

**EVALUATION OF MILK MARKETING BY SAHIWAL FARMERS OF KAJIADO
AND NAROK COUNTIES: DETERMINANTS OF PARTICIPATION, OUTLETS
CHOICE DECISION AND PRICES**

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for the Award of the Master of Science Degree in Agricultural Economics of Egerton
University**

EGERTON UNIVERSITY

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DECLARATION AND RECOMMENDATION

Declaration

I declare that this thesis is my original work and has never been submitted in any university for the award of a degree.

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DEDICATION

I dedicate this thesis to my father Francis Mukundi, my mother Rachael Mukundi and my siblings for their continued support and prayers.

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ABSTRACT

To improve pastoralists' livelihoods, Sahiwal cattle breed, resilient and dual purpose in nature with the benefits of both improved milk and beef production and better adapted to harsh conditions in Arid and Semi-Arid Lands (ASALs) were introduced by Kenya Agricultural Research Institute (KARI) now Kenya Agricultural and Livestock Research Organization (KALRO). With potential expected increase in milk production, the market profiles are likely to change, yet the underlying factors driving this change are unclear. Using data from a random sample of 320 pastoralist households and 64 milk traders from Narok and Kajiado Counties, this study analyzed factors that influence milk market development in pastoral areas using Structure conduct and performance market analysis model (SCP); Multinomial logit (MNL) model; Double hurdle (DH) model; and Hedonic price model (HP) data were analyzed in order to provide information on possible effects on the output market changes contingent on increased production as a result of increase in number of Sahiwal cattle breed for milk market development. Gini coefficient, Lorenz curve and concentration ratios from SCP show that middlemen and processors dominated in the milk market. The DH results indicated that Sahiwal cattle, increased income and membership to groups increased participation while long distances to markets reduced participation. The MNL results showed that most pastoralists sold their milk to the middlemen and choice of other marketing channels was significantly influenced by total income, distance to the point of sale and group membership. The HP results showed that increased transaction cost reduced the price that the farmers received. Improving physical and market infrastructure, promoting high value marketing points is an intervention that is likely to make the market competitive. Ability to meet transaction costs associated with marketing and increased social capital through group membership is necessary. Reducing transactions cost and ensuring information symmetry by improving social networking among the farmers could improve milk prices.

LIST OF ABBREVIATIONS AND ACRONYMS

ASAL	Arid and Semi-Arid Land
ASDS	Agricultural Sector Development Strategy
EPZA	Export Processing Zones Authority
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GOK	Government of Kenya
IFAD	International Fund for African Development
KARI	Kenya Agricultural research Institute
KALRO	Kenya Agricultural and livestock research organization
KES	Kenyan shillings
KRDS	Kenya Rural Development Strategy
SCP	Structure Conduct and Performance
SPSS	Statistical Package for Social Sciences
US\$	US dollars

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CHAPTER ONE

INTRODUCTION

1.1 Background Information

Agriculture continues to be a major sector of the Kenyan economy; it contributes about 26% of the Gross domestic product (GDP) directly and 25% indirectly, and provides more than 18% of formal employment and more than 70% of informal employment in the rural areas (GOK, 2010). However, the sector is faced with a myriad of challenges that constrain its development to achieve its production potential. These challenges include: limited agricultural land, declining soil fertility and land degradation, inadequate rainfall, lack of suitable crop varieties and animal breeds for the harsh low rainfall environment and high pest/disease incidences (GOK, 2010; Barret *et al.*, 2002). What this means is that any improvements in agricultural productivity would require the development of high impact and suitable agricultural technologies to fully exploit the country's land, genetic and water resources (GOK, 2010).

Moreover, the rural populations mostly depend on small scale agriculture for food and income and because of constraints in agricultural production, farmers in rural areas have remained poor (Olwande and Mathenge, 2010). Smallholder agriculture is one of the major areas that can be developed for rural growth and livelihood improvement with the aim of getting large numbers of the rural poor out of poverty (Hazell, 2005). The challenge of improving rural incomes requires some form of revolution out of the semi-subsistence that demands low-input leading to low-productivity in farming systems that are attributes of farmers in rural areas (Jayne *et al.*, 2007). This is even more critical in the arid and semi-arid lands (ASALs) of Kenya.

The livestock subsector is the most dominant in ASALs and a major source of livelihood for many in these areas contributing 7% to the GDP (GOK, 2010; EPZA, 2007). It comprises mainly dairy, meat, eggs, hides, skins and wool production with meat and milk production being very important both as a source of protein and income. In meat production about 67% of the red meat is produced in the ASALs under pastoral system of production (EPZA, 2007). The dairy section supports many Kenyans mostly in medium and high rainfall areas who mainly rely on it for income from milk sales. The industry is one of the most developed with

estimated annual revenue of about US \$¹ billion, and contributes about 3.3% to the GDP (GOK, 2010). The economic development and employment opportunities created by increased milk production, improved marketing outlet efficiency, and greater consumer demand for affordable dairy products are enormous. Development of effective and efficient dairy marketing is crucial in achieving the twin millennium development goals of reducing poverty and ending hunger in Kenya (Karanja, 2002; GOK, 2010).

However, dairy production is concentrated in medium to high rainfall areas which mostly support exotic dairy breeds. To increase milk supply from ASALs, exotic dairy breeds cannot be prioritized since they cannot withstand harsh conditions in these areas (Kavoi *et al.*, 2011). Interventions to increase milk supply in the market have however concentrated on medium to high rainfall areas neglecting the ASALs which equally have the potential to supply the market with enough milk. To utilize the milk potential in ASALs, there is a need to increase the number of cattle breeds that are well adapted to the harsh conditions in these areas. Though African indigenous breeds such as Zebu are well adapted to the harsh ASALs climatic conditions, they have low reproduction rate and low milk production for that matter (Peixoto *et al.*, 2006). They show a high frequency of short lactations which is partly due to the inability of the cattle to let down milk in the absence of a calf and also due to low genetic potential of the cow to produce milk for longer periods (Peixoto *et al.*, 2006). Sahiwal cattle genetic resources have been prioritized for development through genetic improvement and proper management for use in ASALs particularly under the pastoral production systems (Ilatsia *et al.*, 2006). This is because Sahiwal breeds are dual purpose in nature mainly being utilized for milk and beef production. They have relatively high milk production and growth performance compared with predominant African indigenous breeds. They are also heat tolerant and they have been seen to exploit the dairy potential in pastoral areas (Joshi *et al.*, 2001; Boone *et al.*, 2006). There has been promotion of Sahiwal breed mostly by Kenya agricultural research institute (KARI) now Kenya Agricultural and Livestock Research Organization (KALRO) and this has influenced the value that pastoralists attach to the breed, giving it a priority in pastoral areas (Ilatsia *et al.*, 2011).

This prioritizing of Sahiwal breed in pastoralist areas is likely to move farmers to the market oriented system of production from semi subsistence system of milk production that is

¹ US \$ 2 billion is equivalent to KES 168 billion at exchange rate of KES 86 for 1 US \$ in the year 2014.

characterized by low input use, low production, poor market participation and market linkages (Jayne *et al.*, 2007). With market oriented production, effective and efficient milk marketing system is important to strengthen milk market linkages among farmers and other milk market actors (Jaleta, 2009). Marketing in pastoralist areas is ineffective and inefficient, likely to mostly characterized by informal marketing outlets such as hawking to hotels, food kiosks and trading centers at low prices (Nyariki *et al.*, 2009). unexpanded milk marketing in pastoralist areas may be attributed to; underdeveloped markets, poor farmers with limited capital to invest in handling and processing equipment and worsening infrastructure, particularly roads (Lightfoot *et al.*, 2005).

For that reason, any changes in output products for instance increased milk production is likely to impact pastoralist market linkages leading to market development. Farmers selling milk in pastoralist areas incur varied costs upon decisions they make in milk markets. They are likely to decide on market participation, level of participation and prices for milk in the market and make choices of marketing outlet to ensure highest possible benefits. When making marketing decisions, farmers consider such factors as infrastructure condition and distance to markets that are likely to lower benefits and they incur costs to provide best possible trade-off in risk reduction (Dorward, 2004). This study therefore aims at characterizing milk market outlets, determine the factors that influence choice of milk marketing outlets, milk market participation and milk prices for milk market development in pastoral areas.

1.2 The statement of the research problem

Many pastoralists in Kenya are mostly poor and practice subsistence farming. Commercialization of dairy farming in pastoral areas is likely to benefit the pastoralist farmers by increasing their income sources and levels. Challenges to increased milk production in ASALs are mainly due to restricted supply of dairy stock, poor animal health, inadequate feeding, poor extension service delivery and poor market facilities. Since commercialization in any agricultural production is based on producing for markets and maximizing profits, marketing decision by pastoralists are likely to influence change from subsistence system of production to market oriented system of production. Since Sahiwal cattle breeds produce more milk than the pre-dominant local breeds in pastoralist areas, there is increase in their demand among the small scale farmers due to the benefits they have of increased production. Increase in number of Sahiwal cattle breeds among pastoralists is

likely have an effect on milk marketing outlets as well as milk prices and consequently influence milk market development in pastoral areas. Since the introduction and adoption of Sahiwal breed into the pastoralist livestock production system, the subsequent effects on milk market development are unclear and the underpinning drivers of milk marketing outlets. Prices play a key role in a market and determinants of milk prices are yet to be established in pastoral areas of Kajiado and Narok Counties and this study therefore seeks to fill these gaps.

1.3 Objectives

1.3.1 General objective

To contribute to the understanding of milk market and its development for the economic welfare of pastoralists keeping Sahiwal cattle in Narok and Kajiado Counties.

1.3.2 Specific objectives

1. To determine milk market structure in pastoral areas of Kajiado and Narok Counties.
2. To determine the factors that influence milk market participation and extent of participation among pastoralists in Kajiado and Narok Counties.
3. To determine factors influencing pastoralists' choice of milk marketing outlets in Kajiado and Narok Counties.
4. To analyze the determinants of milk prices in pastoralist milk markets in Kajiado and Narok Counties.

1.4 Research Questions

1. How is milk market structured in Kajiado and Narok Counties?
2. What are the factors influencing milk market participation and extent of participation among the pastoralists of Kajiado and Narok Counties?
3. What are the factors influencing choice of a marketing outlet among pastoralists Kajiado and Narok Counties?
4. What are the factors that influence milk pricing in milk markets of Kajiado and Narok Counties?

1.5 Justification

Markets play an important role in assuring better income levels and welfare for the farmers contributing to poverty reduction and alleviation (IFAD, 2004). In pastoral areas, the main economic activity is livestock production with main products produced being beef and milk.

Markets of the major products from pastoralist areas are likely to have an effect on the income levels among the pastoralists. By raising income levels of the pastoralists, markets increase the purchasing power which positively influences demand for other consumer goods enhancing welfare. Those supplying the consumer goods and providing other services due to farmers' purchasing power will also have improved incomes and welfare. Markets promote growth and facilitate accumulation of assets; this provides the farmers with an opportunity for improved lifestyle with improved nutrition and balanced diet (Altman *et al.*, 2009). With limited access to markets, livestock farmers are likely to produce under subsistence production system and thus the need for market improvement.

Consequently, market access improvement is likely to increase productivity and supply of livestock products without which anticipated increase in demand for milk will not be realized. Market access is restricted primarily by among other factors such as transaction cost which are created by market attributes such as location, market actors attributes and opportunity cost of supply to the market. Market development in rural areas is likely to increase income among the rural poor and help eradicate hunger and poverty. This is one of Kenya's goals in vision 2030 and millennium development goals. Pastoral areas like Kajiado and Narok Counties are inhabited by pastoralists who are mostly poor with low levels of income and increasing their income levels will take them out of poverty. Understanding of market and market development will help in interventions to increase income of pastoralists by the development agencies such as the government and donors. The study also provides information for policy makers in drafting of policies dealing with market development and poverty eradication mostly in rural areas. The study as well contributes to the body of knowledge in scholarly literature and can be used as a source literature for further studies.

1.6 Scope and limitation

The study was limited to Kajiado and Narok Counties where the scope covered pastoralists and milk traders from these areas. The study focused on the marketing of milk and its effect on Sahiwal farmer and it was based on recall and approximations.

1.7 Definition of terms

Arid and semi-arid lands (ASALs) - Sub humid zones characterized by low erratic rainfall of up to 700mm per annum, periodic droughts and different associations of vegetative cover and soils (FAO, 1986).

Market participation - Choice to buy or sell in a given market (Boughton *et al.*, 2007)

Marketing outlet - Path through which goods and services flow in one direction from producer to the consumer, and the payments generated by them that flow in the opposite direction from consumer to the producer (Kotler *et al.*, 2009)

Marketing - The performance of all business activities involved in the flow of products and services from the point of initial production until they are in the hands of the final consumer (Kohls and Uhls, 1990)

1.8 Outline of the thesis

This thesis is organized in nine chapters. Chapter one gives the background of the research problem addressed in this study. Chapter two describes the literature reviewed, discusses the conceptual and theoretical frameworks. Chapter three describes the study area, sampling procedure and data collection strategies used. It also gives a detailed description of variables used in various models in this study.

The results from this study are presented in five separate chapters (chapter four, five, six, seven and eight). In chapter four, survey descriptive statistics results are presented and discussed. The milk market structure is determined using the SCP market analysis model and results presented and discussed in chapter five. In chapter six, determination of the factors that influence milk market participation and extent of participation using the Double hurdle model are presented and discussed. A multinomial logit model was used to determine factors that influence pastoralists' choice of milk marketing outlets and the results presented and discussed in chapter seven. Chapter eight analyzed the determinants of milk prices in pastoralist milk markets using hedonic price model. Results for the determinants of milk prices are presented and discussed in detail in this chapter eight. Summary, conclusions and implications are presented in chapter nine.

CHAPTER TWO

LITERATURE REVIEW

2.1 Milk as source of livelihood among the pastoralists

Livestock play multiple roles among the pastoralists including provision of food, as meat or other animal products such as milk, cash income from sale of live animal or products such as milk, socio-cultural and religious functions, and the basis of traditional social relations, asset and security against risks among others (Guliye *et al.*, 2007). Livestock contributes to food security being a source of high value animal protein and micronutrients important in the diets of children and lactating women (Delgado *et al.*, 1999 cited in Rege and Gibson, 2003). Pastoralists mostly depend on milk for daily food supply versus other animal products because: milk is available daily but products such as meat are only available sporadically (Sadler *et al.*, 2009; Mwacharo and Rege, 2002). Similarly pastoralists always preserve the herd for future food and livelihood security and ties. Milk production is influenced by the availability of natural pasture and water such that, better environment/climate leads to increased milk production and vice versa. The success of pastoral family is determined by the amount of milk their animals yield because milk and milk products are the mainstay of their diet and at times the very survival of the household is contingent on their continued production (Sadler, *et al.*, 2009). Milk and milk product marketing among the pastoralists is done to fulfill their main basic needs requirements for their livelihood (Nyariki *et al.*, 2009). The contribution of milk in improving household welfare through increased income from sales is great.

Due to the fast growing demand for dairy products in the region, milk supply side has been forced to react. Kenya being one of the major milk producers in the region has intervened to improve its livestock productivity through utilizing available resources and technologies in ASALs. Sahiwal cattle breeds and their crosses which is an improvement to the indigenous breeds are selected by various farmers given their underlying adaptive advantages in ASALs. Increase in number of Sahiwal cattle breed and their crosses, mostly promoted by KARLO have influenced the value that pastoralists attach to the breed, leading to increased milk production in ASALs (Ilatsia *et al.*, 2011). This chapter therefore, aims at giving a full account of the contribution of milk marketing to livelihoods.

2.2 Marketing of milk in pastoralist areas

Milk production in pastoralist areas is not market oriented and a minor portion of the locally produced milk enters the market owing to the marketing constraints and lack of processing techniques suitable for smallholder dairying (Kedija *et al.*, 2008). In order to sustain increased milk production from high milk producing breeds such as Sahiwal cattle, disposal of excess milk should be well facilitated (Kedija *et al.*, 2008). Processing of milk is likely to provide the producers with additional source of cash and facilitate investment and conserve milk for future use.

The informal milk market has remained dominant among the pastoralists. Milk and milk products reach to consumers mostly through informal marketing systems. Muriuki *et al.* (2001) noted that in areas without formal milk marketing outlets excess milk is normally hawked in small quantities in townships and trading centers and sold to collectors or traders nearby towns. The proportion of total production marketed through the formal markets is small (Muriuki *et al.*, 2011). Several constraints hinder the expansion of milk marketing among the pastoral community (Nyariki *et al.*, 2009). The most important constraints include underdeveloped rural milk markets, shortage of capital to invest in handling and processing facilities and poor rural infrastructure particularly roads among others.

2.3 Marketing outlets characteristics

Markets link producers and consumers when they trade their produce and/or purchase food and other necessities. Markets in the rural areas have unique characteristics that differentiate them from those in the urban. Rural markets are characterized by poor infrastructure, weak institutions and high illiteracy levels. Ouma *et al.* (2003) while evaluating non-market benefits from cattle in smallholder Kenyan crop livestock systems using contingent valuation method found that poor transport and infrastructure resulted into imperfect and inefficiently integrated markets.

In an evaluation of characteristics of sheep and goat markets in Marsabit County using descriptive statistics Tura *et al.* (2006) revealed that there was high illiteracy level among traders and weak legal backing for market management committee and this was due to low levels of education among the traders which led to traders having limited business skills. Markets in rural areas are also seasonal and they only function when there is produce from the farmers to be sold. In their study Tura *et al.* (2006) observed that 50% of sheep and goat

markets were seasonal and they only operated when there was produce from the farmers. Investment is a key component for market development, when the traders have high capital they are likely to invest in areas such as improving infrastructure and give an incentive to service providers such as banks to operate within the market. Traders in rural areas operate with low capital having low purchasing power and they pay by cash because financial institutions are mostly not accessible (Tura *et al.*, 2006).

Efficiency in marketing system is of great importance in moving goods from producer to consumer (FAO, 2011). A marketing outlet is said to be efficient when there are few intermediaries and the farmers get high price for their produce and the consumers pay less for the same produce. Increase in number of intermediaries in any outlet is likely to make it perform poorly. Using price spread and commodity chain analysis in assessing the efficiency of cattle marketing in pastoral areas of Hadiya zone in Ethiopia, Arficho (2011) observed that producers share was large in direct sale to consumers followed by direct sale to butchers through rural collectors. Producers who supplied directly to the consumers had the highest returns. Actions of actors in marketing outlets showed a high correlation between actions and outcome in terms of profits as observed by Tura *et al.* (2006). Farmers received lower prices by sale to cooperatives because cooperatives were managed by some members who were not producers.

2.4 Market participation

Market participation is the decision by a farmer to sell farm produce in a particular market and the amount to sell. These decisions can be influenced by several individual and exogenous factors. These factors that determine farmer's market participation are likely to be specific on the type of farmer, commodity and areas where the farm is located. Poor access to market constraints many farmers in selling their produce in market (Lightfoot *et al.*, 2005). Access can be defined in terms of distance to the nearest market or availability of buyers among other factors. In a study on determinants of livestock market participation in Kenya and Ethiopia, Bellemare and Barret (2004) using Ordered Tobit model found that high transaction cost determined by accessibility, influenced the farmer's decisions on both market participation and the level of market participation. Ehui *et al.* (2009) also observed that long distances to the market limited households from selling their produce to the market. When the producers are near to the market they are likely to sell more of their produce. Omiti *et al.* (2009) found that pre-urban farmers who were near to the market and had access

to market information sold more produce than their counterparts in rural areas. Makhura *et al.* (2001) observed that farmers were constrained from participating in markets by increased transaction cost. This was emphasized by Alene *et al.* (2008) who noted that transaction cost had negative effects on marginal product sold in the market and concluded that institutional innovations such as group marketing were likely to mitigate the cost of accessing markets. This was also emphasized in studies by Goetz (1992), Chianu (2006) and Ouma *et al.* (2010); they found that more time taken to the market, a proxy for distance led to poor households' access to markets due to increased transaction costs. Output price may not have effect on decision to participate but it provides incentive to increase level of participation (Alene *et al.*, 2008). Better output prices and market information were key incentives for increased sales. Since prices and distances to the market were found to be constraints in marketing, they are also likely to highly influence pastoralist milk farmers in milk marketing decisions.

