FACTORS INFLUENCING PERFORMANCE OF THE DAIRY INDUSTRY IN MERU CENTRAL DISTRICT, KENYA: A CASE OF KATHERI DAIRY CO-OPERATIVE SOCIETY

BY

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DECLARATION

This research project report is my original work and has not been presented for a degree in any other university.

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DEDICATION

This is dedicated to my wife, Alice Murugi, for her prayers and moral support she gave me and my children, James Njenga, Lucy Wambui, Julius Chege and Mercy Wanjiku who I would like to inspire and encourage to study more to serve mankind because the future is theirs.

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ABBREVIATIONS AND ACRONYMS

ASAL	Arid and Semi-Arid Lands
CAIS	Central Artificial Insemination Station
COMESA	Common Market for Eastern and Southern Africa
DCRP	Dairy Cattle Research Project
DRSK	Dairy Recording Services of Kenya
ERS	Economic Recovery Strategy for Wealth and Employment Creation
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
KCC	Kenya Cooperative Creameries
KDB	Kenya Dairy Board
KNBS	Kenya National Bureau of Statistics
KSB	Kenya Stud Book
LRC	Livestock Recording Centre
MDGs	Millennium Development Goals
MoALD&M,	Ministry of Agriculture Livestock Development and Marketing
MoCD	Ministry of Cooperative Development
MoLD	Ministry of Livestock Development
NDDP	National Dairy Development Project
SACCOs	Saving and Credit Cooperative Societies
SDP	Smallholder Dairy Project
SRA	Strategy Revitalization of Agriculture
UNICEF	United Nations International Children Fund

ABSTRACT

The Kenya vision 2030 is the country's new development blueprint aiming at transforming the country into a newly industrializing, middle income country providing a high quality life to all its citizens by the year 2030. The vision is based on three pillars; the economic, the social and the political. The dairy industry contributes towards the economic pillar and in view of this the Ministry of Livestock Development (2010) developed the National Dairy Master Plan with a focus on realizing the vision 2030. The overriding development goal is to make Kenya a globally competitive prosperous nation with a high quality life by the year 2030 through strategies aimed at enhancing food security and sustainable economic development. To realize this vision, the revitalization of the agricultural sector remains a prerequisite condition for achieving food security, economic recovery, economic growth, employment and wealth creation. This is, therefore, crucial in achieving the twin Millennium Development Goals of reducing poverty and reducing hunger in Kenya by the year 2015. The study therefore, intended to investigate factors influencing performance of the dairy industry in Meru Central District, Kenya, through the following objectives; evaluating the quality of breeds, assessing the types of animal feeds, identifying how milk cold chains and how milk marketing influence performance of the dairy industry in Meru Central District in order to make a contribution to vision 2030 and the Millennium Development Goals. The study used a descriptive survey design. The use of questionnaires was used as the instrument for this study. Data collection was done though simple random sampling from the 3,400 registered dairy farmers in Katheri Dairy Cooperative Society where a sample population size of 204 respondents was targeted for the study. Pretesting of data collection instrument was done to prove validity of the instrument. The collected data was cleaned, coded and analyzed using Statistical Package of Social Sciences and results presented in tables and percentages. The study found out that Friesian was the highly reared cattle breed and that majority of the dairy farmers were milking only one cow. On type of feeds, the study found out that the farmers fed their animals using natural grass and dairy meal. It was also established that the dairy farmers sold the milk immediately to avoid spoilage and that those who were near a milk cooling facility enabled them sell milk from the evening milking. The study established that the farmers preferred using brokers/middlemen to market their milk and that dairy farming was profitable. The research findings are important to the dairy farmers, milk processors, milk market players, Ministry of Livestock Development, Ministry of Cooperatives Development and policy makers.

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The structure of dairy farming varies enormously from country to country. In many developing countries, the owner of the holding has just one cow, while in commercial dairying enterprises the worldwide average herd size is typically more than 100 animals. According to Food and Agriculture Organization (2009), in the United States, many of Californian herds have more than 1,000 animals. About 90% of California's milk is produced in herds of more than 500 animals. Within the European Union, there is a vast difference between the structure of dairying in a country such as the Netherlands and the dairy industries in Baltic countries, for example, in the former, the majority of herds consist of more than 100 animals and the average herd size is 60 animals per holding. In a country such as Lithuania, average size of a dairy holding is five cows, and only 28% of animals are in herds of more than 50 cows.

In 2007 there were some 670 million head of milking animals in the world. About one-third of these are cows which produced more than 80% of the world's milk output (Food and Agriculture Organization, 2009). Buffaloes account for about 8% of the world's milking animals and produced almost 13% of the world's milk output. There are also large numbers of milking sheep and goats, but each animal produces only a small volume of milk and overall these animals, along with camels, account for less than 5% of world milk production. The quantity of milk produced in a year by an animal varies enormously according to breed, feed and management practices. The world average of 2,300 kg per year per cow is somewhat meaningless because it is influenced heavily by the large numbers of poor-yielding animals in less developed countries across the globe (Food and Agriculture Organization, 2009). In many developed dairying countries, yields are typically 4,000–5,000 kg/head and exceptionally reach 6,000–8,000 kg/head in particular intensively managed enterprises. In such systems, cows will be selected on the basis of yield, the calving interval will be closely monitored (cows produce milk only when they have been put in calf), inseminations will be with bulls from high-yielding daughters, the animals will have their feeding rations controlled probably by computer, and they may be milked three times a day. The cows will produce significant volumes of milk, but will be kept for only a small number of lactations, maybe four or five. After this, the animals will be culled.

The total world production of all kinds of milk amounts to some 670 million tons/year. Relatively little is produced in Africa and Oceania, even though Australia and New Zealand are two of the most important countries for world dairy trade (Food and Agriculture Organization, 2009). North, South and Central America produce a quarter of the world's milk supply, with the region's largest producer, the United States, producing around half of this total (84 million tons in 2007). Europe produced some 210 million tons of milk, with the European Union producing 151 million tons and the Russian Federation a further 32 million tons (Food and Agriculture Organization, 2009). Asia accounts for one-third of world's milk production, with India the largest regional producer at 103 million tons. Of this quantity, more than half (57 million tons) is from buffaloes. India accounts for two-thirds of the world's entire production of buffalo milk. China is the other large producer in the region, with 37 million tons of milk.

As the dairy industry develops, an increasing proportion of milk is delivered to dairies. Farmers have moved away from feeding their milk to livestock and farm households, and have been encouraged to deliver their milk to processing establishments and buy back the products that they need for themselves and their livestock. Today, it is not so much the surplus milk that is sold by the farmer, but rather all the milk, which is the main source of income for the farmer. In many countries, for example, the United States and Australia, the concept of retaining milk on the farm has almost completely disappeared. In the European Union, more than 95% of all the milk produced is now delivered to dairies, and even in the ten new European Union Member States that joined in 2004, the proportion of milk delivered to dairies has increased from 70% in 2003 to 77% in 2007.

In India, the results of Operation Flood are well known for dairy development in the developing world. The principal features of this model are: a three-tier structure owned by the dairy farmers through their cooperatives, namely village societies which collect the milk and provide inputs and services, district cooperative unions (which collect milk from the village societies and process and market it) and state federations (which coordinate marketing and promote dairy development); a National Dairy Development Board, responsible for project planning and technical advice and the Indian Dairy Corporation, responsible for financing (Banerjee A., 2009). These organizations have high-level political support and control the import of dairy product donated milk powder and butter oil used to finance infrastructure for milk processing and marketing and not for on-farm investments and most dairy equipment produced in the country,

as a result of the existing level of industrial development and the boost given by Operation Flood. Various factors helped Operation Flood succeed; milk production was already high (roughly 20 times the average milk production density found in Africa) at the start of Operation Flood, which made it possible to establish a sustainable marketing structure without having to immediately increase production. In India, milk is mainly produced under zero-grazing conditions within the villages and milk collection points are close to the farmers' homesteads, making for easy access to milk collection, provision of concentrates and breeding and veterinary services. Operation Flood was specifically designed to link distant milk sheds with urban markets. Producers needed a guaranteed outlet for peak milk production and this could be provided by using the milk powder supplies as a buffer stock in the dry season. It should also be emphasized that Operation Flood has not been successful within a radius of about 100 km of big cities, where direct sales to consumers and high producer prices made cooperative marketing and processing unattractive. The basis for Operation Flood in the villages is the Village Milk Producers Cooperative, managed and owned by the farmers without any direct government control or supervision. Government control, through the Registrar of Cooperatives, is strong in countries under English law, but in India the cooperative movement was initially facilitated by high-level political support.

In Africa there are basically two systems of marketing milk and milk products, informal and formal. Under the informal system, which operates in both rural and urban areas, milk is sold fresh or processed direct to the consumer or to a trader who in turn delivers the milk or milk products to the consumer (Nell A. J., 1990). In the formal system, milk is delivered direct, or through a system of collecting and chilling centres, to a dairy plant where it is pasteurized and processed. The formal system caters primarily to high-income urban consumers. Past efforts to increase supplies and improve processing in Africa focused largely on the establishment of large-scale centralized plants to provide liquid milk for urban dwellers. The approach was initially influenced by the emphasis on the supply of pasteurized milk for children (for example by United Nations International Children Fund-UNICEF) and by the availability of cheap or free imports of skim-milk powder and butter oil. Because of low production levels, inadequate collection systems and unattractive prices for locally produced milk (relative to subsidized imports); these plants have relied heavily on imported materials.

Dairy farming in East and southern Africa, for example Kenya and Zimbabwe, started in the beginning of the century on medium to large scale farms using imported cattle (Nell A. J., 1990). Keeping dairy cattle on specialized farms requires knowledgeable and skilled management. Private commercial farmers in Africa (Kenya, Zambia and Zimbabwe) have proved that it is possible to achieve high milk production levels but this has not always been true of parastatals. In general, private large-scale dairy farming is limited to a few areas in sub-Saharan Africa and is not expanding. The common experience is one of lack of capital and recurrent funds, including foreign exchange, and insufficient freedom to set producer prices and to settle labour problems. The major problems of most collection systems in Africa include the small volumes supplied per producer, the pronounced seasonality of supplies, dispersed and relatively low-income retail markets, high ambient temperatures, poorly developed transportation systems and heavy seasonal rainfall. The main limiting factor for all systems is the time it takes for the milk to reach the consumer or the processing unit.

1.2 Statement of the problem

Kenya is a well-known example of successful smallholder dairy development. The establishment of large-scale dairy farms during the colonial period led to the creation of a structure of services, for example, Kenya Cooperative Creameries (KCC), research institutes, milk recording schemes, herd books, Kenya Farmers Association shops. Despite all those developments, it is estimated that 56% of Kenya's population live below poverty line (Republic of Kenya, 2004). Of these 70% are in the rural areas where the people engage in subsistence farming accounting for over 50% of those living below the poverty line. The incidence and prevalence of poverty and hunger is most severe in arid and semi-arid lands (ASALs), rural areas and urban slums and among women. To reduce hunger, government spends an estimated US$ 40 to 65 million annually on famine reliefs in the ASALs and the figure is much higher, as the US$45-65 million does not take into account famine relief support from Non Governmental Organizations (Food and Agriculture Organization, 2009). People vulnerable to poverty and hunger are those who are heavily dependent on rain-fed subsistence farming. It is estimated that 50.6% of the Kenyans have no access to adequate food and, even when they do, the little food accessed is often of poor, intermittent and of low nutritional value this despite the efforts put in place to improve the dairy industry over the years. The widespread adoption of dairy cattle in the country was stimulated by several interacting factors such as the conducive policy and institutional environments provided

by successive Governments. Through the Structural Adjustment Programmes the dairy industry was liberalized in 1992 and the services the Government was offering were privatized, for example, the breeding services, veterinary clinical services and milk marketing. Despite all the studies done none has been carried out in Meru Central District on the performance of the dairy industry. Therefore, this study intends to investigate factors influencing performance of the dairy industry in Meru Central District, Kenya.

1.3 Purpose of the study

The purpose of this study was to investigate factors influencing performance of the dairy industry in Meru Central District, Kenya: A case of Katheri Dairy Co-operative Society.

1.4 Objectives

The research study had the following objectives;

1. To evaluate how the quality of breeds influence performance of the dairy industry in Meru Central District.
2. To assess how types of animal feeds influence performance of the dairy industry in Meru Central District.
3. To identify how milk cold chain influence performance of the dairy industry in Meru Central District.
4. To establish how milk marketing influence performance of the dairy industry in Meru Central District.

1.5 Research questions

This research study sought to answer the following questions

1 How do qualities of breeds influence performance of the dairy industry in Meru Central District?

2 To what extent do types of animal feeds influence performance of the dairy industry in Meru Central District?

3 To what extent does milk cold chain influence performance of the dairy industry in Meru Central District?

4 How do milk marketing influence performance of the dairy industry in Meru Central District?

1.6 Significance of the study

The economic development and employment opportunities created by increased milk production, improved milk marketing efficiency and greater consumer demand for affordable dairy products

are enormous. Increasing effectiveness and developing an efficient dairy marketing and support system for farmers is therefore crucial in achieving the twin Millennium Development Goals of reducing poverty and ending hunger in Kenya through enhanced performance of the dairy industry**.** According to the Ministry of Livestock Development Dairy Master Plan (2010), the dairy subsector has potential to improve the livelihoods of the majority smallholder family farmers and pastoral communities and enhance transformation from subsistence farming to competitive, commercial and sustainable dairy industry for economic growth and wealth creation**.** Therefore this research study seeks to investigate factors influencing performance of the dairy industry in Meru Central District, Kenya: a case of Katheri Dairy Co-operative Society. This study will be useful to the dairy farmers, milk processors, milk market players, Ministry of Livestock Development, Ministry of Cooperatives Development and the policy makers in the formulation of policies and decision making with an aim of spurring increased milk production and enhance performance of the dairy industry in Kenya.

1.7 Limitations of the study

The number of dairy farmers is quite big in Meru Central District as majority of homesteads keep dairy cow(s). Due to the resources and time that was available, not as a large sample was involved in the study as would be desired. This study was carried out for Katheri Dairy Co-Operative Society in Meru Central District.

1.8 Delimitation of the study

This study was carried out on dairy farmers registered with Katheri Dairy Cooperative Society in Meru Central District. The study focused on active and non-active members of the Katheri Dairy Cooperative Society on factors influencing performance of the dairy industry in Meru Central District,

1.9 Assumptions of the study

The assumption of the study was that the respondents would answer all the enquiries honestly and objectively according to their knowledge and that the information so collected was correct and truthful. Also the assumption of the study was that the sample selected would be representative of the larger population and that the study would not raise false expectations from the dairy farmers and other dairy industry stakeholders.

1.10 Definitions of significant terms

Animal feed — Any agricultural foodstuff used specifically to feed domesticated livestock, such as cattle, goats, sheep, horses, chickens and pigs. Most animal feed is from plants, but some is of animal origin. It includes hay, straw, silage, compressed and pelleted feeds, oils and mixed rations, and sprouted grains and legumes.

Cattle breed — A race or variety related by descent and similarity in certain distinguishable characteristics. In Africa there are two main races of cattle: indigenous and the exotic or imported breeds

Dairy Co-operative society — An association of individual businesses, farmers, ranchers, or manufacturers with milk interests intending to cooperate in marketing, shipping and related activities often using a single brand name to sell their products efficiently, and then share the profits based on the production, capital or effort of each.

Income — Is monetary gain proceeds from labour, business, property, capital of any kind, produce of a farm, rent of houses, the proceeds of professional business, the profits of commerce or of occupation, or the interest of money or stock in funds.

Milk cold chain — Is a temperature-controlled supply chain. An unbroken cold chain is an uninterrupted series of storage and distribution activities which maintain a given temperature range. It is used to help extend and ensure the shelf life of products such as fresh agricultural produce, milk and frozen food.

