university 5=other(specify)_____	**Experience in dairy farming (years)**	**Primary Activity** 1=farmer 2=civil servant specify)_____ 3=Businessman 4=retired with pension 5=retired without pension 6=others (specify)_____
[_____]	[_____]	[_____]	[_____]	[_____]

1.2 Please provide the following information

Distance from the homestead to the main road	**Distance from the homestead to the nearest major market**	**Do you have any motorable transport**	**Do you have any none motorable transport**	**Road type from the homestead to the main road**	**Mode of transport to market**	**Average dairy wage in the area (per day)**
		1=Motor cycle *2=Vehicle*	*1=Bicycle* *2=Wheelbarrow* *3=other(specify)*	*0=Earth road* *1=Murram* *2=Tarmac*	*1= foot* *2=Bicycle* *3=motorcycle* *4=vehicle*	
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	

1.3 Please provide the following information about your household's cattle holding

	Number present on the farm	**Number in milk**	**Number in-calve**
Cow grade			
Cow crosses			
Cows, local			
Heifer grade			
Heifer crosses			
Heifer local			
Calves			
Bull, grade			
Bull, crosses			
Bull local			

2.0 PRODUCTION INFORMATION

2.1 What are your 3-5 main cost factors? Give an estimate on how much you spend on them

Cost factor	**Estimate cost(KSH)**
1	
2	
3	
4	
5	
6	

2.2 Have you undertaken any of the following activities in the last three years?

Activity	**Response** 1= yes 2= no	**If yes above, what factors influenced your choice to undertake the activity?** 1=low cost 2=Buyer needs 3=regulatory board requirements 4=Availability 5=Gain competitiveness 6=Increase profits 7=Increase efficiency 8=Expand customer base 9=other (specify)_____	**If NO, do you have plans for engaging or improving any of the mentioned activities** 1= yes 2= no
Bought new machinery			
Improved cattle feed			
Increased technology use			
Increased delivery speed (to customer)			
Reduced animal disease incidence			
Improved quality and safety of milk			

Cut down losses			

2.3 Are you aware of international/national standards and regulations in dairy farming? (e. g. ISO norms, GAP, GMP, quality standards and laws, etc.) 1=yes [ ] 0= No [ ]

If Yes, What are these standards? Describe below

_____

_____

2.4 What requirements do your buyers have? (E.g. with regard to quality, delivery time, reliability, health standards, production standards etc.)

_____

_____

2.5 What kind of packaging materials do you use for your product? _____

2.6 With regard to your production: What are the strengths and weaknesses?

	Strength	***Weaknesses***
Availability of feed		
Lack of extension advice		
High cost of animal feed		
high incidence of diseases		
Inadequate animal husbandry skills		
Inadequate credit		

3.0 MARKETING INFORMATION

3.1 Where do you get your supply (raw materials, designs, tools, machines etc.) from?

Input (specify)						
Source						

3.2 What kind of information do you get from your suppliers?

Information about their products and services	About new technologies and methods	About available services	How to use and maintain inputs (eg chemicals, machines)	Other

3.3 Is this information easily available? Yes [___] No [_____]

If no, why not?_____

3.4 Who in the household makes the decision to sell milk?

1=father [___] 2= mother [___] 3= manager [___] 4=other (specify) _____

3.5 Does any member of the household belong to a group?

1=Yes [_____] 0=No [_____]

If yes, please provide the following information

Household member 1= Household head 2=spouse 3=son 4=Daughter	**Group type** 1=Common interest group Specify_____ 2=Community based organization 3=Farmer 4=cooperative	**When joined**	**Purpose of group** 1=Collective 2=marketing 3=Income generation 4=Saving and credit others	**How the group started**	**If externallysupport** 1=Ngo 2=ministry of livestock 3=Credit lending institution 4=Research institution 5=Other (Specify)	**If yes, is there a membership contribution fee (**Please specifyamount**)**
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

If you participate, what are the major benefits in participate in the	**If no, what are your reasons for not participating?**

group?	
1= high buying price 2= Reliability 3=Proximity 4=support services 5= Assured market 6= Access to credit 7= Access to training 8=Stable prices 9=Better prices for products 10=Access to inputs 11=Others (specify)[_____]	1=offer lower prices 2= member of other groups 3=Not interested 4=Entry fee is high 5=other(specify)_____]