Market participation highly depends on amount produced by the farmer, if the farmers produce more there is a likelihood that the surplus after consumption will be sold. Ehui *et al.* (2009) in their study using Heckman-2-stage in identifying policy and technological options to increase participation and sales of small holder producers in livestock markets in Ethiopian Northern highlands found that physical capital influenced market participation. This was emphasized by Olwande and Mathenge (2012) and Reyes *et al.* (2012) using Double hurdle model who also noted that farmers with high levels of capital were likely to produce more and even pay more for the produce to reach the market. A study by Ouma *et al.* (2010) found that farmers that were wealthy (they had a car or a bicycle, a proxy for wealth) did not participate in banana markets through sales. Logit models and Heckman-2-stage are restrictive models and this may results in biasness in estimation of parameters. When some factors for example transaction cost are expected to influence participation decision and not the level of participation restrictive models are not appropriate. Double hurdle model is not restrictive and therefore appropriate because it removes the assumption that the two decisions on participation and level of participation are affected by the same set of factors.

2.5 Farmers' choice of market outlets

Choice for marketing outlets can be defined as the farmers' decision on the point of sale for farm produce. Farmers receive prices and other benefits that are varied in different marketing outlets and the farmer is likely to choose the one which gives higher benefits. The choice of a market outlet is likely to determine the price that the farmers will receive for the produce

they sell. Using conditional logit analysis, Staal *et al.* (2006) evaluated farmers' choice of milk marketing outlets among those available in Gujarat, India. They found that farmers were likely to select formal marketing outlets for disposing their farm produce. Choice of formal outlets (private traders and cooperatives) was associated with high levels of production which were highly correlated with number of adults in the household, more land and high number of livestock (Mburu *et al.*, 2007). In a study by Chikazunga *et al.* (2008), farmers chose informal marketing outlets because they could not meet threshold quality and quantities levels required for the formal marketing outlets. They were constrained by low levels of education, access to land and other production assets such as green houses.

When the farmers market their produce, the mode, time of payment and other financial services are highly considered. When the farmers do not prefer being paid every time they deliver, security of the payments must be guaranteed. In studies by Staal *et al.* (2006), Mburu *et al.* (2007) and Voors and D'Haese (2010), it was observed that farmers preferred outlets that paid on monthly basis or had formalized credit terms and payments were secure. This was however not consistent with findings of Shiferaw *et al.* (2008) who, in their study on rural market imperfections and the role of institutions in collective action to improve markets for the poor found that most farmers chose middlemen who dominated rural grain markets. These middlemen could pay cash while farmer groups could not. This led to outlet characterized with long and complex and high transaction cost which lowered farmers' share of consumer price.

This therefore shows that social characteristics are specific to a community and they are likely to differently influence the choice of marketing outlet among diverse groups. Technology used both in production and handling of agricultural commodity is specific on a given commodity and similar factors are likely to influence choice differently. Due to differences between ASALs and highlands, similar factors were also likely to have different effects on choice of marketing outlet in ASALs. Multinomial logit model was used instead of binomial logit because it permitted estimation of qualitative choice when more than two alternatives are involved.

2.6 Product pricing

Goods are seen as bundles of quality characteristics and the 'marginal value' consumers put on each characteristics gives the total value of a given good (Lancaster, 1966; 1976). Each

commodity has unique attributes that influence its price in a given market and so factors considered in pricing are not similar. Price of a given commodity in a given market is of importance because it reflects the benefits the farmers are likely to get from sales. Using structural heteroskedasticity in mean estimation method, Barrett *et al.* (2002) identified the determinants of livestock producer prices for pastoralists in Northern Kenya rangelands. They found that animal characteristics, periodic event such as season, price risk and imposition of quarantines negatively influenced expected prices. Prices responded strongly to rainfall which reflected livestock health and productivity. Predictable regular demand and supply shifts associated with ceremonies demand shocks due to quarantine also affected prices. Response of prices due to rainfall is of use in this study since health of animals will determine quality and quantity produced affecting prices in the market. The price estimation method used does not give the value that farmers attached to each price determinant but hedonic price model will.

In identification of the factors influencing short-run, intra year cattle prices in central of West Africa, Timothy (2006) used Hedonic price model and found that market location and season of supply and sales had an effect on prices. Market participants had preferred cattle attributes and they were willing to pay premium prices consistent with preferences. Maynard and Stoeppel (2006) studied the impact of breeding, racing and market characteristics on broodmare auction prices using Hedonic price analysis model in Keeneland in U.S. Prices were highly responsive to the sire stud fee, the broodmares age, and progeny performance in graded stakes races, with pronounced day of sale effects. Bett *et al.* (2011) in their study to determine indigenous chicken attributes and socio economic characteristics that influence the price differentials for live indigenous chicken in Western Kenya using Hedonic price model found that weight, body size, plumage color and the general body condition significantly influenced the price. Gender of trader, transport cost, number of traders and presence of market information was found to influence prices. Risks associated with prices were transferred back to the farmers and to end users. They also found that traders did not provide information on prices and consumer preferences which had an effect on price. The studies from Timothy *et al.* (2006), Maynard and Stoeppel (2007) and Bett *et al.* (2011) show that in Hedonic pricing each commodity has its own unique attributes that influence its price and it is unlikely that the same characteristics will have the same effects on price. Studies on factors influencing pricing in pastoralist areas have mostly focused on animal pricing and rarely on

milk pricing. Each commodity has its own unique attributes that are considered and also attributes that are external for instance the type of the farmer and location of the farmer.

2.6 Theoretical framework

The theory behind determination of factors influencing pastoralists' choice of milk marketing outlets is random utility theory. The theory underpinning determination of the factors that influence milk market participation and extent of participation among pastoralists is the theory utility maximization and profit maximization theory. The theory underpinning determination of milk market structure in pastoral areas and analysis of the determinants of milk prices in pastoralist milk markets is the profit maximization theory.

2.6.1 Random utility theory

Every farmer is a rational decision maker maximizing utility relative to his choices. It is assumed that given farmer i in making a decision considering exclusive alternatives that constitute the choice set I^i of milk marketing outlets, the choice set may differ according to the decision maker. The farmer i assigns each alternative j in his choice set of perceived utility U_j^i and selects the marketing outlet that maximizes his utility. The utility assigned to each choice alternative depends on a number of measurable attributes of the alternative itself and the farmer who is the decision maker.

$$U_j^i = U^i X_j^i \quad (2.1)$$

In equation 2.1, U^i is the perceived utility and X_j^i is a vector of attributes relative to alternative j and to decision maker i , utility is not known with certainty and it must be represented in general by a random variable. The probability that the farmer will select alternative j conditional of his choice set I^i is given by:

$$P^i(j/I^i) = P^i(U_j^i > U_k^i) \quad \forall k \neq j \quad k \in I^i \quad (2.2)$$

The perceived utility U_j^i can be expressed as sum of two terms: a systematic utility and a random residual. Systematic utility V_j^i represents mean of all farmers having the same choice

context as decision maker i . ε_j^i captures the combined effects of the various factors that introduce uncertainty in choice modeling, it is expressed in equation 3 as:

$$U_j^i = V_j^i + \varepsilon_j^i \quad \forall j \in I^i \quad (2.3)$$

with $V_j^i = E(U_j^i)$, then $E(V_j^i) = V_j^i$, $\text{var}(V_j^i) = 0$ and $E(\varepsilon_j^i) = 0$, $\text{var}(U_j^i) = \sigma^2_{ij}$ and this yields:

$$P^i(j/I^i) = \text{Prob}(V_j^i - V_k^i > \varepsilon_k^i - \varepsilon_j^i) \quad \forall k \neq j \quad k \in I^i \quad (2.4)$$

where P^i is the choice probability. Equation 2.4 gives the probability of farmers selecting alternative j and it suggests that the choice of a given alternative depends on the systematic utilities of all competing alternatives and on the law of joint probability of random residuals ε_j . A farmer is likely to choose the option that gives a higher utility among the alternatives.

2.6.2 Utility maximization theory

The pastoralist farmer regularly makes market decisions in livestock production, the main source of livelihood and income in the region. The farmer decides whether to participate in milk market or not by comparing utility values. According to a Von Neuman Morgenstern utility function, the farmer is assumed to maximize expected utility (Fishburn and Kochenberger, 1979). When making a decision on participating in milk market, the i^{th} farmer compares the expected utility with participation, $E(U_p(W))$ to the expected utility without market participation, $E(U_{wp}(W))$. Factors that influence the decision to participate are used as vectors of attributes of decision made by farmer i and ε_i is a random disturbance term that arises from unobserved variation in preferences, attributes of the alternative, and errors in optimization. Given the usual discrete choice analysis and limiting the amount of non-linearity in the likelihood function, $E(U_p(W))$ and $E(U_{wp}(W))$ may be written as:

$$E(U_p(W)) = \alpha_p X + \varepsilon_p \quad (2.5)$$

$$E(U_{wp}(W)) = \alpha_{wp} X + \varepsilon_{wp} \quad (2.6)$$

The difference in expected utility may then be written as:

$$E(U_p(W)) - E(U_{wp}(W)) = (\alpha_p X + \varepsilon_p) - (\alpha_{wp} X + \varepsilon_{wp}) = (\alpha_p - \alpha_{wp}) X + (\varepsilon_p - \varepsilon_{wp}) = \alpha X + \varepsilon \quad (2.7)$$

A given choice will result if $E(U_p(W)) - E(U_{wp}(W)) > 0$; whereas, a preference without choice will be revealed if $E(U_p(W)) - E(U_{wp}(W)) < 0$.

The observed decision by the farmer for instance market participation, is hypothesized to be the end result of characteristics of a farmers and a complex set of preference comparisons made by the farmer (Adesina and Forson, 1995). If the benefits that the farmer gets from participating in markets are large giving a higher utility the farmer is likely to increase participation.

2.6.3 Profit maximization theory

When a farmer makes a decision on milk marketing, his objective is assumed to be profit maximization. Milk prices in the markets reflect the profit level that the farmer is likely to get. Since milk prices are affected by factors that are endogenous and exogenous, the farmer ensures that the desired attributes for high prices are maintained and by this costs are incurred. When sale price is high the farmer is likely to make high profits after he pays all costs from production to sale because profits are the difference between the revenue from sales and costs. Sellers and buyers in the market consider the important attributes in pricing to ensure that the prices they pay or receive coincides with product condition. When a farmer or trader is setting or accepting a given price for the commodity he/she must weigh alternatives to ensure that production and transaction costs are met and reduced to maximize on profits. With the assumption that tastes and preferences of the product by the consumers are given and invariable and the farmer is also assumed to have complete knowledge about demand and costs in the market. The farmer is likely to ensure that attributes that give the commodity high prices are maintained at reduced costs to maximize on profits. Any firm maximizes its profits when it satisfies the two conditions; Marginal Cost is equal to Marginal Revenue (MC =MR) and the MC curve cuts the MR curve from below.

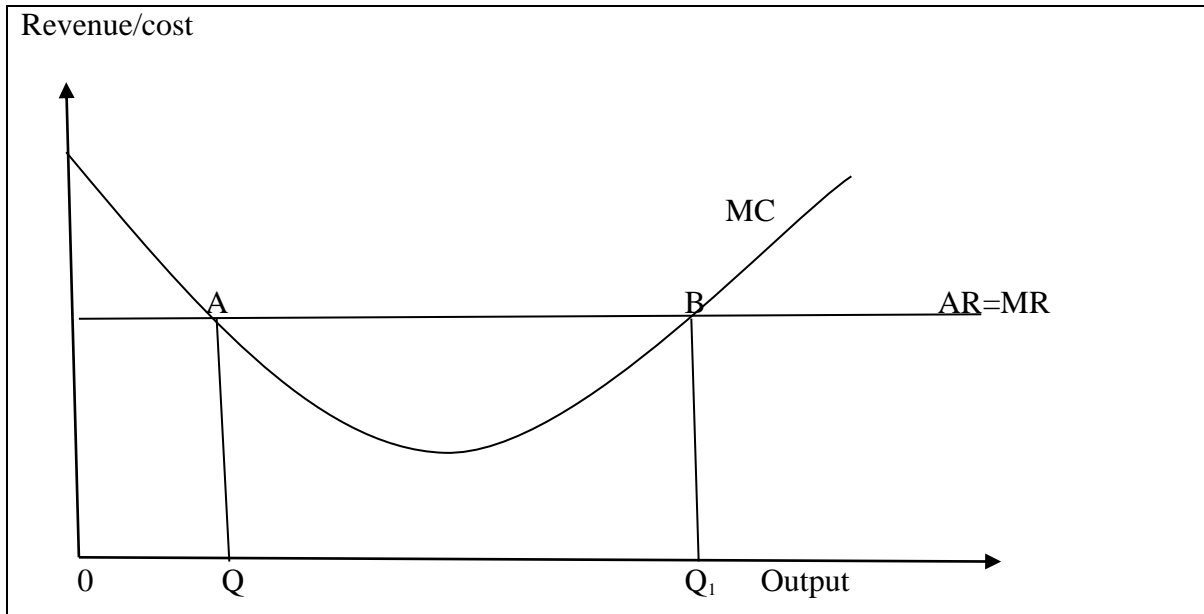


Figure 2.1: Profit maximization in a farm

Source: (Dutta and Radner, 1999)

In Figure 2.1, point 0Q shows that the condition of $MC = MR$ is satisfied but it is not a point of maximum profits because after point A, the MC curve is below MR curve. It does not pay to produce the minimum output when it can earn larger profits by producing beyond 0Q. When it reaches the 0Q₁ level of output where the firm satisfies both conditions of equilibrium it will earn the highest profits maximum profits refer to pure profits which are excess above the average cost of production. It is the amount left with the farmer after making payments to all the factors of production, including wages of management. The profit maximization condition of the firm can be expressed as:

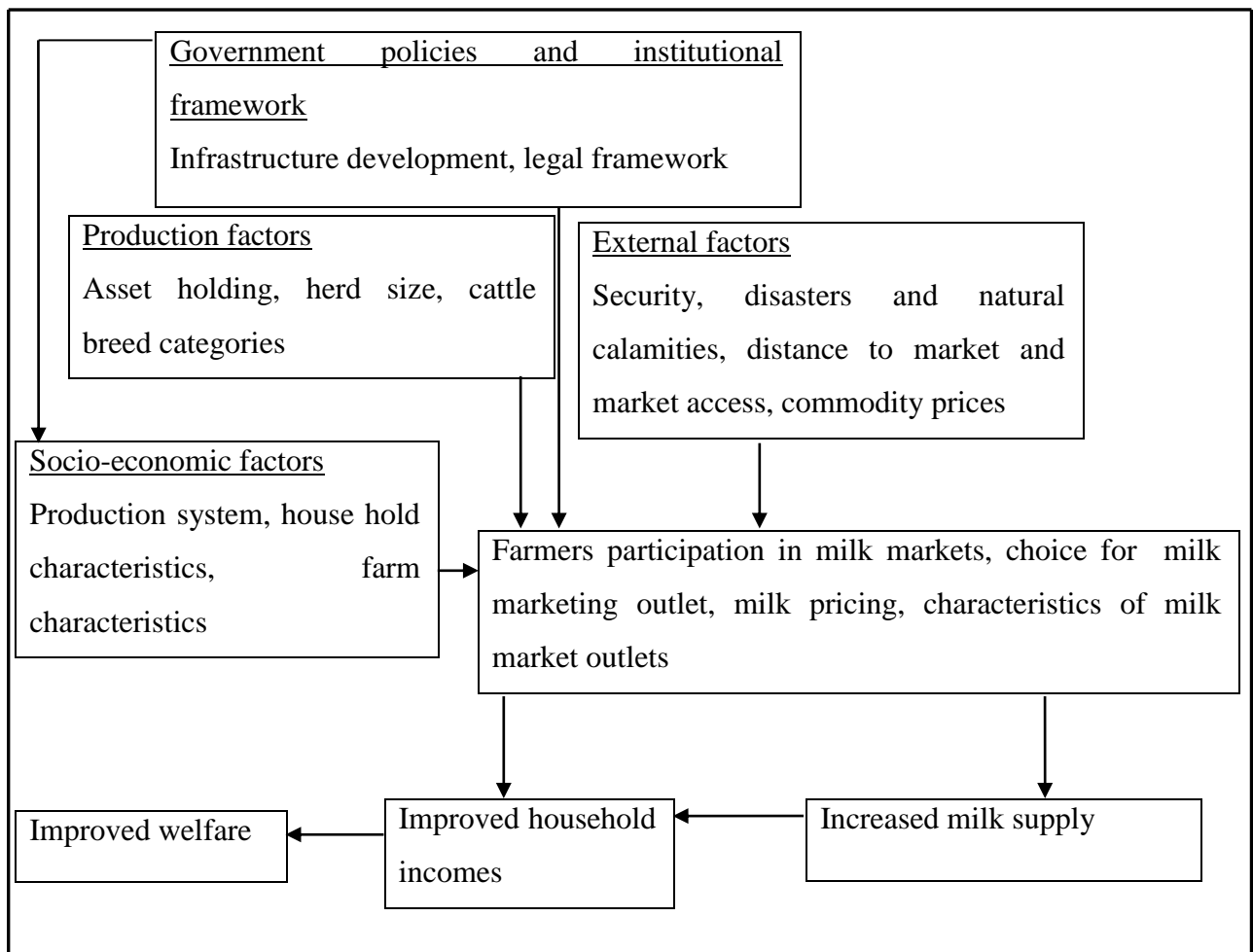
$$\Pi = R(Q) - C(Q) \quad (2.8)$$

where Π is the profit, $R(Q)$ is the revenue and $C(Q)$ is the total cost and Q is the total units of output sold. The profit maximization condition is applicable in either a perfectly competitive or monopoly condition.

2.7. Conceptual Framework

Figure 2.2 demonstrates own conceptualization of the study in a diagrammatic form. In this framework, it is assumed that milk marketing outlets characteristics, farmers' choice milk marketing outlets, participation in milk markets and milk prices in pastoral areas are likely to

be affected by various factors. Government policies relating to infrastructure development and legal framework (Figure 2.2) are some of the factors and they are hypothesized to either have a positive or negative influence. Policy on infrastructure development and strong legal framework are likely to strengthen market linkage increasing market participation, milk prices and encouraging formal market outlets in the area.



————> Direction of influence

Figure 2.2: Conceptual framework

Disasters and natural calamities are hypothesized to have a negative effect on marketing decisions, for instance if the herd is affected by drought, production is likely to decrease and this will hamper outlet development due to seasonality and negatively affect farmer's market participation due to reduced production. Production factors are also postulated have positive or negative influence on marketing decisions. If the farmer has factors of production that will enable him/her produce more, increased production will have an effect on decisions that are made on milk marketing. With increased production the farmer is likely to participate in

markets, choose outlet that can handle more milk and offer good prices and this will have an influence on milk market outlet characteristics. The conceptual framework hypothesizes that given different choices the farmer or the decision maker will choose that which maximizes his/her profits and reduces transaction cost. When profits are maximized the household will have increased incomes which will improve their welfare.

