# INFLUENCE OF INFRASTRUCTURE DEVELOPMENT ON MILK SALES VOLUMES IN CHESUMEI SUB COUNTY, NANDI COUNTY KENYA.

BY

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# A PROJECT SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENT OF THE DEGREE OF MASTER OF ARTS IN PROJECT PLANNING AND MANAGEMENT IN THE UNIVERSITY OF NAIROBI

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## DECLARATION

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

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This project has been submitted for examination with my approval as University supervisor.

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## **DEDICATION**

I dedicate this study to my husband Barnaba Sawe who has financed my education and encouraged me at hard times and my children Mercy, Cynthia, Bethwel and Brimins who gave me humble time to concentrate on my studies.

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## LIST OF ABBREVIATION AND ACRONYMS

GDP Gross Domestic Product AADT Average Annual Daily Traffic. CSD Context Sensitive Design. DOLIDAR Department of Local Infrastructure Development and Agricultural Roads. FAO Food Agricultural Organization IMT Intermediary Mode of Transport ISO International Standards Organization ITTCC International Telegraph and Telephone Consultative Committee. KEBS Kenya Bereu of Statistics KCC Kenya Cooperative Creameries KNBS Kenya National Bureau of Statistics KRB Kenya Roads Board LVR Low Volume Roads. NGDP National Gross Domestic Product RICS Road Inventory and Condition Survey. RAI Rural Accessibility Index. RR Rural Roads. TRB Transportation Research Board.

## ABSTRACT

Agriculture, in Kenya, is the backbone of the economy. Its contribution to the Gross Domestic Product is much higher than other contributors of the economy such as tourism. According to Muriuki (n.d.) agriculture is subdivided into sub-sections. One of the sections is livestock production which entails the dairy industry. Unlike in the past, smallholder production of milk is now becoming commercial or market oriented. As a result of the changed market orientation of milk, responsible stakeholders have gone ahead to develop what is called collection centers. Like any other economic activity, dairy farming is dependent on infrastructure. A geographical study of Chesumei Sub County, Nandi County reveals that infrastructure is found both in the rural and urban areas. The infrastructure was affected by rains and bad weather conditions. Therefore, when it is raining they hinder transportation because of the state they are in. So, the main reason for this research was to examine the specific influence of infrastructure on milk sales volume by dairy farmers. The research obtained its data from questionnaires which were administered by the researcher and interview assisted by a research assistant. Descriptive research design and snowball techniques were used in the research. The study targeted a population of 1000 who are the dairy farmers in the area of study and to whom the sample size was chosen from. A simple random technique was used to choose the subjects participating in the study, by administering 286 questionnaires. Target population for the study was farmers in Chesumei Sub County with a target of 1000respoedents. The sampling procedure used was snow balling arriving at a sample size of 286 respondents. Non probability method was used during the data collection method. The researcher used questionnaires to collect the data from the field which had both open ended and closed ended questions. A pilot study was done to test the validity and reliability of the research instruments. This was done by obtaining the Cronbachs alpha of the study. Data was analyzed using SPSS to obtain the descriptive data such as frequencies, and percentages of the respondents. Inferential statistics was also used to obtain the influence of various variables on sales of milks as per the conceptual framework. Descriptive analysis allows the researcher to retrieve percentages and counts participant's views on the influence of rural roads access on milk delivery to collection centers in Chesumei Sub County, Nandi County Kenya. The findings of the study were presented in table and conclusion was drawn from them. The study indicated that transportation, telecommunication, energy and water and sanitation did influence the amount of milk sales during the study and came up with the recommendations that farmers be sensitized in order to understand the importance of these factors and the solutions from themselves, County Government and National Government.

#### **CHAPTER ONE**

### Introduction

## 1.1 Background of the Study

Milk, opaque whitish or yellowish liquid secreted by the mammary glands of female mammals for their nourishment of the young (Encarta 2008). In the global perspective, Faiz, et al (2012) and Cotton, (2011), while carrying research on rural transportation and their influence on human livelihood noted that through green, eco-friendly, and people-friendly roads, not only environmental concerns such as water quality, land conservation, and wildlife protection are addressed, but livability in rural neighborhoods is enhanced by traffic calming, speeds limiting, noise, safety hazards and Agricultural productivity and profitability. Livability goals and objectives in transportation have drawn the interest and attention of transportation leaders across the United States, including the U.S. Secretary of Transportation and the FHWA Administrator (Rousseau, 2010). In developed countries such as USA, Britain, Germany, Australia and others, transportation is characterized by the volume of traffic that use per day thereby referred as mostly the low-volume roads and they are the lower order of the worldwide land transport.

According to the World Bank, (2010) statistics the low-volume roads cover 30 million kilometers connecting the world's population, while 31% of this population does not have adequate access to transport. A larger percentage of the population come from developing countries, who do not have even the all-weather roads, which are key measures to development of agriculture and other rural related development activities.

The United States has the largest road system in the world of over 6.52 million Kilometers by 2008 with 67% paved (Highway Statistics 2008). The road network for sub-Sahara Africa countries including Djibouti, Mauritania, South Sudan and South Africa, has an average of 20.6% paved while the rest of the rural roads are not paved and found in the rural areas where most of the Agricultural activities are conducted (Rural Roads, 2011)

Germany is the most important milk producing country within the EU, accounting for nearly20 % of total EU milk production. The number of milk farmers has decreased by 60.4 % from 278,000 in 1990 to 110,000 in 2005. Nevertheless, the average number of cows per farm is only 38 (ZMP, 2006). This is quite small compared to other relevant EU milk producing countries such as the UK which has an average herd size of 79 per farm. The processing level is also facing considerable structural changes. Within the last 16 years, the number of dairies in Germany has decreased by 71.9 % from 360 in 1990 to 101 in 2006 (MIV, 2007). Even though with 101 enterprises in 2006 the number of processors is still rather high compared to countries such as Denmark or the Netherlands, a considerable loss of farmers' market power seems to be evident. The market share of the five largest processors in Germany (Nordmilch, Humana Milchunion,

Müller, Hochwald and Campina Germany) totaled up to 33 % in 2005 (Deutsche Milchwirtschaft, 2006). Due to overcapacities, the dairies are in a highly competitive situation with respect to raw milk procurement. The world market is currently characterized by a strong demand pull. The raw milk market is regionally limited because of product specificities, namely the perishableness. Due to transportation cost considerations, the radius of milk hauling will only seldom be above 200km around the plant. Thus, several dairies are in strong competition for the same suppliers.