Milk marketing	Is the performance of milk business activities involved in the flow of goods and services from the producer to the consumer
Performance of dairy industry	Is the economic value of the dairy subsector that can be tapped to drive development goals through transformation into a globally competitive dairy value chain that will provide high quality life and wealth creation.
Raw milk	Is the unprocessed lacteal secretion, practically free from colostrum, by the complete milking of one or more healthy cows.

1.11 Organization of the Study

This research project study is organized into five Chapters. Chapter One covers background of the study, statement of the problem, purpose of the study, objectives, research questions, significance of the study, limitations of the study , delimitation of the study and assumptions of the study. Chapter Two covers and gives overview of the dairy industry, the world dairy industry perspective, the dairy industry in tropical countries, the dairy industry in India, the dairy industry in Kenya, quality of cattle breeds, types of animal feeds, milk cold chain, milk marketing, the theoretical framework, the conceptual framework and the knowledge gap. Chapter Three covers research design, target population, sampling technique and sample size, methods of data collection, validity instruments, reliability instruments, data analysis, ethical consideration, operationalization of variables. Chapter Four covers data analysis, presentation and interpretation of the data collected from the respondents, which include introduction, demographic information, quality of breeds, types of feeds, milk cold chain, milk marketing and correlation analysis. Chapter Five covers the discussion of key data findings, conclusions drawn from the findings highlighted and recommendations made there-to.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The literature review covers the following topics: overview of the dairy industry, the world dairy industry perspective, the dairy industry in tropical countries, the dairy industry in India, the dairy industry in Kenya, quality of cattle breeds, types of animal feeds, milk cold chain, milk marketing, the theoretical framework, the conceptual framework and the knowledge gap

2.2 Overview of the dairy industry

Processing and marketing of milk are important levels of dairy development and growth of the industry. Kenya has one of the largest dairy industries in sub-Saharan Africa with a milk market share of 24 percent in the region (Karanja, 2003). Smallholder farmers are the major suppliers of raw milk to the dairy cooperative societies in the country and especially in the high potential areas (Karanja, 2003). According to Falvey et. al. (1999), the future for smallholder dairy development will rely on continued research and education of smallholders themselves. Research needs to challenge existing assumptions and acknowledge integrated systems and the central role of smallholders while focusing on technical parameters of breeding systems, herd recording, feeding systems, production of breeds, management of reproduction and health, multiple uses of animals and milk harvesting systems. The strong social research requirement of smallholder dairying in the tropics contrasts with that of dairy research in more developed countries while the technical elements share common scientific bases. The future for individual countries in smallholder dairy production is likely to vary according to the stage of development of a country, the relative levels of market protection, and an understanding of smallholder dairying by international development agencies.

There is a great deal of variation in the pattern of dairy production worldwide. Many countries which are large milk producers consume most of this internally, while others for example, New Zealand, export a large percentage of their milk. Internal consumption is often in the form of liquid milk while the bulk of international trade is in processed dairy products such as powder. Most milk-consuming countries have a local dairy farming industry and most producing countries maintain significant tariffs to protect domestic producers from foreign competition. According to Food and Agriculture Organization (2009), the largest worldwide milk producer is

the European Union. By country comparison, the largest milk producer is India while the largest exporter is New Zealand, and the largest importer is China.

2.3 The World Dairy Industry Perspective

The dairy has been part of agricultural practice for thousands of years. Dairy farming has been transformed into an industrialized system, creating optimal integration between the production unit (the cow), technologies and equipment (engineering). Producing more milk with less dairy cows improves the economic performance of the farm unit and also drastically reduces the ecological imbalance. In 2007 there were some 670 million head of milking animals in the world. About one-third of these are cows, which produced more than 80% of the world's milk output (Food and Agriculture Organization, 2009). Buffaloes account for about 8% of the world's milking animals, and produce almost 13% of the world's milk output. There are also large numbers of milking sheep and goats, but each animal produces only a small volume of milk, and overall these animals (along with camels) account for less than 5% of world milk production.

The quantity of milk (yield) produced in a year by an animal varies enormously according to breed, feed and management practices. The world average of 2,300 kg/year per cow is somewhat meaningless because it is influenced heavily by the large numbers of poor-yielding animals in less developed countries across the globe. In many developed dairying countries, yields are typically 4,000–5,000 kg/head and exceptionally reach 6,000–8,000 kg/head in particular intensively managed enterprises. In such systems, cows will be selected on the basis of yield and the calving interval. The world milk production after stagnating in 2009 rebounded in 2010 and is expected to grow initially in excess of 2% annually for the next three years, causing prices to decline. As prices adjust downward, the growth in milk production after 2013 is expected to be less vigorous (Food and Agriculture Organization, 2010). The average dairy industry annual growth for the next ten years is projected at 1.9%, compared with the 2.1% average annual growth experienced in the past decade. Between 2010 and 2020, world milk production is projected to increase by 153 metric tonnes. The majority, 73%, of the additional milk production is anticipated to come from developing countries. India and China alone account for 38% of global gains. The global milk production share of developed countries is expected to fall below 50% while the milking animals share drops below 10% by 2020. In contrast, the share of Least Developed Countries (LDCs) in global milk production will remain at only 4% while their share

in global animal inventories is nearly 30%. The large disparity between the share of milk production and inventories between developing and developed countries is, to a large extent, a consequence of an enormous gap in milk yields, but also the reliance on sheep, goats and camels as milk animals, which have inherently lower yields than milk cows.

New Zealand and Australia (Oceania) presence on the international dairy markets has increased considerably after the elimination of domestic support and deregulation, but also after reduced market participation of some traditional exporters (notably from the European Union). The global export market share of Oceania has risen from 20% in the 1980s to more than 40% today. The region has become an important driver of global dairy markets with milk production predominantly based on lower cost pasture systems that are less influenced by movements in feedstock prices but more dependent on weather conditions.

According to Food and Agriculture Organization (2009), New Zealand accounts for only two per cent of world milk output but is the second largest seller of manufactured milk products on the world market, exporting 80 per cent of its production and accounting for around one quarter of export sales on a milk equivalent basis. Australia produces less than two per cent of world milk, exports 45 per cent of total production and accounts for around ten per cent of export sales. The major exporter is the European Union which provides 47 per cent of all export sales. During the 1990s the United States increased exports following the 1990 Farm Bill's export enhancement provisions and supplies eight per cent of world exports. The European Union, New Zealand, Australia and the United States account for 90 per cent of total world exports with the remaining 10 per cent of exports coming from other exporters such as Canada, non European Union countries of Western and Eastern Europe, Argentina and Uruguay. In recent times, Poland and the Czech Republic are increasing exports of milk powders, and the Baltic States are also playing an increasingly active role in world trade. Dairy products from these newer exporters go mainly to the Middle East, Central and South America, North Africa and South East Asia.

2.4 The Dairy Industry in Tropical Countries

Tropical regions in parts of Asia, the Middle East, South and Central America and Africa produce one third of the measured cows' milk produced annually throughout the world. Small numbers of specialized dairy farms operate in all tropical countries. Commercial dairy production is found in tropical regions between 300 meters and 1500 meters altitude. While significant tropical dairy industries can be found in Kenya, Zimbabwe, India and the Caribbean,

for many sound reasons, dairy farming has been slow to establish in the tropics. Milk production in the tropics has been limited by the extreme climates, by low quality tropical feeds that are generally high in fibre and low in digestibility and have a short season of growth. Also limiting milk production are the diseases and parasites associated with hot and wet conditions. Milk yields per cow have been low and seasonal. As well, land tenure, economic incentives and marketing systems, transport and distribution systems, and support services such as credit, veterinary services, equipment and technical advice have often been inadequate for highly productive, profitable dairy production of the type common in more developed countries (Food and Agriculture Organization, 2010). Therefore, most of the milk produced in tropical areas has come from the farming operations of millions of smallholders and semi-nomadic owners of cows, buffalo, sheep, goats and camels, and generally has been a sideline to other more profitable cropping or pastoral activities. Cows produce two-thirds of all milk produced in tropical countries.

Dairy production in most tropical countries has had a large subsistence family component, with smallholders mostly producing milk for family food, and selling any seasonal surpluses, and importantly, with each cow rearing a calf. The typical subsistence operations would have two to four milking cows, or buffalo that are kept for cropping activities. Once the cows are milked, tropical environmental conditions make it difficult to keep milk without refrigeration, so milk is usually delivered soon after milking. It is then boiled before use or converted to other products such as ghee, cheese, fermented and concentrated products. Where conditions are more conducive to temperate animals in the medium altitudes and humid coastal regions, pure-bred cows (particularly Friesians) are preferred. Large commercial dairy farms are found in tropical Australia and in Central and South America, in the Pacific and Caribbean islands and the high land areas of East Africa and in Israel, and West Asian countries

2.4.1 The Dairy Industry in India

Milk production in India is dominated by small and marginal landholding farmers and by landless labourers who, in aggregate, own about 70 percent of the national milch animal herd (Gupta, 1983). As crop production on 78 percent of the agricultural land still depends on rain, it is prone to both drought and floods, rendering agricultural income uncertain for most farmers. The milk produced in India is distinctly seasonal. It comes from cows and buffalos in equal proportion, with a small contribution from goats. Cows produce, on average, 446 litres of milk

annually and buffalo produce 861 litres of milk annually. Eighty per cent of all local milk is consumed in liquid form. The growth in milk production reflects India's unique history, industry and policy structure set up under Operation Flood which the Indian Government, the World Bank and the European Community Food Aid funded. It was designed to achieve milk self-sufficiency. India is the fourth largest milk-producing region in the world, after the European Community, United States and the states of the Commonwealth of Independent States (an association of former Soviet republics that was established in December 1991 by Russia, Ukraine, and Belarus to help ease the dissolution of the Soviet Union and coordinate inter-republican affairs)

Operation Flood is a system of rural milk producer co-operatives that purchase, process and market milk, provide technical services and infrastructure (Banerjee A., 2009). The early funding of Operation Flood One was done through commercial resale of dairy product received as aid under the World Food Program. The product came from the European Community and the revenue from sales of aid product was used to develop infrastructure for local co-operatives. Operation Flood Two set up the institutional framework comprising a three tiered co-operative structure of societies, unions and federations. Operation Flood in its third stage involved eight million dairy farming families. There are 200 milk processing plants in the co-operative, government and private sectors. Operation Flood dairies market three-quarters of the milk produced. Under the Operation Flood scheme, daily supplies of milk are collected from over 60,000 village milk procurement centres to meet consumer demand for drinking milk. This accounts for 5.5 million tons or ten per cent of total milk produced. The remaining 90 per cent of milk is utilized on-farm, sold to small operators in nearby towns, or used to produce ghee or other products. The demands of consumers in the four major cities of India: Bombay, New Delhi, Calcutta and Madras, and the regional variations in milk supply, led to the establishment of a National Milk Supply Grid system via train and road tankers. Rural producers are linked with urban consumers through the National Milk Supply Grid by moving milk from surplus to deficit regions. Barriers to trade are substantial and there is a domestic dairy policy of increased self-sufficiency. India's imports have been declining as a proportion of total production. Imports are subject to 60 per cent tariffs, plus state sales taxes and general excise duties **(**Food and Agriculture Organization, 1993).

As a result of various actions under the three phases of the program, the country witnessed a phenomenal increase in milk production. Milk production which was almost stagnant around 23 million Metric tonnes per annum during the 1970s rose to a level of around 69 million Metric tonnes per annum (1996-97) with India emerging as the second largest milk producer in the world. Despite the growing population the per capita availability of milk which was declining, has significantly increased, reaching a level of more than 200 g per person per day. In most of the States, the unions have State Dairy Federations. Around 10 million farmers have become members of the village dairy co-operatives. In the year1997-98 these co-operatives collected on an average 12.26 million litres of milk every day. The program has been an outstanding success encouraging farmers to take up dairying as the most important subsidiary occupation. It has offered a regular and reliable source of income for farmers with more than 62 per cent of milk procurement in the Operation Flood areas coming from the marginal farmers and landless households.

2.5 The Dairy Industry in Kenya

Dairy farming in Kenya dates back to the colonial period. Many settlers ventured into large dairy farming with the support of the colonial administration. The first high yielding cattle breeds were introduced into the country during the colonial period. The period also led to the emergence of formalized institutional and organizational framework for milk marketing as well as delivery of livestock breeding and health services (Ngigi, 2005). Kenya is one of the largest producers of dairy products and with the highest per capita consumption of milk in Africa, estimated as being four times the Sub Saharan African average of 25 kg (Republic of Kenya, 2005). The dairy industry accounts for 14% of the agricultural Gross Domestic Product (GDP) and 3.5% of the total GDP. It is based predominantly on smallholder production, which accounts for about 70% of the total annual milk production in the country (Kenya Dairy Board, 2007). Estimates of the number of smallholder households depending on dairy for part of their livelihoods vary between 625,000 to 800,000 (Leksmono et. al, 2006, Kenya Dairy Board, 2007). Dairy farming contributes to poverty reduction and equity in gender distribution of incomes since it is easily undertaken in small scale by women. Based on dairy farming experience accumulated over 90 years, Kenya has a relatively large herd of improved dairy cattle compared to other countries in the region (Ngigi, 2005). The traditional milk drinking culture and keeping of traditional cows have also helped in the development of the sector. Dairy production in Kenya is largely for the

domestic market. Occasional surpluses may be exported to regional markets and shortfalls may be met through imports of milk powder, especially during drought period.

The Dairy Industries Act was enacted in 1958 to preserve the dominance of Kenya Cooperative Creameries (KCC) in the market. The KCC became the sole agent in the marketing of dairy products in the main urban centres, which became known as "scheduled areas". The Kenya Dairy Board (KDB) was also instituted under the act as the state agent to regulate the industry. KCC was appointed the sole agent for the processing, packaging and sale of milk in the scheduled urban areas by the KDB. The act also established regulations that were interpreted as keeping raw milk out of the scheduled urban areas, where consumers were to be served pasteurized milk through the formal market. At independence, the government sought to increase the involvement of smallholder farmers in dairy production. One of the country's broad development objectives was improving the welfare and the distribution of resources as reflected in the Sessional Paper Number 10 of 1965 on African Socialism and its application to Kenya, which set out among the development objectives, the need to achieve high and growing per capita incomes equitably distributed among the citizens (Muriuki et. al, 2003, Republic of Kenya 1965). Improved welfare and equitable distribution of the country's resources were at the centre of the development policy. The government regarded the state control of the dairy subsector as central to its development, as was the case with other economic activities. Control of economic activities was considered central for the country's social and economic development.

The government appointed a commission of inquiry in 1964 primarily to address the issue of the dismal market participation by smallholders. The 1964 Kibaki Commission on Dairy Development recommended increased access to the Kenya Cooperative Creameries (KCC) by all farmers as long as they met the acceptable quality, through the abolition of contracted milk quotas. This made KCC a guaranteed market for all raw milk as well as a buyer of last resort. It also became an agent for the implementation of statutory controls in milk prices. Private dairies dealing with raw milk were shut down, giving KCC all monopoly rights and mandate to accept all milk delivered. KCC embarked on a rapid expansion programme, with guaranteed loans from the government, and official monopoly access to protected urban market This expansion in capacity was necessary to achieve a national network of chilling stations and processing plants and packaging commensurate with its new role. This enabled it be a reliable outlet for all dairy farmers and since it cushioned the smallholder farmers from price fluctuations it offered a stable

marketing system (Ngigi, 2005). This contributed greatly to the confidence that farmers came to cultivate in KCC over the years. Government investment in the dairy industry during this period took the form of highly subsidized inputs for breeding, animal health services and production, in addition to intensified training for local staff.