CHAPTER THREE

METHODOLOGY

3.1 Study area

Narok County lies within latitude $0^{\circ} 50'$ and $2^{\circ} 05'$ South and within longitudes $35^{\circ} 58'$ and $36^{\circ} 05'$ East. It borders Democratic republic of Tanzania to the South, Nakuru and Bomet Counties to the North, Kisii County to the West, and Kajiado to the east. It has a population of about 850,920 persons with poverty rate of 38.3% (GOK, 2009).

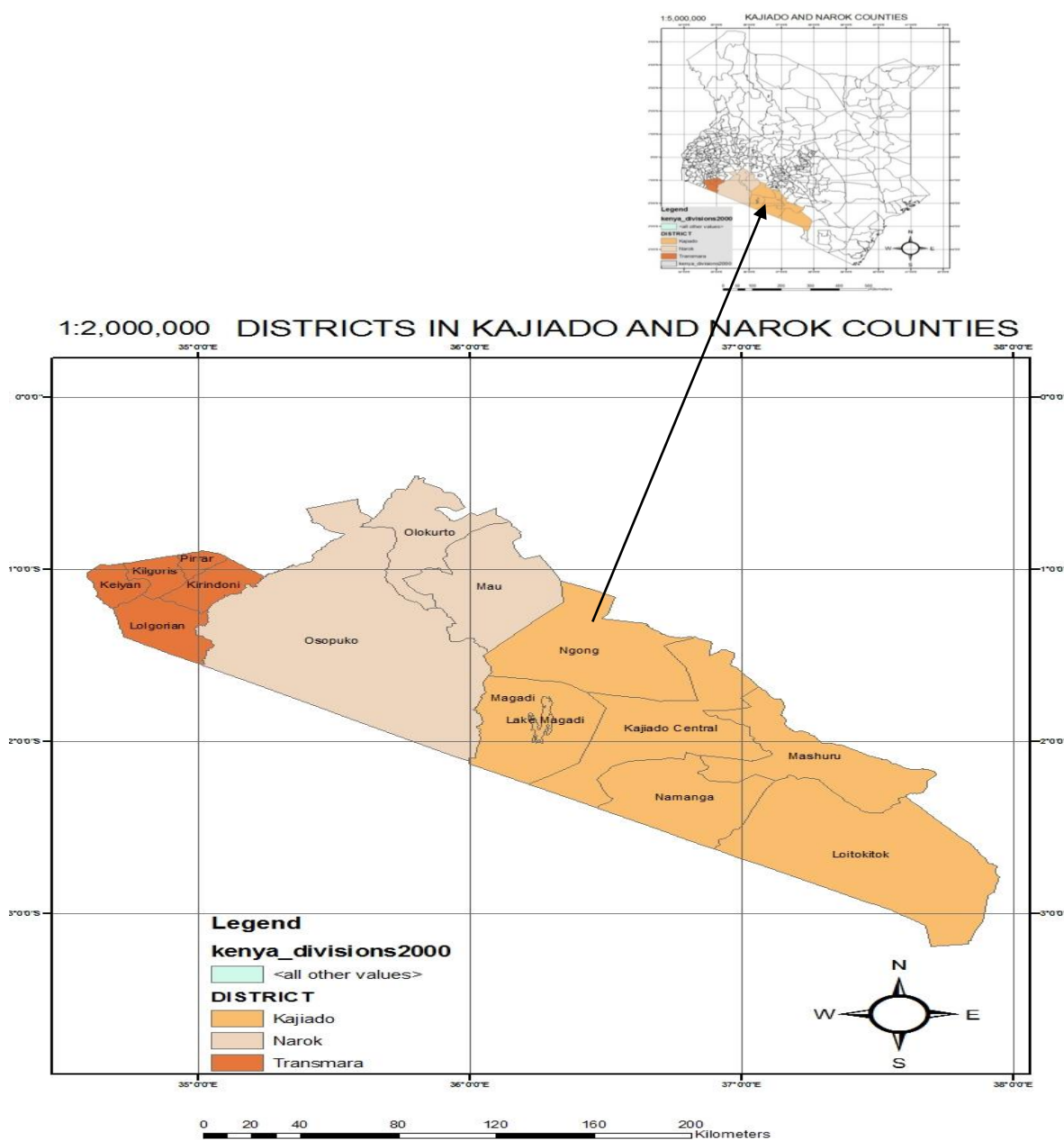


Figure 3.1: Map of Kajiado and Narok Counties
Source: Virtual Kenya and Google earth pro. 2014

About 70% of the people in Narok have primary education and only about 7% have attained secondary education (GOK, 2009). Kajiado County lies within latitude 01° 53' South and within longitudes 36° 47' East. It borders the Democratic republic of Tanzania to the South, Narok County to the West, Kiambu and Nakuru Counties to the North, and Nairobi, Makueni and Machakos Counties to the east. It has a population of about 687,312 persons with poverty rate of 11.6% (GOK, 2009). About 62% have primary education and about 12% have attained secondary education (GOK, 2009). The topography of Narok and Kajiado Counties can be categorized into: the highlands and the lowlands. The highlands have altitude ranging from about 3,000 meters while in the lowlands it ranges between about 1,000 to 1,400 meters above sea level. The highlands have fertile volcanic soils suitable for intensive agriculture. Large-scale farmers inhabit the highlands, which receives reliable rainfall ranging from 1200mm-1800mm per annum. The lowlands have high potential for livestock rearing. Nomadic pastoralists and small-scale subsistence cultivators inhabit the lowland areas which are mostly characterized by poor quality soils and unreliable rains (Munyasi *et al.*, 2012).

3.2 Sampling procedure and sample size

The Pastoralists and milk traders in Narok and Kajiado Counties formed the population assumed to be infinite from which sample was drawn. Sample size of 200 farmers from Narok County and 120 farmers from Kajiado County and 32 milk traders from each County was taken which was calculated using the proportion sample size determination formula as given by Kothari (2004), it is represented by equation² (3.1):

$$n = \frac{z^2 pq}{e^2} \tag{3.1}$$

where n is the desired sample size, p is the assumed proportion of the farmers and milk traders in Narok and Kajiado which equal to 0.5, q represents $(1-p)$ and z (1.976) is the standard variance given at a confidence level in this case α is equal to 0.05 and e is the level of statistical significance set which is equal to 0.05.

² Using equation 3.1 the sample size was obtained as 384, namely $\frac{(1.96)^2(0.5)(0.5)}{(0.05)^2}$

Narok and Kajiado Counties were purposively selected because of the presence of pastoralists having a priority of keeping Sahiwal cattle. Multistage sampling technique was used whereby in the first stage two divisions from each County namely Kajiado central and Magadi in Kajiado County and Keiyan and Lolgolian in Narok County were purposively selected based on production systems (i.e. pastoralism, agro-pastoral and ranches). In the final stage a sample of pastoralists and milk traders were selected through a systematic random sampling from source list which was obtained from the district livestock program officer.

3.3. Data collection

The data for this study was collected using pretested structured questionnaires. There were two sets of questionnaires one for the farmers and the other for the milk traders in pastoral areas. The data on social economics activities, farmers and traders characteristics and other attributes affecting milk market was collected.

3.4. Data analysis

The variables were summarized using descriptive and inferential statistics. The structure conduct product market analysis model was used to characterize milk marketing outlets. Double hurdle model was used to assess factors influencing the decision by pastoralist farmers to participate and the extent which they participated. Multinomial logit model was used to evaluate the factors influencing farmers' preferences for different marketing outlets and Hedonic price model was used to evaluate factors that determine milk prices. SPSS and STATA software packages were used for data management and analysis.

3.5 Description of variable used in the analysis

Table 3.1 gives a description of variables that were used in various econometric regression models. Independent variables chosen were mainly based on literature review findings. A description of these variables is given discussing the likely effects they would have on farmers' decision and choices in the market as well as their effect on milk price.

TLU (total livestock units) is a continuous variable measured by livestock numbers owned by the household converted to a common unit. A marginal increase in herd size is expected to positively influence decision on market outlet choice and market participation because of the expected marketable surplus. Bardhan *et al.* (2012) found that increased production of milk

positively influenced market participation among the smallholder dairy farmers in Uttarakhand.

Agebelow35, *Age35_45*, *Age_orv45* (age of the household head) are dummy variables with youth farmers (Age below 35 years), Middle age farmers (35 to 45 years), and aged farmers (over the age of 45) and is often used as a proxy for experience in farming and Marketing. Studies by Tiunza *et al.*, (2001) and Ouma *et al.*, (2010) reported positive effect of age on market participation. Age is also expected to have positive influence on choice of market outlet and market participation by pastoral farmers in Kenya because older farmers are likely to have more experience and higher levels of investments to meet transaction costs.

Education_Level (education level of the household head) are dummy variables with categories of no formal education, primary education and secondary education each indicating the level of education completed by the household head. Household with more years of education are more likely to accept new ideas to improve household income as well as find information on production and market therefore enhancing market participation. In a study by Holloway *et al.* (1999) education was found to have a positive effect on quantity of milk supplied to the markets in Ethiopian highlands. On the other hand highly educated household heads are likely to have non-farm income from formal employment therefore reducing the need for supplementing household income from milk sales thereby negatively influencing market participation. This shows that the effect of education on market choice and market participation is expected to be mixed.

The variable *Grupmebersp* (household member belonging to a group or association) is a dummy with 1 indicating group membership and 0 indicating non membership to groups. Participation of household to groups increases access to information important both in production and marketing. Groups offer services such as marketing credit to its members and this in turn influence positively on market outlet choice and market participation. Groups also reduce transaction costs that a household is likely to incur on market participation. Berhanu *et al.* (2013) indicated that farmer's group membership had a positive influence on choice of formal marketing outlets by the dairy farmers in Wolaita zone, Ethiopia.

Variable *Totacattle_milkprod* (total amount of milk produced per day) is a continuous variable measured by litres of milk produced by the household. A marginal increase in

amount of milk produced is expected to have significant effect on amount of milk surplus marketable and consequently have an influence on decision to participate in the market as well as on milk outlet choices.

Variable *Totacattle_milksold* (total amount of milk sold per day) is a continuous variable measured by litres of milk sold by the household. A marginal increase in amount of milk produced is expected to have significant effect on price the farmer receives as well as on milk outlet choice.

Owns_milk (who make decision on use of milk) is a dummy variable with value of 1 for wife, 0 for husband making decision about milk that is produced by the household. Women have been observed to own and market most of the milk among the pastoralists and therefore women ownership of milk is likely to positively influence participation in the milk market.

The variable *Liveanimalsale* (total income from live animal sales per year) is a continuous variable measured in Kenyan Shilling (KES) with the annual income from sale of cattle. With low income from cattle sales farmers are likely to supplement household incomes from other avenues such as sale of milk (Bardhan *et al.*, 2012). Increased sale of cattle is likely to negatively influence market participation. Sales from livestock represent the wealth endowment of a household. Poorer households are likely to sell milk to easily accessible outlets because of costs of transaction associated with marketing (Bernard *et al.*, (2007).

Tdist (total distance covered to the point of milk sale) is included in the models to capture transaction costs and its role in influencing market participation. Many studies have found distance to influence choice and decisions in market participation. For example Omiti *et al.* (2009) and Ouma *et al.* (2010) noted that long distances reduced market participation and the amount sold due to increased transaction costs. It is expected that farmers located far from the markets increase travel time and costs which impact negatively on market participation.

Sah_cows (total number of Sahiwal cows owned) is a continuous variable, the higher the number of Sahiwal cows a farmer has the more likely they are to participate in the market and to have marketable surplus and is expected to positively influence participation and marketable surplus.

Totainput_cost (total input cost per year) is a continuous variable measures in KES for the inputs such as concentrates, drugs and salt for the livestock. This variable is expected to have a positive or a negative influence on market decisions. Variable *Milkprc* (milk price per litre) is a continuous variable. Higher prices act as an incentive to sell and therefore prices are expected to influence choice and participation positively.

Acs_roads (access to all weather roads) is a dummy variable introduced to capture effect of market access on milk marketing decisions. Markets are sources of information and likely centers for milk collection by the buyers. Ease access of these markets enable farmers to get information on milk marketing and also access collection center easily reducing transaction costs. Access to output markets is expected to influence market decision on choice and participation positively. *Inforsource* (main source of information on milk enterprise) is a categorical variable indicating the point from which the farmer source information. Ease of access to milk market information is likely to influence decisions in marketing and prices received by the farmers.

Table 3.1: Description of variables for the Double hurdle, Multinomial logit and Hedonic price models

Variable	Variable description	Type	Unit of measurement	Model
Dependent variable				
<i>Marketpartcpatn</i>	Household participates in milk markets or otherwise	Dummy	1 = Participates in market 0 = Otherwise	DH
<i>MarkInten</i>	Amount of milk sold	Continuous	Litres	DH
<i>Marketoutlet</i>	Household choice of different marketing outlets	Categorical	0 = Middlemen 1 = Neighbors 2 = Farmer cooperatives 3 = Processors 4 = Retailers	ML
<i>Price</i>	Market price of milk	Continuous	KES	HP
Independent variables				
Resource endowment				
<i>TLU</i>	Herd size	Continuous	Number of cattle	DH, ML,HP
<i>Tsah_cows</i>	Total number of Sahiwal cattle	Continuous	Number of cattle	DH, ML,HP
<i>Tatacattle_milkproduced</i>	Amount of cattle milk produced	Continuous	Litres	DH
Household characteristics				
<i>Agebelow35</i>	Household head aged below 35	Dummy	Yes =1 No= 0	DH, ML,HP
<i>Age35_45</i>	Household head age 35-45 years	Dummy	Yes =1 No= 0	DH, ML,HP
<i>Age_orv45</i>	Household head aged above 45	Dummy	Yes =1 No= 0	DH, ML,HP
<i>Education_none</i>	No formal education for the household head	Dummy	Yes =1 No= 0	DH, ML
<i>Education_primary</i>	Primary education level for the household head	Dummy	Yes =1 No= 0	DH, ML
<i>Education_secondary</i>	Secondary education level for the household head	Dummy	Yes =1 No= 0	DH, ML
<i>Liveanimalsales</i>	Livestock income sales	Continuous	KES	DH, ML
<i>Own_milk</i>	Milk use decision maker	Dummy	1 = Wife 0 = Husband	DH, ML,HP
Distance to services and infrastructure				
<i>Tdist</i>	Distance to the milk sale point	Continuous	Km	DH,ML, HP
<i>Infor_source</i>	Main information source	Dummy	1 = Radio 0= Family and friends	DH,ML,HP
<i>Acs_roads</i>	Road condition to nearest market	Categorical	1 = All-weather 0= Dry weather	DH,ML, HP
<i>Prcmilk</i>	Milk prices	Continuous	KES per liter	DH, ML
<i>Acs_agri_outmkt</i>	Access to agricultural output markets	Dummy	Yes =1 No= 0	DH, ML

<i>Amount_sold</i>	Amount of milk sold	Continuous	Litres	HP
<i>Grupmebersp</i>	Membership in groups	Dummy	0 = No 1 = Yes	DH,ML,HP
<i>Buyer_retailers</i>	Retailer buyer	Dummy	0 = No 1 = Yes	HP
<i>Buyer_neighbors</i>	Neighbor buyer	Dummy	0 = No 1 = Yes	HP
<i>Buyer_middlemen</i>	Middlemen buyer	Dummy	0 = No 1 = Yes	HP
<i>Buyer_cooperatives</i>	Cooperatives buyer	Dummy	0 = No 1 = Yes	HP
<i>Buyer_processors</i>	Processor buyer	Dummy	0 = No 1 = Yes	HP

Note: DH= Double hurdle model, ML= Multinomial logit model and HP= Hedonic price model.

CHAPTER FOUR

4.0 DESCRIPTIVE STATISTICS FOR FARM AND FARMERS' CHARACTERISTICS

Tables and figures in this chapter present the summary statistics of variables used in this study. Several variables showed significant mean differences between farmers in Kajiado and Narok Counties and between farmers who participated in milk market and those who did not. The descriptive statistics presented in this section are comprised of demographic, socio economic and institutional characteristics of the farmers in the study region. Demographic characteristics comprises of gender of respondent and household head and age of household head. The socio economic characteristics comprises of education level of household head and farm characteristics. Institutional characteristics are such as group membership by household head, marketing and distance to the markets.

Table 4.1: Education levels and age of the household heads

Variable	whole sample		Narok		Kajiado		χ
	Count	Percent	Count	Percent	Count	Percent	
Age category							
Youth farmers (Below 35 years)	68	17.66	42	20.29	26	14.61	4.2056
Middle age farmers (35-45 years)	100	25.97	58	28.02	42	23.60	
Aged farmers (Above 45 years)	217	56.36	107	51.69	110	61.80	
Level of education							
No formal education	154	40	83	40.10	71	39.89	1.2138
Primary	96	24.94	55	26.57	41	23.03	
Secondary	71	18.44	38	18.36	33	18.54	
College/University	64	16.62	31	14.98	33	18.54	

Age of the household head is an important factor in production and marketing of farm produce. The higher the age of the farmer the more likely that farmer has increased investment and experience in production and marketing unlike the young farmers who are characterized by low levels of investment and experience. Most of the household heads were aged above 45 years with about 17.66% being aged below 35 years (see Table 4.1).

Majority of the household heads (40%) had no formal education (see Table 4.1). For those who had received formal education about 18.4% had secondary education, 24.94% primary, and about 16.62% had attained college/ University education. This indicates low literacy levels among the pastoralists.

For farmers to improve their farming practice, information in different aspects in farming such as production and marketing from different players in livestock industry is important. Table 4.2 presents the main sources of information the farmers depended on. Sources of information were mostly from the radios for about 71.4% households, with about 13.5% relying on chiefs and local leaders and about 2.9% relying on neighbors. This was also noted in a study by Omiti *et al.* (2009) who found that formal sources such as radio were the dominant information sources among farmers in rural areas followed by informal sources which included social network with neighbors.

Table 4.2: Main sources general information by the household

Sources of information	Whole sample		Narok		Kajiado	
	Count	Percent	Count	Percent	Count	Percent
Radio	275	71.4	155	74.88	121	67.98
Local leaders/ chiefs	52	13.5	33	15.94	19	10.67
Neighbors/Friends	11	2.9	9	4.35	2	1.12
Television	45	11.69	10	4.83	35	19.66

Table 4.3 presents means of selected farmer's and farm characteristics. The average herd size in this study was about 78.27 livestock units per household. The average herd size by total livestock unit (TLU) for farmers in Kajiado County and Narok County was 72.70 and 83.06 respectively and the difference was significant at 1%. The average herd size for the farmers that participated in markets and those who did not was 81.11 and 67.08 respectively.

The average milk produced in litres per day by the farmers in Kajiado and Narok Counties was 4 and 5.28 with no significance difference (see Table 4.3). The average amount of milk in litres produced per day was larger (5.32 litres) for farmers that participated in milk market than those who did not participate in milk market (1.24 litres). The average milk produced per day for the farmers that kept Sahiwal cattle breed and those who did not was 48.5 litres

and 16.7 litres respectively. This indicated that amount of milk produced determined market participation decision and also Sahiwal cattle contributed to high milk production.