China has not traditionally presented significant opportunities for foreign dairy companies, but the tastes of Chinese consumers are changing fast and this has been reflected in the recent rapid growth in sales of dairy products (KPMG 2008). As retail buyers have squeezed the margins in Europe and North America, Asia has become an increasingly attractive market, particularly for suppliers based in Australia and New Zealand. In 2006, total dairy consumption in China reached 19 million tones and the market has grown at a compound annual growth rate of over 10 percent since 2003. Consumption per capita is still low and the chilled product supply chain is still developing, so companies need the right strategy to identify areas of opportunity, penetrate the market and distribute their products effectively.

While per capita consumption levels are low, the size of the market and its potential for sustained growth mean China's impact can no longer be ignored.

Demand from China is already having a bearing on market prices for many dairy products across the world.

This report, produced by KPMG China's Commercial Due Diligence team, focuses mainly on the growth in demand for staple milk products in China, but will also be relevant to anyone involved in producing and trading other dairy-related products such as butter fats and ice cream. Agriculture, in Kenya, is the backbone of the economy. Its contribution to the Gross Domestic Product is much higher than other contributors of the economy such as tourism. Studies reveal that Agriculture contributes more than 30% of the GDP and over 50% of foreign currency (Muriuki, n.d.). Other than being the backbone of the economy, agriculture has employed many Kenyans; allowing them to meet their daily needs and contribute to the economy.

Radcliffe (2009) studied the South African dairy sector with main focus on transportation of milk to Cooperatives, collection centers and or consumers and found out that the urban dairy farmers had access to good roads while the rural small scale farmers consumed their milk due to high cost of transportation to the urban markets. In Tanzania dairy production has for many years been a communal activity until the introduction of dairy farming as a business by the East Africa Dairy Development (EADD) through local organizations, Mvema, (1991) and Nyange, (1993). The EADD Programme funded by Bill and Melinda Gates Foundation changed the dairy focus to business in Tanzania, Uganda and in Kenya.

According to Muriuki (n.d.) agriculture is subdivided into sub-sections. One of the sections is livestock production which entails the dairy industry. Research by FAO reveals that Kenya's dairy industry is the most advanced in whole of East Africa (Muruiki, n.d.). According to Muia et al (2011) Kenya's dairy industry contributes approximately 14% of agricultural gross domestic product. It also contributes 3.5% of the total gross domestic product (Muia et al., 2011).

Kenya is estimated to have approximately 3.4 million dairy herds. These 3.4 million herds of dairy cattle produce about 3.1 billion litres of milk per year (Kenya National Bureau of Statistics (KNBS), 210). Kenya's dairy industry is dominated by smallholders who own approximately 98% of the total heads of cattle in the country. They contribute 80% of the total milk being produced annually (Stall et al., 2001).Unlike in the past, smallholder production of milk is now becoming commercial or market oriented. This change has been brought about by the changing climate, economic environment and increased pasture production by farmers. Therefore, most farmers are rearing dairy cattle for commercial purposes. With the change in trend industries like Brookside, New KCC and Oldoinyo Lessos have emerged. These industries are responsible for collecting milk from the farmers at a price and processing them into products like cheese (Stall et al., 2001).

As a result of the changed market orientation of milk, responsible stakeholders have gone ahead to develop what is called collection centers. Collection center is described as a central place where all the gallons of milk is assembled for collection by the responsible marketers, buyers or processors which are mostly big organizations like Brookside or cooperative societies. Transportation to collection centers is usually done by bicycle or hand (Stall et al., 2001).

Chesumei Sub County like Central province is one of the leading producers of milk in the country. Dairy farming is considered as one of the main economic activity in the sub county. Smallholder farmers are now practicing dairy farming in a large extent because of the subsidies provided by processing companies. The farmers are encouraged since they can earn from it. According to a survey done by the county government dairy farming has contributed a lot to improving livelihood of the people. Rural roads are an important sector in rural development, which deals in all aspects of development including agriculture, health, education, forestry, fisheries, small-scale industries, trade, commerce etc. that depends on good communication. A rural transportation network will give shape to the living environment of villagers; rather roads of rural transportation are the connectivity elements in our society. Rural road connectivity is not only the key component of Rural Development in Africa; it is also recognized as an effective poverty reduction measure. Improved accessibility to all quarters of a village and the external markets is an indispensable prerequisite for the provision of adequate living conditions in rural areas. The absence of roads in rural areas leads to stagnation of socio-economic conditions of the villagers (Broadman, 2007)

### 1.2 Statement of the Problem.

Dairy farming is an important economic activity in the country. Its contribution to the economic growth of the nation is vital. Studies reveal that dairy farming contributes 3.5% to the GDP. A research done by Muruiki (n.d.) discloses that dairy farming has grown considerably over the years. The growth has changed the perspective of farmers from consumption to commercialization. Farmers are now profit-oriented. The growth has seen processing firms going into villages to collect milk sold to them by the farmers. Since the firms cannot move all over, they have established cooperatives and collection centers where farmers bring their milk. Collection centers vary depending on place and distance. Milk delivery to collection centers is directly dependent on road access. In Kenya today, poor transport infrastructure is recognized as a major milk production and marketing bottleneck as it impedes rapid transport of farm inputs from urban centers to the rural areas and milk from the rural areas to ready urban markets.

A number of studies have been carried out on the influence of roads access on milk delivery to collection centers. The studies have covered a wide scope of the country. However, the studies have some gaps in it. Most of them gave a general idea of the influence. Few studies have taken the initiative of being specific. As a result, stakeholders have a general idea of the influence. The conventional infrastructure variables may also be inappropriate in the sense that they do not represent agriculture-specific infrastructure. Most direct agriculturerelated "infrastructure" may be rural roads and irrigation if applicable (World Bank, 2005; Williams *et al.*, 2006; Buys *et al.*, 2006; Broadman, 2007).Therefore, this study endeavors to carry out a critical examination of the influence of rural roads access on milk delivery to collection centers in Chesumei Sub County, Nandi County Kenya.

#### **1.3 Purpose of the Study**

The purpose of this study was to investigate the influence of infrastructure development on milk sales volumes by farmers' in Chesumei Sub County, Nandi County, Kenya.

## 1.4 Objectives of the Study

The main objective of the study was to examine the influence of infrastructure on milk sales volume by farmers' in Chesumei Sub County, Nandi County, Kenya. The specific objectives were:

i. To establish the influence of transportation on milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya.

- To determine the influence of telecommunication on milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya.
- To assess influence of energy sources on milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya.
- iv. To establish the influence of water sources and uses and sanitation on milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya.

## **1.4.1 Research Questions**

- i. To what extent does transportation influence milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya?
- ii. How does telecommunication influence milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya?
- iii. Does energy influence milk sales volumes by farmers in Chesumei Sub County, Nandi County, Kenya?
- iv. How does water and sanitation influence sales of milk volume of farmers in Chesumei Sub County, Nandi County, Kenya?