The government supported widespread introduction of highly productive breeds of dairy cows. There was also a major land transformation during this period involving the subdivision and redistribution of former large farms owned by white farmers. The land transfer programme contributed significantly to the increase in smallholder dairy production. By mid 1970s, smallholder dairy farmers had overtaken the large-scale farmers as the major producers of milk in Kenya (Leksmono et. al., 2006; Ngigi, 2005). During this period, the dairy sector enjoyed various forms of donor support. The development of cooperatives in the country also greatly benefitted from donor support. The sector experienced rapid production growth between 1981and 1991 with an average annual growth rate of 10% (Ngigi, 2005). Producers continued to benefit from subsidized support services until the mid-1980s when subsidies were gradually removed in the latter part of the decade.

In the high potential areas, the economic importance of the cow has increasingly shifted to commercial milk production while at the same time retaining the complementary role of sustaining soil fertility for sustainable agricultural production. In such areas, increasing population pressure interacting with the need to sustain soil fertility has driven the change in production structure with dairying becoming an important component of agricultural production.

With respect to the region's agricultural development, the colonial era is accredited with the introduction of a number of economically important crop and animal species as well as a variety of improved farming methods and marketing institutions, which not only revolutionized the region's agriculture, but also shaped the course of subsequent agricultural development. Among the most notable agricultural changes was the introduction in Kenya of the artificial insemination (A.I.) in 1935, reproductive technology, which made possible the improvement of milk yields by crossing low-yielding but essentially more disease resistant local breeds with exotic breeds . This was accompanied with the introduction of attendant dairy production management practices including the use of acaricides in dips to control tick-borne diseases.

The colonial era also saw the institution of a dairy marketing policy upon which the country's post independent dairy policy has been fashioned. Although these developmental efforts were

introduced for the benefits of the imperial country rather than the indigenous people, they nonetheless formed the basis upon which the dairy industry now observed in the country was built. The period of colonization had the following significance for the country's dairy industry; introduction of high-yielding breeds of cattle effectively laying the foundation for an agricultural activity that has grown to be a major source of livelihood to the majority of smallholder farmers in the country and emergence of formalized institutional and organizational frameworks for milk marketing, production and delivery of curative and preventive services, artificial insemination and tick-control services.

In Africa, Kenya is the only country, after South Africa that produces enough milk for both domestic consumption and export. Sudan on the other hand is the largest producer of milk in the Common Market for Eastern and Southern Africa (COMESA), but it does not produce enough to satisfy both domestic and export markets. The dairy industry is the single largest agricultural sub-sector in Kenya, larger even than tea (Muriuki, 2004). Large scale dairy farming accounts for 20 per cent of national milk production and small scale farming 80 per cent.

Although Kenya's dairy sector has a significant contribution to the national economy, household incomes and food security, the industry faces a number of technical, economic and institutional problems in milk production, processing and marketing (Karanja, 2003). These constraints affect the ability of the sector to participate and compete in the domestic and regional markets. Some of the main constraints to increased milk production in Kenya have been identified as seasonality in production, inadequate quantity and quality of feed, including limited use of manufactured cattle feeds, and lack of good quality animal husbandry and farming practices. Poor access to breeding, animal health and credit services and high cost of artificial insemination (AI) service are other constraining factors. In some areas, dairy producers are faced with the problem of poor infrastructure (roads, electricity), inadequate milk collection and marketing system, poor interaction and priority setting between research, extension and training, and limited farmers' involvement in the output market, hence reducing the incentives to increase milk production (Smallholder Dairy Project, 2005).

2.6 Quality of Cattle Breeds

In Africa there are two main races of cattle, *Bos indicus*, cattle with humps which include the Boran and Zebu cows (indigenous) and the *Bos taurus*, exotic or imported breeds. The two races

can cross breed, and the crosses can be very productive both in terms of growth rates for beef, improved milk production as well as disease resistance (Biovision, 2013). Kenya is a home to a wide range of cattle genotypes. Within the East and Central Africa region, Kenya has the highest number of exotic dairy cattle. As for indigenous breeds, Kenya also ranks high with Ethiopia and Sudan topping the list of African countries with the highest population of indigenous cattle breeds.

The main purpose of dairy breed of cattle is to produce milk, reproduce to provide replacement cows for the future and most of all to provide a means of living for farmers in the dairy business by providing the most milk at the least possible cost. All cows can produce milk but the most suitable for commercial milk production are few. The most important dairy breeds of cattle in Kenya are Friesian, Aryshire, Guernsey and Jersey breeds. The rest are either good for beef or as dual purpose animals (Xtalia Farm, 2011). Among the exotic high milk producing breeds introduced in the country during the colonial era were Friesians, Ayrshire, Guernsey and Jersey in the order of high milk volume production. Some agro-ecological zones are not suitable for pure breed high yielding milk cows, but can benefit from crossbreeding the local breeds of cattle with exotic breeds. However, for pure breeds and the crossbred cattle this will only be useful if management practices such as improved feeding, plenty of fresh water and a reliable source of veterinary services are available which without these conditions the survival rate of pure and cross breeds is likely to be low. The introduction in Kenya of the Artificial Insemination (A.I.) in 1935 made possible the improvement of milk yields by crossing low-yielding but essentially more disease resistant local breeds (*Bos indicus)* with exotic breeds (*Bos taurus)*. The current milk production level of 4–5 litres/cow per day can be improved through improved breeding programmes by use of high milk producing genetics. This will, however, only occur if there is investment in market infrastructure and general improvement in the economy (Ngigi 2005). Dairy is an important factor in the effort to reduce poverty in the rural areas of Kenya. Most smallholders start very poor and struggle to acquire their first cow as a means to get out of poverty and to sustain their household.

Therefore, owning a cow is a means of survival. Provision of efficient and affordable reproductive services has been a major dairy policy strategy in the country. The strategy has particularly been identified as being central to the development of the smallholder herd and, over the years, has taken the form of heavy public investment in artificial insemination services. The

Central Artificial Insemination Station (CAIS), a government parastatal, was already in place at the time of independence. However, it mainly operated as a bull-semen producing agent for Cattle Breeders' Associations, which were mainly patronized by large-scale dairy farmers by then. The need to broaden CAIS clientele to cover smallholder dairy farmers was only addressed after independence.

To address the need, the Kenya Government, with assistance from the Swedish International Development Agency established the Kenya National Artificial Insemination Station in 1966 to be the government organization designated to perform and coordinate actual field inseminations (Food and Agriculture Organization, 1991, MoALDM, 1997). The CAIS is still entrusted with the responsibilities of recruiting Kenya-bred pedigree bulls, collection, preservation, and distribution of the semen. The recruitment relies on supportive services of a number of organizations including the Kenya Stud Book (KSB), the Dairy recording Services of Kenya (DRSK), and the Livestock Recording Centre (LRC). Up to 1987, the provision of AI services was heavily subsidized with farmers meeting less than 20 % of the cost of A.I. services. The aim was to encourage widespread upgrading of the country's dairy herds. The system placed heavy demands on government expenditure and as a consequence, provision of the services was heavily reliant on donor projects. In 1992 The Artificial Insemination services were privatized and since then the farmers had to meet the full cost of the service. This caught many small-scale dairy farmers unprepared and the number of inseminations drastically went down.

The 2009 Kenya population was 38.6 million people (Ministry of Planning, 2010) and is estimated to hit 58 million in the next 20 years. The current per capita milk consumption is estimated at 110 litres, which is projected to increase to 220 litres by the year 2030 due to envisaged better incomes and better marketing. This will translate into an increase from the current annual production of 4.5 billion litres to 12.76 billion litres of milk. This amount of milk representing the demand by 2030 cannot be achieved at the current national average productivity levels of 5 litres of milk per cow per day as the number of animals required would be too many. The path to meeting this increased demand in milk consumption is greater increase in animal productivity levels accompanied with little increases in the population of dairy cattle, dairy goats and camels.

2.7 Types of Animal Feeds

Dairying is a biologically efficient system which converts large quantities of inedible roughage to milk. It is to a certain extent a more efficient and intensive system, in terms of nutrients and protein production for human consumption from a given area or quantity of feed, than beef or sheep farming (Nell A. J., 1990). Milk production is more efficient than beef production when the nutritional potential of the feed resource base is high and therefore capable of supporting high levels of production. It is a continuous production process and requires a continuous supply of feed of consistently good quality. Interruption of feed supply even for a short period causes a marked decrease in milk yield during the remaining part of the lactation. Beef production, on the other hand, is a non-continuous process and is often better adapted to the seasonal fluctuations that are so common in sub-Saharan Africa.

Improved feed availability and quality will be a key strategy to realize the largest proportion of the needed animal productivity levels and supporting animal population increases. Feeding is the major constraint to achieving the targeted milk production because of heavy dependency on rain-fed forage and pasture production while there is poor adoption of conservation of animal feeds to smoothen seasonal fluctuations in milk production. Efficient utilization of dairy concentrates is needed to match the high cost of quality concentrates. According to the Ministry of Livestock Dairy Master plan (2010), the actions that can enhance better feeding for increased animal productivity include the following: increase acreage under pasture and fodder, increase availability of seeds of improved forage varieties, promote adoption of feed conservation technologies, enforce standards of both raw materials and finished concentrates and train more farmers to make home ration formulation and on mixing of feeds. These feeding strategies when adopted will enhance reproductive performance in the national herd.

Feeding of a dairy cow is very important as a high and economic milk production can only be achieved with well fed cow. The cost of feeding contributes highest to total cost of milk production. If a cow is kept under zero grazing, feeding needs even more attention as she will entirely depend on how the farmer feeds her. A dairy cow requires feed for the following purposes: milk production, body maintenance, her own growth and the growth of the calf (if pregnant). This implies that the cow should receive a ration balanced in energy, protein and minerals. Unbalanced ration leads to decreased milk production, poor body condition of the cow and fertility problems. Good feeding leads to higher milk production, good health, and more

calves. However good quality feeds are expensive. Feeding is the major constraint to achieving the targeted milk production because of heavy dependency on rain-fed forage and pasture production while there is poor adoption of conservation of animal feeds.

Feeds can be divided into two groups, roughages and concentrates. Roughages are bulky feeds like napier grass, maize stover, Lucaena, banana stem, sweet potato vines, hay and silage. These feeds are usually grown on the farm and are the cheapest to feed to the cow. Good quality roughage is the basis of a high milk production. Roughages like maize stovers, banana stems, yellowish napier grass and silage of napier grass are low in protein. In order to compensate for this shortage, roughages rich in protein like Leucaena, desmodium, sweet potato vines, leaves of fodder trees for example Leucaena, calliandra, should be added to balance the ration (Ministry of Livestock Development, 2010). These legumes should not be fed in large quantities because of poisoning and or bloat. Efficient utilisation of dairy concentrates is needed to match the high cost of quality concentrates The quality of commercial concentrates may be doubtful due to weak enforcement of standards that has failed to discourage infiltration of substandard commercial feeds into the market. Minerals (for example calcium, phosphorus, magnesium, copper, salt,) supplements are very important for a dairy cow. Lack of certain minerals can result in: poor fertility, low milk production, deformed skeleton in young animals and metabolic diseases,, a good example of this is the milk fever or hypocalcaemia.

2.7.1 Extension Service

Improvement in cattle genetic has been coupled with efforts of enhancing the smallholder's capacity to realize the potential of high-yielding breeds of dairy cattle. The Government, through the national extension program, has put much effort to extending better dairy husbandry. Efforts have also been through training at university level, diploma, and certificate colleges. Donor agencies have also contributed greatly in enhancing the efficiency of extension service. Notable among these is the contribution made by the Dutch government. In 1980, the National Dairy Development Project (NDDP), a bilateral Kenya-Dutch collaborative effort, was launched. The project was mainly aimed at extending to farmers research findings of the Dairy Cattle Research Project (DCRP) conducted at the Naivasha Animal Husbandry Research Station since the late 1960s as part of Dutch assistance to Kenya's livestock sector (MoALD&M, 1997). The project's major activity was the promotion of intensive smallholder dairying in high potential area by promoting, for farmer's adoption, a zero grazing package comprising better napier grass

management coupled with better cattle feeding practices. Latter the project incorporated an activity to introduce and promote the production of leguminous fodder trees by the farmers for use as animal feed supplement (Kaitho et. *al*, 1993; Murethi et. *al*, 1995). The overall goal of the project was to increase national milk production through enhancement of smallholder farm's dairy cattle carrying capacity and smallholder's capacity to realize dairy cattle production potential by use of high-yielding fodder. In addition, the project aimed at intensifying the internal dependence between dairy and crop production through use of better utilization of urine and manure.

2.8 Milk Cold Chain

Milk being a highly perishable commodity that deteriorates quickly under ambient temperature, cold storage is the best method for its preservation (Grimaud et.al. 2007). Milk quality across the value chain could be improved through changing milking practices to ensure better hygienic conditions and improvement of milk handling and storage conditions maintaining the cold chain. Once the cows are milked, tropical environmental conditions make it difficult to keep milk without refrigeration, so milk is usually delivered soon after milking because it has a short self life if left to stay in the natural environment. It is then boiled before use or converted to other products such as ghee, cheese, fermented, and concentrated products.

An unbroken cold chain is an uninterrupted series of storage and distribution activities which maintain a given temperature range. It is used to help extend and ensure the shelf-life of products such as fresh agricultural produce, seafood, frozen food, photographic film, chemicals and pharmaceutical drugs. According to Cameron L.(2008) raw milk is approximately 99-102 degrees Fahrenheit (37.2-38.9 Degree Celsius) as it comes from the cow, and needs to be chilled to 40°F (4.4 Degree Celsius) as fast as possible, preferably within an hour of milking since bacteria count doubles every 20 minutes at body temperature. Chilling the milk fast ensures a longer shelf life and it just tastes better. Milk will have less off flavors if it is chilled quickly and stays cool. If milk does not stay cool, it will sour and separate. Rapid cooling inhibits the lactic-acid bacteria which causes milk to sour and will also inhibit the growth of bacteria. The bulk tank at the farm is the beginning of the "cold chain". For optimal preservation of the milk quality, the milk should be cooled as quickly as possible and kept cool during transportation, storage and us

According to the Singapore Standard (2002, the establishment and sustaining of the Cold Chain are essential ingredients for upholding the safety of consumers and the protection of public health while preserving the nutritional and sensory qualities of perishable food products such as milk and dairy products. Furthermore, the Cold Chain adds on an additional dimension in extending the much desired shelf-life of food products without increasing health risks, by holding back microbial spoilage while maintaining the original intrinsic characteristics and qualities of the product.

According to Kisaalita W. S. (2010), the dairy market in sub-Saharan African countries is separated into two main channels namely an informal channel and a formal channel. The formal channel includes milk collected from the farmers, cooled at a collection center and then transported to central processing facilities which may be private or public, where it is processed, packaged and marketed locally or exported to neighboring countries. The informal channel includes milk that is marketed directly from the farms, usually without any processing. In the informal channel, most of the morning milk collected on the farm is either sold to local or peri-urban markets or private collection centers that in turn sell directly to the urban public. Transportation to collection centers or urban markets is often done on foot, on the back of a bicycle and by public means. Once the milk reaches the market, it is sold as is to the consumer. The morning milk can be taken to markets because it is daytime and people can safely travel on roads. Since traveling at night might be unsafe and milk is highly perishable and cannot be kept till the next day without preservation, the evening milk is used for the farmers' families and the surplus is either sold where a local market exists, processed into low value products like ghee, or wasted. The refrigeration option is not available to most smallholders, as they do not have access to grid electricity and kerosene refrigerators are not economical and difficult to maintain. The high postharvest losses, especially during the rainy season present an opportunity.
The advent of sophisticated modern technologies which are employed in food processing, manufacturing and packaging have revolutionized the whole concept of food preparation and delivery. These have a significant impact on the perception and expectations of consumers towards food safety and quality. Twining of sophisticated food production techniques with attendant proper management of the Cold Chain for perishable food products is an inseparable and natural outgrowth of recent advances in sciences and technologies. Proper management of every link of the Cold Chain constitutes an integral part in the production and delivery of

wholesome milk and dairy products to the consumers. Complementing this is the careful management of the temperature profile of the supply chain, starting from the dairy farm and dairy plant, to the warehouse and points of sale at stores and supermarkets, and ending in consumers' homes.