Table 4.3: Means of selected farm attributes

Variable	Whole sample	County		<i>t</i>	Market participation		<i>t</i>
		Kajiado	Narok		Yes	No	
Income (KES)	363639.0	382375.5	346970.8	-0.48	390439.8	262586.9	-1.42*
Milk produced (Ltrs)	4.70	4.00	5.28	2.4*	5.32	1.24	-5.7*
Herd size (TLU)	78.27	72.70	83.06	1.2	81.11	67.08	-1.35
Distance sell point (Km)	4.6	5.5	3.9	-2.4*	5.426	-	-5.7*
Number of observations	384	178	206		325	59	

*P < 0.01, **P < 0.05 and ***P < 0.10 mean difference significant at 1%, 5% and 10% probability levels, respectively, n is sample size.

The average yearly income in Kenya shillings (KES) for livestock sales by the farmers in Kajiado and Narok Counties was 382375.5 and 346970.8 with no significance difference (see Table 4.3). Farmers that participated in milk markets had a larger average income (390439.8) than those that did not participate (262586.9) showing that milk market participation increased level of household income.

The average distance in Kilometers (km) to the point of milk delivery for the farmers who participated in milk markets was 5.4 km. The average distance to the point of milk delivery for the farmers in Kajiado County was larger (5.5 km) than Narok County (3.9 km) (see Table 4.3). This shows that, farmers sometimes travelled longer distances to deliver their milk to the market, probably motivated by the high milk yields that they obtained, and the income accrued from the sale of milk. Although long distances are sometimes treated as a hindrance to market access, with proper incentives, farmers can positively participate in the market, and hence contribute to the growth of the economy.

Table 4.5 presents distribution of farmers in study area with respect to milk market participation and point of milk sale. Out of the farmers who participated in milk markets 42.5% were from Kajiado County and 57.5 % from Narok County, while for those farmers who did not sell milk, 67.8% were from Kajiado and 32.2% were from Narok County.

Table 4.4: Distribution of farmers in relation to market participation, Sahiwal ownership and milk marketing point according to Counties

Farmer characteristic	Kajiado		Narok	
	N	%	N	%
Pooled data (n= 384)	178	46.4	206	53.6
Market participation (Yes or No)				
Yes n= 325	138	42.5	187	57.5
No n= 59	40	67.8	19	32.2
Point of milk sale				
Middlemen (n=155)	52	33.5	103	66.5
Neighbor (n= 23)	8	34.8	15	65.2
Processors (n=41)	22	53.7	19	46.3
Farmer cooperative (n=29)	22	24.1	7	75.9
Retail shops and hotels (n=77)	34	44.2	43	55.8

Note: Figures in the parentheses are the percentages of the subsamples with reference to sub sample size (n).

Several milk outlets were identified during the study. These include neighbors, middlemen, processors and other retail shops. The farmers that sold their milk to the neighbors 34.8% and 65.2% were from Kajiado and Narok Counties respectively and for those who sold milk to the middlemen 33.5% and 66.5% were from Kajiado and Narok respectively (see Table 4.4). The farmers selling their milk to farmers cooperative 53.7% and 46.3% were from Kajiado and Narok, for those selling to processors 24.1% and 75.9% came from Kajiado and Narok County. For the farmers who were selling to retail shops and hotels 44.2% and 55.8% came from Kajiado and Narok respectively.

Most farmers sold their milk to middlemen (37.9%). About 19.5% sold their milk to hotels and retail shops, 7.5 % of the farmers to cooperatives, 9.6% to the neighbors and 10.1% to the processors as presented in the Figure 4.2. This implies that most farmers sold milk through informal channels. This was in agreement with Muia *et al.* (2011) who found that most farmers in rural areas marketed their milk through informal channels such as middlemen and neighbors.

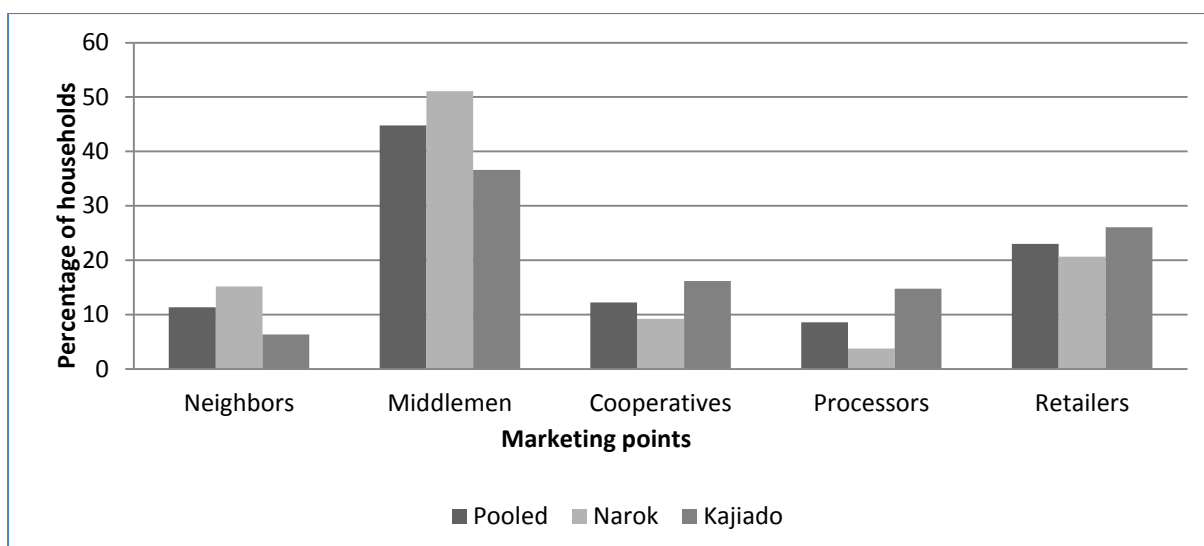


Figure 4.1: Percent households supplying milk to various marketing points

In about 93.53% of the households, the wife was responsible for selling farm milk (see Table 4.5). This could be explained by the fact that females mostly make decisions concerning use of animal products among the pastoralists. This was also observed by Lumadede *et al.* (2011) who found that about 86% of households studied in Ethiopian pastoral areas, women were responsible for milk marketing. About 47% of the households were members of organized group while 54.3% did not belong to any organized group (see Table 4.5). The reason why most farmers did not belong to any group could be non-existence of such groups in their locality, lack of gains or poor group organization.

Table 4.5: Frequencies on group membership and responsibility to sell milk and road condition

	Pooled		Narok		Kajiado	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Group membership						
Yes	175	46.79	92.0	46.0	83	47.7
No	199	53.21	108.0	54.0	91	52.3
Household member responsible to sell milk						
Females	318	93.53	162	90.5	156	96.89
Male	6	1.76	4	2.23	2	1.24
Jointly	16	4.71	13	7.26	3	1.86
Road condition to the market						
Poor condition	251	70.11	133	70.53	118	70.24
Accessible	106	29.61	56	29.47	50	29.76

For 65.2% of households the roads to the nearest input or output markets were in poor conditions with only 27.5% of the households having roads that were accessible (see Table 4.5). The findings are consistent with those of Muia *et al.* (2011) who noted that 70% of the rural population did not access good roads and covered long distances to the market.

CHAPTER FIVE

MILK MARKET STRUCTURE IN THE PASTORALISTS' AREAS OF KAJIADO AND NAROK COUNTIES

5.1 Introduction

Dairy products constitute the largest food expenditure item in Kenyan households (Argwings-Kodhek *et al.*, 2005; Salasya *et al.*, 2006). The production is dominated by small scale farmers and contributes about 70% of total milk production in Kenya (Kiptarus, 2005). In the pastoral region, milk is an important component of the diet and a preferred staple that provides significant nutrients necessary for body growth and reduced protein deficiency malnutrition (Galvin, 1992; Kalkwarf *et al.*, 2003 Fratkin *et al.*, 2004; Njarui *et al.*, 2011). Apart from being important to the producers, dairy products are also an important part of the diet among the households that do not produce any milk. For that reason, its marketing and distribution to the consumers outside the farming areas is critical.

Milk market structure in Kenya is defined by informal milk market that controls an estimated 70% of the total milk marketed in Kenya (Wambugu *et al.*, 2011). This sector is important and is driven by among other factors the traditional preferences for fresh raw milk and its relatively lower cost. After independence, the government continued the policy of tight market control that was put in place by colonial governments in order to protect farmers and stabilize prices. Over the years it became clear that the elimination of market forces and dependence on bureaucracies was not efficient to match supply and demand and the system became increasingly insufficient and thus led to liberalization of the milk market (Muriuki *et al.*, 2004).

The milk market in Kenya is now in the hands of private sector (Lusato and Bennett, 2011) and the role of government through institutions has diminished. Private actors have steadily expanded their sphere of influence to take benefit from profit opportunities offered by a commercialized dairy sector. A lot of changes have occurred in handling and marketing of milk and dairy products including admittance of new players into the dairy market previously controlled by the government milk processors which, by and large has lots of benefits to the farmers. The numbers of middlemen have increased dramatically with more milk processors entering the formal market.

Although many studies have been done to characterize the milk market post liberalization (e.g. Staal *et al.*, 1997, Ngigi *et al.*, 2000, Muriuki *et al.*, 2003), very little has been done on the same in the pastoral region. With the introduction of Sahiwal breed in these ASALs there has been an increase in milk production which has necessitated farmers to participate in the milk market to dispose off the surplus production. When markets are not well characterized, there are possibilities of inefficiencies which hinder its development to full potential. For the farmers to get benefits from milk they produce in their farms, the market structure must be efficient. This study aimed at characterizing the milk market structure in pastoral areas specifically in Kajiado and Narok Counties in order to contribute to efforts geared towards market development. The results from the study would inform on interventions on milk market development to guarantee efficiency in milk market structure.

5.2 Data

The analysis in this chapter used random cross sectional data that was collected from milk traders in Kajiado and Narok Counties between December 2012 and January 2013. Traders gave information on milk business capital, milk sources and prices on purchase and sale. Milk market structure in the study area was determined by computing Gini coefficient and Lorenz curve for the milk business in the year 2012.

5.3 Empirical framework and Structure model specification

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To achieve the objective that seeks to determine the milk market structure in pastoral areas, structure conduct and performance (SCP) market analysis model was used. For the purposes of this study, only the structure component of the model was used.

The Market structure or concentration refers to the relatively stable features that influence the rivalry among the buyers and sellers operating in a market (Caves, 1992). Some of the elements of market structure include the number of traders in the market, barriers to entry and exit, and the vertical coordination mechanisms. To determine concentration, the market shares of individual traders in terms of volume of milk traded was represented in Lorenz curves which show the level of inequality in the market. A Gini coefficient (defined by area between line of perfect equality and Lorenz curve), according to Brown (1994) is used to measure the level of inequality in market shares among traders.

The Gini coefficient is used together with the concentration ratio to show level of inequality and control of each firm in the market. Concentration ratio shows the proportionate income share of each firm from total income from all firms given as:

$$C = \sum_{i=1}^{r=4} S_i \quad (5.1)$$

In equation (5.1), C represents the concentration ratio, S_i is the percentage market share of the i^{th} farm and r is the number of largest firms for which the ratio was calculated and for this study r is four firms, S_i is given by:

$$S_i = \frac{F_{income}}{AggF_{income}} \quad (5.2)$$

where F_{income} is individual firm income and $AggF_{income}$ aggregated income from all firms in the market. The lower the concentration ratio the more evenly spread of market share and the more the market efficiency. Gini coefficient is considered high when it is greater than 0.35 indicating inequitable distribution (Ike and Chukwuji, 2005; Dillon and Hardaker, 1980).

5.4 Results and discussions

Figures 5.1, 5.2 and 5.3 present the Lorenz curves of milk market share in terms of income. The tendency towards high concentration is evident from the Lorenz curve.

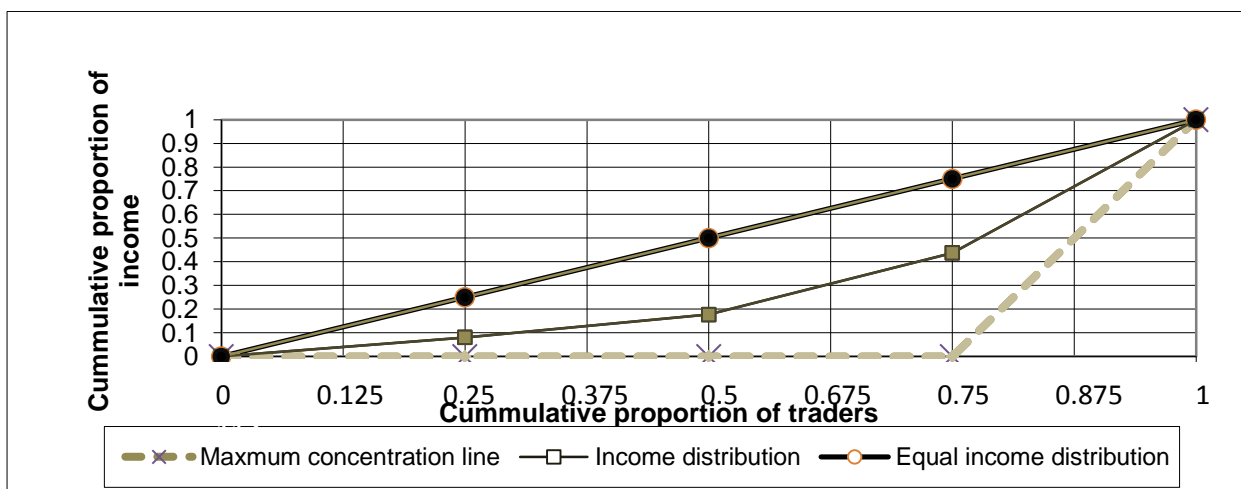


Figure 5.1: Lorenz curve of milk market share among milk traders in Kajiado and Narok Counties in terms of income

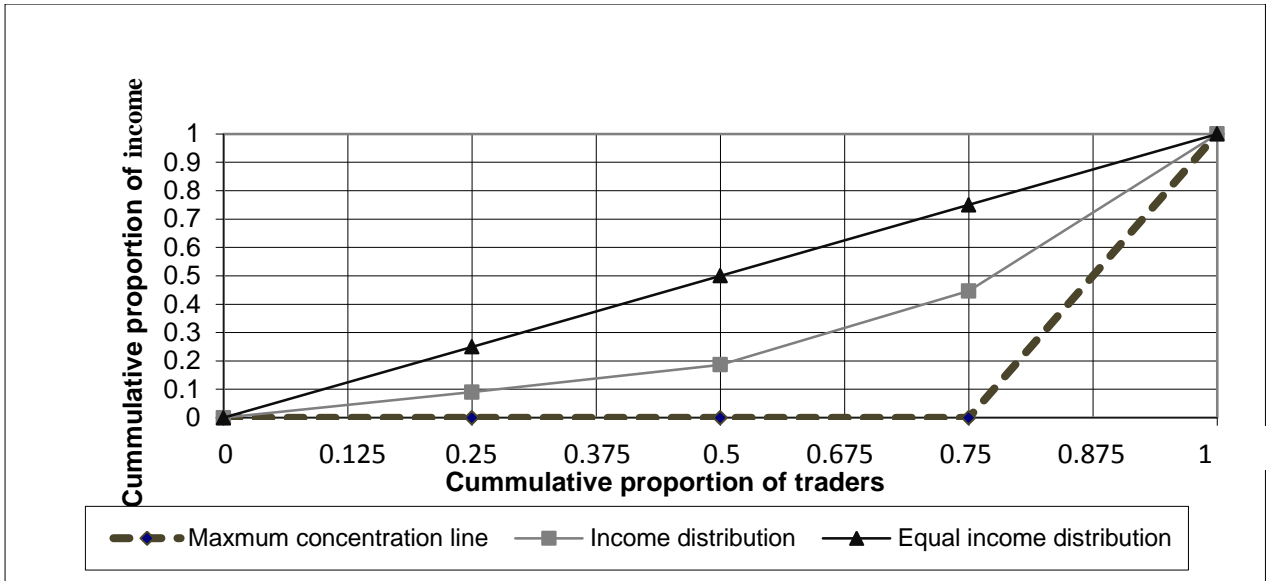


Figure 5.2: Lorenz curve of milk market share among milk traders in Kajiado County in terms of income

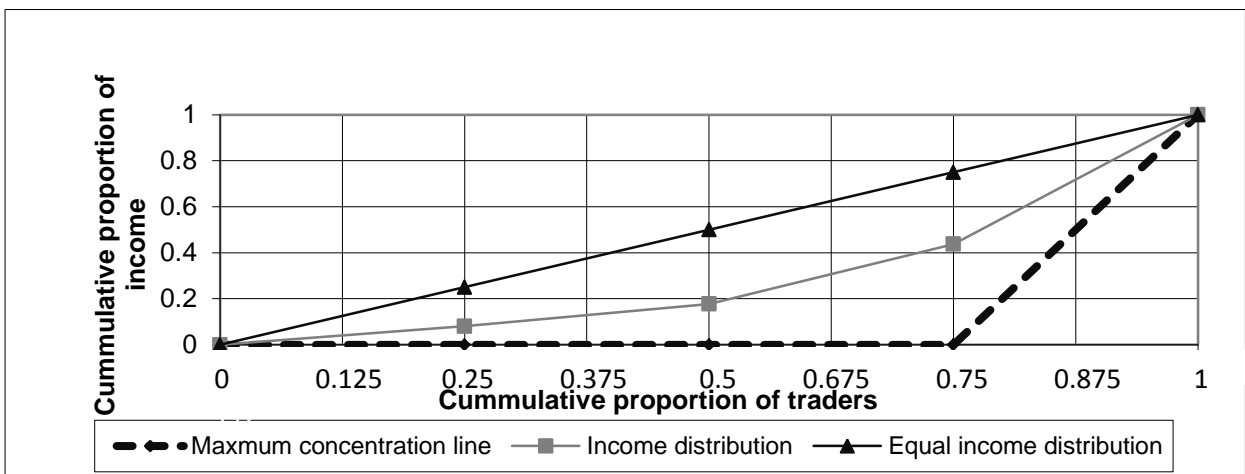


Figure 5.3: Lorenz curve of milk market share among milk traders in Narok County in terms of income

High concentration is reflected by the greater inequality in market share distribution which widens the gap between the Lorenz curve and line of equal income distribution. The Gini coefficient from the Lorenz curve for whole sample (Figure 5.1) is 0.3048. The Gini coefficient for Kajiado and Narok Counties is 0.306 (Figure 5.2) and 0.202 (Figure 5.3) respectively. The observed Gini coefficients in our study are considered to be low as described by Ike and Chukwuji (2005) and Dillon and Hardaker (1980). Gini coefficient measuring market concentration ratio ranges from zero to one, where one results when there is a monopsony in the market and only one milk trader buys all milk in the market. The results from this study shows Gini coefficient of 0.3048, 0.306 and 0.202 for the whole

sample, Kajiado and Narok Counties respectively implying that the traders in these markets operate in close to an imperfect market being dominated by a few traders. This was probably due to long distances to the markets, poor infrastructure, lack of market information and lack capital to invest in cooling facilities among others. This finding was consistent with those by Juma *et al.* (2010) in a study on market power and efficiency in indigenous small ruminant marketing outlets in the pastoral areas. In this study they found that small ruminant markets suffered from inefficiencies such as low purchasing power leading to dominance by a few traders. Dominance in the milk market by a few outlets indicated that there were long chains in milk market. A study by Shiferaw *et al.* (2006) established that interaction among buyers led to long and complex outlets with high transaction cost which lowered farmers' income.