Do you sell your evening milk? 1=Yes 0=No	**If answer is NO, How is the milk used?** 1= home consumption 2=Give to neighbors 3=Process 4= Preserve 5= others (specify_____	**Do preserve milk?** 1=Yes 0=No	**If YES, how?** 1= Refrigeration 2=Water bath 3=Earthen pot 4= Wet charcoal 5=Leave outside overnight 6=Others (specify) _____
[_____]	[_____]	[_____]	[_____]

3.6 Who do you sell your milk to?

Buyer type	**Terms of payment** *1= on the spot* *2= weekly* *3= monthly [ ]* *4=other (specify……. ……)*	**Cost per litre**	**Point of sale/collection point**	**Distance to the point of sale**	**delivery/collection Responsibility for** 1=buyer 2=seller(farmer)	**If seller who delivers** 1=self 2=spouse 3=Boy child (<18years) 4=girl child (<18 years) 5=Son (above 18 years) 6=daughter(>18 years) 7=female worker 8=Male worker	**If seller ,Time taken to deliver to collection/sales point**	**If seller, Means of transport to collection/sales point** *1= foot* *2=Bicycle* *3=motorcycle* *4=vehicle*	**If seller Cost of transport to the point of sale(per trip)**

Type 1 [_____]									
Type 2 [_____]									
Type 3 [_____]									
Type 4 [_____]									

[1=neighbor's] [2= nearby schools] [3= Local restaurants] [4= local shops] [5=Self-help group]

[6=Cooperative society] [7= Processing companies] [Any other (specify) [_____]

Is it easy is it to find buyers for your products? 1= Yes [___] 0=No [_____]

3.7 Do you incur any costs in finding your buyer? 1= yes[_____] 0=No[_____]

If yes, please specify

Cost item	**cost**	**Frequency of transaction**	**Time taken per day**
Communication(airtime)			
Transport			
Bargaining			

How do you interact with your buyer(s)? 1=Directly, face to	**How often do you meet your buyer(s)*to discuss business related matters and exchange new***	**What kind of information do you get from your buyer(s)?** 1= about new market trends 2=About market requirements	**Is the information received enough? Please**	**What is the nature of relationship between you and your buyer(s)** 1= Formal contract

face. 2=Through an intermediary (e.g. collector)	***information?*** 1=Daily 2=Once per week 3=At least once per month 4=At least once every three months 5=other (specify)	(e.g. quality standards) 3= About new technologies and methods 4= About available business services 5= About costs and prices	**specify** 1= yes 2=no	2=verbal agreement 3= Buyer dictates the terms 4= equal rights relationship 5= You can easily find another buyer 6=you are bound to a particular buyer (for various reasons)
[_____]	[_____]	[_____]	[_____]	[_____]

3.8 Do you have any bargaining power to influence the selling price of your products? Yes [_____] No [_____]

Do you perform the following activities before you sell your milk?*(tick appropriate)* Boil milk [__] Process: - mala[__] -Yoghurt [__] -cheese [__] -Ghee[__] Other(specify) [_____]	**What influenced your choice to perform activities?** 1= High costs of value addition equipment 2=unavailability of equipment 3=limited market for value added products 4=Inadequate value addition skills 5=Ready market for raw milk	**What determines the quantity in which you process** 1=Capacity of processing equipment 2= need to meet market demand 3=need to expand the market 4= capacity of storage facility 5= other (specify	**Do you have any formal training on the activity**? 1=Yes 0 =No	**If No formal training, where did you acquire the knowledge** 1=traditionally 2=though other farmers 3=specify	**Purpose for value addition** 1= own consumption 2 =for sell

	[_____]	[_____]	[_____]	[_____]	[_____]