## 1.5 Significance of the Study

The findings of this research are of great value to the following stakeholders: researchers and scholars because the study acts as one of the foundation for further research in this field. The researchers used the study to further understand the dairy industry and fundamental factors influencing it. The study also added to the knowledge and findings disclosed by other researchers. The research enlightened the policy makers on the importance of rural roads access in development of the dairy industry.

The study also is of great benefit to farmers and milk processing firms. They will understand the contribution of rural roads to the industry thus appreciating it. It will also assist them come up with techniques that enable them compete with other producers all over the world.

#### **1.6 Basic Assumptions of the Study**

Several assumptions were made in this study. The first assumption was that respondents will return all the questionnaires and they were sincere and honest information concerning rural road access and their delivery of milk to collection centers. Secondly, it was assumed that the findings of this study will be expected to benefit dairy farmers on milk delivery to collection centers and that the recommendations of the study will be accepted by implementing authorities.

### 1.7 Limitations of the Study

The researcher was limited to conducting the study in the rural areas where most smallholder dairy farmers reside and some of the respondents may be illiterate. Secondly, the researcher was limited to the language barrier thus had to look for an interpreter at time when she came across famers that did not understand the national language.

## **1.8 Delimitations of the Study**

The study was confined to the influence of infrastructure on milk sales volume by farmers in Chesumei sub county, Nandi County in Kenya. The study delimited its findings to responses from dairy farmers delivering milk to collection centers in Chesumei Sub County. The study also delimited itself to extraneous variables which are beyond the researcher's control such as respondents' honesty in provision of information. The study was limited to the sample size of 286 selected from a sample population of 1000 farmers in the area of study.

## **1.9 Definition of Significant Terms**

**Infrastructure development:** Physical and organizational structures and facilities in operation needed and used by a society. These facilities keep changing positively for solving and easing the work of the users.

**Dairy farming**: Dairy farming is described as the rearing of cows for milk production purposes. The milk produced in this case can be for domestic consumption or for commercial purposes

**Milk sales volume**: Amount of milk weighted in kilos and sometimes litres that are sold at a given period of time.

**Rural Roads**: They are feeder roads connecting to other bigger roads. They connect the individual farmers to others at the rural farmlands.

**Earth Surface roads:** They are roads that are covered with some soil types on the surface to strengthen them for use by medium size vehicles and trucks.

## 1.9.1 Organization of the Study

This study was organized in five chapters. The first chapter contained the introduction, background of the study, statement of the problem, purpose of the study, objectives of the study, research questions, significance of the study, basic assumptions of the study, limitations of the study, delimitations of the study, definition of significant terms as used in the study and organization of the study. Chapter two was basically reviewed of literature in line with study and according to the objectives of the study. Moreover, chapter two has theoretical framework, conceptual framework and summary of literature reviewed. Chapter three has methodology which has the research design, target population, sample size, sample selection, research instruments, pilot testing of instruments, validity of research instruments, data collection procedures, data analysis techniques and ethical issues in research. Chapter four gave the data analysis, presentation, interpretation and discussion, while chapter five provided for the summary of findings, conclusions and recommendations.

## **CHAPTER TWO**

## LITERATURE REVIEW

## **2.1 Introduction**

This chapter presents the concept of rural road access and milk delivery to collection centers. The review of literature gives a background of the different types of road networks, dairy farming and concept of collection centers. In addition an overview of previous studies done in this field is given. The gaps noted in this study will also be examined and discussed.

### 2.2 Transportation and Sales of Milk Volume

Depending on the distance from the factory where the milk is treated to the consumption center, transport may be direct from the factory to the retailer or by rail or road to the place of consumption, distribution being made by delivery vehicles to the retailer. This affects the quality of milk which in turn will affect the sales. Large road vehicles and railway wagons should be well insulated, and preferably refrigerated with the aid of ice, dry ice or a refrigeration compressor. Usually refrigeration is necessary only during part of the year.

Transport by heavy lorry or rail to the retail delivery vehicles should be carried out under conditions that ensure that the milk does not remain exposed to air temperature or light. Depending on the organizations concerned and the timetables, a cold store may be necessary to hold milk between unloading and reloading. Expectations of the nation's public transportation system are high, and certainly no less so in rural America. Transport Research Laboratory (2002), reported that roads in rural Africa, in particular gravel roads are vital to the socioeconomic wellbeing of local communities. They provide access to schools, clinics, jobs, markets, neighboring communities, and a link to the higher order road network. Therefore, whilst these roads tend to carry relatively low levels of traffic, they play a very important role in the development of rural areas, and it is vital that they remain open to traffic throughout the year, including the wet season. One possible method of achieving this is to seal the gravel running surface with a thin bituminous surfacing. Socio-economic development and subsequent economic growth on the African continent is hampered by several limiting factors, including the lack of adequate roads infrastructure (Hine, 2004).

Research states that rural transport depends on appropriate infrastructure, where rural infrastructure consists mainly of rural roads, tracks, trails and footpaths. These may vary in quality, depending on weather, season, construction and maintenance. As rural households, and in particular African women, spend a large amount of time and effort on transport activities to fulfill their basic needs, they are very often severely hampered by the lack of an adequate rural roads network. As a result of this significant limitations of growth and development of rural communities in Africa have been experienced in the past, and are also being experienced today (Hine, 2004).

## 2.2.1Transportation as a portion of GNP

Gross National Product (GNP) expresses a nation's total economic activities, of which transportation forms a part. In the late 20th century in the United States, between 17 and 18 percent, or about one-sixth, is associated with transportation. The figure can be broken down into passenger and freight transportation. About 11 percent of GNP is accounted for by movement of people and about 6 percent by movement of goods (Wood, 2012). More than four-fifths of expenditures for movement of people in the United States are associated with the private automobile—its purchase, operation, and maintenance. About one-tenth of the expenditure on intercity travel is for travel by air; the remaining tenth is spent for rail, taxi, transit bus, and school bus. The vast majority (four-fifths) of money spent for intercity movement of freight goes to highway carriers; rails receive only about one-tenth, and the remainder is divided between air, water, and pipeline. Donald (2010) says that it should be noted that more than four-fifths of the expenditures for both personal and freight intercity transportation goes to highway users. In economic terms, this represents by far the most important segment of transportation in the United States. At one time, railroads were the most important, but their role has steadily declined since World War I.

According to the United States Bureau of Labor Statistics, in 1989 the typical household spent \$27,810. Housing accounted for \$8,609; transportation (mainly automobiles) accounted for \$5,187; and food accounted for \$4,152 (Johnson 1989). Looking at the age of consumers, those under 25 spent the highest

proportion of their income, after housing, on transportation; presumably much of this went for automobiles and for automobile insurance premiums. By almost any measure, the great significance of transportation to individuals and, aggregated together, to society is apparent.