In Table 5.1, the results of concentration ratios of milk traders in Kajiado and Narok Counties are presented. Hotels and retail shops had a concentration ratio of 0.0806 and farmer cooperatives had a concentration ratio of 0.0967 indicating that they did not dominate in the milk market and had very low influence on competition in the milk markets. The middlemen and the processors had concentration ratios of 0.2600 and 0.5670 respectively indicating that they dominated in the milk markets with the middlemen having influence of perfect competition while processors had likely oligopoly dominance in the milk market.

Table 5.1: Concentration ratios of milk traders in Kajiado and Narok Counties

Buyers	Concentration ratio	Likely market influence
Hotels and shops		
Whole sample	0.0806	Low competition
Kajiado County	0.1038	low competition
Narok County	0.0638	low competition
Farmer cooperative		
Whole sample data	0.0967	Low competition
Kajiado County	0.1200	low competition
Narok County	0.0670	low competition
Middlemen		
Whole sample	0.2600	Perfect competition to oligopoly
Kajiado County	0.1800	Perfect competition to oligopoly
Narok County	0.4700	Perfect competition to oligopoly
Processors		
Whole sample	0.5670	Medium likely oligopoly
Kajiado County	0.3600	Medium likely oligopoly
Narok County	0.2300	Medium likely oligopoly

To understand the milk structure among the pastoralists, results on Gini coefficient and concentration ratios were used together to draw conclusions. The results showed that

middlemen and the processors dominated in milk market in whole sample and in disaggregated samples of Narok and Kajiado counties. This can be explained by the fact that most buyers that could reach the farms in the interior were the middlemen who sold their bulky collection to the processors. Processors are few but have a large capital base that enables them to buy a lot of milk. Middlemen have a small capital base but they are many and when these individual capital bases are aggregated middlemen are seen to have a big share in the market. The middlemen compete among themselves and other buyers. These findings are consistent with those of Kumar (2010) who noted that middlemen had the largest share in milk marketing in the informal sector equally competing with the cooperatives in the formal sector in Bilha, India. The middlemen high concentration ratio suggest that informal markets play an important role in milk marketing though majority operate at small scale. The lowest concentration ratio was 0.0806 and the highest was 0.5670 indicating that there was a wide gap in relative size among the buyers in the milk industry.

The processors and the middlemen were found to dominate in milk markets this suggest the processors' strong capital base and large numbers of middlemen. The results were in line with those of Shiferaw *et al.* (2006) in a study on rural institutions and producer organizations in imperfect markets in semi-arid areas eastern Kenya. The authors observed that middlemen dominated in rural grain markets because of their cash payment mode while other outlets such as farmer groups did not have capital to pay cash. The differences in concentration ratios among the buyers may have stemmed from differences in capital base, ownership and control of marketing facilities as well as trading experience and expertise. A plausible explanation for processors dominance over all other outlets could also be that they were the overall buyers of milk from farmer groups and middlemen who collected milk from the rural and interior areas.

5.5 Conclusion

This chapter determined the milk market structure in pastoralist areas using the SCP market analysis model. The Gini coefficient from Lorenz curve was 0.305, 0.306 and 0,202 for whole sample, Kajiado and Narok Counties respectively (tending to zero) and concentration ratios were 0.0806, 0.967, 0.260, and 0.567 for the retailers, the farmer cooperatives, the middlemen and the processors respectively. In the Counties the concentration ratios were in the same range with concentration ratios from the whole sample dataset.

Interventions should focus on improving physical and market infrastructure to reach the interior areas where most of the middlemen source milk from to increase competition from other buyers. Though emphasis is mostly on formal milk marketing outlets such as processors and cooperatives, the middlemen marketing chain representing the informal marketing outlets need to be addressed in a constructive manner in view of its dominance in pastoral areas and more so in remote areas where formal outlets such as processors find it hard to reach. Middlemen also collect milk from remote areas and supply it to the formal outlet linking the farmers to the markets. Increased attention on value addition and safety in food industry however work against the informal milk marketing outlets such as middlemen favoring their competitors. Training and certification programs of small scale traders would allow improving their performance, including quality control, which would serve the interest of the farmers, traders and consumers.

CHAPTER SIX

MILK MARKET PARTICIPATION AMONG THE PASTORALISTS

6.1 Introduction

With its adaptability to the ASAL climate, Sahiwal genetic resources can contribute to increased milk production and hence offer a source of livelihood. For this to be realized, access to market for the surplus milk is inevitable. Nonetheless, access to rural markets is characterized by many factors that determine the ability of farmers to participate in these markets or not. Several studies have evaluated the factors that determine market participation and the extent to which farmers involve themselves in different markets. In these studies, various factors have been observed to influence decisions on market participation. For example Bellemare and Barret (2004) in their study on determinants of livestock market participation in Kenya and Ethiopia found that high transaction cost that was determined by market accessibility negatively influenced the decisions by farmers to participate in the market. This was emphasized by Ehui *et al.* (2009), Omiti *et al.* (2009) and Makhura *et al.* (2001) who noted that factors that lowered transaction cost were likely to influence farmers to participate in markets. Conditions and circumstances in different areas vary and also with different products in the market.

This shows that decisions on market participation are likely to be influenced by environment and situations that surround the farmer. Unfortunately, most of the market participation studies have not been conducted in areas where the Sahiwal genetic resource have been introduced as a dual purpose breed, and one that have a likely effect on market participation. Although livestock dynamics are expected to allow the rural poor to contribute to the growing market most pastoralists lack reliable marketing outlets that could provide full benefit especially from Sahiwal cattle genetic resources (Devendra, 2001; Omore *et al.*, 2004). There are constraints that restrain farmers in pastoral areas from selling cattle milk thereby failing to get the benefits from the market. To achieve these benefits it is necessary to address constraints within the milk marketing system and ensure that the farmers participate in milk markets. This study therefore aims at determining the factors that influence participation in milk markets among the pastoralists. The information generated from this study can be used to draw insight on relevant interventions to ensure pastoralists participation in milk market enhancing market development.

6.2 Data

The sample unit constituted a household. A multistage sampling procedure was adopted with the pastoralists in the study area forming the sampling frame. Three hundred and eighty four households were sampled. Data was collected using structured questionnaires through interviews. Data collected included socio economic, institutional and infrastructure characteristics. The variables that were considered included the age, gender and education level attained by a household head, total land size owned by a household, distance to the nearest market, level of production and prices for the farm produce, herd characteristics, farmer group membership and information source .

6.3 Model specification and empirical analysis

To achieve the second objective that seeks to determine the factors influencing decision and extent of market participation a Double hurdle model was used. The choice of this model was based on the fact that the decisions to participate in the market and how much or the level of participation can be made jointly or separately by the farmer (Berhanu and Swinton, 2003). When censored data models such as Tobit are used in market participation analysis, the factors leading to participation are assumed to be the same as those that determine the intensity of participation (Greene, 2000). If a given farmer characteristic is known to have positive influence on decision to participate in the market then it may lead to prediction that a farmer will choose to participate in the market (Teklewold *et al.*, 2006). Double-hurdle model generalizes the Tobit model by allowing for a separate first hurdle which represents a farmers' decision to participate in market, and a second hurdle which represents the decision about how much to sell in the market. A sale is realized only after both hurdles are cleared, the two decisions can be modeled as dependent on or independent of each other (Cragg, 1971). Explanatory variables may appear in both equations or in either of one and a variable appearing in both equations may have opposite effects in the two equations (Teklewold *et al.*, 2006).

In the double hurdle model, it is assumed that if a household makes a decision to participate in the market, the resulting observation for sale is positive and the Double-hurdle model is then represented as:

$$P(Y_1 = 1) = P(Q_s > 0) = Z_1\alpha + e \quad (6.1)$$

Y_1 defines the market participation decision and takes the value of one if the household made a decision to participate in market and a value of zero if no participation, Q_s represents quantity or value sold in the market, Z_1 is the set of variables that enter the first hurdle defining factors that affect the discrete probability of market participation, α is a parameters to be estimated and e is an error term that is normally and independently distributed with a mean of zero. When $Y_1 = 1$ then the quantity sold is represented in an equation as;

$$Q_s = X_1\beta + u \quad (6.2)$$

where, Q_s represents quantity or value sold in the market, X_1 are set of variables that enter the second hurdle defining factors that affect the discrete probability of intensity of participation, β is a parameter to be estimated, u is an error term that is normally and independently distributed with a mean of zero.

The empirical market participation model estimated was as follows:

$$\begin{aligned} \text{Marketpartpatn} = & \beta_0 + \beta_1 \text{femaleown} + \beta_2 \text{price} + \beta_3 \text{Acs_roads} + \beta_4 \text{milkproduced} + \\ & \beta_5 \text{Herdsiz}e + \beta_6 \text{Grupmebersp} + \beta_7 \text{Infor_sor}ce + \beta_8 \text{Age_ovr}45 + \quad (6.3) \\ & \beta_9 \text{Agebelow}35 + \beta_{10} \text{Education_primary} + \beta_{11} \text{Education_sec}ondary + \\ & \beta_{12} \text{Sahiwal_co}ws + \mu\beta_{13} \text{Income} + \beta_{14} \text{County} + \beta_{15} \text{Tdist} + \varepsilon \end{aligned}$$

The intensity empirical model was estimated as follows:

$$\begin{aligned} \text{MarkInten} = & \beta_0 + \beta_1 \text{femaleown} + \beta_2 \text{price} + \beta_3 \text{Acs_roads} + \beta_4 \text{milkproduced} + \\ & \beta_5 \text{Herdsiz}e + \beta_6 \text{Grupmebersp} + \beta_7 \text{Infor_sor}ce + \beta_8 \text{Age_ovr}45 + \quad (6.4) \\ & \beta_9 \text{Agebelow}35 + \beta_{10} \text{Education_primary} + \beta_{11} \text{Education_sec}ondary + \\ & \beta_{12} \text{Sahiwal_co}ws + \mu\beta_{13} \text{Income} + \beta_{14} \text{County} + \beta_{15} \text{Tdist} + \mu \end{aligned}$$

The dependent variable in the first hurdle (*Marketpart*) in equation 6.3 refers to whether the farmer had sold milk and the dependent variable in the second hurdle (*MarkInten*) refers to the amount of milk that was sold. Description of independent variables used is shown in Table 3.1 in chapter three. Before running the regression model, all the independent variables that were hypothesized to influence participation in market and its intensity were checked for

the existence of multicollinearity problem. Variance inflation factor (VIF) was used to test multicollinearity problem following Maddala (1993) where VIF is defined as:

$$VIF(X_1) = \frac{1}{1 - R_i^2} \quad (6.5)$$

R_i^2 represent the squared multiple correlation coefficient between explanatory variables. VIF that exceed 10 indicate the existence of multicollinearity, variable is said to be highly collinear (Gujarati, 1995). All the variables had a value of less than 10 as fundamental (Maddala, 1993) shown in appendices 2 and 3.

6.4 Results and discussion

6.4.1 Factors influencing milk market participation

Table 6.1 presents the double hurdle results on market participation. The variable representing income earned from livestock sales had positive significant influence on milk market participation. The households with high levels of income from livestock sales had a higher probability of participating in milk markets. Lapar *et al.* (2003) observed that farmers with high level of income participated in milk markets because they could bear risk associated with marketing. This suggests that well-off households in terms of high income levels participated in milk markets possibly because they could meet the transaction cost of participating in markets.

There was positive significant relationship between amount of milk produced and the decision to participate in milk market as presented in Table 6.1. Households that produced more milk had a higher probability of participating in milk markets. This indicated that with increase in amount of milk produced the pastoralists were likely to make a decision to sell milk possibly because of increased marketable surplus. The results are consistent with findings by Bardhan *et al.* (2012) in their study among smallholder dairy farmers in Uttarakhand who found that increase in production increased farmers participating in markets.

The location of the farm had a positive significant influence on decisions of the farmers to participate in the milk markets. From the result farmers from Narok County were more likely to participate in milk markets. This is probably because farmers in Narok County produced

more average milk as observed in differences between County means and this was likely to increase amount of milk available for marketing positively influencing market participation.

Table 6.1: Double hurdle coefficients of factors influencing milk market participation

Variables	Whole sample	Kajiado	Narok
Female own milk	0.026 (859.205)	0.130 (430.001)	0.194 (624.294)
Price	0.001(28.716)	0.005 (12.265)	0.005 (43.320)
Access to good roads	0.051 (698.274)	0.164 (366.571) *	0.040 (564.381)
Amount of milk produced	0.002 (12.407) **	0.005 (8.434) **	0.004 (10.753) *
Herd size(total livestock units)	-0.001 (9.397) *	-0.001 (6.554) *	-0.001 (9.488) *
Group membership	0.037 (621.060) *	0.037 (309.441) *	0.140 (555.939) **
Radio as source of information	0.013 (690.283)	0.109 (324.310)	0.126 (614.307)
Age (Reference = 35 to 45 years)			
Age above 45 years	0.046 (718.283) **	0.024 (348.236) **	0.044 (673.787) **
Age below 35 years	-0.037 (931.594)	-0.040 (482.751)	-0.012 (824.103)
Education level (Reference = No formal education)			
Education level primary	-0.026 (744.558) **	-0.061 (362.937) **	0.041 (601.717) ***
Education secondary	-0.049 (764.687)	0.019 (394.998)	-0.082 (719.222)
Number of Sahiwal cows	0.000 (12.539) *	0.000 (8.676) *	0.000 (12.191) *
Income from livestock sales	0.000 (0.000) *	0.000 (0.000) **	0.000 (0.000) **
Narok county	0.112 (645.432) **		
Distance to the point of sale	0.131 (7.917)	0.112 (3.111)	0.122 (5.893)
Constant	6.293 (625.098) ***	4.987 (774.161)	5.518 (500.914)
Number of observations	334	148	186
Wald χ^2 (17)	71.250	32.070	18.980
Prob > χ^2	0.000	0.001	0.089
Log likelihood	-1214.004	-484.705	-708.164

* p<0.001, ** p<0.05 and *** p<0.01 denote significance at 1%, 5% and 10% confidence level. Standard errors are in parenthesis

The education level (secondary education) of the household head had a negative significant influence on decision to participate in the milk market as compared to farmers with no formal education. This is probably because with more education the farmers are able to look for other jobs and diversify income sources and consequently use milk for consumption at home. This was in line with Lapar *et al.* (2003) in a study on smallholder livestock producers in Philippines who established that educated farmers had opportunities for off-farm employment. These findings were inconsistent with Holloway *et al.* (2000) in a study on Transaction Costs, Cooperatives and Milk-Market Development in the Ethiopian highlands and found that educated farmers were able to gather more information influencing market participation.

Number of Sahiwal cows significantly influenced the decision to participate in milk markets positively; the influence was highest in Narok County because on average they had higher numbers of Sahiwal cows per household than their counterparts in Kajiado. High milk production from Sahiwal cattle was likely to influence marketing of surplus milk. Sahiwal cattle represent an asset base for milk production in pastoralist area and an increase in asset base is likely to influence participation. This was in line with Dovonan and Poole (2014) and Amanikwah *et al.* (2012) who indicated that investment in assets scaled up the level of production positively influencing participation.

Access to all weather roads had a significant positive influence on market participation significant in Kajiado County as presented in Table 6.1. The households that had access good roads that were accessible at all times were likely to participate in milk markets. Buyers in the rural areas bulk milk from various households or collection points, ease of access to this households and collection points maximizes on the profits by reduction of transaction costs associated with poor road infrastructure. Dovonan and Poole (2014) observed that improvement of market access through accessible roads increased probability of market participation. These findings were also in tandem with Enete (2009) who found that presence of buyers who were easily accessible to the farmers made them to sell surplus produce. These buyers also offered average higher prices and this could possibly influence the farmers to participate in milk markets. This indicated that presence of milk buyer influenced decision of the pastoralists in participating in milk markets.

Pastoralists' membership to groups and associations positively and significantly influenced the decision to participate in the milk markets as presented in Table 6.1. The households that were members of organized groups had a higher probability of participating in milk markets. This implied that groups were a source of market information and this reduced the level of information asymmetry between the farmers and milk traders. Barret and Christopher (2008) stated that smallholder farmer participation to groups influenced the decision to sell farm produce.

The herd size negatively and significantly influenced participation in whole sample and Narok County. Households with large herd sizes were unlikely to participate in milk markets. This indicated that dependence on dairying as additional source of income decreased with

increase in herd size. Herd size indicated level of wealth in a household and the higher the income from cattle sale the less likely a household was to look for supplementing incomes. Bardhan *et al.* (2012) in their study noted that farmers with low incomes sold more milk to supplement their lower incomes.

The age above 45 years had a positive and significant influence on market participation as presented in Table 6.1. With increase age of the household heads it was likely that the farmers would sell milk. The possible reason could be that with increase in age, farmers were likely to be more experienced and needed more resources to cater for the growing family needs. With increase in age, farmers were also likely to have high capital which increases level of production, positively influencing market participation.

6.4.2 Factors influencing level of participation in milk

Table 6.2 presents the double hurdle results on extent of milk market participation. The household income had positive significant influence on amount of milk sold in the market in whole sample and Narok County. This indicated that poor households sold little amount of milk in the market. This could be explained by low level of production among the poor households or inability to meet the transaction costs that are associated with increased volumes marketed.

The amount of milk produced had a positive significant relationship with amount of milk sold as presented in Table 6.2. This indicated that increased milk production increased the amount that was sold. This was in tandem with the findings by Omiti *et al.* (2007) who found that increased production led increased level of market participation.

Primary level of education positively influenced the amount of milk that was marketed. If the household head had primary education they sold more milk in the market as compared to household heads with no formal education and with secondary education. Secondary education had negative significant influence on amount of milk sold. This is probably because with more education the farmers are able to look for other jobs and diversify income sources and consequently use milk for consumption at home.

The herd size negatively and significantly influenced extent of participation. Households with large herd sizes were likely to sell less milk compared to those with smaller herds. This

indicated that dependence on dairying as additional source of income decreased with increase in herd size. Herd size indicated level of wealth in a household and the higher the income from cattle sale the less likely a household was to look for supplementing incomes. Bardhan *et al.* (2012) in their study noted that farmers with low incomes sold more milk to supplement their lower incomes.

Table 6.2: Double hurdle coefficients of factors influencing level of participation in milk market

Variables	Whole sample	Kajiado	Narok
Female own milk	4.430 (3.819)**	7.856 (3.425)**	12.007 (5.664)*
Price	0.228 (0.157)	0.112 (0.090)	0.168 (0.344)
Access to good roads	2.115 (3.241)	-1.905 (2.269)	5.816 (5.334)
Amount of milk produced	0.907 (0.030)*	0.954 (0.027)*	0.869 (0.045)*
Herd size(total livestock units)	-0.118 (0.035)*	-0.076 (0.044)**	-0.151 (0.049)*
Group membership	-1.791(2.944)	2.214 (2.301)	-5.415 (4.716)
Radio as source of information	0.789 (3.245)	0.573 (2.307)	6.560 (5.700)
Age (Reference = 35 to 45 years)			
Age above 45 years	3.177 (3.365)**	2.863 (2.436)**	3.112 (5.578)**
Age below 35 years	-6.478 (4.479)	-0.830 (3.659)	-10.200 (6.936)
Education level (Reference = No formal education)			
Education level primary	6.308 (3.491)**	2.173 (2.788)	6.705 (5.675)
Education level secondary	-4.919 (4.196)**	-1.014 (2.908)**	-6.627 (6.984)
Number of Sahiwal cows	0.145 (0.041)*	0.085 (0.054)**	0.186 (0.055)*
Income from livestock sales	0.000 (0.000)**	0.000 (0.000)**	0.000 (0.000)**
Narok county	-8.039 (3.147)		
Distance to the point of sale	-1.935 (0.653)*	-0.341 (0.991)**	-1.508 (0.823)**
Constant	2.248 (8.295)**	-11.792 (5.912)**	-5.217 (14.102)
Sigma constant	18.771 (1.057)*	9.845 (0.745)*	21.806 (1.665)*
<hr/>			
Statistics	Whole sample	Kajiado	Narok
Number of observations	334	148	186
Wald χ^2 (17)	71.250	32.070	18.980
Prob > χ^2	0.000	0.001	0.089
Log likelihood	-1214.004	-484.705	-708.164

* p<0.001, ** p<0.05 and *** p<0.01 denote significance at 1%, 5% and 10% confidence level. Standard errors are in parenthesis

Female decision maker had a positive influence on amount of milk sold. If the person who made decision on sale of milk was a female more was likely to be sold in the market than when decision on milk sale was made by males. Women among the pastoralists have little

resources to control and given a chance they maximize the opportunity and sell more to meet family needs

The number of Sahiwal cattle owned per household had a positive significant relationship with amount of milk sold. Farmers who had large number of Sahiwal cattle were likely to produce more milk consequently having more marketable surplus. When farmers raise their asset base in production in increasing number producing units, more is likely to be produced for sale. These findings are in tandem with those of Amanikwah *et al.* (2012) who found that increased capital base led to increased level of market participation which resulted from increased production.