3.9 Has any member of your household been trained in any milk value adding methods? Yes [____] No [_____]

If yes, provide the following information

Member trained 1=household head 2=spouse 3=son 4=Daughter 5=Other (specify)	**Value addition knowledge** 1=Cooling 2=Yorghurt, 3=Mursik/Mala 4=Cheese 5=Ghee 6=other (specify)	**When trained**	**Training provider** 1=NGOs 2=Ministry of agriculture 3=college 4=University 5=Any other(specify)	**Method of training** 1=workshop 2=Full time	**Who paid for the training?** 1=self 2=Government 3=donor	**What influenced the need to train?** 1=own motivation 2=other farmers 3=Family members 4=Ministry officials 5=other(specify)	**Do you apply the training knowledge** 1=yes 0=No	**If yes Which one**	**If no why** 1=capital constraint 2=inadequate training 3=Not interested
[_____]	[_____]	[____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

3.10 Over the past year, how much have you received for each dairy product sold?

Raw milk Buyer type	**Selling price per liter at farm gate**	**Quantity delivered to buyer**	**Packaging cost**	**Transport cost**	**Time taken to look for buyer**	**Licensing cost**	**Selling price to the buyer**
1_____							

2_____							
3_____							
4_____							
5_____							
6_____							
7_____							

Product	**Quantity of raw milk used per litre**	**Cost of ingredients**				**Utility cost**			**Packaging cost**	**Transport cost**	**Labor cost**	**Selling Price per unit**
		Flavor	**Sugar**	**Other (specify)**	**_____ __**	**Electricity**	**Water**	**Other (specify)**				
Mala												
Yoghurt												
Cheese												
Ghee												
Other (specify)												

3.11 What strengths or weaknesses, if any, do you face in milk marketing?

	Strength	**Weaknesses**
demand		
prices		
Transport		

contractual arrangement		
standards		
access to markets		
road network		
Other(specify)		

Appendix 2**:** survey questionnaire**:** Self-help groups

SERIAL NO _____DATE OF INTERVIEW _____

NAME (Optional) _____

1.0 GENERAL INFORMATION

2.0 PLEASE PROVIDE THE FOLLOWING INFORMATION

Age of the group(years)	**Size of the group/enterprise**	**Estimated value of enterprise(KES)**	**Activity** 1=processing 2= distributing 3=Marketing 4=Support 5=Any other (specify)]	**Other income generating activity**	**Distance from the group to the nearest major market**	**Do you have any motorable transport** *1=Motor cycle* *2=Vehicle*	**Road type from the homestead to the main road** *0=Earth road* *1=Murram* *2=Tarmac*
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

2.1 Have you undertaken any of the following activities in the last three years?

Activity	**Response** 1= yes 2= no	**If yes above, what factors influenced your choice to undertake the activity?** 1=low cost 2=Buyer needs 3=regulatory board requirements 4=Availability 5=Gain competitiveness 6=Increase profits 7=Increase efficiency 8=Expand customer base 9=other (specify)_____	**If NO, do you have plans for engaging or improving any of the mentioned activities** 1= yes 2= no

Bought new machinery			
Increased products			
Increased technology use			
Increased delivery speed (to customer)			
Expanded market			
Improved quality and safety of milk			
Cut down losses			

2.2 Do you add value to raw milk/any dairy products you handle?

1=yes [_____] 0 No [_____]

2.3 Has your staff been trained in any milk value adding methods?

Yes [_____] No [_____]

If yes, provide the following information

Staff trained 1=Manager 2=Proccessing staff 3=any	**Value addition knowledge** 1=Cooling 2=Yorghurt,	**When trained**	**Training provider** 1=NGOs 2=Ministry of	**Method of training** 1=workshop 2=Full time	**Who paid for the training?** 1=self 2=Government 3=donor	**What influenced the need to train?** 1=own motivation 2=other	**Do you apply the training knowledge** 1=yes	**If yes Which one** (specify)	**If no why** 1=capital constraint 2=inadequate training

other(specify) _____	3=Mursik/ Mala 4=Cheese 5=Ghee 6=other (specify)		agriculture 3=college 4=University 5=Any other(specify)		4=The group	competitors 3=Ministry officials 5=other(specify)	0=No		3=Not interested
[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]	[_____]

1.6. Do you regularly change the specifications of your product according to new trends and developments on the market? (e.g. the design of a product)

Please provide the following information

Products	**If yes What factors have influenced your decisions to add value**?	**If No, what factors constrain you from performing the mentioned activities?**	**What determines the quantity in which you process or add value?**
1=mala 2=yoghurt 3=ghee 4=cheese 5=any other	1= Availability of equipment 2= Have the skills 3= need to meet market demand 4=need to expand the market 5=increase profits 6=other(specify ……..	1= High costs of value addition equipment 2=unavailability of equipment 3=limited market for value added products 4=Inadequate value addition skills 5=Ready market for raw milk 6= others (specify)……..	1=Capacity of processing equipment 2= need to meet market demand 3=need to expand the market 4= capacity of storage facility 5= other (specify …….