#### **2.2.2 Transportation's role in strengthening the economy**

Lewis et al (2000) says that transportation facilitates communication and commerce. Alexander Hamilton, secretary of the Treasury in the 1790s, believed that internal improvements were necessary for the nation's economic growth (Clark, 2012). The word "infrastructure" is used to describe all the facilities that an economy has in place, including its transportation network of roadways, railroad tracks, and ports, as well as the vehicles and vessels to use them. An adequate infrastructure is a prerequisite to economic development. Transportation and communications are important in developing and strengthening social, political, and commercial ties. These ties must be developed before trade can be handled on a regular basis. Transportation also is necessary for goods to reach markets where they can be sold or exchanged for other merchandise or services. Transportation undertakings have proved to be a fertile ground for inventors, innovators, entrepreneurs, and their supporting investors. Much of the dynamic growth in the United States and other countries in the 20th century can be attributed to transportation.

Transportation allows each geographic area to produce whatever it does best and then to trade its product with others (Winston 2010). In addition to direct, or back-and-forth trades, it is also possible to use transportation to link together a number of different steps in the production process, each occurring at a different geographic site. Speedy modes of transportation (such as air) allow perishable foods to be distributed to wider market areas. Transportation also allows workers to reach their job sites. Lastly, because of transportation, it is possible for a producer to reach a large number of markets. This means that the quantity of output can be large enough that significant production economies of scale will result.

A transportation network makes markets more competitive. Economists often study resource allocation—that is, how specific goods and services are used. A transportation system improves the allocation process because it widens the number of opportunities for suppliers and buyers. The road network has huge impact on the marketing of milk as it links the production areas with the processors, rural and urban markets (marsgroupkenya.org). A few cooperative societies have their own means of transport in form of pickups, trucks and Lorries. However, due to reduced intake by most cooperatives, most vehicles are underutilized and in poor condition. Poor road network often results in high transactional costs and inaccessibility to input and output markets in the sector. In terms of marketing, this may lead to uncompetitive pricing since the high transport costs will be factored in the high prices. Poor infrastructure has also contributed to the poor market integration in the country (Ndun'gu, 2014). Milk is highly perishable and sometimes the poor road network may lead to delays in the collection of milk thus a faster reduction in quality which may result to losses if the milk is rejected by the processors due to spoilage. Poor road network may also lead to spillages which if added up could lead to losses in revenue to the farmer (Ndun'gu, 2014).

Due to limited market opportunities, there is a category of losses that the farmer experiences commonly known as "forced consumption". This is where the surplus or uncollected milk issued by the family, the calves, if there are any, and sold or given to the neighbor. In most cases, the family may be consuming more than it would normally require hence the forced consumption. The Dairy Master Plan report indicated that "forced consumption" is critical in the estimation of supply response, especially where it is assumed that provision of cooling facilities will draw forth the evening milk and where the general assumption is that if evening milk could be collected, total marketed milk could rise by 40 to 50 percent. This, however, may not be true. Provision of over 60 coolers to societies in early and mid 1980s on the assumption of losses of the evening milk did not succeed in drawing the milk. The Rapid Appraisal study reports that a Ministry of Agriculture report estimated that 30 percent of milk production from these districts is lost annually due to the poor state of roads hence limited distribution.

Therefore, with poor roads, the volume of milk being taken by traders will reduce because of the effect of leftovers. Middlemen fail to buy the milk because they cannot access collection centers. As a result, farmers tend to incur losses and increased forced consumption. According to research carried out in Lugari district, milk losses occurred because the transport from the collecting agent could not reach the villages or the farmers were unable to reach the collection centre. In both cases, the causes were as a result of the poor condition of the roads during the wet season. However, it was reported in many instances that this occurred during only a short period of the year. Whereas this may be seen to reduce the potential number of days when a loss could be realized, it is also true that while the farmer was able to reach the milk collection centre, the condition of roads further from the centre may have caused the milk collection vehicles not to come to the centre (Ministry Of Livestock Development, 2010)

According to Hine and Elis (2001), an efficient transport system is critically important to efficient agricultural marketing. If transport services are infrequent, or of poor quality or expensive then farmers will be at a disadvantage when they attempt to sell their crops. An expensive service will naturally lead to low farm gate prices (the net price the farmer receives from selling his produce). Seasonally impassable roads or slow and infrequent transport services, coupled with poor storage, can lead to losses as certain crops (e.g. milk, fresh vegetables, tea) deteriorate quickly over time. If the journey to market is made over rough roads then other crops (e.g. bananas, mangoes) may also suffer losses from bruising; this will also result in lower prices to the farmer. Tracey-White (2005) noted that mobility in rural areas could be hampered by the lack of transportation facilities and unavailability of good roads. He canvasses the need to study how transport systems affect the marketing channels and therefore the long term agricultural productivity. He stated that the mode of transportation used, length and time of the journey and the costs of transport all affect the efficiency of marketing system and therefore farm output. He listed benefits attached to improved transport as: that agricultural surplus reach collection centres and markets timely, a reduction of time burden for family members and a reduction in transportation damages to perishable crops. Additionally, an improved transport reduces operating costs to vehicle users and provides more direct and cost effective access to public utilities. Classifying bicycle and motorcycle as Intermediary Mode of Transports (IMT) the author predicted the prevalence of motorcycle.

The adoption of IMT may have the following effects on agricultural production and marketing: cultivation of large farm areas, utilization of more fertile remote soils and heavier crops production, increased utilization of fertilizer and manure, reduction in effort and drudgery and spill-over effects if animals are used for ploughing and transport enabling farmers respond better to markets signals (Hine & Ellis, 2001). These authors also found that African farmers receive only 30-50% of final market price against 70-85% to Asian farmers with most of

the difference due to high transport costs caused by an access of rural roads. They observed that a reduction in transport cost by 20% rise farm gate price by 6%.

It was also noted that though road investment plays an important role in reducing transport costs, improving feeder roads may have little impact if "no change in transport mode occurs", that is "upgrading 5 km of feeder road from earth to gravel might only increase farm gate price by about 10% only, while bringing motor vehicle access 5 km closer to farms would increase farm gate price by over 100% as much". Transportation cost is not also unconnected with road roughness and seasonality (Wozemba & Rashid, 2008).

According to a study done in Uganda by Wozemba and Rashid road access are vital for development if dairy industry. According to their analysis the good road networks in the country which are mostly damaged increases the chances of dairy investment. Moreover, it improves supply of milk top collection and processing centers since the roads allow easy access to the area (Wozemba& Rashid, 2008). World Food Programme, (1994) report in Zanzibar indicated that rural or traditional milk producers, who were scattered all over the country, had very low milk volumes and therefore individual farmers could not transport their milk to the urban markets. The farmers also did not have an organized milk collection system in the rural areas and therefore milk vendors took the initiative of collecting milk from the producing farmers and delivering them to the market centres. The report also revealed that in very interior rural areas where the vendors could not reach, milk was consumed without any sale and therefore no income realized by such livestock farmers. The marketing report of WFP showed that the vendors also faced some challenges in transporting the milk for very long distances using bicycles and on bad feeder roads. Milk vendors also pushed the prices lower for the dairy farmers in order for them to save money for maintenance and repairs for their bicycles, spillages and spoilages due to long distance and long hours taken on bad roads.