The amount of milk sold in the market was positively and significantly influenced by the age of the household head (age category of over 45 years) as presented in Table 6.2. High level of investment and experience is highly correlated with age. Farmers are likely to have high level of production and networks for milk market with age because of increase in investment over time. This corroborated with findings by Staal *et al.* (2006) who established that experience which was highly correlated with age influenced the level of market participation.

The distance covered to the market had a negative significant influence on amount of milk sold. The distance increases the cost of transaction that the farmers incur in delivering milk to the market and this is likely to reduce the amount sold. Barret and Christopher (2008) in their study on Smallholder Market Participation in Eastern and Southern Africa found that reduced cost of transaction by improvement of market infrastructure positively influenced amount sold.

6.5 Conclusion

This chapter analyzed the factors that influence milk market participation and extent of participation using the double hurdle model. Total income from livestock sales, amount of milk produced, group membership, access to all weather roads, Number of Sahiwal cows owned, age above 45 years and location in Narok County significantly influenced the decision to participate in milk markets. Secondary education and herd size had a negative significant relationship with decision to participate in market.

Total income, amount of milk produced, number of Sahiwal cattle owned and age of the household head above 45 years and female ownership of milk had positive significant relationship with amount that was sold. Distance to the point of sale and secondary education category significantly influenced amount of milk that was sold in the market negatively.

In enhancing market participation among the pastoralist actors should note that total income play a significant role. This therefore in suggests that innovations to increase income among the poor households can be instrumental in exploiting marketing opportunities. Training farmers on diversification on income generating enterprises and increasing number of Sahiwal cows owned by farmers through breeding programs and awareness is essential. Groups provided information and financial services to the farmers and these are critical in accessing market opportunities. Increasing social capital among the pastoralists is therefore of great value in enhancing access to markets. Development agencies need to focus on infrastructure development to ensure that farmers can easily access the markets.

CHAPTER SEVEN

DETERMINANTS OF FARMERS' CHOICE OF MILK MARKETING OUTLETS

7.1 Introduction

Poor market participation among the rural households is considered to be a major constraint to fighting poverty. Choice of market outlet by the household is an important strategy for poverty alleviation and food security in developing countries (Heltberg and Tarp, 2002, Njarui *et al.*, 2009). Given different options for outlet market the farmer is likely to choose one that will give highest remunerations. This indicates that an efficient, well integrated and responsive market that is characterized by good performance is basic for optimal allocation of resources and stimulating households to increase output (FAO, 2003). Facilitating market participation of households as well as developing competition within the chain and efficiency is a valuable precondition in improving livelihoods (Lundy *et al.*, 2004).

Pastoral areas have elaborate potential for milk production and marketing, households' choices of milk market outlets is an important and common activity. Households are motivated by different factors to adopt a milk outlet. Several studies for example Staal *et al.* (2006), Mburu *et al.* (2007) and Voors and D'Haese (2010) have observed that farmers preferred marketing outlets for various reasons that included payment schedule, other services such as credit and security in payments. Trust conceptualized as the confidence a party in an exchange places on the credibility and reliability of his exchange-partner highly influences the choice by the farmer (Morgan and Hunt, 1994; Moorman, et al 1993). Prices differ widely even within the same location and time. Price differences are also likely in relatively well-integrated markets (Staal *et al.*, 1997). Buyers such as middlemen pay cash and the spot sale prices tend to be at a higher than sales where the producer only gets paid a month (Ngigi *et al.*, 2000) and this is likely to influence the choice by the farmers. Pastoralist choice determinants of market outlet are likely to be influenced by the commodity attributes of milk; the risk factors inherent in market outlets available to the smallholders; and the producer household-specific factors predisposing a household to sell in one or the other market outlet. Identification of factors faced by households in market outlet choice is therefore an important strategy in achieving development in rural areas. The study aims at providing an empirical basis for identifying pathways to optimize on milk market outlet

choices of the households filling the gap by assessing factor affecting milk marketing outlet choices among the pastoralists.

7.2 Data

Data was collected from two Counties where there are pastoralists keeping Sahiwal cattle breeds. A multistage sampling procedure was used to get a representative sample of three hundred and eighty four farmers. Farmers were interviewed using structured questionnaires to collect data on Socio economic, institutional and infrastructure characteristics that were postulated to influence the choice of marketing outlet for cattle milk.

7.3 Model specification and empirical analysis

Markets give a farmer number of choices of marketing outlets available for marketing of produce from the farm. The farmer is likely to choose a market outlet that is likely to give the highest benefits. The analysis presented in this study Multinomial logit model was used in analysis of factors that determine choice of a milk marketing outlet. Choice of a given marketing outlet is discrete meaning it is chosen among other alternative outlets.

Letting Y_i be a random variable representing the adoption of marketing outlet chosen by any farmer, with the assumption that each farmer faces a set of discrete, mutually exclusive choices of milk marketing outlets. The farmer is likely to choose a outlet that gives the highest returns or benefits. Choice of milk market outlet is assumed to depend on a number of socioeconomic characteristics and other factors. Multinomial logit model for marketing outlets specifies the following relationship between the probability of choosing option Y_i and the set of explanatory variables X as (Greene 2000)

$$\text{Prob}(Y_i = j) = \frac{e^{\beta_j X_i}}{\sum_{k=0}^j e^{\beta_k X_i}}, j = 0,1,\dots,J \quad (7.1)$$

where β_j is a vector of coefficients on each of the independent variables X . Y_i takes values (1, 2, 3, 4, 5) each representing choice of marketing outlet (Neighbor = 1, middlemen = 2, Processors (KCC/Brookside) = 3 Farmer cooperative = 4, Retailers (Hotels/Shops) = 5).

Equation one can be normalized to remove indeterminacy in the model by assuming that $\beta_0 = 0$ and the probabilities can be estimated as:

$$\text{Prob}(Y_i = j | X_i) = \frac{e^{\beta_j X_i}}{1 + \sum_{k=0}^j e^{\beta_k X_i}}, j = 0, 1, \dots, J, \beta = 0 \quad (7.2)$$

The dependent variable is therefore the log of one alternative relative to the base alternative. The MNL coefficients are difficult to interpret and associating the β_j with the j^{th} outcome is misleading and tempting. To interpret the effects of explanatory variables on the probabilities, odds ratios or relative risk ratios are usually derived as (Greene 2003).

The odds ratio of choosing j rather than 1 is given by:

$$\frac{\text{Pr}(y_i = j)}{\text{Pr}(y_i = 1)} = \exp(X_i \beta_j) \quad (7.3)$$

therefore e^{β_j} gives the proportionate change in the relative risk of choosing alternative j rather than 1 when X_{ir} changes by one unit.

The odds ratios measure the expected change in probability of a particular choice being made with respect to a unit change in explanatory variable (Greene, 2000). The signs of odds ratios and respective coefficients may be different as the former depend on magnitude of all other coefficients.

The empirical outlet choice model estimated was as follows:

$$\begin{aligned} \text{Marketoutlet} = & \beta_0 + \beta_1 \text{Income} + \beta_2 \text{TLU} + \beta_3 \text{Agebelow35_45} + \beta_4 \text{Age_ovr45} + \beta_5 \text{Price} \\ & \beta_6 \text{Education_primary} + \beta_7 \text{Education_secondary} + \beta_8 \text{Tdist} + \beta_9 \text{Grupmebersp} + \\ & \beta_{10} \text{Inputcost} + \beta_{11} \text{County} + \beta_{12} \text{Own_milk} + \beta_{13} \text{Access_roads} + \\ & \beta_{14} \text{Tatacalles_milkproducd} + \beta_{15} \text{Inforsource} + \beta_{16} \text{Tsah_cows} + \mu \end{aligned} \quad (7.4)$$

The dependent and independent variable are described in chapter three, table 3.1. VIF was used to check for multicollinearity and all the variables had a value of less than 10 shown in appendix 1. VIF values of less than 10 indicate that there was no sign of multicollinearity (Maddala, 1993).

7.4 Results and discussion

Table 7.1 presents Multinomial logit results for choice of milk marketing outlet by pastoralists. The level of household income from livestock sales significantly and positively influenced the likelihood that a farmer will sell milk to the retailers and the processors or cooperatives as opposed to the middlemen. Plausible reason could be that the retailers were likely to offer higher prices than the middlemen. High levels of incomes indicated that the households had enough money that could be used to meet their needs and supplementing this income was likely to be low and surplus milk was probably disposed through the easily accessible marketing outlets that included the neighbors regardless of the price they offered. Household with high levels of income were also likely adopt the monthly payment schedule since they meet their needs from other incomes and thereby choose cooperatives and processors which mostly keep the payments and pay the farmers at the end of the month. This was in line with findings by Lapar *et al.* (2003) who found that farmers with high income levels could adopt delayed payment and even bear the risks of payment failure. Farmers with higher levels of income are also able to meet cost in delivering milk to the retailers, cooperatives and processors; they therefore chose to sell milk to the buyers who gave them higher prices or were able to buy milk in bulk. Findings by Bernard *et al.* (2007) established that poorer households were likely to market their produce through a marketing outlet if it was easily accessible indicating that low cost was incurred during the transaction.

There was a positive significant relationship between the farm herd size (TLU) and choice of neighbours and retailers in the whole sample and Narok County and processors in Kajiado as milk marketing outlets as presented in Table 7.1 instead of selling to the middlemen. This may be explained by the ease access to the markets points for the farmers who sold milk just to dispose the surplus from the farm since this a minor income source. Herd size is an indication of wealth among the pastoralists and with increased wealth farmers can meet high transaction cost to reach better markets. These findings were in line with Berhanu *et al.* (2010) who found that farmers did not sell through outlets if they offered low prices. This implied that farmer with large herds of cattle were not likely to choose middlemen as marketing point for their produce because they could meet the costs for search of better markets in terms of price.

Table 7.1: Multinomial logit model odds ratio results on factors influencing farmers' choice for different milk marketing outlets

Variable	Neighbors			Processors			Cooperatives			Retailers		
	Whole	Kajiado	Narok	Whole	Kajiado	Narok	Whole	Kajiado	Narok	Whole	Kajiado	Narok
Total amount of milk sold	1.000 (0.005)	0.328 (0.062)	1.002 (0.006)	1.012 (0.004)***	1.017 (0.010)	1.010 (0.006)***	0.985 (0.011)***	1.002(0.10)**	7.745 (15.287)	0.993 (0.005)	0.985 (0.011)	0.990 (0.007)
Income from cattle sales	1.026 (1.967)	1.090 (0.009)	1.0720(0.000)	1.231 (2.317)**	1.114 (0.146)***	1.290 (0.178)**	1.432(0.00)***	1.396(0.00)***	1.451 (0.019)*	1.562 (0.002)**	1.329 (0.000)*	1.439 (0.000)***
Total cost of inputs	1.027 (2.330)	0.999 (0.331)	1.764 (0.088)	1.111 (2.106)	1.564 (0.049)	1.223 (0.007)	1.047 (0.038)	1.080 (1.041)	1.580 (0.038)	1.320(1.000)	1.045(0.002)	0.922 (0.998)
Milk own female	0.238 (0.129)*	0.092 (0.100)**	0.337 (0.216)***	0.236 (0.136)**	0.218 (0.39)**	0.140 (0.097)**	0.382 (0.429)**	0.102 (0.129)**	0.034 (0.214)***	0.465 (0.226)	0.382 (0.429)	0.418 (0.245)
Price	1.004 (0.024)	26.321 (77.600)	0.990(0.038)	0.910563(0.02)*	0.865 (0.04)*	0.945 (0.05)**	0.970 (0.019)***	0.877(0.036)*	0.017 (0.000)***	0.997 (0.0148)	0.970 (0.019)	1.045 (0.033)
Access to good roads	1.915 (0.858)	0.056 (4.072)	2.385 (1.233)	2.361 (1.053)***	3.889 (2.731)***	1.715 (1.180)**	2.165 (1.175)*	0.532 (0.438)*	0.073 (0.000)**	1.551 (0.526)	2.165 (1.175)	1.017 (0.500)
Distance to the sale point	0.989 (0.008)	0.566 (311.794)	0.990 (0.011)	1.004 (0.010)*	1.011 (0.02)**	0.983 (0.014)*	0.996 (0.008)**	1.080 (0.101)**	0.954 (7.000)***	0.994 (0.006)*	0.996 (0.008)*	1.031 (0.036)*
Herd size (TLU)	1.010 (0.005)***	35.307 (82.030)	1.008 (0.006)**	0.995 (0.006)	0.968 (0.020)***	1.005 (0.01)	1.008 (0.012)	1.016 (0.016)	0.037 (12.386)	1.008 (0.004)***	1.008 (0.012)	1.013 (0.006)**
Group membership	2.481 (1.110)	1.122 (0.259)	1.102 (0.559)	2.592 (1.111)**	10.463 (8.176)*	1.382 (0.891)**	2.010 (1.133)***	3.501 (2.611)***	2.346 (1.678)**	1.251 (0.393)	2.010 (1.133)	1.480 (0.640)
Source of information	1.111 (0.540)	319.000 (420.000)	1.752 (1.104)	1.564 (0.735)	0.801 (0.583)	2.727 (2.155)	1.049 (0.600)	1.019 (0.768)	3.020 (1.340)	1.178 (0.412)	1.049 (0.600)	0.957 (0.484)
Age above 45 years	2.385 (1.283)	0.000 (0.000)	2.103 (1.268)	1.492 (0.702)	2.421 (1.770)	0.794 (0.618)	2.643 (1.636)**	4.525 (3.892)**	2.300 (9.400)***	1.284 (0.446)	2.643 (1.636)	0.904 (0.439)
Age below 35 years	1.506 (1.021)	2.310 (1.870)	0.862 (0.685)	0.842 (0.587)***	0.997 (1.37)**	0.928 (0.81)***	3.832 (3.215)	10.916 (12.788)	8.100 (3.800)	1.109 (0.503)**	3.832 (3.215)***	0.633 (0.405)**
Primary education	1.159 (0.585)	0.000 (0.000)	1.753 (0.995)	0.569 (0.320)	0.300 (0.330)	0.617 (0.479)	2.744 (1.791)	2.274 (1.952)	0.000 (0.000)	1.648 (0.601)	2.744 (1.791)	1.138 (0.567)
Secondary education	0.789 (0.465)	0.000 (0.000)	0.912 (0.627)	0.334 (0.211)	0.382 (0.351)	0.202 (0.243)	1.720 (1.108)**	0.370 (0.388)**	1.390 (3.470)***	1.213 (0.481)	1.720 (1.108)	1.172 (0.679)
Number of Sahiwal cows	1.000 (0.007)	0.021 (7.493)	0.987 (0.008)	1.002 (0.007)	1.029 (0.024)	0.999 (0.007)	0.991 (0.016)	0.973 (0.021)	4.021 (0.283)	0.989 (0.006)	0.991 (0.016)	0.987 (0.007)
Narok county	2.174 (1.249)***			0.154 (0.075)*			0.038 (0.024)*			0.547 (0.1931)		
	Whole sample			Kajiado			Narok					

Observations	292	122	170
LR $\chi^2(48)$	278.450	189.780	122.000
Prob > χ^2	0.000	0.000	0.000
Log likelihood	-268.289	-83.15958	-153.582
Pseudo R ²	0.3416	0.5329	0.2843

* p<0.001, ** p<0.05 and *** p<0.01 denote significance at 1%, 5% & 10% confidence level, Middlemen market outlet used as the base category. Standard errors are in parenthesis.

Positive significant relationship was observed between the distance to market and likelihood that a farmer will either choose processors and retailers (shops/hotels) (Table 7.1). This revealed that the benefits such as good prices and assured milk market influenced farmers to cover long distances to market their milk produce. These findings concur with Bardhan *et al.* (2012), who established that farmers chose marketing points away from the farm as long as they were easily accessible and they paid better prices. This implied that with increase in distance to market, farmers preferred to sell to dairy cooperatives, processors or hotels, rather than neighbors and middlemen because of increased benefits such as good prices.

There was a significant positive relationship between the household group membership and choice of the processors and cooperatives as milk marketing outlet as presented in Table 7.1. As pastoralists joined farmer groups there was an increase in the likelihood that they will market their produce through the processors and cooperatives rather than selling to middlemen. This indicated that farmers that were in groups marketed their produce through formal marketing outlets. The possible reason for this could be that most formal marketing outlets buy milk in large quantities and individual farmers have to come together and collect their small quantities together. This collaborated with findings by Wollni and Zeller (2006) who indicated that membership to groups increased probability that a farmer will use cooperatives. A study by Berhanu *et al.* (2013) also indicated that farmers that were in groups were likely to market their produce through formal outlets that included the farmer cooperatives and the processors. This implied that as farmers joined groups they were likely to shift away from informal marketing points to formal marketing points such as the cooperatives and the processors.

There was a significant positive relationship between Narok County and choice of the neighbors, the processors and the cooperatives. This indicated that farmers in Narok were likely to choose the neighbors, the processor or the cooperatives instead of the middlemen as compared to their counterparts in Kajiado County. This could be explained by ease of access to the neighbor buyers and high production of milk that was likely to attract cooperatives and processors in Narok in comparison with Kajiado County.

Female ownership of milk positively and significantly influenced the choice of neighbors, cooperatives and the retailers. Women use income from sale of milk to mostly cater to immediate daily consumable in the household. They are likely to choose an outlet that will

pay promptly and use that money to buy food and other items they need. Negative significant relationship of female milk ownership with the choice of cooperatives in Kajiado County could be due to low membership in groups which positively influenced the choice of cooperatives and processors. In Narok County, female ownership significantly influenced choice of processors probably because of high membership in groups. Wollni and Zeller (2006) established that farmers in groups had access to market information which was likely to influence the choice of formal outlets.

There was a positive significant relationship between the age category of below 35 years and the choice of the processors and the retailers. This indicated that youthful farmers were likely to market their milk to either the processors or the retailers instead of selling to the neighbors. The age category above 45 years significantly and positively influenced the farmers to choose the neighbors or the cooperatives as a marketing point instead of marketing through the middlemen. The probable reason could be, as age increases farmers are likely to be endowed with more resources accrued from continued investments for a long period. They are therefore able to meet cost associated with milk delivery to formal outlets which were able to buy milk in bulk. Another plausible reason for differences of choice due to age could be possibly because older people are likely to have diversified in income generating activities spreading the risk through investments reducing the need to supplement income with sales from milk. This was in tandem with Enete (2009) in the study on middlemen and cassava marketing among cassava farmers in Africa and observed that farmers were likely to choose the readily available buyers in the village.