	[_____]	[_____]	[_____]

2.4 Please provide the following information

Buyer type	**Terms of payment** 1= on the spot 2= weekly 3= monthly [ ] 4=other (specify…… ……	**Cost per litre**	**Point of sale/collection point**	**Distance to the point of sale**	**delivery/collection Responsibility for** 1=buyer 2=seller(group)	**If seller ,Time taken to deliver to collection/sales point**	**If seller, Means of transport to collection/sales point** *1= foot 2=Bicycle 3=motorcycle 4=vehicle*	**If seller Cost of transport to the point of sale(per trip)**
Type 1 [_____]								
Type 2 [_____]								
Type 3 [_____]								
Type 4 [_____]								
Type 5 [_____]								
Type 6 [_____]								

2.5 Do you buy evening milk from farmers/your suppliers? 1=yes [_____] 0=No [_____]

If no, why?

2.6 Please provide the following information on the dairy products

Raw milk Buyer type	**Selling price per liter at farm gate**	**Quantity delivered to buyer**	**Packaging cost**	**Transport cost**	**Time taken to look for buyer**	**Licensing cost**	**Selling price to the buyer**
1_____							
2_____							
3_____							
4_____							
5_____							
6_____							
7_____							
8_____							

Product	**Quantity of raw milk used per litre**	**Cost of ingredients**				**Utility cost**			**Packaging cost**	**Transport cost**	**Labor cost**	**Selling Price per unit**
		Flavor	**Sugar**	**Other (specify)**	**_____**	**Electicity**	**Water**	**Other (specify)**				
Mala												
Yoghurt												

Cheese												
Ghee												
Other (specify)												

Please provide the following information

What marketing strategy do you employ to gain competitiveness in your market 1= Pricing (eg through raising or lowering prices) 2=Promotion eg through adverts 3= Distributing to customers 4= Providing the right product needed in the market 5=other(specify)_____	**Do you have any linkages with the following?** 1= Ministry of livestock development 2=Credit lending institutions (specify)…….. 3= Research institutions 4= Kenya dairy Board 5=others specify)……	**What constraints, if any, do you face in milk processing**? 1=inadequate processing skills 2=inadequate capacity 3=inadequate equipment 4=standard regulations 5=Cost of equipment 6=Any other	**Do you offer any other services to your customers apart from buying milk?** 1=yes 0=No	**If yes, please specify** 1= training 2= loans 3=free transport 4=other (specify)
[_____]	[_____]	[_____]	[_____]	[_____]

What constraints, if any, do you face in milk marketing?	**Do you get any**	**If no, which areas**

1=low demand 2=low prices 3=High cost of transport 4=Unfavorable contractual arrangement 5=Inability to meet required standards 6=limited access to certain markets 7=poor road network 8=Uncertainty of prices	**support from government agencies or donors in relation to your dairy enterprise** 1=yes 2=no	**would you like to have support in your dairy enterprise?** (Please specify) 1=Training 2=Marketing 3=credit 4=Any (specify) _____

Thank you

APPENDIX 3: Probit regression results

Probit regression showing factors that influence decisions to add value to milk

Probit regression — Number of obs = 261; LR chi2(19) = 85.92; Prob > chi2 = 0.0000; Log likelihood = -52.168; Pseudo R2 = 0.4516