2.9 Milk Marketing

According to Fafchamps (2004) and Poulton (1998), a well-integrated market system is necessary for an efficient allocation of productive resources, which contributes to regional food security and a reduction of price risks by preventing unnecessary price volatility. It has been widely believed that markets do not function effectively in Sub-Saharan Africa due to high transportation costs, high transaction costs, and imperfect contract enforcements which provided rationale for governments to intervene in markets actively since the independence. The dairy industry globalization, together with domestic and trade policy reforms, have shifted international dairy markets from a supply driven paradigm, characterized by excess production and depressed world prices, to a more demand driven paradigm, responsive to market signals and changing consumer preferences. The sector is increasingly shaped by the prospects of sustained high prices for dairy products. Higher international prices are creating incentives for investment, expansion and restructuring in local dairy industries. Higher prices and a correspondingly higher value of milk production have also set the dairy sector among the highest gross value sectors in agriculture. However, high prices can also have negative consequences for the dairy industry. Under very high prices, demand may retreat and dairy ingredients can be replaced by cheaper substitutes in food manufacturing (Food and Agriculture Organization, 2010). Changing production formulas and recipes can have along lasting impact as there would be a certain resistance to reverse the process.

The higher price outlook for dairy may also mask that the global dairy sector is increasingly confronted with higher production costs and what appears to be more unstable market environment; more extreme weather patterns, rapidly changing macroeconomic situation, input prices and, consequently, increased price variability. Nearly all world milk production takes place in countries which protect dairy farmers from competition and heavily subsidize their production to pay higher than world export prices for milk equivalents. Only New Zealand and Australia have low protection of dairy production that results in domestic surpluses which are

exported. The prices dairy farmers receive for producing milk around the world vary considerably.

The marketing of milk itself was liberalized in 1992 in Kenya (Ngigi, 2005, Muriuki et. al, 2003). Milk prices were decontrolled and the Kenya Cooperative Creameries (KCC) monopoly on urban markets was revoked, ending 60 years of its dominance. Following liberalization two groups of players entered the dairy sector to compete with KCC and gradually take over its milk marketing and processing roles. The first group was small-scale milk traders, who moved in large numbers to buy raw milk from farmers and sell it to consumers. The rise of these small-scale traders both contributed and responded to the collapse of marketing cooperatives during the 1990s, (Leksmono, 2006). The second group of new players was formal private processors. According to Ngigi (2005), the first of these were commercial farms (such as Brookside, Delamere and Illara), with their own milk supplies, which integrated forward into processing. Much as with liberalization in 1992, the outcomes of the revitalization of KCC can be debated. However, there is a widespread view that the revitalization of KCC has had a positive impact on the Kenyan dairy sector. (Leksmono, 2006) noted that the re-launch of KCC has broadened the competition in the formal market segment, contributing to better farm gate prices and the current relative exuberance in the dairy sector. Confidence that production will grow again comes from the entry of new players into the dairy sector since the revival of KCC. All this has led to farmer confidence that his income is better and is assured.

2.9.1 Milk Processors and Market Players in Kenya

Processing and marketing of milk are important levels of dairy development and growth of the industry. By the end of 2007, there were 52 licensed processors with an inbuilt capacity of 2.9 million litres a day but only 26 were active (Ministry of Livestock Development, 2008). They process a wide range of products including fluid, cultured and solid milk products such as cheese, ghee, condensed and evaporated milk, ice-cream and frozen desserts. On the other hand, marketing is important because it links consumers to the products. The large milk processors are concentrated in Nairobi and the traditionally dairy regions of central highlands and Rift Valley region. As a result most of the milk products requirements for semi-arid are imported from these regions.

There is good market opportunity for different milk products due to expanding population and improved income in the rural urban trading centres within the region. In order to improve

smallholder dairy production in the region, milk production must be accompanied by processing to produce a variety of products to meet market opportunities. Further milk is highly perishable thus there is need to process into products that have a longer self-life, easier to handle and transport to long distance market outlets. Processed milk products can also be stored and offloaded into the market when demand arises.

The industry has grown tremendously since its liberalization in 1992. Liberalization led to a rapid growth of the informal milk trade that mainly consists of small-scale operators dealing in marketing of raw milk. At that time, there was an emergence of new institutional arrangements in milk collection, processing and marketing, which included hawkers, brokers, self-help groups, neighbours and business establishments like hotels (Karanja, 2003). The informal milk market controls an estimated 70 percent of the total milk marketed in Kenya (Kenya Dairy Board 2009; Government of Kenya 2006). This sector is important and is driven by among other factors the traditional preferences for fresh raw milk and its relatively lower cost. Raw milk markets offer both higher prices to producers and lower prices to consumers but with several challenges relating to quality control and standards, and the associated health and safety concerns.

According to Staal (1999) dairy marketing in Kenya is mainly of liquid milk where over 80% is sold raw with the participation of itinerant milk traders (hawkers) who control about 28% of marketed milk. Presently, milk pricing mechanism in Kenya is complex because of multiple market channels dominated by informal market players. Those selling in the formal market are price takers. Milk prices are set by the leading processors in the country presently. The farm gate price or the net realizable price is the factory gate price adjusted for transportation and other handling costs. The highest demand for milk in Kenya is in the urban areas where per capita incomes are highest. The urban population growth is rapid with a change in the total population from 24% in1999 to 30% in 2010. The projected urban demand is an average rate of 5% which has to be met with domestic production because Kenyan milk consumers have a strong preference for liquid fresh milk. Rising global milk price is an indication of expanding opportunities for opening the hitherto access barriers to global market for smallholders from which they can earn more from their milk as some manufacturers seek alternative, less expensive milk. Until recently the dairy industry in Kenya was characterized by one major processor, the Kenya Co-operative Creameries (KCC). Before liberalization of the dairy industry in 1992, KCC enjoyed a near monopoly of the Kenya Dairy market. With the emergence of numerous small-

scale to medium scale dairy processors, the market has become more competitive. In this competitive market, KCC is facing a challenge from the new manufacturers while the new manufactures have to compete first against a well established and large processor like KCC and secondly between themselves for a slice of the same market: the Kenya consumer.

The survival of individual dairy processors will very much depend on how successfully they can win consumer confidence in their products. This calls for knowledge and skills in marketing techniques Most of the newly established small to medium scale dairy processors have very little or no experience in milk marketing. In order to assist them improve their marketing skills, the training programme for small scale dairy sector under project GOK/FAO/TCP/KEN/6611 in collaboration with Dairy Training Institute, prepared a guide on Milk and Milk products marketing to be used for training the private small scale dairy processors. The emphasis is on practical approaches to marketing taking into account the real situation existing in Kenya at the present moment. Milk production and consumption levels, the range of products consumed, and consumer habits and attitudes in relation to milk products vary considerably from country to country and even within a country. However, the nature of the product involved is the main determinant of product marketing systems that will develop. To minimize deterioration of quality in the tropics, milk has to be moved to the customer within two to three hours of milking, or milk products have to be made which will keep without refrigeration, or preservatives added to the fresh milk, or it has to be cooled as soon as possible on the farm or at a collection centre. Well-organized milk schemes collect milk from widely-scattered suppliers, chill it in bulk, and transport it to processors with minimal delay.

Generally there are two main channels namely, formal and informal marketing channels in the marketing system for milk. Kaynak (1986) defines a marketing system as the sequence of transactions and commodity movements between the producer and the ultimate consumer. Such a sequence includes bulking (or assembly) and distribution. Alternatively, the marketing system may be defined as the process of creating form, time and space utility (Kohls and Uhl, 1985). According to Mdoe et. al.(1993) a marketing system for milk involve all elements that influence, directly or indirectly, the movement, transformation and price of fresh milk once it leaves the point of production. These include: collection of milk from dairy producers, the transformation system, if any, which processes and/or packages milk products for final consumption, the transportation system that moves milk and milk products between the collection of milk from

dairy producers and the transformation system. According to GOK/FAO/TCP/KEN/6611 project findings, there are several categories of key players in the marketing chain each with its own vested interests. Consumers want to get what they need at the lowest price possible. Producers on the other hand are interested in getting the highest possible return for their milk. Between them, there are market intermediaries or middlemen who perform various marketing functions such as transportation or retailing. Their interest is to make the highest profit possible from their particular business operation. Currently the number of Dairy Farmers Co-operatives in the country is growing with membership and sales increasing from 210 Cooperatives with 266,000 members in 1994 to 337 Cooperatives with 344.000 members in 2000. There are 36 registered processors, mostly serving a limited geographical area.

The New KCC and Brookside are the major milk processors with a few farmers cooperatives (Meru Central, Limuru and Githunguri) engaged in processing milk and value added products. Increasing numbers of registered cooperatives and increasing membership may reflect the growing importance of smallholder dairying rather than their success. Revival strategy of most of the small dairy Co-operatives is to trade in raw milk in the urban centres to stabilize their milk intakes and tap the market of conservative consumers who favour fresh raw milk. However, small Co-operatives realize narrow profit margins from the sale of milk compared to private sector traders who are more efficient with minimal overheads. The milk marketing system in Kenya has shown that there are at least 8 different marketing channels as show in Table 2.1.

Table 2. 1: Milk marketing channels

Milk Marketing Channels	Number of intermediaries
Producer → consumer	0
Producer → milk hawker → consumer	1
Producer → processor → consumer	1
Producer → processor → retailer → consumer	2
Producer → dairy co-operative society → processor → retailer → consumer	3
Producer → milk transporter → processor → retailer → consumer	3
Producer → milk trader → processor → retailer → consumer	3
Producer → dairy cooperative society → milk transporter → processor → retailer- → consumer	4

Adopted from; Milk Processing Guide Series Volume 6.

The number of intermediaries involved will have a bearing on both producer and consumer milk prices. The shorter the channel the more likely that the consumer prices will be low and the producer will get a higher return. A notable omission in the milk marketing channel obtaining in Kenya is the absence of wholesalers. Retailers obtain their dairy products directly from processors. From the consumer point of view, the shorter the marketing chain, the more likely is the retail price going to be low and affordable. This explains why, following the liberalization of the dairy industry, direct sales of raw milk from producers to consumers (channel 1) or through hawkers (channel 2) has been on the increase despite the public health risks associated with the consumption of untreated milk and milk products. Milk producers may not necessarily benefit from a short marketing chain i.e. milk processors in channels 5 - 6 may be paying farmers the same price as hawkers. However, farmers sometimes prefer selling milk to hawkers because other factors such as prompt payments and inaccessibility to formal market outlets such as producer co-operatives or lack of near by milk processing factory. The biggest disadvantage of direct milk sales to consumers by hawkers is the total lack of quality control and the frequent rate

of adulteration of milk with (dirty) water, which is illegal. An efficient milk marketing chain is one which enable the farmers to receive at least 50% of the retail price of milk.

2.9.2 Milk quality concerns

Good quality milk production is one of the main objectives in dairy farming whether in either large or small scale farms. This is because milk of good quality is desirable and hence saleable to the processors and acceptable by the consumers. Good quality milk and milk products as measured by consumers is wholesome, of good appearance, good predictable taste and flavour, maintaining original nutritional qualities, safe from harmful micro-organisms and substances, and has a long shelf-life. To produce good quality milk, the producers must be certain that milk comes out not only from disease-free animals but also from healthy udders by using properly sanitized equipment and maintained at its best for appearance, flavour, nutritional values, and free from drugs and chemical residues, with the least possible microbial contamination. Unhealthy udders which are mostly attributed to mastitis, regardless of the causes, definitely produce bad quality milk, either in terms of milk composition or bacterial contamination. Only sound mastitis management can help producers make more money by running, not necessarily a mastitis-free farm, but at least a near mastitis-free farm (Thirapatsakun, 1989). Mastitis causes economic losses from decreased milk production and increased management costs. Losses from mastitis are twice as much as losses from infertility and reproductive diseases. The largest proportion of the losses results from a direct drop in milk revenues, the non-marketable milk contaminated with antibiotics, decreased milk production which invariably accompanies the infection and premature culling of the animal in many instances.

2.9.3 Dairy Cooperative Societies

Two major factors that have shaped the development or performance of co-operative sector in Kenya in the recent past include liberalization and globalization. Until the liberalization of the Kenyan economy, cooperatives were heavily controlled by the government that determined the scope of operations and regulations within which they operated. Government withdrew from supporting and supervising co-operatives in 1992 which caught the co-operative leadership inadequately prepared to effectively steer their organizations for growth or face the stiff competition occasioned by liberalization/ globalization (Wanyama et. al. 2008). Cases of inadequate management skills, corruption, leadership wrangles, misappropriation of society

assets and general mismanagement started creeping in. Coupled with low sales most marketing co-operative found themselves dormant, collapsing or struggling to survive. In addition to these challenges are political interference, unfavorable government policies, legal constraints, social and cultural dynamics and rapid technological advancement. The adverse operating environment characterized by increasing input prices, dwindling consumer purchasing power hence producer prices, poor member contribution, inadequate external (financial) support have not spared Kenya co-operatives that have resulted into loss of or dwindling profitability and inability to fund development projects. Equally, the split of giant marketing co-operatives and collapse of marketing unions have reduced the capacities of the co-operatives to serve members effectively and to meet the challenges posed by globalization. Reduced donor and government support and involvement in co-operatives has left co-operatives to the vagaries of the markets.

Thus, prior to the re-establishment of the Ministry of Cooperative Development in 2003, the co-operative movement was faced with a lot of challenges with many societies almost collapsing due to mismanagement, anarchy and leadership wrangles. This scenario was attributed to the inadequacies of the Co-operative Societies Act No.12 of 1997. In the light of this, the following issues became apparent: the withdrawal of government and external donor support and involvement called for improved and professional management in co-operative societies. Adoption of current management practices based on the global context is an urgent issue in co-operatives if they have not only to survive but also to compete effectively, and remain relevant through provision of quality services to its clients. This should happen within the context of co-operative values and principles. The government of Kenya has since reviewed some aspects of the Law (Co operative act of 2003 and Cooperative rules of 2004) and formulated new policies (Co-operative policy paper 2004) to promote revival and better management and profitability in co-operatives. Besides amendment of the co-operative act in 2004, the government has also developed strategies to create wealth and reduce unemployment (Economic Recovery Strategy of June 2003) and revitalize agriculture (Strategy for revitalizing Agriculture, 2004). Part of these strategies involved revival of co-operative sector by promoting policies friendly to the marketing co-operatives. As a result of these interventions, co-operatives have had a turnaround effect and recorded a commendable growth in the recent past. Some of the achievements include: revival of dormant co-operatives; amendment of co-operative society act of 1997 (2004); revival of Kenya Creameries Cooperative and hence market for most dairy marketing cooperatives; improvement

in producer prices; recovery of Saving (SACCO) dues; and venturing into the use of information technology in management.

Co-operatives in the country are grouped into agricultural co-operatives (including marketing), financial (SACCOs), Service (Housing and Insurance), and consumer co-operatives. The movement cuts across all sectors of the economy including agriculture, finance, livestock, housing, transport, construction, and manufacturing. The concentration is however within the agricultural sector and finance. According to Kenya National Bureau of statistics-KNBS (2007), there were 11,635 registered co-operatives in Kenya with at least 7 million members. About 4,414 of these are agriculturally based, with 3,037 being agricultural marketing co-operatives.