A positive significant relationship was also observed between choice of cooperatives and the education category of secondary education. Farmers with high primary education level were likely to choose the retailers as a marketing point for their milk instead of choosing the middlemen. Farmers with high levels of education can access information on different marketing outlets and are likely to have more information on the same (Wollni and zeller, 2006). Processors and cooperatives have the benefit of accumulating daily sales which are then paid at the end of the month and are also able to buy milk in bulk quantities during all season unlike middlemen who do not have the bulking capacity.

There was a positive significant relationship between access to good roads and choice of the processors and the retailers as marketing outlets. This was probably due to means of transport

used by the farmers or the processors to transport milk from the farm. With poor roads, farmers just sold milk to the readily accessible buyers who could buy the produce. Access to markets through good roads reduce marketing costs, thus encourage market orientation. Positive relationship was observed between distance and likelihood that a farmer will either choose processors, cooperatives and retailers (shops/hotels) see Table 7.1. Farmers chose marketing points away from the farm as long as they were easily accessible and they paid better prices.

There was a positive significant relationship between amount of milk sold and choice of the processors and cooperatives as marketing points. The cooperatives and processors are able to buy large quantities of milk from the farmer. Farmers producing large amounts of milk are likely to choose cooperatives because of assured market for the milk. The findings were consistent with those of Schipmann and Qaim (2010) on Supply Chain Differentiation, Contract Agriculture, and Farmers' Marketing Preferences study in Thailand. They found that farmers who produced large amounts of pepper chose to market through cooperatives because they could buy all of their produce.

There was a positive significant relationship between the choice of cooperatives and processors as marketing points with the increase in price per liter of milk instead of choosing the middlemen. Farmers were likely to choose the cooperatives and processors as a marketing point for their milk instead of choosing the middlemen with increase in price. Prices fluctuate during wet and dry season and farmers are likely to choose the most predictable point of sale for the milk produce in terms of price.

7.5 Conclusion

This chapter analyzed the factors that influence pastoralists' choice of milk marketing outlets using multinomial logit model. Milk marketing outlets choice options in the model included; the neighbors, middlemen, farmer cooperatives, processors and the retailers. From the results the indication was that most farmers in the study area marketed milk through middlemen and this formed the base from which farmers made other outlet choices. Total household income from animal sales significantly influenced sale to retailers and processors. The herd size positively influenced choice of neighbor consumers, distance to point of sale had a positive significant relationship to the choice processors and cooperatives while group membership positively and significantly influenced choice of processors in place of middlemen. The age

below 35 years influenced choice of cooperatives and retailers while age above 45 years had a positive relationship with choice of neighbors and processors. Household heads with secondary education had a positive relationship with choice of cooperatives in place of middlemen as milk marketing points. Access to good roads influence choice of processors and retailers instead of selling to the middlemen. Amount of milk sold and prices influenced choice of processors and cooperatives.

The results indicate that farmers' choice of marketing outlet is linked to structure of the market outlets in terms of availability, price they offer, payment mode and amount of milk they can handle. The main aim of the farmers is to have high returns and they adopt milk market outlet choices that give the best of these returns. Development partners in rural areas particularly those working with the pastoralists should promote and provide technologies that increase the level of production such as Sahiwal breeds to enable them produce surplus milk for markets. Improvement of infrastructure in rural areas especially the roads and handling facilities is crucial in enticing many buyers so as to bring competition and consequently raise prices and the level of production by the farmers. Policies to strengthen farmer groups and group formation should be adopted because farmer groups act as sources of information and a platform through which farmers could act collectively and have more bargaining power.

CHAPTER EIGHT

MILK PRICES IN PASTORALISTS' MARKETS

8.1 Introduction

Dairy production in pastoralist areas is predominantly at subsistence level with low production and seasonal variations (FAO, 2011). Slow growth of dairy industry is attributed to climatic conditions, cattle breeds and management practices by the Pastoralists (Waithaka *et al.*, 2000). There are many opportunities in the livestock production among the pastoralists that would provide more milk output and therefore improving food security and livelihoods of the rural poor farmers (Muriuki, 2011).

Milk is produced by many livestock farmers providing an opportunity for them to benefit from the market growth and health improvement, through provision of food and monetary contribution to the household economy (Kiptarus, 2005). Market growth can be achieved by a well facilitated market structure that compliments production in the rural areas (Devendra, 2001). However marketing of milk among the pastoral community is mostly informal and localized within rural market and farmers most of the time depend on exploitive middlemen who buy farm produce and resale in the urban markets (Omore *et al.*, 2004). The market failures coupled with the nature of trade have enticed pastoralists to depend on traditional milk production and marketing practices overtime inspite of milk fetching higher prices in the market. The price that the farmer get from sale of farm produce reflects the benefits accrued and is influenced by unique characteristics that are associated with the product. Several studies for example in identifying determinants of livestock producer prices for pastoralists in northern Kenya rangelands Barrett *et al.* (2002) found that animal characteristics, season, price risk and quarantines influenced expected prices. Bett *et al.* (2011) in their study to determine indigenous chicken attributes and socio economic characteristics that influence the price differentials for live indigenous chicken in western Kenya found that weight, plumage color, gender of trader, transport cost, number of traders and presence of market information influenced the price. From these studies it was clear that each commodity has its own unique attributes that influence its price and it is unlikely that the same characteristics will have the same effects on price of different commodities.

This study determines if the price differences in the pastoral milk markets are influenced by socioeconomic factors and nonmarket attributes. It is possible to determine factors which are

most important in explaining the discrepancy in milk prices which can be traced in milk production and marketing.

8.2 Data

Random cross sectional data was collected from pastoralists in Kajiado and Narok Counties between December 2012 and January 2013. A multistage sampling procedure was adopted to get a sample that represented farmers' livestock production practices in the area. Three hundred and eighty four respondents were randomly selected. Data on factors that were likely to influence price levels as described in chapter three was collected. The data was collected through interviews using structured questionnaires.

8.3 Model specification and empirical analysis

Hedonic price model was used in the analysis of factors that influence prices received by farmers. Every farm produce has bundles of quality characteristics. Farmers and buyers attribute each of the characteristics to the price each influencing price positively or negatively explaining different prices for milk. Milk can be described by the vector of its independently measured characteristics such that the observed price will be a combination of the coefficients of all the attributes. In hedonic model milk market price is presented as the sum the prices buyers are willing to pay for each characteristic that increases utility and the characteristics of market, sellers and buyers (Martínez-Garmendia, 2010) given by:

$$P = f(X, Z) + e \quad (8.1)$$

where P is the market price, X are factors determining price or product attributes, Z is set of covariates determining or sellers and buyers attributes and e is an error term that is independently and normally distributed with a mean of zero.

When the P in equation (8.1) is differentiated with respect to any attribute in X or Z , the embedded price function for that particular characteristic is yielded. When these embedded prices are regressed against the actual quantities/qualities chosen by the people it is possible to get the marginal willingness to pay for milk.

The empirical hedonic price model estimated was as follows:

$$\begin{aligned}
Price = & \beta_0 + \beta_1 Own_milk + \beta_2 Acs_roads + \beta_3 Amount_sold + \beta_4 TLU + \beta_5 Grupmebersp \\
& + \beta_6 Infor_sorce + \beta_7 Age_ovr45 + \beta_8 Agebelow35 + \beta_9 Education_primary + \\
& \beta_{10} Education_secondary + \beta_{11} TSah_cows + \beta_{12} Income + \beta_{13} County + \beta_{14} Tdist \\
& + \beta_{15} buyer_retailers + \beta_{16} buyer_middlemen + \beta_{17} buyer_cooperatives + \\
& \beta_{18} buyer_processors + \varepsilon
\end{aligned} \tag{8.2}$$

The dependent variable (*Price*) refers to the observed price per litre of cattle milk sold and independent variables are described in chapter three table 3.1. Multicollinearity test for all the variables had values of less than 10 as requisite (Maddala, 1993) shown in appendix 4.

8.4 Results and discussion

Table 8.1 presents Hedonic price model results for factors influencing milk prices in Kajiado and Narok Counties. The coefficient for the total milk produced was positive and significant at 5% significant level. This implied that the farmers who produced more milk sold their milk at higher prices than the farmers who produced less. It also implied that farmers who had more milk in their farms, attracted buyers who gave them better prices. Milk buyers assemble milk from different places incurring cost when assembling. When milk is already assembled in a central point the traders are willing to pay high prices since less cost has been incurred in assembling. Amount of milk produced depend on the farm characteristic and season during production. Influence of amount produced on price was also noted by Franks (2002), Barret *et al.* (2003), Timothy *et al.* (2006) and Bett *et al.* (2011) who stated that prices were influenced by amount of produce that was in the market. Seasonal variation in prices was also noted in studies by Ngigi *et al.* (2011) and Wambugu *et al.* (2011).

There was a positive significant relationship between the household membership to groups and the prices as presented in Table 8.1. This means that household that were in groups sold milk at higher prices while the household that were not in groups sold milk at lower prices. The groups act as points where the farmers share information on the prices, if there is information asymmetry on the prices and the market for farm produce farmers are likely to be exploited by the buyers. The farmers groups enable the farmers to come together and bargain for better prices and even link the farmer group members to better markets in terms of prices. This was also established by Bett *et al.* (2011) and Upton (2000) who pointed out that that in presence of information asymmetry, traders exploited the farmers by paying them lower prices.

Table 8.1: Hedonic price model coefficients of factors influencing milk prices

Variable	Whole sample	Kajiado	Narok
Total amount of milk sold	0.007 (0.015) ^{***}	0.026 (0.031) ^{***}	0.028 (0.014) ^{**}
Total income from cattle sales	0.001 (0.000)	0.022 (0.000)	0.001 (0.000)
Total cost of inputs	0.034 (0.000)	0.012(0.000)	0.030(0.000)
Milk own female	-2.436 (1.503)	-2.712 (3.204)	-0.924 (1.387)
Access to good roads	1.978 (1.195) ^{***}	2.101 (2.192) ^{***}	0.892 (1.200) ^{**}
Distance to the sale point	-0.082 (0.020) [*]	-0.123 (0.036) [*]	0.027 (0.023)
Herd size (TLU)	-0.038 (0.015) [*]	-0.064 (0.036) ^{***}	-0.028 (0.013) ^{**}
Group membership	1.474 (1.086) ^{**}	5.274 (2.061) ^{***}	-0.565 (1.065) ^{***}
Source of information	0.037 (1.186)	-0.546 (2.072)	0.069 (1.271)
Age above 45 years	0.384 (1.258)	1.311(2.345)	-0.100(1.276)
Age below 35 years	1.554(1.636)	3.598(3.339)	0.227(1.575)
Primary education	3.420(1.270) [*]	6.124(2.370) ^{**}	2.134(1.259) ^{***}
Secondary education	0.922(1.417)	1.316(2.585)	0.217(1.421)
Number of Sahiwal cows	0.039(0.017)	0.073(0.044) ^{***}	0.019(0.016)
Narok county	-7.838(1.145) [*]		
Buyer retailer	0.910(2.272)	-0.590(3.841)	2.217(2.484)
Buyer cooperative	-8.073(2.833) [*]	-8.465 (4.798) ^{***}	-9.290(3.349) [*]
Buyer processor	-5.242 (2.682) ^{***}	-8.552(4.689) ^{***}	-0.501(2.884)
Buyer middlemen	1.369(2.218) [*]	3.397(4.106) ^{**}	0.766(2.226) ^{**}
Constant	40.153(3.004) [*]	40.637(5.779) [*]	31.943(2.759) [*]
Observation	385	178	207
F(df)	(15, 369) = 4.870	(14,163)=2.740	(14, 192) = 1.330
Prob > F	0.000	0.001	0.193
R-squared	0.165	0.190	0.088
Adj R-squared	0.13	0.121	0.022
Root MSE	10.340	12.830	7.504

^{*} p<0.001, ^{**} p<0.05 and ^{***} p<0.01 denote significance at 1%, 5% and 10% confidence level. Standard errors are in parenthesis.

Inverse significant relationship was observed between the distance and the milk prices as presented in Table 8.1. This indicated that pastoralists that sold milk farther from the farm gate sold it at higher prices than their counterparts who sold at the farm gate. The plausible reason for high prices further from the farm could be the likely high demand and low supply in markets away from the point of production. This was also noted by Bett *et al.* (2011) and Owuor and Bebe (2009) who found that costs of transporting farm produce to the markets

located farther away from the farm were transferred to the farmers. Transactions costs lower the benefits that the farmer is likely to get, the farmer has to increase the price of commodity to ensure that they get the desired profits. When the farmers travel long distances to reach markets, any cost they incur has to be transferred to the price of milk. Farmers also search for market away from flooded local market and because the supply is low in areas away from the farms, they are likely pay better prices.

There was a positive significant relationship between the road condition from the farm to the nearest output market and the milk price for whole sample and Kajiado County (Table 8.1). This indicated that the better the road condition to the farm gate the better the prices received by farmers. The farms that were connected to the nearest output market with roads that were in good condition were likely to attract buyers who paid good price unlike farms that were inaccessible due to poor roads condition. Poor roads are also likely to increase the cost of doing business by the traders and they pay less to the farmers transferring the cost to the farmers. This was in tandem with findings by Ngigi *et al.* (2011) and Wambugu *et al.* (2011) who found that, farms in remote areas with poor physical and market infrastructure received low prices for their farm produce. Location of the farmer was also likely to influence the type of buyer. This was consistent with findings by Wambugu *et al.* (2011) who pointed out that long chain to the final consumer negatively affected prices that were paid to the farmers. When the buyers were highly concentrated in given location, they negatively affected the prices that the farmers received.

There was a negative significant relationship between the cooperatives and the processors buyers. Middlemen recorded the highest relationship followed by processors indicating that they gave higher prices than other buyers. Middlemen compete with each other and with other buyer types; this competition is likely to raise the prices received by the farmers (Enete, 2009).

Location of Narok County had a negative significant relationship with prices. Farmers in Narok county received lower average prices that their counterparts in Kajiado county. This is probably because of Narok county average milk production was higher than that of Kajiado County and this surplus in the market could result to lower prices.

8.5 Conclusion

This chapter analyzed the factors influencing milk prices using the hedonic price model. From this study the total milk produced, household group membership, road condition to the nearest market, buyer types who included middlemen, neighbors and the retailer buyers were found to have a positive significant relationship with price. The distance to the sell point had a significant negative relationship with the milk prices also herd size, processors and cooperative buyers had a negative relationship with price. The study identified that determination of milk prices is dependent on farm characteristic and location of the farm from the market.

Therefore, to ensure that farmers get the highest return from milk sales they access to the markets and information was paramount. Development of rural infrastructure such as roads and buying centers should be a priority by the development agencies to ensure that farmers get good returns from milk sales. Improved infrastructure is likely to attract many buyers who compete for the producer raising the price the farmer gets. Collective action is also capable of assisting farmers in getting good prices and farmers should be encouraged to join farmer groups to ensure that they share market information and improve their bargaining power.

CHAPTER NINE

SUMMARY, CONCLUSIONS AND IMPLICATIONS

9.1 Introduction

Agricultural commercialization involves the shift from subsistence farming to increased market-oriented production. Commercialization in Agriculture is usually measured as the ratio of percentage value of marketed output to total farm production (Haddad and Bouis, 1990). Commercialization of farm enterprise entails measures such as adoption of new technology to improve farm productivity increasing market participation; use of new technology such as inputs is guided by profit maximization objectives (Omiti *et al.*, 2006).

Developing countries have been ardent on diversifying rural economies, individual farms shift from highly diversified, subsistence oriented towards more specialized production oriented toward market (Kimenju *et al.*, 2008). Specialization among the pastoralists has been concentrated in livestock production systems leading to increased livestock production. Specialization of pastoralists to livestock production has led to introduction and prioritization of Sahiwal cattle genetic resources and this has led to increase in milk production from these areas (Ilatsia *et al.*, 2006). With increase in number of Sahiwal cattle genetic resource milk production is now market oriented.

The dairy industry in Kenya is liberalized and a large proportion of smallholder farmers still engage in subsistence agriculture and they are unable to benefit from liberalized markets. Poor infrastructure (Dorward *et al.*, 2005) and lack of market institutions (World Bank, 2002) are challenges leading to high transaction cost discouraging farmers to shift from subsistence farming. Marketing of agricultural produce and particularly milk in pastoralist areas of Kajiado and Narok Counties is a challenge posing a threat to food security in this region. Increase in supply from smallholder farmers leads to a regular decline in real food prices due to increased competition and lower costs in food marketing and processing (Jayne *et al.*, 1995). Changes in supply improve the welfare of smallholder farmers and consumers in areas where the produce is supplied by lowering food prices increasing the purchasing power. This enables reallocation of limited household incomes to purchase of other food items and invest to improve productivity in the farm.

The dairy sector has a number of players, investments in its commercialization to guarantee market access among the pastoralists could reduce poverty but this requires efficiency in priority (Geda *et al.*, 2001). The potential benefits selling produce at higher prices and buying inputs at reduced prices due to commercialization are efficiently transmitted to poor households when market access is guaranteed (IFAD, 2001).

The forces that lead to agricultural commercialization include factors as increased market demand for food arising largely from population growth and demographic change; urbanization; the development of infrastructure and market institutions (Pingali and Rosegrant, 1995). At the farm level, agricultural commercialization is mainly affected by climate; infrastructure and market access both input and output markets; resource and asset endowments; and cultural and social factors (Pender *et al.*, 2006). These factors alter the conditions of commodity supply and demand, output and input prices, and transaction costs and risks faced by farmers, traders and other players in production and marketing system (Pender and Alemu, 2007).

9.2 Structure of milk marketing outlets in pastoralist areas

Dairy products are consumed by a large population in Kenya both in rural and urban areas (Argwings-kodhek *et al.*, 2005; salasya *et al.*, 2006). For the dairy product to reach the consumers away from the farm mostly in urban centers, it has to go through the marketing system. Market structure influence the interaction between the buyers and sellers of milk in the milk marketing system and this consequently have an effect on market development (Caves, 1992). Since the market links the producer to the consumer, its structure is important in determining the kind of benefits the farmers and consumers are likely to have and influence on market development impacting on welfare of the rural population. This led to formulation of the first objective which aimed at determining the structure of milk marketing outlets in pastoralist areas using the SCP market analysis model.

The Gini coefficients, Lorenz curves and concentration ratios results indicated that milk traders operated in close to imperfect market, dominated by middlemen and a few processors. In areas where middlemen and processors operated competition for milk from the farmers was high within middlemen and other buyers. The processors appeared to be the biggest buyers of milk followed by middlemen.

The results indicated that, policy makers and other key development agencies should consider improvement of physical and market infrastructure to reach the interior remote areas where most of the middlemen source milk to increase competition from other buyers.