### 2.3 Telecommunication and Milk sales Volumes by Farmers

The agri-business sector's supply chain, for example, has changed significantly with increasing investment in cold-chains across the country. With this, fruits and vegetables are being transported long distances and milk grid is able to pick up and delivers liquid milk from and to remote areas more frequently. Here the role of cooperatives like AMUL has been exemplary both in increasing the size of the distribution network and also in re-organizing the supply network very efficiently along with enormous buildup of social capital – a pre-requisite for growth in emerging economies (Chandra and Tirupati, 2003). The dissemination of information and communication technologies (ICTs) in developing countries provides much opportunity to transfer knowledge and information by private companies and government department. Mobile phones have provided new approach to farmers to make tentative decisions much more easily than before. Use

of mobile phones leads to greater social cohesion and improved social relationships among farmers and business community (Kwaku & Kweku, 2006).

Wireless telephone that permits telecommunication within a defined area that may include hundreds of square miles, using radio waves in the 800–900 megahertz (MHz) band. To implement a cell-phone system, a geographic area is broken into smaller areas or cells, usually mapped as uniform hexagrams but in fact overlapping and irregularly shaped. Each cell is equipped with a low-powered radio transmitter and receiver that permit propagation of signals between cellphone users

Beginning in 1985, a study group of the Geneva-based International Telecommunication Union began to consider specifications for Future Public Land Mobile Telephone Systems (Borth 2010). These specifications eventually became the basis for a set of "third-generation" (3G) cellular standards, known collectively as IMT2000. The 3G standards are based loosely on several attributes: the use of CDMA technology; the ability eventually to support three classes of users (vehicle-based, pedestrian, and fixed); and the ability to support voice, data, and multimedia services. The world's first 3G service began in Japan in October 2001 with a system offered by NTT DoCoMo. Soon 3G services were being offered by a number of different carriers in Japan, South Korea, the United States, and other countries. According to Britannica (2014) several new types of service compatible with the higher data rates of 3G systems have become commercially available, including full-motion video transmission, image transmission, location-aware services (through the use of global positioning system [GPS] technology), and high-rate data transmission. This technology enhances communication between people and thus lowering various costs that could have been incurred during communication.

Different communication requirements necessitate different network solutions, and these different network protocols can create significant problems of compatibility when networks are interconnected with one another (Schwarts 2005). In order to overcome some of these interconnection problems, the open systems interconnection (OSI) was approved in 1983 as an international standard for communications architecture by the International Organization for Standardization (ISO) and the International Telegraph and Telephone Consultative Committee (ITTCC). The OSI model, as shown in the figure, consists of seven layers, each of which is selected to perform a well-defined function at a different level of abstraction. The bottom three layers provide for the timely and correct transfer of data, and the top four ensure that arriving data are recognizable and useful. While all seven layers are usually necessary at each user location, only the bottom three are normally employed at a network node, since nodes are concerned only with timely and correct data transfer from point to point. It is through open Systems interconnections that we obtain services such as Short Message Services, which leads to great development of mobile banking industry (Hayes 2013).
Short Message Service (SMS) and voice record have given improvements in social relations. Mobile phone based social-networking in the developing countries goes to show the growing importance of this aspect Mobile phones are considered as important for agriculture development. This technology has provided connectivity and offer benefits such as mobility and security to owners (Goodman, 2005; Donner, 2006).

Thorpe W., Muriuki H.G., Omore A., Owango M. O. and StaalS. (2000), found out that milk prices are determined by several factors especially in the rural small holder dairy producers. The development of smallholder dairy farmer is constrained by many factors including feed scarcities, disease challenges, poor state of infrastructure such as rural access roads and limited access to suitable credit and general poor national economic performance. Others include poor access to production and marketing services for agricultural inputs. Infrastructure such as rural access roads and rural electricity supplies have major influence on milk marketing efficiency and are perhaps the most limiting factors to the development of rural smallholder dairy. It is believed that the current level of milk production of 4 to 5 litres per cow per day can be improved if there is investment in market infrastructure and general improvement in the economy. Participation of milk traders also referred as milk hawkers dominate the milk informal market and handle bulk of the marketed milk (Thorpe et al. 2000), pays the higher farm gate prices and offer lower consumer prices.

Over the past decade, mobile phone coverage has spread rapidly in Africa, Asia and Latin America. As of 2009, over half of the populations in sub-Saharan Africa, Asia and Latin America had access to mobile phone coverage. Mobile phone coverage has greatly exceeded investments in other infrastructures in these countries, namely, electricity and roads. Coinciding with this increase in mobile phone coverage has been an increase in mobile phone adoption, even in some of the world's poorest countries. As of 2008, there were about 4 billion mobile phone subscribers worldwide, with 374 million subscriptions in Africa, 1,791 in Asia and 460 million in Latin America (International Telecommunications Union, 2009). While initial adoption was primarily by the wealthy, urban and educated residents, mobile phones are currently being adopted by the rural poor in some of the world's poorest countries (Mbiti, 2010).

Reductions in cost of information Mobile phones significantly reduce communication and information costs for the rural poor in developing countries. This not only provides new opportunities for rural farmers' to obtain access to information on agricultural technologies, but also to use ICTs in agricultural extension systems. Since 2007, there has been a proliferation of mobile phonebased applications and services in the agricultural sector, providing information on market prices, weather, transport and agricultural techniques through voice, short message service (SMS) and internet. While such programs are innovative, they are not without challenges, and it is not yet clear that they will substitute for existing agricultural extension systems. Furthermore, as many of these projects are fairly recent, empirical evidence on their success is still not proven. In order to measure the impact of such services on farmers" knowledge, adoption and welfare, as well as the cost-effectiveness of such services, rigorous impact evaluations are needed (Aker, 2010).

There are several reasons why the ECA believes that information technology is central to poverty reduction, which in turn is central to the empowerment of women: ICTs provide the most cost-effective way of serving remote, rural areas without the huge infrastructure costs of traditional landlines. The capacity to acquire and communicate knowledge is the foundation of development. If development depends on empowering people and communities to take control of their own lives, access to information through improved communications is an essential component of growth. The application of ICTs to improving social services is enormous. Basic education could be vastly improved. The World Health Organization (WHO) claim 40% of health is exchanging information. Many of the problems of health prevention relate to poor communications and limited access to information. ICTs are of enormous value in the control of epidemics and contagious diseases. Other values of ICT can be illustrated as follows; Participation in the information economy and the development of e-businesses itself offers many possibilities for wealth creation particularly for small and microenterprises.