According to Wanyama et. al. (2008) the contribution of co-operatives to poverty reduction in Africa since the liberalization of the sector in the mid 1990s from a rural livelihoods perspective is evident and that co-operatives have significantly contributed to the mobilization and distribution of financial capital by creating employment and income generating opportunities for both their members and non-members alike. Accordingly, these organizations are utilizing their relatively less excluding features like open and voluntary membership and democratic leadership to reduce exclusion in society by enabling those willing to join an opportunity to generate an income. The income so-generated is used not just to meet household consumption needs, but also to enhance income-generating capacities of people by investing in educational and health requirements of individuals and households. Furthermore, co-operatives contribute to human capital by creating a forum for education and training for their members in a bid to reduce ignorance. They also enable their members to mobilize funds for taking care of their health needs. It is in this regard that co-operatives are increasingly contributing to poverty reduction in Africa.

Since the liberalization in 1992, the outcomes of the revitalization of KCC can be debated. However, there is a widespread view that the revitalization of KCC has had a positive impact on the Kenyan dairy sector. Leksmono (2006) noted that the re-launch of KCC has broadened the competition in the formal market segment, contributing to better farm gate prices and the current relative exuberance in the dairy sector. Confidence that production will grow again comes from the entry of new players into the dairy sector since the revival of KCC. The current vibrancy in the sector is thus associated with the development of farmer support services like feeds suppliers, providers of artificial insemination services and other services supporting the dairy industry.

There has been an increase in those providing veterinary services like agro-vet enterprises, whilst non-governmental organizations and microfinance institutions have seen dairy as a strategic activity for poverty reduction interventions.

In Meru region dairy farming started being formally organized in the 1960s (Riita Launonen et. al., 1985) when the first dairy farmers' cooperatives societies were founded in North and South Imenti. Katheri dairy cooperative society was the first dairy society to be formed and registered in 1962, then Githongo, Kithirune, Nkuene and Buuri in 1963. According To Meru Central Development Plan 2008—2012, the number of dairy animals in Meru Central District was 36,860 and the local breeds (Zebu) were 6,570. The Meru Dairy Project was started as an effort to develop dairying in a rural area that is not near a major city. Meru Municipality had only72,000 people in 1979 (Launonen et. al, 1985). According to Korhonen (1987), the project strategy was designed to improve milk collection and cooling at the primary cooperative society level and improve milk processing and marketing at the Cooperative Union level. This approach was aimed at encouraging farmers to produce more and deliver their surplus milk to the existing dairy cooperatives for further transportation to the processing plant. The Meru project seems to have succeeded in at least one dimension, getting more farmers involved in commercial dairying. The number of active dairy cooperative societies in Meru increased from 9 in 1983, when the processing plant was opened, to 18 in 1986 and the number of active members increased from 4500 to 9000 (Korhonen, 1987). Some of these new members were likely to have been selling milk privately before they joined, but the doubling of active members in just three years probably reflects a combination of new farmers selling milk as well as farmers increasing their sales to the point where active membership was attractive. The Meru project was aimed at small farms with only a few milking cows and relatively low milk production.

2.10 Theoretical Framework

This study is based on Keynes theory of employment, interest and money. According to Keynes (1936), The General Theory of Employment, Interest and Money sought to bring about a revolution, commonly referred to as the Keynesian Revolution, in the way economists thought, especially in relation to the proposition that a market economy tends naturally to restore itself to full employment after temporary shocks. This theory introduced important concepts such as the consumption function, the multiplier, the marginal efficiency of capital, the principle of effective demand and liquidity preference.The central argument of this Theory is that, the level of

employment is determined, not by the price of labour as in neoclassical economics, but by the spending of money (aggregate demand). Keynes argues that it is wrong to assume that competitive markets will, in the long run, deliver full employment or that full employment is the natural, self-righting, equilibrium state of a monetary economy. On the contrary, under-employment and under-investment are likely to be the natural state unless active measures are taken.

One implication of this Theory is that a lack of competition is not the fundamental problem and measures to reduce unemployment by cutting wages or benefits are not only hard-hearted but ultimately futile. As far as individual industries are concerned demand depends on the public wish to buy the products' of that industry, as opposed to buying the products of quite different industries, or investing the money to earn something from it. It also depends on whether the public has the necessary cash, which is in turn related to the amount of employment and the level of wages.

Keynes examination of aggregates places most emphasis on demand because of its influence on the level of employment. His theories and his public policies to correct shortfalls that stemmed from them were derived essentially from vicissitudes in demand in the total economy. Effective demand defines the volume that will keep the wheels of industry rolling in conditions of equilibrium, where aggregate demand balances aggregate supply as business is currently organized. Effective demand is the aggregate incomes or proceeds which the entrepreneurs expect to receive, inclusive of the incomes which they will hand on to other factors of production, from the amount of current employment which they decide to give.

The only way to revive business confidence and get the private sector spending again was by cutting taxes and letting business and individuals keep more of their income so they could spend it. Or having the government spend more money directly, since that would guarantee that 100 percent of it would be spent rather than saved. If the private sector couldn't or wouldn't spend, the government would have to do it. For Keynes, the government had to be prepared to act as the spender of last resort.

The purpose of Keynesian employment theory is to offer a solution to periods of excessive unemployment (for example, during. recession). This solution is tied to the idea that employment depends on what firms need to produce, and their production level, in turn, depends on what individuals and firms plan to buy: this is what Keynes calls aggregate expenditure. Aggregate

expenditure is the key to economic activity. That is, what households, businesses and government plan to buy will be the determinant of what firms will eventually produce. In the first step of the analysis, a simplified model excludes government, assumes that no foreign sector is present, and the level of real income (not prices) is the major determinant of aggregate expenditure.

Keynesians' belief in aggressive government action to stabilize the economy is based on value judgments and on the beliefs that macroeconomic fluctuations significantly reduce economic well-being and the government is knowledgeable and capable enough to improve on the free market. This had bearing with the Kenya government in 2003 when the Kenya Creameries Cooperative was given a grant to revive it after its collapse due to mismanagement and political interference leading to a revitalized dairy industry in the country thereafter where the farmers were assured of at least a market of their milk and hence a regular income.

2.11 Conceptual Framework

The conceptual framework shows the relationship between the variables identified as shown in Figure 1.

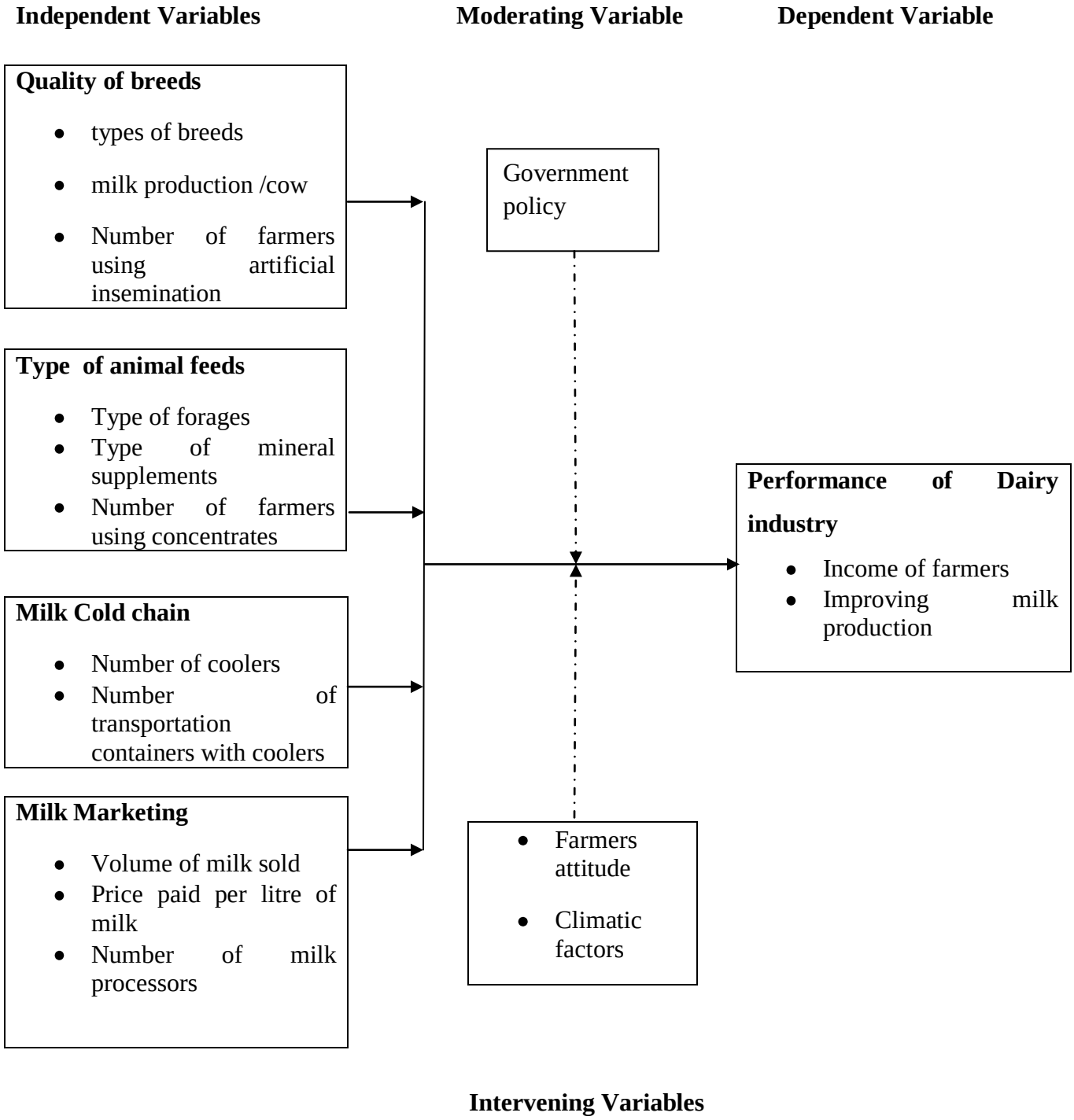

Figure 1: Conceptual Framework of the study.

2.12 The knowledge gap

As the human population continues to grow the land parcels per person becomes smaller meaning that the land size may not be able to sustain the large cattle population that will be required to produce enough milk for the growing population, therefore, there is need to keep few animals that can produce high milk volumes per animal. A study done by Muriuki (2010) shows commercial activities and benefits to members included milk collection, processing and marketing as the core activity for Githunguri Dairy Society which also provided other services such as input supply stores (mainly feed) and Artificial Insemination services to members. The stores also provide food for the members' family which brought gender empowerment as men no longer squander scarce family resources as they used to as families' access them first through the stores, hence improved motivation on the family to produce more milk. The income inflows are continuous and consistent, the Dairy Society guarantees prompt payment and the members are guaranteed steady income. So far no study has been done in this area (Meru Central District) and hence this study aims at investigating the factors influencing performance of the dairy industry in Meru Central District, a case of Katheri Dairy Co-Operative society.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology which was used in the study. The chapter covers the research design, target population, sampling techniques and sample size, methods of data collection, validity of instruments, reliability of instruments, data analysis, ethical consideration, operationalization of variables and summary.

3.2 Research Design

A descriptive survey was used in the description of the affairs of the current status of the variables in the study, out of which the formulation of important principles of knowledge and solutions to significant problems might result. A descriptive survey design was appropriate for this study because it involved fact finding and enquiries. It also generated qualitative and quantitative data from the research objectives. The descriptive research design was used as the respondents were interviewed in their normal settings as well as they described their experiences in their usual life situations.

3.3 Target Population

The target population for this study was the dairy farmers in Katheri location where Katheri Dairy Cooperative Society operate in Meru Central District. Katheri Dairy Cooperative Society has 3400 registered dairy farmers (Meru Central District Cooperative Officer, 2012), both active and inactive. The key informants targeted were milk processors, officers from the Ministries of Livestock Development and Cooperative Development and Katheri Dairy Cooperative Society management committee members.

3.4 Sampling Technique and Sample size

Radom sampling provides an efficient system of capturing the variations or heterogeneity that exists in the target population. Simple random and purposive sampling technique was used in this study. According to Yamane (1967), the Table helps to determine the sample size for the survey research. This study used a sample size of 212 at 7% level of significance (204 dairy farmers and 8 key informants). The dairy farmers were sampled from the 5 sub-locations of Katheri Dairy Cooperative Society catchment area in Meru Central District as shown in Table 3.1.

Table 3. 1: Sampling of dairy farmers

Sub location	Dairy farmers	Percentage	Sample Size
Kinjo South	686	20	41
Kinjo North	722	21	43
Kathiranga North	690	20	41
Kathiranga West	641	19	39
Kathiranga Central	661	20	40
Total	**3,400**	**100**	**204**

Sampling of key respondents was done purposively and involved the following; 1 Divisional Livestock extension officer, 1 District Cooperative officer, 2 milk processors and 3 Katheri Dairy Cooperative Society management committee members.

3.5 Methods of Data Collection

The data for this study was collected by the use of questionnaire tool. The questionnaires comprised of both closed and open ended questions in order to encourage in depth responses to be captured. Questionnaires and interview schedules were arranged for key respondents. The researcher recruited a research assistant who was conversant with livestock issues to assist in the administration of the questionnaires to dairy farmers.

3.6 Research Instruments

The researcher used questionnaires as the research instruments. The questionnaires consisted of open and closed questions to which were administered to both dairy farmers and the key respondents.

3.7 Validity of Instruments

Validity is the accuracy and meaningfulness of inferences, which are based on the research results. It is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. To enhance validity the researcher sought maximum possible co-operation from all the respondents by establishing a friendly relationship prior to conducting the interviews. All the respondents were made aware of the purpose of the study so that a good rapport and confidence was inspired on the respondents before the actual administration of the questionnaire. Also the researcher sought advice and periodic reviews by the University Supervisors in the specific disciplines applied. The efficiency and effectiveness of the

questionnaires were reviewed together with the supervisors from time to time. Comments and suggestions from my colleagues were taken into consideration throughout the course of the study. Piloting of the questionnaires was also done.

3.8 Reliability of Instruments

According to Boit, et. al. (2009), reliability is concerned with consistency in the production of the results and refers to the requirement that, at least in principle, another researcher, or the same researcher on another occasion, can be able to replicate the original piece of research and achieve comparable evidence or results, with similar or same study population. To test reliability of instrument, the researcher used the split-half technique. The researcher aimed at determining the consistency or reliability coefficient. The instrument was broken into equivalent halves after administering. Pearson's correlation coefficient technique was used to summarize the strength and direction (negative or positive) of a relationship between two variables. The closer the correlation is to +1 or -1, the stronger the likely correlation. A perfect positive correlation is +1 and a perfect negative correlation is -1. For example, a correlation value of -0.73 suggests a fairly strong negative relationship.

3.9 Data Analysis

Data analysis is the critical examination of the coded data and making inferences. The collected data was edited; coded and analyzed using Statistical Package for Social Sciences because it is fast and flexible and provides more accurate analysis resulting in dependable conclusions. Technically speaking, data processing implies editing, classification, coding, and tabulation of collected data so that they are amenable to analysis (Kothari, 2004). Data analysis involves computation of certain measures along with searching for patterns of relationships that exist between the dependent variables and independent variables. The data was analyzed according to variables and objectives of the study. Descriptive statistics was used to analyze, present and interpret data. Descriptive analysis involved use of frequency distribution tables and cross tabulation which was used to generate values between dependent and independent variables used in the study. Content analysis was used for the qualitative data from the interview guide and the questions in the questionnaire. Data will be interpreted and presented in form of means and tables.