9.3 Factors influencing market participation and the level of participation

Pastoralist households routinely make decision on sale of milk and how much to sell. Markets are some of the foundation for development strategies in rural areas and understanding household market participation is crucial. If households fail to participate in actively in markets development strategies may not achieve the goal of wealth creation and poverty eradication among the rural poor improving their welfare (Bellemare and Barret, 2004; ILRI, 2002; Ehui, 2009). Market frictions discourage households from participating in markets reducing their chance to take advantage of market opportunities and government macroeconomic influence through changing market incentives. There are factors that limit market participation that include transaction cost and lack of financial and physical capital. Identifying options to increase market participation and level of participation is important in context that milk plays a key role among the pastoralist because it is produced by most households. Sales from milk are believed to significantly improve income and welfare of pastoralist households. This led to formulation of the second objective that aimed at analyzing factors influencing milk market participation and the level of participation among the pastoralist in Kajiado and Narok Counties. The results from DH model described in chapter 6 indicated that there was a difference in relationship between dependent variables and independent variables in the two tiers.

The findings indicated that innovations to increase income among the poor households can be instrumental in exploiting marketing opportunities. Interventions to reduce risk of reduced household income are therefore pivotal and this can be achieved by training farmers on diversification on income generating enterprises. Increasing social capital among the pastoralists is of great value in enhancing access to markets. Development agencies need to focus on infrastructure development to ensure that farmers can easily access the markets.

9.4 Factors influencing farmer's choice for different marketing outlets

When a farmer is marketing milk from the farm there are set of marketing outlets from which the farmer chooses. Farmer's choice is influenced by farm characteristic as argued by Timothy *et al.* (2006), that amount of milk produced influenced the choice of marketing

outlet. Farmers characteristic for instance education level as noted by Chikazunga *et al.* (2008) are likely to influence the choice of a marketing outlet. Market characteristics such as payment mode as observed by Voors and D'Haese (2010). Socioeconomic and institutional factors are likely to be varied according to locations of the farm and market, and also among diverse groups influencing choice of marketing outlets differently. This led to formulation of the third objective which intended to determine factors influencing farmer's choice for different milk marketing outlets in Narok and Kajiado Counties.

The factors influencing farmer's choice of milk marketing outlets were evaluated using multinomial Logit model. The results show that most pastoralists sold their milk to the middlemen. Choice of other marketing outlets was influenced by income from sale of live animal, distance to the point of sale, herd size, person responsible for milk sales and group membership.

This therefore indicates that the choice of market outlet is linked to structure of the market outlets in terms of availability, price they offer, payment mode and amount of milk they can handle. The main aim of the farmers is to have high returns and they adopt milk market outlet choices that give the best of these returns. Development partners in rural areas particularly those working with the pastoralists should promote and provide technologies that increase the level of production such as Sahiwal breeds to enable them produce surplus milk for markets. Improvement of infrastructure in rural areas mostly the roads and handling facilities is crucial in enticing many buyers bring competition and consequently raising prices and level of production by the farmers. Policies to strengthen farmer groups and group formation should be adopted because farmer groups act as sources of information and a platform through which farmers could act collectively and have more bargaining power.

9.5 Factors that determine milk prices in pastoralists markets

An efficient marketing system is one capable of moving farm produce from the farmer to the final consumer at lowest cost with the farmer and consumer getting the greatest benefits (FAO, 1997). Inefficient marketing systems are characterized by high transaction costs that are at the expense of the farmer and the final consumer. High perishability of milk under rural conditions is associated with high frequency of individual transaction cost. Milk is highly perishable and frequencies of market transaction tend to be high (Staal *et al.*, 1997). Producer prices of a given commodity can be decomposed on factors that affect the prices in

the market. Understanding the factors leading to price differences in the market is important in market development. This led to formulation of the fourth objective that aimed at analyzing the factors that determine milk prices in pastoralist markets.

The Hedonic price model results indicated development of rural infrastructure such as roads and buying centers should be a priority by the development agencies to ensure that farmers get good returns from milk sales. Improved infrastructure is likely to attract many buyers who compete for the producer raising the price the farmer gets. Collective action is also capable of assisting farmers in getting good prices and farmers should be encouraged to join farmer groups to ensure that they share market information and improve their bargaining power.

9.6 Policy implications

Commercialization of dairy farming in pastoral areas is the pathway through which households in pastoralist areas are likely to increase income sources and levels. Since there is promotion in supply of dairy stock of Sahiwal cattle that are well adapted to the ASALs conditions, this increased production should be based on producing for markets and maximizing on profits.

Farmers make decisions as they change from a system of subsistence farming to a market oriented system. Decisions by the farmers are likely to have an influence on milk market development in these areas. There are various socio economic and institutional factors that influence decisions that farmers are likely to make when marketing produce from their farm. Farmer group membership has been identified as a key factor in influencing decision in milk market participation and choice of marketing outlets because of their contribution to reduction of transaction costs. Rural developers that target development through markets should promote farmer group formation in rural areas. This is because groups act as a social capital where farmers share information concerning market attributes that are likely to be beneficial in farm produce marketing. Access to market as influenced by distance to the market and road condition also affected the decision in the market either to participate, level of participation and choice of a given outlet and also the prices. The rural developers should promote policies that are likely to improve infrastructure in rural areas to ensure that farmers have easy access to market.

9.7 Suggestions for further research

The study was only undertaken in Kajiado and Narok Counties and since Sahiwal cattle have been adopted in other regions, further research could be carried out in those areas where dual purpose Sahiwal breeds have been introduced and evaluate effect of actions of other key players not considered in this study.

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APPENDICES

Appendix 1: Variance inflation factor (VIF) multicollinearity test results for the Multinomial logit model of market choice

Variable	VIF	1/VIF
Income	3.23	0.310
Access to good roads	2.81	0.356
Amount of milk produced	2.32	0.432
Herd size(total livestock units)	2.03	0.494
Group membership	2.02	0.495
Radio as source of information	1.99	0.502
Age above 45 years	1.95	0.513
Age below 35 years	1.8	0.556
Education level primary	1.13	0.888
Education secondary	1.11	0.903
Number of Sahiwal cows	1.05	0.952
Income from livestock sales	1.04	0.965
Narok county	1.03	0.967
Mean VIF	1.81	

Appendix 2: Variance inflation factor (VIF) multicollinearity test results for the double hurdle model (1st hurdle) of market participation

Variable	VIF	1/VIF
Female own milk	3.55	0.282
Price	2.83	0.353
Access to good roads	2.5	0.401
Amount of milk produced	1.93	0.519
Herd size(total livestock units)	1.91	0.524
Group membership	1.61	0.621
Radio as source of information	1.43	0.701
Age above 45 years	1.22	0.823
Age below 35 years	1.21	0.825
Education level primary	1.21	0.828
Education secondary	1.12	0.889
Number of Sahiwal cows	1.12	0.891
Income from livestock sales	1.08	0.929
Narok county	1.07	0.930
Distance to the point of sale	1.05	0.955
Mean VIF	1.66	

Appendix 3: Variance inflation factor (VIF) multicollinearity test results for the double hurdle model (2nd hurdle) of market participation level

Variable	VIF	1/VIF
Total cattle sold	3.55	0.282
Income	2.83	0.353
Number of sahiwal	2.5	0.401
Age 35_45yrs	1.93	0.519
Age over 45yrs	1.91	0.524
Middlemen buyer	1.61	0.621
Retailer buyer	1.43	0.701
Neighbor buyer	1.22	0.823
Distance to the market	1.21	0.825
Land size	1.21	0.828
Secondary education	1.12	0.889
Primary education	1.12	0.891
Group membership	1.08	0.929
Female milk decision	1.07	0.930
Access to good roads	1.05	0.955
Mean VIF	1.66	

Appendix 4: Variance inflation factor (VIF) multicollinearity test results for the hedonic price model

Variable	VIF	1/VIF
Middlemen buyer	3.42	0.292
Retailer buyer	2.59	0.386
Neighbor buyer	2.02	0.495
Processor buyer	1.82	0.549
Distance to the market	1.32	0.756
House hold size	1.31	0.762
Narok	1.22	0.818
Education none	1.18	0.850
Age below 35 years	1.15	0.871
Female milk decision	1.1	0.907
enterprises	1.1	0.908
Income	1.09	0.916
Information source radio	1.07	0.936
Input cost	1.07	0.939
Access to good roads	1.03	0.969
Mean VIF	1.5	

Appendix 5: Household survey questionnaire

Household Survey 2012

Egerton University

Evaluation of milk marketing and its role on economic welfare on Sahiwal farmers of Kajiado and Narok Counties

I am a student from Egerton University studying milk marketing and its role on economic welfare of Sahiwal farmers in Kajiado and Narok Counties. The purpose of this study is to understand more about marketing of milk in pastoral areas. Your participation in this study will be highly appreciated. Your responses are completely confidential and will be used for research purposes to help improve milk marketing. Am also talking to other farmers and your responses will be used with responses from other farmers.

Instruction (*fill codes given in spaces appropriately*)

1.0 BACKGROUND INFORMATION

Household number (HHID) _____ Survey date _____

Name household head _____ gender ____ (1= Male 2= Female)

Age of household head _____

Education level of household head (*Number of years in school*) _____

Name of the respondent _____ gender ____ (1= Male 2= Female)

Age of the respondent _____

Education level of the respondent (*Number of years in school*) _____

Name of interviewer _____

Name of County _____

Name of division _____

Name of location _____

2. 0. Land characteristics

2.1 Does this household own any land? _____ (0 = No 1=Yes)

2.2 What is the mode of ownership of owned land? _____ (1= Private 2= Communal 3= Public 4= Rented)

2.2 What is the size of land owned by this household? Size _____ Acres

2.3 How was the land acquired? _____ (codes: 1= Inheritance 2= Bought 3= Gift 4= allocated to by community 5= walked in)

2.4 When was the land acquired? _____ (year)

2.5 What is the size of land leased in by this household? Size _____ Acres

2.6 What is the size of land leased out by this household? Size ____ Acres

3. 0 Herd characteristics

3.1 Kindly tell us about the cattle owned and total expenses for purchase, feeds, veterinary and other expenses in the last 12 months from January 2012 to December 2012

Cattle breeds	Number owned	Number sold	Revenue from sale	Number bought	Cost of buying (total)	Cost of feeds (total)	Veterinary care cost (total)	Other expenses (total)
1. Sahiwal								
2. Local breeds								
3. Other specify								
4. Other specify								

3.2 Lets look at milk production and use in this household in the last 12 months from January 2012 to December 2012 on average

Cattle breed	Average	Number of high milking months.....	Number of low milking months.....

		Average amount of cow milk produced per month	Average amount consumed per month	Average amount sold per month	Average amount of cow milk produced per month	Average amount consumed per month	Average amount sold per month
1. Sahiwal							
2. Local breeds							
3. Other specify							
4. Other specify							

3.3 Cow milk marketing details

3.3.1 Who makes decision about use of cow milk produced in this house hold i.e. what to consume and sell..... (1= Husband alone 2= Husband and wife 3= Wife alone 4= Someone else)

3.3.2 Milk sales and distance to milk market in high milking months.

Where did you sell cow milk During high milking months	Price per unit in KES	Distance to the place of sale in km
Local retail shops/ milk bars		
Cooperative/ group specify.....		
Middlemen		
Hotels		
Neighbor		

Processors specify.....		
Other specify.....		

3.3.4 Milk sales and distance to milk market in low milking months.

Where did you sell cow milk During low milking months	Price per unit in KES	Distance to the place of sale in km
Local retail shops/ milk bars		
Cooperative/ group specify.....		
Middlemen		
Hotels		
Neighbor		
Processors specify.....		
Other specify.....		

3.3.5 Did you incur any cost in marketing of milk?..... (1= Yes 0 = No)

3.3.6 If you incurred cost fill the table

Sale point	Costs				
	Total marketing costs in KES	Information (use cost codes below)	Negotiation (use cost codes below)	Monitoring (use cost codes below)	Transport (use cost codes below)
Local retail shops/ milk bars					
Cooperative/ group specify.....					
Middlemen					
Hotels					
Neighbor					
Processors specify.....					

Other specify.....					
Cost codes: None=0, Very low=1, Average=2, High=3, Very high=4					

3.3.7 What is the means of milk transport to the main buyer? __ (0 = None 1 = Bicycle 2 = Car 3 = Motorbike 4 = Other specify)

3.3.7 Have you bought any equipment or made any investment(s) to enable you market your milk..... (1 = Yes 0 = No)

3.3.8 If yes which are the three main investments and their value?

Investment	Value in KES
1.	
2.	
3.	

3.3.9 Why did you choose to sell to the buyers listed above? (Choose the three most important in terms of highest volumes)

Reasons	Buyer one specify (0= If not reason mentioned 1= If mentioned)	Buyer two specify (0= If not reason mentioned 1= If mentioned)	Buyer three specify (0= If not reason mentioned 1= If mentioned)
1. Offers high prices			
2. Nearest			
3. Only buyer available			
4. Trustworthy			
5. No strict standards			
6. Pays promptly			
7. I can negotiate on price			
8. No worry about spoilage			
9. Other specify.....			
10. Other specify.....			

3.10 Effect of ceremonies, seasons and holidays on milk prices

Seasons, ceremonies or holidays	Did the seasons, ceremonies or holidays listed affect your cow milk prices (1= Yes 2= No)	If yes how many months	What was the average price per litre	How did prices rise or fall from the average of KES..... (use negative (-) to indicate decrease and plus(+) to indicate increase)
1. Christian festivals e.g. Christmas				
2. Muslim festivals e.g. Ramadthan				
3. Public holidays				
4. Marriage				
5. Circumcision				
6. Dry season				
7. Wet season				

4.0 Information on groups and associations

4.1 Are you or any other house hold member a member of any group or association?.....(

1= Yes 0= No)

4.2 If yes what type of groups or associations do you belong to?

Type of group	1= Yes; 0= No
1. Crop producer group	
2. Livestock producer group	
3. Farmers cooperative society	
4. Sacco	
5. Roscas (Rotating credit and saving accounts)	
6. Community welfare groups	
7. Other specify.....	

4.3 What benefits or services do you get from groups or associations that you belong to?

Benefits or service	1= Yes; 0= No
1. Marketing of produce specify.....	
2. Training on crop production	
3. Training on livestock production	
4. Input access	
5. Welfare/ social support.	
6. Other specify.....	
7. Other specify.....	

5.0 agricultural assets owned

5.1 Which agricultural assets do this household own?

Agricultural assets		Quantity	Total value
1	Tractor		
2	Car/van		
3	Motor cycle		
4	Bicycle		
5	Television		
6	Radio		
7	Generator		

8	Chaff cutter		
9	Solar panel		
11	Milking churn		
12	Zero grazing unit		
13	Milking shed		
14	Milk transport container		
15	Cart		
16	Other specify.....		
17	Other specify.....		

6.0 Access to socioeconomic infrastructure.

6.1 please indicate the distance, type of road and mode of transportation to the nearest facilities.

Facility	Distance to the nearest facility in Kms	Type of road to the nearest facility.(1= Dry weather Murram 2= Tarmac)	Most frequent means of transportation(1= Walking 2= Bicycle 3= Motor bicycle 4= Matatu/ car)
Agricultural product market			
Milk collection or selling point			
Agricultural input market			
Public transport system			
Bank			

Thank you for your time.

Appendix 6: Trader Questionnaire

Market Survey 2012

Egerton University

Evaluation of milk marketing and its role on economic welfare on Sahiwal farmers of Kajiado and Narok Counties

I am a student from Egerton University studying milk marketing and its role on economic welfare of Sahiwal farmers in Kajiado and Narok Counties. The purpose of this study is to understand more about marketing of milk in pastoral areas. Your participation in this study will be highly appreciated. Your responses are completely confidential and will be used for research purposes to help improve milk marketing. Am also talking to farmers and other traders, your responses will be used with responses from other farmers.

1.0 BACKGROUND INFORMATION

Trader number _____ Survey Date _____

Type of the trader _____ (Farmer cooperative =1 Middlemen =2, Retailers =3, Processors =4)

Name of the trader _____ gender _____ (1= Male 2= Female)

Age of the trader _____

Education level of the trader (*Number of years in school*) _____

Name of Interviewer _____

Name of County _____

Name of division _____

Name of location _____

2.0 Business background

2.1 When you start operating in milk business in this area? _____ (Year)

2.2 What was the initial capital that you started with? _____

2.3 What is the current capital? _____

2.4 What is the minimum capital requirement to start a business like this? _____

2.5 How many milk traders like you are operating in this village? _____

2.6 What proportion of these traders are women? _____ (%)

3.0 Milk volume traded and prices

3.1 Type of milk products traded and volumes traded in the period of January 2012 to December 2012

Type	Number of Months of high supply	Volume (in litres) traded per month during high supply	Number of Months of low supply	Volume (in litres) traded per month during low supply
Fresh milk				
Mala milk				
Yoghurt milk				
Cheese				
Butter				
Other specify....				
Other specify....				

3.2 Price variation during the periods of high and low supply

Milk form	Buying price during months of high supply			Selling price during months of high supply			Buying price during months of low supply			Selling price during months of low supply		
	Min price per liter	Average price per liter	Highest price per liter	Min price per liter	Average price per liter	Highest price per liter	Min price per liter	Average price per liter	Highest price per liter	Min price per liter	Average price per liter	Highest price per liter
Fresh milk												

Mala milk												
Yoghurt milk												
Cheese												
Butter												
Other specify....												

4.0 Sources of milk for sale

4.1 What are the main sources where you get your milk for sale?

Milk form	Main source					Secondary source				
	Main source	% share in total milk traded	Distance (in Km) to point where collected	Type of road	Transportation and handling cost in KES	Secondary source	% share in total milk traded	Distance (in Km) to point where collected	Type of road	Transportation and handling cost in KES
Fresh milk										
Mala milk										
Yoghurt milk										
Cheese										

Butter										
Other specif y....										
Codes for sources (1= Farmers 2= Brokers/Hawkers 3=Cooperatives 4= Other specify)										

4.2 Are you able to obtain milk stock that you need at all times?.....(0=No 1= Yes)

4.2.1 If no what are the three main reasons

4.2.1 a.....

4.2.1 b.....

4.2.1 c.....

4.3 Are you able to buy all milk supplied from the main and secondary source at all times?.....(0=No 1= Yes)

4.3.1 If no what are the three main reasons

4.3.1a.....

4.3.1b.....

4.3.1c.....

5.0 information sources

5.1 Where do you get information that is of use in your business?

Type of information	Main Source	Validity in terms of trustworthiness
Milk prices		
Reputable suppliers		
Marketing and management strategies		
Reputable buyers		
Source codes 1= Other traders 2= Farmers 3= Traders associations 4= Other specify.		Validity codes: 1= Trustworthy 2= Neutral, 3= Untrustworthy

6.0 Milk Buyers

6.1 Who are the main buyers of your milk?

Milk form	Main buyer					Secondary buyer				
	Main buyer	% share in total milk traded	Distance(in Km) to point where sold	Type of road	Packaging and delivery cost in KES,	Secondary buyer	% share in total milk traded	Distance(in Km) to point where sold	Type of road	Packaging and delivery cost in KES, if any.
Fresh milk										
Mala milk										
Yoghurt milk										
Cheese										
Butter										
Other specify...										
Codes for sources (1= Farmers 2= middlemen 3=Cooperatives 4= Other specify)										

7.0 Credit access and associations

7.1 Could you obtain credit for the purpose of running your business?..... (0= No 1=Yes)

7.2 During the period of January 2012 to December 2012 6received any credit for the purpose of running your milk business?..... (0= No 1=Yes)

7.3 If yes, what were the sources and how much did you receive in total?

Source	Total amount in KES
Bank /Sacco/ cooperative society	

Friend/ relative	
Money lender	
Other specify.....	

7.4 are you a member of any marketing group or traders association?..... (0= No 1=Yes)

7.6 What services do you receive from your group(s)

Service	0= No 1=Yes
Credit service	
Training on marketing and management	
Market information	
Welfare support	

Thank you for your time.