In Uganda regardless of farm group membership, male and female use of SMS focused on two categories: greetings with family and friends and agricultural consultation which included coordination for farm group meetings and access to agricultural inputs as well as market information from local businessmen and farm group members. Respondents did not indicate receiving or accessing market information from organizations, such as Food net, that distribute SMS market updates. Regardless of gender or farm-group membership status, use focused on: coordination for access to agricultural inputs, consultation with expert advice, attainment of market information, agriculture emergency security, and Monitoring of financial transactions.

On perception of impact of the mobile phone, Uganda farmers were unanimously focused on: transportation efficiency, benefits of agriculture emergency security, increase in contacts and opportunities, increase in market access, and increase in efficiency resulting in greater output (Brandie et al, 2008).

Mobile phones can improve access to and use of information about Agricultural technologies, potentially improving farmers' learning. Farmers require information on a variety of topics at each stage of the agricultural production process. In many developing countries, such information has traditionally been provided by personal exchanges, radio and perhaps landlines and newspapers. Compared with these mechanisms, mobile phones can significantly reduce the costs of obtaining agricultural information. Mobile phones are significantly less expensive than the equivalent cost of personal travel or a newspaper, yet more expensive than landlines or radio. Nevertheless, landlines are not readily available in most regions of the country, and radio only provides price information for specific products and markets on a weekly basis. The reduction in search costs associated with mobile phones could increase farmers' access to information through their private sources, such as members of their social network. This could speed up or increase farmers' contact with other adopters in a social network, thereby allowing farmers to learn from more farmers. While this could potentially increase the rate of technology adoption, it could also reduce the rate of adoption in the presence of learning externalities (Foster et al,1995, 2010).

Reduced costs of disseminating information could increase the extension system's geographic scope and scale, as well as facilitate more frequent and timely communications between extension agents and farmers. The impact of these reduced costs on farmers' adoption decisions will depend upon the ability of such information to serve as substitute for in-person mechanisms (Aker, 2011)

In Nigeria it was observed that farmers using cell phone made greater number of contact than those made by farmers who had physical contact with extension agents. It could be inferred from this finding that farmers using cell phone are more informed than farmers making contact with extension agents. Production levels of Cell phone users were also found to be higher than those of non-cell phone users on average. It could be deduced from this result why income per annum of cell phone users' farmers was higher than those non cell phone users. Hence living standard of the cell phone users cannot be compared with that of non phone users. (Bolarinwa et al., 2011).

However, adoption of mobile phones by fishermen translated into direct economic benefits. (Jensen, 2007). Use of mobile phone-based money transfer services can spur smallholder commercialization and improve welfare of such households. Consequently, there is need to expand the coverage of mobile phonebased money transfer services in rural areas. (Kirui et al, 2010)

## 2.4 Energy use and Sales of Milk Volume

According to a Dairy System directory, there are 23 milk processing companies in Kenya. Brookside controls 44 per cent of the milk market followed by the New KCC at 20 per cent while Githunguri Dairy Farmers Co-operative is ranked third with 17 per cent. Sameer – processors of Daima Milk – commands a six per cent market share (Andae, 2015).

## 2.4.1 Voltage usage and Service of Cooling

Any electrical or electronic device that maintains the voltage of a power source within acceptable limits. The voltages needed to keep perishable products within the prescribed range that can be tolerated by human consumption (Lay 2008). Such a device is widely used in fridge of all types to match the output voltage of the generator to the electrical load and to the charging requirements of the battery. Voltage regulators also are used in electronic equipment in which excessive variations in voltage would be detrimental. In fridge, voltages rapidly switch from one to another of three circuit states by means of a spring-loaded, double-pole switch. At low speeds, some current from the generator is used to boost the generator's magnetic field, thereby increasing voltage output. According to Maxwell (2009) at higher speed of the fan, resistance is inserted into the generator-field circuit so that its voltage and current are moderated. At still higher speeds, the circuit is switched off, lowering the magnetic field. The switching rate is usually 50 to 200 times per second. Perishable product require frequent and free movement of air current that is produced by the fan at higher speed thus producing the cool breeze, lowering voltage amount lowers the electric power of the motor thus perishable products in fridge and freezers become rot at short period of time.

## 2.4.2 Solar energy

Radiation from the Sun capable of producing heat, causing chemical reactions, or generating electricity. The Sun is an extremely powerful energy source, and sunlight is by far the largest source of energy received by the Earth, but its intensity at the Earth's surface is actually quite low (Ashok 2010). This is essentially because of the enormous radial spreading of radiation from the distant Sun. A relatively minor additional loss is due to the Earth's atmosphere and clouds, which absorb or scatter as much as 54 percent of the incoming sunlight. Yet the total amount of solar energy incident on Earth is vastly in excess of the world's current and anticipated energy requirements. According to Foster (2007) if suitably

harnessed, this highly diffused source has the potential to satisfy all future energy needs. In the 21st century solar energy is expected to become increasingly attractive as an energy source because of its inexhaustible supply and its nonpolluting character, in stark contrast to the finite fossil fuels, coal, petroleum, and natural gas.

Stanley (2004) says that in 2012 Tokelau completed a New Zealand-funded solar energy project that made the atolls nearly self-sufficient in electricity generation. Solar-panel grids installed on each of the atolls allowed Tokelau to discontinue, for the most part, the use of diesel-powered generators that ran on costly imported fuel. This was sufficient to supply power source in the whole of New Zealand

Solar Energy produces power that is easily harnessed and used effectively can produce a lot of viable products. Foster (2007) solar energy is one of the cheapest and reliable sources of energy that the human kind can ever obtain. The type of energy used predominantly will show the cost of producing various products in the industry to go up.

## 2.4.3 Electricity and Milk Pasteurization

Electricity provides heat for various functions and with the use of modernized equipment's safeguarding the products. Britannica (2014) states that heat-treatment process that destroys pathogenic microorganisms in certain foods and beverages. It is named for the French scientist Louis Pasteur, who in the 1860s

demonstrated that abnormal fermentation of wine and beer could be prevented by heating the beverages to about 57° C (135° F) for a few minutes. Pasteurization of milk, widely practiced in several countries, notably the United States, requires temperatures of about  $63^{\circ}$  C (145° F) maintained for 30 minutes or, alternatively, heating to a higher temperature, 72° C (162° F), and holding for 15 seconds (and yet higher temperatures for shorter periods of time). The times and temperatures are those determined to be necessary to destroy the Mycobacterium tuberculosis and other more heat-resistant of the non-spore-forming, disease-causing microorganisms found in milk. The treatment also destroys most of the microorganisms that cause spoilage and so prolongs the storage time of food.