MLKFM_BSEL	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEX	-.8499078	.3215787	-2.64	0.008	-1.480191	-.2196251
AGE	.0098298	.0159057	0.62	0.537	-.0213448	.0410044
EDUC	-.0582596	.1610569	-0.36	0.718	-.3739254	.2574062
EXP_DAIRY	-.054907	.0228303	-2.41	0.016	-.0996536	-.0101604
COWS	.1113229	.0496565	2.24	0.025	.0139979	.2086479
MLK_PRIC	1.13278	.3724658	3.04	0.002	.4027604	1.862799
ROAD_NETWKS	.3809057	.3026197	1.26	0.208	-.212218	.9740294
VAL_SKILLS	1.555673	.3888559	4.00	0.000	.7935295	2.317817
BARGN_POWR	.4878061	.3513866	1.39	0.165	-.2008989	1.176511
TOP_MONTHLY	-.6546579	.3115999	-2.10	0.036	-1.265383	-.0439333
GRP_BLG	-.3667624	.3537523	-1.04	0.300	-1.060104	.3265793
HUSD_SKILLS	-.7423081	.3461202	-2.14	0.032	-1.420691	-.063925
CUT_LOSS	1.133711	.468937	2.42	0.016	.2146118	2.052811
QUALITY	-.708926	.4219841	-1.68	0.093	-1.536	.1181477
DELIVERYTIME	.639959	.4175327	1.53	0.125	-.1783901	1.458308
STDS	-.2001277	.4257319	-0.47	0.638	-1.034547	.6342916
DIST_RD	.1196157	.0909988	1.31	0.189	-.0587388	.2979701
DIST_MKT	-.0719227	.0487946	-1.47	0.140	-.1675582	.0237129
MOT_TRSNPT	-.7271598	.370773	-1.96	0.050	-1.453862	-.0004581
_cons	-1.758371	.9124396	-1.93	0.054	-3.54672	.0299778

APPENDIX 4: marginal effects after probit

Marginal effects after probit
y = Pr(MLKFM_BSEL) (predict)
= .01783334

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
SEX*	-.0480225	.02782	-1.73	0.084	-.10254	.006495	.59387
AGE	.0004317	.00074	0.59	0.558	-.001013	.001876	44.1341
EDUC	-.0025587	.0072	-0.36	0.722	-.016666	.011549	1.89272
EXP_DA~Y	-.0024114	.00136	-1.77	0.076	-.005079	.000256	14.4176
COWS	.0048891	.00277	1.76	0.078	-.000549	.010327	3.81609
MLK_PRIC*	.098442	.05626	1.75	0.080	-.011833	.208716	.241379
ROAD_N~S*	.0193821	.01861	1.04	0.298	-.017084	.055849	.337165
VAL_SK~S*	.218328	.09923	2.20	0.028	.023832	.412824	.126437
BARGN_~R*	.0215136	.01806	1.19	0.233	-.013874	.056901	.528736
TOP_MO~Y*	-.0372853	.025	-1.49	0.136	-.086292	.011721	.655172
GRP_BLG*	-.0196808	.02297	-0.86	0.392	-.064698	.025336	.743295
HUSD_S~S*	-.0268725	.01767	-1.52	0.128	-.061509	.007764	.32567
CUT_LOSS*	.0323115	.01805	1.79	0.073	-.003071	.067694	.758621
QUALITY*	-.0287654	.0195	-1.47	0.140	-.066994	.009463	.398467
DELIVE~E*	.0401358	.03638	1.10	0.270	-.03117	.111441	.260536
STDS*	-.0078301	.01473	-0.53	0.595	-.036707	.021047	.214559
DIST_RD	.0052533	.00414	1.27	0.205	-.002866	.013373	1.41161
DIST_MKT	-.0031587	.00229	-1.38	0.168	-.007653	.001336	5.01169
MOT_TR~T*	-.0253037	.01587	-1.59	0.111	-.056405	.005798	.298851

(*) dy/dx is for discrete change of dummy variable from 0 to 1

APPENDIX 5: Tobit regression results

Tobit regression showing factors that influence decisions by farmers to participate in a dairy channel

Tobit regression

Number of obs	= 245
LR chi2(24)	= 54.92
Prob > chi2	= 0.0003
Log likelihood = -850.47508	Pseudo R2 = 0.0313