3.10 Ethical Considerations

While conducting the study, the researcher ensured that research ethics were observed. This was achieved by the researcher explaining the nature of the study to the respondents before the questionnaire was administered. Explaining the nature of the research study, assuring them anonymity, privacy and confidentiality gained the respondents cooperation. Participation in the study was voluntary. The objectives of the study were explained to the respondents with an assurance that the data provided was to be used for academic purpose only

3.11 Operationalization of Variables

The Operationalization of Variables is given in Table 3.2;

Table 3. 2: Operationalization of Variables

Objective	**Type of variable**	**Indicator**	**Measu-rement scale**	**Tools of analysis**	**data analysis**	**Level of analysis**
To establish the quality of cattle breeds influencing the dairy performance in Meru Central District	**Independent** Cattle breeds	• milk production/cow • types of breeds • number of farmers using Artificial inseminatio-ns	ratio	Means and percentage	quantitative	Descriptive Statistics
To establish the types of animal feeds influencing the dairy performance in Meru Central District	Types of Feeds	• Type of forages • Type of mineral supplements • No of farmers using concentrates	ratio	Means and percentage	quantitative	Descriptive Statistics
To identify how	Milk cold	• Number of	ratio	Means and	quantitative	Descriptive

milk cold chain influence performance of the dairy industry in Meru Central District.	chains	coolers • Number of transportati-on containers with coolers		percentage		Statistics
To establish the milk marketing influencing the dairy performance in Meru Central District	Milk Marketing	• Volume of milk sold • Price paid per unit of milk • Number of milk processors • Number of milk market players	Ratio	Means and percentage	quantitative	Descriptive Statistics
	Dependent Performance of the dairy industry	• Income of farmers • Improving milk production	ratio	Means and percentage	quantitative	Descriptive Statistics

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents a detailed data analysis, presentation and interpretation of the data collected from the respondents. The chapter also provides the major findings as well as results of the research study.

4.1.1 Response Rate

The study targeted a sample size of 204 respondents from which 134 filled in and returned the questionnaires making a response rate of 65.69% (Table 4.1). This response rate was good and representative and conforms to Mugenda and Mugenda (1999) stipulation that a response rate of 50% is adequate for analysis and reporting; a rate of 60% is good and a response rate of over 70% is excellent.

Table 4. 1: Response Rate

Response rate	**Frequency**	**Percentage**
Responded	134	65.69
Nonresponce	70	34.31
Targeted	**204**	**100.0**

4.1.2 Reliability Analysis

A pilot study was carried out to determine reliability of the questionnaires. The pilot study involved the registered dairy farmers. Reliability analysis was subsequently done using Cronbach's Alpha which measures the internal consistency by establishing if certain item within a scale measures the same construct. The results are shown in Table 4.2.

Cronbach Alpha was established for every objective which formed a scale (Gliem and Gliem, 2003). The Table 4.2 shows that the quality of breeds had the highest reliability (α= 0.898), followed by types of animal feeds (α=0. 735), milk Cold chain (α=0. 721) and milk Marketing (α=0. 716). This illustrates that all the four variables were reliable as their reliability values exceeded the prescribed threshold of 0.6.

Table 4. 2: Reliability Analysis

Scale	Cronbach's Alpha	Number of components
Quality of breeds	0.898	8
Type of animal feeds	0.735	7
Milk Cold chain	0.721	6
Milk Marketing	0.716	6

4.2 Demographic Information

The study sought to establish the background information of the respondents including respondents' gender, age marital status, education level, position in the household and acres of land owned.

4.2.1 Respondents Gender

The findings in Table 4.3 show the gender of the respondents.

Table 4. 3: Respondents Gender

Gender	Frequency	Percentage
Male	88	66.5
Female	46	34.3
Total	**134**	**100.0**

From the findings, the study established that the majority of respondents were male, 66.5% while females were 34.3% of the respondents. This shows that there are more male than females registered dairy farmers with Katheri Dairy Co-operative Society.

4.2.2 Respondents Age

Table 4.4 shows the age of the respondents.

Table 4. 4: Respondents Age

Age (years)	Frequency	Percentage
15-25	14	10.4
26-40	52	38.8
41-60	68	50.7
Total	**134**	**100.0**

On the age of the respondents, the study found that the majority of the respondents were between 41- 60 years (50.7%), 38.8% were aged between 26- 40 years while 10.4% were aged between 15-25 years. This shows that majority of the dairy farmers are middle aged and therefore have enough experience on the subject being researched on.

4.2.3 Marital Status

On the marital status of the respondents, the findings are shown in Table 4.5

Table 4. 5: Marital Status

Marital Status	Frequency	Percentage
Married	114	85.0
Single	13	9.7
Divorced	6	4.5
Windowed	1	0.7
Total	**134**	**100.0**

The findings show that 85.0% of the respondents were married, 9.7% of the respondents were single, 4.5 % were divorced while 0.7 were windowed. These results show that majority of the respondents were family people therefore responsible and accountable.

4.2.4 Respondents Level of Education

The Table 4.6 shows the level of education of the respondents.

Table 4. 6: Respondents' Level Of Education

Level Of Education	Frequency	Percentage
Degree	9	6.7
Diploma	25	18.6
Certificate	91	67.9
Primary	9	6.7
Total	**134**	**100.0**

From the findings, 67.9% of the respondents had a certificate as their highest level of education, 18.6% of the respondents had a diploma as the highest level of education while 6.7% had a degree and primary certificate respectively as the highest level of education. This shows that majority of the respondents were well equipped with the required dairy farming skills.

4.2.5 Head of Household

The study also sought to establish whether the respondents were head of household. Table 4.7 show head of household.

Table 4. 7: Head of Household

Head of Household	Frequency	Percentage
Yes	96	71.6
No	38	28.4
Total	**134**	**100.0**

According to the findings, majority of the respondents (71.6%) were heads of household while 28.4% were not heads of household. From this results we can therefore state that majority of the respondents were heads of the households and had therefore opted for dairy farming as a means of income so as to be able to sustain their families

4.2.6 Acres of Land Owned

Table 4.8 show acres of land owned.

Table 4. 8: Acres of Land Owned

Acres	Frequency	Percentage
0.5-1.0	61	45.5
1.5-2.0	51	38.1
2.5-3.0	22	16.4
Total	**134**	**100.0**

On the number of acres the respondents owned, it was found that 45.5% of the respondents owned between 0.5-1 acres, 38.1 % of the respondents owned between 1.5-2 acres while 16.4% of the respondents owned 2.5-3 acres. This shows that majority of the registered dairy farmers with Katheri Dairy Co-operative Society are smallholder households.

4.3 Quality of Breeds

The study sought to evaluate how the quality of breeds influences performance of the dairy industry in Meru Central District. This involved determining the type of cattle breed reared, the numbers of cows the respondents were milking, average milk production during the dry and wet season, cases of mastitis in the last one year, period the cows took to get another calf, whether the respondents used artificial insemination for breeding, the preferred breed when using artificial insemination and why.

4.3.1 Type of Cattle Breed Reared

The study also sought to determine the type of cattle breed the respondents reared, shown in Table 4.9.

Table 4. 9: Type of Cattle Breed Reared

Breed Reared	Frequency	Percentage
Friesian	61	45.5
Ayrshire	57	42.5
Guernsey	12	9.0
Jersey	4	3.0
Total	**134**	**100.0**

From the findings, majority of the respondents (45.5%) indicated that they reared Fresians, 42.5% of the respondents indicated that they reared Ayrshire, 9.0% of the respondents indicated that they reared Guernsey while 3.0% of the respondents indicated that they reared Jersey. From these findings we can therefore deduce that the respondents reared exotic high milk producing breeds.

4.3.2 Number Of cows milked

The study further sought to determine the numbers of cows the respondents were milking Table 4. 10.

Table 4.10: Number Of cows milked

Number of Cows	Frequency	Percentage
1	91	67.9
2	32	23.9
3	9	6.7
4	1	0.7
More than 5	1	0.7
Total	**134**	**100.0**

From the findings , 67.9% of the respondents indicated that they were milking one cow,23.9% of the respondents indicated that they were milking two cows, 6.7% of the respondents indicated that they were milking three cows while 0.7% of the respondents indicated that they were milking four and more than five cows respectively. We can therefore infer that most smallholders start very poor and struggle to acquire their first cow as a means to get out of poverty and to sustain their household (Ngigi 2005).

4.3.3 Average Milk Production Per Day

Average Milk Production During the Dry Season

The average milk production during the dry season is shown in Table 4.11

Table 4. 11: Average Milk Production During the Dry Season

Litres	Frequency	Percentage
0-5	27	20.1
6-10	78	58.2
Above 10	29	21.6
Total	**134**	**100.0**

According to the findings, 58.2% of the respondents indicated that the average milk production during the dry season was between 6-10 litres. 21.6% of the respondents indicated that the average milk production during the dry season was above 10 litres, while 20.1% of the respondents indicated that the average milk production during the dry season was between 0-5 litres. From these findings we can deduce that low levels of milk production were registered during the dry seasons of the year. This could mostly be attributed to decreased feeds due to absence of rain.

Average Milk Production During the Wet Season

The average milk production during the wet season is shown in Table 4.12

Table 4. 12: Average Milk Production During the Wet Season

Litres	Frequency	Percentage
0-5	7	5.2
6-10	48	35.8
Above 10	79	59.0
Total	**134**	**100.0**

From the findings, the study established that majority of the respondents (59%) indicated that the average milk production during the wet season was above 10 litres, 35.8% indicated that the average milk production during the wet season was between 6- 10 litres while 5.2% % indicated that the average milk production during the wet season was between 0- 5 litres. These results show that with increased rains came increase in feeds (forage) which subsequently contributed to the high milk production.

4.3.4 Cases of Mastitis Experienced by dairy farmers

The study sought to find out about if the respondents had experienced any cases of mastitis in the last one year. The results are shown in Table 4.13

Table 4.13: Cases of Mastitis Experienced by dairy farmers

Any Case Of Mastitis	Frequency	Percentage
Yes	71	53.0
No	63	47.0
Total	**134**	**100.0**

With regard to whether the respondents had experienced any cases of mastitis in the last one year, majority (53%) indicated that they had experienced cases of mastitis while 47% indicated that they had not experienced cases of mastitis. We can therefore deduce that most of the milk being produced had microbial contamination (Thirapatsakun, 1989) at one time within the year.

4.3.5 The Period Taken By the Cow To Calf

Table 4. 14 show the period the cows took to get another calf.

Table 4.14: The Period Taken By The Cow To Calf

Months	Frequency	Percentage
0-5	9	6.7
6-10	8	6.0
11-15	85	63.4
16-20	20	14.9
Above 21	12	9.0
Total	**134**	**100.0**

In determining the period the cows took to get another calf.63.4% of the respondents indicated that the cows took between 11-15 months, 14.9% of the respondents indicated that the cows took between 16-20 months, 9% of the respondents indicated that the cows took above 21 months, 6.7% of the respondents indicated that the cows took between 0-5 months while 6% of the respondents indicated that the cows took between 6-10 months. We can therefore deduce that most of the cows took one year to calf which translated to extended milk production

4.3.6 Use of Artificial Insemination For Breeding

Table 4. 15 indicate whether the respondents used artificial insemination for breeding.

Table 4. 15: Use of Artificial Insemination For Breeding

Artificial Insemination	Frequency	Percentage
Yes	130	97.0
No	4	3.0
Total	**134**	**100.0**

With regard to whether the respondents used artificial insemination for breeding, 97% of the respondents indicated that they used artificial insemination for breeding while 3% of the respondents indicated that they did not use artificial insemination for breeding. From these findings we can therefore deduce that there were improvements of milk yields by cross-breeding low-yielding but essentially more disease resistant local breeds (Bos indicus) with exotic breeds (Bos taurus).

4.3.7 Preferred Breed When Using Artificial Insemination

The study sought to find out the preferred breed when using artificial insemination as shown in Table 4.16.

Table 4.16: Preferred Breed When Using Artificial Insemination

Breed	Frequency	Percentage
Friesian	74	55.2
Ayrshire	51	38.1
Guernsey	6	4.5
Jersey	3	2.2
Total	**134**	**100.0**

According to the findings, 55.2% of the respondents indicated that they preferred Friesian breed when using artificial insemination, 38.1% of the respondents indicated that they preferred breeding Ayrshire using artificial insemination, 4.5% of the respondents indicated that they preferred breeding Guernsey using artificial insemination while 2.2% of the respondents indicated that they preferred breeding Jersey using artificial insemination. From these findings we can deduce that majority of the respondents preferred Friesian for insemination.

4.3.8 Reason For Preference

Table 4. 17 shows the reason for their preferred breeding.

Table 4. 17: Reason for Preference

Reason	Frequency	Percentage
High milk production	104	77.6
Easy to feed	28	20.9
Beautiful colour	2	1.5
Total	**134**	**100.0**

With regard to the reason for their preferred breeding,77.6% of the respondents indicated it was because of high milk production, 20.9% of the respondents indicated it was because they were easy to feed while 1.5% the respondents indicated it was because they had a beautiful colour.

4.4 Type of Feeds

The study sought to establish how types of animal feed influence performance of the dairy industry. This included finding out the dairy farming systems, type of forage feeds used, type of proteineous feeds used, animal mineral supplements and type of animal supplements given.

4.4.1 Dairy farming system

The study sought to establish the respondent's dairy farming system. Table 4.18 show dairy farming system.

Table 4.18: Dairy farming system

Farming System	Frequency	Percentage
Zero grazing	105	78.3
Semi zero grazing	25	18.7
Open grazing	4	3.0
Total	**134**	**100.0**

78.3% of the respondents indicated that they used the zero grazing system, 18.7% of the respondents indicated that they used the semi-zero grazing system while 3% of the respondents indicated that they used the open grazing system. From these findings we can therefore deduce that the farmers were very attentive in feeding their cows.

4.4.2 Type of Forage Feeds Used

In determining the type of forage feeds the respondents used to feed their animals the results are as shown in Table 4. 19.

Table 4.19: Type of Forage Feeds Used

Type of forage	Frequency	Percentage
Natural grass	70	52.2
Napier grass	62	46.3
Hay	1	0.7
Silage	1	0.7
Total	**134**	**100.0**

Majority of respondents (52.2%) indicated that they fed their animals using natural grass,46.3% indicated that they fed their animals using napier grass while 0.7% indicated that they fed their animals using hay and silage respectively. From these findings we can therefore infer that respondents largely use natural grass because it was readily available and cheap to obtain.

4.4.3 Type of Proteineous Feed Used To Feed Cattle

Table 4. 20 show the type of proteineous feed used to feed cattle

Table 4. 20: Type of Proteineous Feed Used To Feed Cattle

Type of Proteineous Feed	Frequency	Percentage
Calliandra	42	31.3
Lucerne	12	9.0
Sweet potato vines	34	25.4
Dairy meal	46	34.3
Total	**134**	**100.0**

According to the findings,34.3% of the respondents indicated that they fed their animals using dairy meal, 31.3% of the respondents indicated that they fed their animals using Calliadra,25.4% of the respondents indicated that they fed their animals using sweet potato vines while 9% of the respondents indicated that they fed their animals using Lucerne. From these findings we can therefore deduce that the cows receive a ration balanced in energy, protein and minerals.

4.4.4 The Feed That Gives Increased Milk Production

The study sought to find out the feed that gave increased milk production. The Table 4.21 show the results.

Table 4. 21: The Feed That Gives Increased Milk Production

Type of feed	Frequency	Percentage
Calliandra	3	2.2
Lucerne	6	4.5
Sweet potato vines	5	3.7
Dairy meal	120	89.6
Total	**134**	**100.0**

From the findings, 89.6% of the respondents indicated that dairy meal gave increased milk production, 4.5% of the respondents indicated that Lucerne gave increased milk production, 3.7% of the respondents indicated that sweet potato vines gave increased milk production while 2.2% of the respondents indicated that Calliadra gave increased milk production. These findings infer that dairy meal had the right balance protein ration which led to increased milk production.