## 2.5 Water, Sanitation and Sales of Milk Volume

Many factors influence the composition of milk, the major components of which are water, fat, protein, lactose and minerals (Looper, 2012). Nutrition or dietary influences readily alter fat concentration and milk protein concentration. Fat concentration is the most sensitive to dietary changes and can vary over a range of nearly 3.0 percentage units. Dietary manipulation results in milk protein concentration changing approximately 0.60 percentage units. The concentrations of lactose and minerals, the other solids constituents of milk, do not respond predictably to adjustments in diet Some 21 mineral elements are known or suspected to be essential for humans. This number includes four that function physiologically as anions or in anionic groupings {chlorine as Cl-, phosphorus as PO4-3, molybdenum as MoO4-2, fluorine as F-}, eight that function in their simple cationic forms {calcium (Ca+2), magnesium (Mg+2), sodium (Na+), potassium (K+), ferrous iron (Fe+2), copper (Cu+2), zinc (Zn+2), manganese (Mn+2) } and which are subject to chelation by either intact proteins or a variety of small, organic molecules; ions of two non-metals {iodine (I) and selenium (Se)} that function as constituents of covalent compounds (e.g.iodothyronine, selenocysteine) that are formed metabolically; and ions from five additional elements: boron (B), chromium (Cr), nickel (Ni), silicon (Si), vanadium (V)} the nutritional significance of which remain to be fully elucidated (Bravardm, 2006). Thus, fourteen mineral elements are established as being essential for good health; these elements in combined form affect bone and membrane structure (Ca, P, Mg, F), water and electrolyte balance (Na, K, Cl), metabolic catalysis (Zn, Cu, Se, Mg, Mn, Mo), oxygen binding (Fe), and hormone functions (I, Cr).

Health consequences of micronutrient deficiencies include increased morbidity, mortality due to reduced immune defense systems and impaired physical and mental development. Deficiencies of several mineral elements, particularly iron and iodine, are the basis of health problems in many parts of the world. Nearly 40% of the world's women are estimated to be anemic due, to a great extent, to poorly bio available dietary iron. Low intakes of Ca, and perhaps Mg, contribute to rickets in children and osteoporosis in women worldwide. Due to inadequate diets, many children are deficient in Fe, Zn, and Cu and other micronutrients especially in developing countries. One third of the world's children fail to reach their physical and mental potentials and many are made vulnerable to infectious diseases that account for half of all child deaths. Nearly 750 million people have goiter or my edematous cretinism due to iodine deficiency, and almost 2 billion people have inadequate iodine nutrition. These nutritional deficiencies decrease worker productivity and increase the rates of disease and death in adults. Many result from diets that may also involve insufficient intakes of Cu, Cr and B. In developed countries changing dietary patterns such as reduced milk consumption may predispose to conditions like osteoporosis.

Water supplies may contain some of these essential minerals naturally or through deliberate or incidental addition. Water supplies are highly variable in their mineral contents and, while some contribute appreciable amounts of certain minerals either due to natural conditions (e.g., Ca, Mg, Se, F, Zn), intentional additions (F), or leaching from piping (Cu), most provide lesser amounts of nutritionally - essential minerals. Many persons consume mineral waters because of the perception that they may be more healthful.

Microorganisms contained in raw (unheated) milk or picked up from the environment will quickly sour and curdle the milk. Cooling slightly above its freezing point keeps milk palatable for a longer time by reducing the multiplication of spoilage bacteria and the chemical changes that they induce. Many countries have laws requiring that milk be pasteurized as a protection against pathogenic (disease-causing) organisms. Pasteurization is a partial sterilization accomplished by raising the milk to a temperature high enough to destroy pathogenic bacteria and a large proportion of those causing spoilage. Pasteurized milk that is kept refrigerated in closed containers will remain consumable for approximately 14 days. Milk fat, being less dense than other milk components, can be efficiently removed in a cream separator by centrifugation, yielding low-fat milk and skim milk. Low-fat milk contains 1–2 percent fat, while skim milk contains less than 0.5 percent fat. Much of the milk sold as a beverage has undergone homogenization, a process in which the milk is forced under high pressure through small openings to distribute the fat evenly throughout the milk.

The enteric absorption of minerals from water is determined by several factors including the intrinsic properties of particular chemical species that are present, physiological conditions of the gut environment, and exogenous factors related to the meal/diet in which the minerals are ingested. Accordingly, waterborne selenium (selenite, selenate) is passively absorbed at somewhat lower efficiencies (60-80%) than the selenoamino acids in foods (90-95%) that are actively transported across the gut. The inorganic oxidized iron in water will be absorbed at very low (<5%) efficiencies similar to that of non-heme iron in plant foods. Mineral absorption is also subject to age-related declines in efficiency (Cu, Zn), early post-natal lack of regulation (Fe, Zn, Cr), adaptive increases in

efficiency by receptor up-regulation during periods of deficiency (Fe, Zn, Cu, Mn, Cr), dependence on other co-present nutrients for metabolism (Se-I, Cu-Fe), and to anabolic and catabolic effects on tissue sequestration (Zn, Se, Cr). Minerals in water are subject to most of the same determinants of bioavailability that affect the utilization of those minerals in foods. For example, phytate, phosphorus and triglycerides can each reduce the lumenal solubility and, hence, the absorption of calcium. Phytate and other non-fermentable fiber components can bind Fe, Zn, Cu and Mg, and sulfides can bind Cu, reducing the absorption of each. Minerals that share transporters can be mutually inhibitory (SO3-2 vs. SeO3-2; Ca+2 vs. Zn+2; Cd+2 vs. Zn+2; Zn+2 vs. Cu+2). In contrast, the bioavailability of the divalent cations (Ca++, Fe++, Cu++, Zn++) can be enhanced by certain chelating substances.

Milk fat and protein percentages are highest during the fall and winter and lowest during the spring and summer. This variation is related to changes in both the types of feed available and climatic conditions. Lush spring pastures low in fiber depresses milk fat (Michael 2010). Hot weather and high humidity decrease dry matter intake and increase feed sorting, resulting in lower forage and fiber intake.

## 2.6 Influence of Institutions on Milk Sales Volume

Institutions involved in supporting the agricultural sector include Educational and training institutions, agricultural research institutions and experiment stations, logistical and regulating functions including credit, storage, transportation and marketing facilities, institutions providing incentives to increase production and productivity; and institutions providing extension services (Boer, n.d.).The dairy industry is governed by a number of institutions. Some of the institutions were established as early as the 1920's. Examples of the institutions that govern dairy farming in Kenya are Kenya Dairy Board, milk processing factories, learning institutions (Boer, n.d.)