RM_QNTY_BYR1	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
SEX	.423307	1.460455	0.29	0.772	-2.454893	3.301507
AGE	.0272977	.0539974	0.51	0.614	-.0791181	.1337135
EDUC	.8682255	.7898102	1.10	0.273	-.6882979	2.424749
DIST_RD	.5477848	.3653326	1.50	0.135	-.1721967	1.267766
DIST_MKT	.2538857	.1472021	1.72	0.086	-.0362138	.5439851
MOT_TRSNPT	2.635057	1.663858	1.58	0.115	-.6440016	5.914115
QUALITY	-.5079155	1.786806	-0.28	0.776	-4.029275	3.013444
DELIVERYTIME	-.6915792	2.053537	-0.34	0.737	-4.738599	3.355441
RELIABILITY	-1.138604	1.598126	-0.71	0.477	-4.288121	2.010913
HEALTHSTDS	3.459947	1.659835	2.08	0.038	.1888168	6.731078
GRP_BLG	2.511935	1.675433	1.50	0.135	-.7899355	5.813806
SELL_MLK	1.063148	1.490723	0.71	0.476	-1.874704	4.001
PRESV_MLK	4.25492	1.612001	2.64	0.009	1.078059	7.431781
BUYER_EASY	2.971778	1.9703	1.51	0.133	-.9112026	6.854759
MLKFM_BSEL	3.914552	2.532439	1.55	0.124	-1.076269	8.905372
MLK_DEMND	-1.214684	2.00402	-0.61	0.545	-5.16412	2.734752
MLK_PRIC	2.040369	1.903371	1.07	0.285	-1.710711	5.791448
MLK_TRSNP	-3.298669	1.736614	-1.90	0.059	-6.721113	.1237743
STANDRD	-.0485411	1.712039	-0.03	0.977	-3.422553	3.325471
ACCESS_MKT	1.313288	1.915521	0.69	0.494	-2.461738	5.088314
ROAD_NETWKS	-.5013616	1.817651	-0.28	0.783	-4.083508	3.080785
VAL_SKILLS	1.334131	2.251175	0.59	0.554	-3.102387	5.770649
TOP_CASH	2.017604	1.832474	1.10	0.272	-1.593755	5.628964
cows	.3678306	.2454593	1.50	0.135	-.1159099	.8515711
_cons	-5.575588	4.146137	-1.34	0.180	-13.74661	2.595438
/sigma	10.19947	.4939933			9.225928	11.17301

Obs. summary: 24 left-censored observations at RM_QNTY_BYR1<=0
221 uncensored observations
0 right-censored observations

APPENDIX 6: Marginal effects after Tobit

Marginal effects after tobit
y = Linear prediction (predict)
= 8.2808086

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
SEX*	.423307	1.46045	0.29	0.772	-2.43913	3.28575	.608163
AGE	.0272977	.054	0.51	0.613	-.078535	.133131	44.0449
EDUC	.8682255	.78981	1.10	0.272	-.679774	2.41623	1.88163
DIST_RD	.5477848	.36533	1.50	0.134	-.168254	1.26382	1.42143
DIST_MKT	.2538857	.1472	1.72	0.085	-.034625	.542396	5.03212
MOT_TR~T*	2.635057	1.66386	1.58	0.113	-.626045	5.89616	.302041
QUALITY*	-.5079155	1.78681	-0.28	0.776	-4.00999	2.99416	.412245
DELIVE~E*	-.6915792	2.05354	-0.34	0.736	-4.71644	3.33328	.273469
RELIAB~Y*	-1.138604	1.59813	-0.71	0.476	-4.27087	1.99367	.534694
HEALTH~S*	3.459947	1.65984	2.08	0.037	.20673	6.71316	.465306
GRP_BLG*	2.511935	1.67543	1.50	0.134	-.771854	5.79572	.742857
SELL_MLK*	1.063148	1.49072	0.71	0.476	-1.85862	3.98491	.432653
PRESV_~K*	4.25492	1.612	2.64	0.008	1.09546	7.41438	.314286
BUYER_~Y*	2.971778	1.9703	1.51	0.131	-.889939	6.8335	.840816
MLKFM_~L*	3.914552	2.53244	1.55	0.122	-1.04894	8.87804	.114286
MLK_DE~D*	-1.214684	2.00402	-0.61	0.544	-5.14249	2.71312	.820408
MLK_PRIC*	2.040369	1.90337	1.07	0.284	-1.69017	5.77091	.253061
MLK_TR~P*	-3.298669	1.73661	-1.90	0.058	-6.70237	.105032	.4
STANDRD*	-.0485411	1.71204	-0.03	0.977	-3.40408	3.30699	.567347
ACCESS~T*	1.313288	1.91552	0.69	0.493	-2.44106	5.06764	.546939
ROAD_N~S*	-.5013616	1.81765	-0.28	0.783	-4.06389	3.06117	.355102
VAL_SK~S*	1.334131	2.25118	0.59	0.553	-3.07809	5.74635	.126531
TOP_CASH*	2.017604	1.83247	1.10	0.271	-1.57398	5.60919	.204082
cows	.3678306	.24546	1.50	0.134	-.113261	.848922	3.82041