4.4.5 Feeding of Cows With animal Mineral Supplements

On the question of whether the respondents gave their animals mineral supplements Table 4.22 show the results.

Table 4. 22: Feeding of Cows with Animal Mineral Supplements

Mineral Supplements	Frequency	Percentage
Yes	128	94.8
No	6	5.2
Total	**134**	**100.0**

94.8% of the respondents indicated that they gave their animals mineral supplements while 5.2% of the respondents indicated that they did not give their animals any mineral supplements. We can therefore deduce that the farmers were perfectly aware of the increased milk production which comes with giving the animals mineral supplements.

4.4.6 Frequency of Feeding Cattle with Mineral Supplements

Table 4.23 shows how the respondents answered on how often they gave mineral supplements.

Table 4.23: Frequency of Feeding Cattle with Mineral Supplements

How Often	Frequency	Percentage
Ad Libitum	49	36.6
During Milking Time	77	57.5
Once A week	4	3.0
Once a Month	2	1.5
Never	2	1.5
Total	**134**	**100.0**

According to the findings, 57.5% of the respondents indicated that they gave the supplements during milking time, 36.6% the respondents indicated that they gave the supplements ad Libitum, 3 % of the respondents indicated that they gave the supplements once a week, 1.5% of the respondents indicated that they gave the supplements once a month while 1.5% of the respondents indicated that they never gave the animals supplements. We can therefore deduce that administering the supplements during milking time ensured that the animals have taken up the mineral supplements

4.4.7 The Type of Mineral Supplement Given

Table 4. 24 depict the type of mineral supplement given.

Table 4. 24: The Type of Mineral Supplement Given

Type of Mineral Supplement	Frequency	Percentage
Mineral Bloc	44	32.8
Natural Milking block	3	2.2
High quality mineral mix	82	61.2
Common salt	5	3.7
Total	**134**	**100.0**

The results showed that, 61.2% of the respondents indicated that they gave their animals high quality mineral mix, 32.8% of the respondents indicated that they gave their animals mineral Block, 3.7% of the respondents indicated that they gave their animals common salt while 2.2% of the respondents indicated that they gave their animals natural milking block. From these findings we can therefore infer that the high quality mineral mix supplements contained all the minerals necessary for high milk production.

4.5 Milk Cold Chain

The study sought to identify how milk cold chain influence performance of the dairy industry. This included milk preserving methods used, whether there is a milk cooling facility in the area and how the facility helps in milk marketing.

4.5.1 Milk Preserving Method Used

The study sought to find out how the respondents preserved milk to avoid spoilage (Table 4. 25).

Table 4. 25: Milk Preserving Method Used

	Frequency	Percentage
Sell Immediately	83	61.9
Cold water Cooling	8	6.0
Take to the dairy society	43	32.1
Total	**134**	**100.0**

From the findings,61.9% of the respondents indicated that they sold the milk immediately,32.1% of the respondents indicated that they cooled the milk in cold water while 6% of the respondents indicated that they took the milk to the dairy society to avoid spoilage. We can therefore deduce that milk was usually delivered soon after milking because it has a short self-life if left to stay in the natural environment.

4.5.2 Milk Cooling Facility In The Area

Table 4.26 shows the responses of the respondents indicating whether there was a milk cooling facility in the area.

Table 4.26: Milk Cooling Facility In The Area

Any Milk Cooling Facility	Frequency	Percentage
Yes	44	32.8
No	90	67.2
Total	**134**	**100.0**

The results depicts that 67.2 % of the respondents indicated that there was a milk cooling facility in the area while 32.8% of the respondents indicated that there was no milking facility in the area. From these findings we can therefore deduce that the dairy farmers had to deliver the milk soon after milking since tropical environmental conditions make it difficult to keep milk without refrigeration.

4.5.3 Usefulness of Milk Cooling Facility in Milk Marketing

The study sought to find out how the milk cooling facility helped in milk marketing (Table 4. 27).

Table 4. 27: Usefulness of Milk Cooling Facility in Milk Marketing

	Frequency	Percentage
Enable to sell milk from the morning milking	6	4.5
Enable to sell milk from the evening milking	124	92.5
Does not help at all	4	3.0
Total	**134**	**100.0**

The majority of the respondents (92.5%) indicated that the milk cooling facility enabled them to sell milk from the evening milking, 4.5% indicated that the milk cooling facility enabled them to sell milk from the morning milking while 3% indicated that the milk cooling facility did not help at all in milk marketing. Therefore we can conclude that the milk cooling facility enhances milk marketing.

4.6 Milk marketing

The study sought to establish how milk marketing influence performance of the dairy industry which included finding out average monthly milk sales, average price of milk during dry and wet seasons, number of milk processor in the area, average monthly income from milk sales, milk marketing channels, any other activity done for a living whether dairy farming is profitable, production levels to start looking for external market and the contribution of various players in the dairy industry.

4.6.1 Average Monthly Milk Sales

The Table 4. 28 show how the respondents responded on their average monthly milk sales

Table 4. 28: Average Monthly Milk Sales

Litres	Frequency	Percentage
50-100	15	11.2
101-150	12	9.0
151-200	16	11.9
201-250	28	20.9
251-300	18	13.4
Above 300	45	33.6
Total	**134**	**100.0**

According to the findings,33.6% of the respondents indicated that their average monthly milk sales was above 300 litres,20.9% of the respondents indicated that their average monthly milk sales was between 201-250 litres,13.4% of the respondents indicated that their average monthly milk sales was between 251-300 litres, 11.9% of the respondents indicated that their average monthly milk sales was between 151-200 litres,11.2% of the respondents indicated that their average monthly milk sales was between 50-100 litres while 9% of the respondents indicated that their average monthly milk sales was between 101-150 litres. From these findings we can therefore deduce that the farmers recorded relatively high monthly sales, which was as a result of good marketing.

4.6.2 Average Price of Milk Sales

The study sought to find the average price of milk during the wet season and dry season.

Milk Price During The Wet Season

The average price of milk sales during the wet season are shown in Table 4.29.

Table 4. 29: Milk Price During The Wet Season

Price	Frequency	Percentage
Kshs 26-27	53	39.6
Kshs 28-29	29	21.6
Kshs 30-31	48	35.8
Above Kshs 32	4	3.0
Total	**134**	**100.0**

From the findings, 39.6% of the respondents indicated that the average price of milk sales ranged between Kshs 26-27,35.8% of the respondents indicated that the average price of milk sales ranged between Kshs 30-31,21.6% of the respondents indicated that the average price of milk sales ranged between Kshs 28-29 while 3% of the respondents indicated that the average price of milk sales ranged above Kshs 32. From these findings we can therefore deduce that during the wet season milk supply was high thus registering a low average price.

Milk Price During The Dry season

The average price of milk sales during the dry season are shown in Table 4.30.

Table 4. 30: Milk Price During The Dry season

Price	Frequency	Percentage
Kshs 26-27	11	8.2
Kshs 28-29	10	7.5
Kshs 30-31	91	67.9
Above Kshs 32	22	16.4
Total	**134**	**100.0**

The study sought to find out the average price of milk sales during the dry season ,from the findings 67.9% of the respondents indicated that the average price of milk sales ranged between Kshs 30-31,16.4% of the respondents indicated that the average price of milk sales ranged above Kshs 32,8.2% of the respondents indicated that the average price of milk sales ranged between Kshs 26-27 while 7.5% of the respondents indicated that the average price of milk sales ranged ranged between Kshs 28-29. From these findings we can therefore deduce that during the dry season milk supply was low and thus farmers took advantage of the situation and sold the milk at high prices.

4.6.3 Average Price Offered By Milk Buyers

The average price offered by milk buyers are shown in Table 4. 31

Table 4. 31: Average Price Offered By Milk Buyers

Price	Frequency	Percentage
Kshs 26-27	15	11.2
Kshs 28-29	18	13.4
Kshs 30-31	95	70.9
Above Kshs 32	6	4.5
Total	**134**	**100.0**

In determining the price offered by various milk buyers, majority (70.9%) of the respondents indicated that the buyers offered Kshs 30-31, 13.4% of the respondents indicated that the buyers offered Kshs 28-29, 11.2% of the respondents indicated that the buyers offered Kshs 26-27 while 4.5% of the respondents indicated that the buyers offered above Kshs 32.We can therefore deduce that the milk buyers offered relatively good prices.

4.6.4 Number of Milk Processors in The Area

Table 4.32 shows the number of milk processors in the area,

Table 4. 32: Number of Milk Processors in The Area

Number of Milk Processors	Frequency	Percentage
None	64	47.8
One processor	39	29.1
Two and Above processors	31	23.1
Total	**134**	**100.0**

The results shows that 47.8% of the respondents indicated that there weren't milk processors in the area, 29.1% of the respondents indicated that there was one processor in the area while 23.1% of the respondents indicated that there were above two processors in the area. Therefore we can deduce that milk was rarely processed into products that have a longer self-life.

4.6.5 Average Monthly Income From the Dairy Farming

Table 4. 33 show the average monthly income the respondents got from their dairy farm.

Table 4. 33 Average Monthly Income From the Dairy Farming

Income	Frequency	Percentage
Kshs 1000-5,000	49	36.6
Kshs 5,000-10,000	84	62.7
Over Kshs 10,000	1	0.7
Total	**134**	**100.0**

The study sought to find the average monthly income the respondents got from their dairy farm, From the findings,62.7% of the respondents indicated that they earned between Kshs 5,000-10,000,36.6% of the respondents indicated that they earned between Kshs 1000-5,000 while

0.7% of the respondents indicated that they earned over Kshs 10,000.We can therefore deduce that the respondents were able to sustain their lives through dairy farming.

4.6.6 Milk Marketing Channels

Pertaining to the marketing channels in milk marketing, the results are shown in Table 4. 34

Table 4. 34: Milk Marketing Channels

Milk Marketing Channels	Frequency	Percentage
Sale to neighbours	30	22.4
Local shops/hotels	16	11.9
Brokers/middlemen	46	34.3
Dairy cooperative society	40	29.9
Milk processor	2	1.5
Total	**134**	**100.0**

The results show that 34.3% of the respondents indicated that they used brokers/middlemen to market their milk, 29.9% of the respondents indicated that they used Dairy cooperative society to market their milk, 22.4% of the respondents indicated that they sold to neighbors, 11.9% of the respondents indicated that they used local shops/hotels to market their milk while 1.5% of the respondents indicated that they used milk processor to market their milk. We can therefore deduce that the respondents preferred marketing their milk using brokers since they were flexible and available.

4.6.7 Any Other Activity Done For A Living

The study sought to find out the other income generating activity the respondents engaged in apart from dairy farming. Table 4.35 shows the responses.

Table 4.35: Any Other Activity Done For A Living

Other Activity	Frequency	Percentage
Formal Employment	28	20.8
Informal employment	8	6.0
Business	21	15.7
Crop farming	77	57.5
Total	**134**	**100.0**

The results show that 57.5% of the respondents indicated that they did crop farming,20.8% of the respondents indicated that they were in formal employment,15.7% of the respondents indicated that they were in business while 6% of the respondents indicated that they were in informal employment. We can therefore deduce that the farmers chose to do crop farming as a means to supplement for the cows food and also made use of the manure they got from the cows to do crop farming with.

4.6.8 Dairy Farming Profitability

Table 4.36 show the findings on whether dairy farming was profitable.

Table 4. 36: Dairy Farming Profitability

	Frequency	**Percentage**
Yes	128	95.5
No	6	4.5
Total	**134**	**100.0**

According to the findings, 95.5% of the respondents indicated that dairy farming was profitable while 4.5% of the respondents indicated that dairy farming wasn't profitable. From these findings we can therefore infer that the respondents were able to sustain their lives from the proceeds they got from dairy farming.

4.6.9 Production Levels Looked For In An External Market

In determining the productions levels at which the respondents looked for an external market, the results are shown in Table 4. 37

Table 4.37: Production Levels Looked For In An External Market

Litres	**Frequency**	**Percentage**
1-5	36	26.7
6-20	61	45.5
Over 20	37	27.6
Total	**134**	**100.0**

45.5% of the respondents indicated that it was between 6-20 litres,27.6% of the respondents indicated that it was over 20 litres while 26.7% of the respondents indicated that it was between 1-5 litres. This results show that majority of the farmers preferred marketing their milk externally.

4.6.10 Contribution of the Dairy Industry Players

Table 4.38 shows that the respondents very strongly agreed that the Ministry of Cooperative Development, processors and Financial Institutions were important as indicated by a mean of 3.4851, 3.1119 and 3.0448 respectively, the respondents strongly agreed that dairy cooperative societies, Ministry of Livestock Development and Livestock Service providers were important as indicated by a mean of 2.9701, 2.6493 and 2.2985 respectively. Inferences can therefore be made that the Ministry of Cooperative Development was a key player in the dairy industry.

Table 4. 38 Contribution of the Dairy Industry Players

Player	N	Mean	Std. Deviation
Ministry of Cooperative Development	134	3.4851	3.69054
Ministry of Livestock Development	134	2.6493	4.17342
Dairy cooperative societies	134	2.9701	1.47123
Processors	134	3.1119	1.16761
Financial Institutions	134	3.0448	2.07334
Livestock Service providers	134	2.2985	3.29509

4.7 Correlation Analysis

In order to establish the relationship between the dependent and independent variables, Pearson correlation analysis was used. The results are shown in Table 4. 39.

Pearson's correlations analysis was then conducted at 95% confidence interval and 5% confidence level 2-tailed. The Table 4.39 indicates the correlation matrix between the factors (quality of breeds, type of feeds, milk cold chain, milk marketing) and performance of dairy industry. According to the table, there is a positive relationship between performance of dairy industry and quality of breeds, type of feeds, milk cold chain and milk marketing of magnitude

0.818, 0.803, 0.702 and 0.679 respectively. The positive relationship indicates that there is a correlation between the factors and the performance of dairy industry. This infers that quality of breeds has the highest effect on performance of dairy industry, followed by type of feeds, then milk cold chain while milk marketing having the lowest effect on the performance of dairy industry. This notwithstanding, all the factors had a significant p-value ($p<0.05$) at 95% confidence level. The significance values for relationship between performance of dairy industry and quality of breeds, types of feeds, milk cold chain and milk marketing were 0.008, 0.009, 0.033 and 0.048 respectively. This implies that quality of breeds was the most significant factor, followed by type of feeds then milk cold chain while milk marketing was the least significant.

Table 4.39: Correlation Matrix

		Performance of dairy industry	Quality of Breeds	Types of feeds	milk cold chain	milk marketing
Performance of dairy industry	Pearson Correlation	1				
	Sig. (2-tailed)	.				
Quality of Breeds	Pearson Correlation	.818	1			
	Sig. (2-tailed)	.008	.			
Type of feeds	Pearson Correlation	.803	.522	1		
	Sig. (2-tailed)	.009	.017	.		

Milk cold chain	Pearson Correlation	.702	.792	.507	1	
	Sig. (2-tailed)	.033	.016	.098	.	
Milk marketing	Pearson Correlation	.679	.573	.720	.541	1
	Sig. (2-tailed)	.048	.019	.012	.004	.

CHAPTER FIVE

SUMMARY OF THE FINDINGS, DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the findings, the discussion of key data findings, conclusions drawn from the findings highlighted and recommendation made there-to. The conclusions and recommendations drawn were focused on addressing the objectives of the study.

5.2 Summary of Findings

The following is a summary of the findings.