(*) dy/dx is for discrete change of dummy variable from 0 to 1

APPENDIX 7:Probit results

Probit regression showing factors influencing decisions to participate in a group

Probit regression

Number of obs	=	274
LR chi2(16)	=	142.24
Prob > chi2	=	0.0000
Pseudo R2	=	0.4507

Log likelihood = -86.687779

GRP_BLG	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
BUYERprocessor	.9087318	.2650706	3.43	0.001	.3892029	1.428261
Act_business	.4051484	.3526133	1.15	0.251	-.285961	1.096258
Educ_none	.6114488	.8862943	0.69	0.490	-1.125656	2.348554
SEX	.2575158	.2434033	1.06	0.290	-.2195459	.7345774
lAGE	.4162649	.2319142	1.79	0.073	-.0382786	.8708085
DIST_MKTsq	-.2710224	.1223494	-2.22	0.027	-.5108229	-.0312219
mode_vehicle	-.315572	.3448225	-0.92	0.360	-.9914116	.3602676
KNWDGE_VAL	1.313599	.5211679	2.52	0.012	.2921282	2.335069
BUYERneighb	-.9884936	.2624776	-3.77	0.000	-1.50294	-.4740469
livestock_ent	-1.981003	.842584	-2.35	0.019	-3.632438	-.3295692
Mot_transport	.6194523	.2988844	2.07	0.038	.0336497	1.205255
TTR2	.0032841	.0136003	0.24	0.809	-.023372	.0299403
MLK_PRIC	-.4356591	.2620896	-1.66	0.096	-.9493454	.0780271
BUYER_EASY	-.3633631	.3233298	-1.12	0.261	-.9970778	.2703516
CREDIT	2.726056	.5119202	5.33	0.000	1.722711	3.729401
BARGN_POWR	.3755918	.2408402	1.56	0.119	-.0964464	.84763
_cons	-.9965578	.9806515	-1.02	0.310	-2.918599	.9254838

APPENDIX 8: Marginal effects after probit

Marginal effects after probit
y = Pr(GRP_BLG) (predict)
= .91411365

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
BUYERp~r*	.1385582	.04909	2.82	0.005	.042339	.234777	.452555
Act_bu~s*	.0514553	.03859	1.33	0.182	-.024186	.127097	.124088
Educ_n~e*	.0630476	.05602	1.13	0.260	-.046741	.172836	.018248
SEX*	.0418351	.04109	1.02	0.309	-.038702	.122372	.594891
lAGE	.0652797	.03976	1.64	0.101	-.012648	.143207	3.69585
DIST_M~q	-.0425024	.02134	-1.99	0.046	-.084322	-.000682	1.95088
mode_v~e*	-.0557091	.068	-0.82	0.413	-.188993	.077575	.222628
KNWDGE~L*	.1118912	.036	3.11	0.002	.041338	.182444	.138686
BUYERn~b*	-.1856457	.0646	-2.87	0.004	-.312257	-.059034	.375912
livest~t*	-.6367488	.27974	-2.28	0.023	-1.18503	-.088468	.021898
Mot_tr~t*	.0828892	.03726	2.22	0.026	.009859	.155919	.29927
TTR2	.000515	.00215	0.24	0.811	-.003706	.004736	15.959
MLK_PRIC*	-.0798756	.05804	-1.38	0.169	-.193637	.033886	.233577
BUYER_~Y*	-.0480989	.03707	-1.30	0.194	-.120759	.024561	.839416
CREDIT*	.3577909	.0466	7.68	0.000	.266457	.449125	.368613
BARGN_~R*	.0597479	.04206	1.42	0.155	-.022692	.142188	.518248

(*) dy/dx is for discrete change of dummy variable from 0 to 1