5.2.1 Quality of Breeds

This study revealed that Friesians was the highly reared cattle breed and that majority of the dairy farmers were milking only one cow. The study also revealed that the average milk production during the dry season was between 6-10 litres and that during the wet season was above 10 litres. The study further revealed that the dairy farmers had experienced cases of mastitis. The dairy farmers also established that the cows took between 11-15 months to calf. It was also established that they used artificial insemination for breeding and that they preferred breeding Friesian using artificial insemination. The study further established that they preferred breeding Friesians because of high milk production and that they were easy to feed.

5.2.2 Type of Feeds

The study found out that majority of the dairy farmers used the zero grazing system. The study also found out that the farmers fed their animals using natural grass and dairy meal. The study further found out that dairy meal gave increased milk production. The study also established that the farmers gave their animals mineral supplements during milking time. The study further established that the farmers preferred giving their animal's high quality mineral mix.

5.2.3 Milk Cold Chain

The study established that the dairy farmers sold the milk immediately to avoid spoilage. The study also established that there was a milk cooling facility in the area. The study further established that the milk cooling facility enabled them to sell milk from the evening milking.

5.2.4 Milk Marketing

The study found out that the average monthly milk sales was above 300 litres. The study further found out that the average price of milk sales ranged between Kshs 26-27 during the wet season and that the average price of milk sales ranged between Kshs 30-31 during the dry season. The study established that there were no milk processors in the area. The study revealed that the farmers earned an average monthly income of between Kshs 5,000-10,000.The study established that the farmers preferred using brokers/middlemen to market their milk. The study further established that the farmers also did crop farming for a living. The study also revealed that dairy farming was profitable. The study also found out the Ministry of Cooperative Development, processors and Financial Institutions were important players in the dairy industry.

5.3 Discussion of key findings

The discussions of the findings of the study are given following objectives of the study.

5.3.1 Quality of Breeds

This study revealed that Friesian was the highly reared cattle breed. According to Ngigi (2005) among the exotic high milk producing breeds introduced in the country Friesians gives the highest milk volume production. The study also revealed that majority of the dairy farmers were milking only one cow. Ngigi (2005) further argues that most smallholders start very poor and struggle to acquire their first cow as a means to get out of poverty and to sustain their household. Therefore, owning a cow is a means of survival. The study further revealed that the dairy farmers had experienced cases of mastitis. This is in line with the literature review where Thirapatsakun (1989) states that unhealthy udders which are mostly attributed to mastitis, regardless of the causes, definitely produce bad quality milk, either in terms of milk composition or bacterial contamination. It was also established that they used artificial insemination for breeding. The introduction in Kenya of the Artificial Insemination (AI) in 1935 made possible the improvement of milk yields by crossing low-yielding but essentially more disease resistant local breeds (*Bos indicus)* with exotic breeds (*Bos taurus)* (Ngigi, 2005).

5.3.2 Type of Feeds

The study found out that majority of the dairy farmers used the zero grazing system. If a cow is kept under zero grazing, feeding needs even more attention as she will entirely depend on how the farmer feeds her (Food and Agriculture Organization, 2010). The study also found out that

the farmers fed their animals using natural grass and dairy meal. These feeds are usually grown on the farm and are the cheapest to feed to the cow. Good quality roughage is the basis of a high milk production Milk production is more efficient than beef production when the nutritional potential of the feed resource base is high and therefore capable of supporting high levels of

production (Dairy Master Plan, 2010). The study also established that the farmers gave their animals mineral supplements during milking time. A dairy cow requires feed for the following purposes: milk production, body maintenance, her own growth and the growth of the calf (if pregnant). This implies that the cow should receive a ration balanced in energy, protein and minerals. Unbalanced ration leads to decreased milk production, poor body condition of the cow and fertility problems. Good feeding leads to higher milk production, good health, and more calves. The study further established that the farmers preferred giving their animal's high quality mineral mix. According to Dairy Master Plan (2010) minerals (for example calcium, phosphorus, magnesium, copper, salt,) supplements are very important for a dairy cow.

5.3.3 Milk Cold Chain

The study established that the dairy farmers sold the milk immediately to avoid spoilage. Grimaud et.al. (2007) argues that once the cows are milked, tropical environmental conditions make it difficult to keep milk without refrigeration, so milk is usually delivered soon after milking because it has a short self-life if left to stay in the natural environment. The study also established that there was a milking facility in the area. Grimaud (2007) states that milk cooling facility help in ensuring that improvement of milk handling and storage conditions to maintain the cold chain are put in place.

5.3.4 Milk Marketing

The study found out that the average monthly milk sales was above 300 litres. Leksmono, 2006) noted that the re-launch of Kenya Creameries Cooperative(KCC) has broadened the competition in the formal market segment, contributing to better farm milk sales and the current relative exuberance in the dairy sector. Confidence that production will grow again comes from the entry of new players into the dairy sector since the revival of KCC. All this has led to farmer confidence that his income is better and is assured. The study further found out that the average price of milk sales ranged between Kshs 26-27 during the wet season and that the average price of milk sales ranged between Kshs 30-31 during the dry season. According to the Food and

Agriculture Organization (2010) stated that higher prices and a correspondingly higher value of milk production have also set the dairy sector among the highest gross value sectors in agriculture. However, high prices can also have negative consequences for the dairy industry. Under very high prices, demand may retreat and dairy ingredients can be replaced by cheaper substitutes in food manufacturing. The study revealed that the farmers earned an average monthly income of between Kshs 5,000-10,000 the Food and Agriculture Organization (2010) noted that dairy farming offered a regular and reliable source of income for farmers. The study also revealed that dairy farming was profitable. Leksmono (2006) argues that dairy farming is profitable compared to crop farming. This is because crop production depends on rain; it is prone to both drought and floods, rendering agricultural income uncertain for most farmers. The study also found out the ministry of cooperative development, processors and financial Institutions were important players in the dairy industry. According to Wanyama et. al. (2008) Co-operatives have significantly contributed to the mobilization and distribution of financial capital by creating employment and income generating opportunities for both their members and non-members alike.

5.4 Conclusions

The research was guided by four research objectives. The following conclusions were made from the study.

1. There is a positive relationship between quality of breeds and the performance of the dairy industry. The current milk production level per day can be improved through improved breeding programmes by use of high milk producing genetics. This will, however, only occur if there is investment in market infrastructure and general improvement in the economy.

2. There is a positive relationship between type of feeds and the performance of the dairy industry. This is to mean that improved feed availability and quality will be a key strategy to realize the largest proportion of the needed animal productivity levels and supporting animal population increases. Feeding is the major constraint to achieving the targeted milk production because of heavy dependency on rain-fed forage and pasture production while there is poor adoption of conservation of animal feeds to smoothen seasonal fluctuations in milk production.

3. There is a positive relationship between milk cold and the performance of the dairy industry. Proper management of every link of the Cold Chain constitutes an integral part in the production and delivery of wholesome milk and dairy products to the consumers.

4. There is a positive relationship between milk marketing and the performance of the dairy industry. This is because a well-integrated market system is necessary for an efficient allocation of productive resources, which contributes to regional food security and a reduction of price risks by preventing unnecessary price volatility.

5.5 Recommendations

From the study findings and conclusions, the study recommends the following.

1. The dairy industry should invest in milk market infrastructure which will subsequently improve breeding programmes.

2. The study also recommends that the dairy industry should focus on improved feed availability and quality as a key strategy to realize the largest proportion of the needed animal productivity levels and supporting animal population increases. The study found that good quality roughage is the basis of a high milk production. Roughages like maize stovers, banana stems, yellowish Napier grass and silage of Napier grass are low in protein therefore in order to compensate for this shortage the study recommends that roughages rich in protein like Leucaena, desmodium, sweet potato vines, leaves of fodder trees for example Leucaena, calliandra, should be added to balance the ration.

3. The dairy farmers should embark on establishing and sustaining of a Milk Cold Chain since it is an essential ingredient for upholding the safety of consumers and the protection of public health while preserving the nutritional and sensory qualities of perishable food products such as milk and dairy products.

5.6 Suggestions for Further Studies

From this study the following areas were found to be in need of information and further research might be required'

1. Another study should be done to investigate on the factors influencing performance of the dairy industry in other districts to allow for generalization.

2. Further studies should be done on the challenges facing the dairy industry in Meru Central District.

3. Further study is also suggested on effects of livestock disease control on performance of the dairy industry in Meru Central District.

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APPENDICES

Appendix 1. Introductory Letter To Participants

Joseph M. Kinyenje

P.O. Box 1705

MERU

Dear Respondent,

RE: DATA COLLECTION FOR RESEARCH PROJECT

I am a postgraduate student of the University of Nairobi, pursuing a Degree of Master of Arts in Project Planning and Management. I am conducting a research on factors influencing performance of the dairy industry in Meru Central District, Kenya: A case of Katheri Dairy Co-Operative Society. You have been selected to help in this study and I do humbly request you to fill the questionnaire honestly and faithfully. The information being sought is meant for research purpose only and will not be used against anyone. No names of individuals or farms will be needed. The information that you will give will be treated confidentially. There will be no implications that can lead to prosecution resulting from your involvement in the study.

Thank you in advance.

Yours Faithfully,

Joseph M. Kinyenje

Reg. No. L50/77613/2012

Appendix 2. Questionnaire For Dairy Farmers

Please read the questions carefully and please tick inside the appropriate box .and fill in the blank spaces provided.

Section A; Background Information

1) Please indicate your gender.

a) Male ☐

b) Female ☐

2) Please indicate you age.

a) 15-25 years ☐

b) 26 -40 years ☐

c) 41-60 years ☐

d) Above 60 years ☐

3) Please indicate your marital status.

a) Married ☐

b) Single ☐

c) Divorced ☐

d) Windowed ☐

4) Please indicate your education level.

a) Degree ☐

b) Diploma ☐

c) Certificate ☐

d) Any other……

5) Are you the head of the household?

a) Yes ☐

b) No ☐

6) How many acres of land do you own? ……

Section B. cattle breeds

1) Which cattle breeds do you keep?

   a) Friesian ☐

   b) Ayrshire ☐

   c) Guernsey ☐

   d) Jersey ☐

   e) Any other……

2) How many cows are you milking? .....

3) What is the average milk production per day? During dry season …… during wet season……..

4) In the last one year have you experienced any cases of mastitis?

   a) Yes ☐

   b) No ☐

5) After the last calf, how long do your cows take to get another calf? …….months

6) Do you use artificial insemination for breeding your cattle?

   a) Yes ☐

   b) No ☐

7) Which is your preferred breed when using artificial insemination?

   a) Friesian ☐

   b) Ayrshire ☐

   c) Guernsey ☐

   d) Jersey ☐

   e) Any other……

8) Why do you prefer the above breed?

a) High milk production ☐

b) Easy to feed ☐

c) Beautiful colour ☐

d) No idea ☐

Section C: Types of Feeds

1) What is your dairy farming system?

   a) Zero- grazing ☐

   b) Semi-zero grazing ☐

   c) Open grazing ☐

2) What type of feeds to you normally feed you animals with? (tick all that apply)

   a) Natural grass ☐

   b) Napier grass ☐

   c) Hay ☐

   d) Silage ☐

   e) Any other ……..

3) Do you feed your cattle with the following? (tick all that apply)

   a) Calliadra ☐

   b) Lucerne ☐

   c) Lucaenia ☐

   d) Dairy meal ☐

4) From your experience which feed(s) gives increased milk production? ……

5) Do you give your animals mineral supplements?

   a) Yes ☐

   b) No ☐

6) How often do you give mineral supplements?

   a) Ad libitum ☐

b) During milking time ☐

c) Once a week ☐

d) Once a month ☐

e) Never ☐

7) Which type of mineral supplements do you give your animals?

a) Mineral block ☐

b) Natural Mineral Block ☐

c) High quality mineral mix ☐

d) Common salt ☐

Section D: Milk cold chain

1) How do you preserve milk to avoid spoilage?

a) Sell immediately ☐

b) Cold water cooling ☐

c) Take to the dairy society ☐

2) Is there a milk cooling facility in your area?

a) Yes ☐

b) No ☐

3) How does the milk cooling facility help in milk marketing?

a) Enable to sell milk from the morning milking ☐

b) Enable to sell milk from the morning and evening milking ☐

c) Does not help at all ☐

Section E: Milk marketing

1) What are your average monthly milk sales? …… litres.

2) What is the average price of milk sales, during the wet season and the dry season?

Wet season ……. Per litre

Dry season ……. Per litre

3) On average what price is offered by various milk buyers ? Ksh…….. per litre

4) How many milk processors are there in your area? .....

5) Generally what is the average monthly income from your dairy farming?

a) Less than Ksh. 1,000 ☐
b) Between Ksh.1,000-5,000 ☐
c) Between Ksh.5,000-10,000 ☐

6) Which milk marketing channel(s) do you use to marketing your milk? (Tick all that apply)

a) Sale to neighbours ☐
b) Local shops/hotels ☐
c) Brokers/middlemen ☐
d) Dairy cooperative society ☐
e) Milk processor ☐

7) Apart from dairy farming, what else do you do for a living?

a) Formal Employment ☐
b) Informal employment ☐
c) Business ☐
d) Crop farming ☐

8) In your opinion do you consider dairy farming as profitable?

a) Yes ☐
b) No ☐

9) At what production levels do you look for an external market?

a) 1-5 litres ☐
b) 6-10 litres ☐
c) Over 10 litres ☐

10) Rate the importance of contribution of the following players to a dairy industry Comment on areas you feel they should have influence on;

1 Very Strong 2. Strong 3. No Influence 4. Weak 5. Very Weak

Player	**Rate**	**Comment**
Ministry of Cooperative Development		
Ministry of Livestock Development		

Dairy cooperative societies		
Milk Processors		
Financial Institutions (banks etc.)		
Livestock Service providers (extension, A.I., Agrovets, etc.)		

Thank very much you for your participation and cooperation

Appendix 3. Questionnaire for key informants

Please read the questions carefully and please tick inside the appropriate box .and fill in the blank spaces. Your involvement in this study is highly appreciated.

1) Name the Organization/Ministry/Department you work in ……

2) What is your position in the organization you work in? …….

3) What period of time have you worked in that position?

   a) 1-5 years ☐

   b) 5-10 years ☐

   c) Over 10 years ☐

4) Which milk processors operate in the area……...

5) Name the dairy cooperative societies operating in Meru Central District ……
   ……...……..

6) Rate the performance of the dairy industry in Meru Central District in terms of economic development as follows;

1- Very Satisfied; 2- Satisfied; 3-Neutral; 4- Dissatisfied; 5 Very Dissatisfied

Indicator	Rating	Comment
Performance of dairy cooperative societies in Meru Central District		
Veterinary services provision to dairy farmers		

Credit accessibility to dairy farmers		
Access to inputs and services to dairy farmers		
Diversification to investments by dairy cooperative societies		
Prices of milk offered		
Quality of dairy breeds		
The quality of feeds		
Rural infrastructure(roads)		
Adoption of high milk producing cows		
Adoption of artificial insemination by dairy farmers		

7) How many milk coolers are installed in Meru Central District? ……

8) In your opinion are milk coolers enough in Meru Central District to promote milk marketing?

   a) Yes ☐

   b) No ☐

9) How many transport containers with coolers are there in your area of operation? ……

10) Give two suggestions which can help improve performance of the dairy industry in Meru Central District?

……

……

……

……

Thank very much you for your participation and cooperation

Appendix 4. Sampling Size Table

	Sample size (n) for Precision (e) of:			
Size of Population	**+/- 3%**	**+/- 5%**	**+/- 7%**	**+/- 10%**
500	**a**	222	145	83
600	**a**	240	152	86
700	**a**	255	158	88
800	**a**	267	163	89
900	**a**	277	166	90
1,000	**a**	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
Over 100,000	1,111	400	204	100

a - Assumption of normal approximation is poor (Yamane, 1967). The entire population should be sampled.