The contribution of the Kenya Dairy Board (KDB) to the development of dairying, particularly in the smallholder subsector, has generated much discussion. The 1958 Dairy Industry Act, Cap. 336, which established KDB, stated that it was "An Act of Parliament to provide for the improvement and control of the dairy industry and its products." However, until recently KDB was better known for its policing of the industry than for any development or improvement. The government has contributed to KDB's poor performance through intermittent interference (Kurwija & Bennett, 2011).

In 1972, the Minister in charge of livestock dissolved the KDB board, leaving the secretariat to be managed by the Ministry until 2000, when a full KDB board was reconstituted. The KBD has since improved its performance and image with support from FAO's Technical Cooperation Programme. It now has a Technical Services Division, regional offices and has embraced the informal sector in supplying raw milk for processing. Other institutions are Department of Livestock Production and the Department of Veterinary Services (departments of the Ministry of Livestock and Fisheries Development [MoLFD], KDB, the Kenyan Bureau of Standards (KEBS), the Kenyan Police, the Weights and Measures, section of the Ministry of Trade, the Public Health Division of the Ministry of Health, the Veterinary Vaccine Production Centre of the Kenyan Agricultural Research Institute, dairy processors and milk traders, dairy input suppliers and dairy farmers organizations (Kurwija & Bennett, 2011).

The most important institutions for dairy industry regulation are the two departments of MoLFD, KDB, KEBS, the Public Health Division of the Ministry of Health, the Weights and Measures Section of the Ministry of Trade, the Kenyan Police and local government councils. Of these, KDB, KEBS and the Public Health Division are central to they framework of the dairy industry. KEBS formulates, revises and implements dairy standards for products, equipment and handling in collaboration with other bodies, particularly KDB (Kurwija & Bennett, 2011).

The Department of Livestock Production is responsible for formulating and overseeing dairy industry policy and its legal framework. Backed by legislation such as the Animal Diseases Act and the Cattle Cleansing Act, the Department of Veterinary Services is responsible for the control of livestock diseases, disease vectors and pests. The Public Health Division of the Ministry of Health enforces the Public Health Act (Cap. 242) and the Food, Drugs and Chemical Substances Act (Cap. 254) regulating the handling of food and other substances intended for human consumption. The Weights and Measures Section of the Ministry of Trade prescribes and calibrates the officially recognized weights and measures for various goods, commodities and products (Kurwija & Bennett, 2011).

## 2.7 Conceptual Framework.

This study examines the influence of rural road access on milk delivery to collection centers by dairy farmers. Rural Road access is an important concept in any economy. It is said to be one of the main factors that influence any enterprise. Therefore, dairy farming being an enterprise is influenced by rural road access. Rural Roads are among the categorized roads by the National Government which are in seven classes. This seven classes are A, B, C, D, E, special purpose roads and unclassified. These roads have different surfaces namely bitumen, gravel and earth. So, this research employs both independent and dependent variable.

## **Independent Variable**

## **Dependent Variable**



Figure 1: Conceptual Framework. Source: Author (2015)

Thematic area	Author(s)	Method	Main findings	Knowledge Gaps
Factors Affecting Procurement Performance in the Milk Processing Firms in Kiambu County	Samuel MburuKaranu, andA. Njeru (2014)	Descriptive survey method design of research.	The study found that there was a positive relationship between information technology and procurement performance in milk manufacturing companies in Kiambu County.	The study did not focus on how transportation means, water and sanitation as well as energy influence the sales of milk. This study will therefore show the gap and focus on these thematic areas
Factors Affecting Milk Composition of Lactating Cows	Michael Looper (2012)	Qualitative research design	Many factors can influence milk composition. This is an important point to remember when evaluating the potential to improve a herd's milk composition and component yields. Certainly, genetics plays an important role, but changes here are slow.	The study focused on the genetic and biological influences of milk production from cattle within the United States. The study did not look at various factors that influence the sales of milk and factors contributing to effective sales of milk. This study will therefore focus on various factors that influence the sales of milk
Nutrients in Water	World Health Organisation (2006)	Descriptive survey method of research	The study found out that water is an important source of mineral and its combination with milk could lead to a healthy growth of individuals	The study did not focus on the supply chain of milk and various factors that influence the production and supply of milk to the society. This study will therefore show the various factors that influence sales and milk production

# 2.8 Knowledge Gap

According to literature review research in this field had not been extensively studied as it is supposed to be. Several researchers have done a broad overview of the influence of infrastructure development on dairy farming and sales. Few studies have narrowed it down to infrastructure development and milk marketing. This creates a broad understanding of the subject which was of little benefit to the farmers and stakeholders in dairy farming. Moreover, little research had revealed factors such as theft as a result of poor infrastructure. This research endeavors to cover all this gaps while at the same time giving areas that need further research.

## 2.9 Summary of Literature Review

This study examined the influence of infrastructure development on milk sales volumes in Chesumei Sub County, Nandi County, Kenya. Several researchers have done a study on the influence of roads on dairy farming. Wozemba & Rashid, Kruse and Mburu agree that when roads are affected, distribution and milk sales centers and processing centers are influenced. Mburu gives an example of post-election violence when most of the roads had been blocked in protest to the outcome of election and states that farmers found difficulty in delivering milk to collection centers due to the blocked roads. Rural farmers at such times had to domestically consume the excess milk which was meant for sale. Urban residents on the other hand stayed without milk for a length of time due to the missed link between the milk producers and consumers.

# CHAPTER THREE RESEARCH METHODOLOGY

## **3.0 Introduction**

Chapter three mainly deals with methodology which was the study design, sampling procedure and actual data collection methods that were carried out. The chapter also gives the basis in which the data was analyzed.

## 3.1 Research Design.

A detailed outline of how an investigation will take place. A research design will typically include how data is to be collected, what instruments will be employed, how the instruments will be used and the intended means for analyzing data collected (Business Dictionary 2014).Best and Khan (1993) defines a research design as a blue print for fulfilling the objectives and answers the research questions, emphasizing that it is a plan and structure of investigation conceived to obtain answers. Consequently, Francis (2010) defines research as an organized and systematic way of carrying out research.

A descriptive research design was used in this research. Descriptive design employs a survey method which mainly involves questionnaires. Survey method was mostly used to retrieve quantitative data which was said to be numerical. When using survey method, the analysis of data was usually carried out using descriptive and inferential statistics. Unlike other research design method descriptive data allows participation of large number of people surely referred to as subjects.

# **3.2** Target Population

The target population refers to the group(s) of youth a program is designed to serve. In order for a program to remain focused and to deliver effective services, it must clearly define its target population and establish a referral mechanism that will ensure it receives the appropriate cases (NCJ 2014).According to Cooper and Schinder (2000) target population is the population the researcher is interested in researching on. In this case they are farmers in Chesumei Sub County. Survey method was carried out on farmers situated in Chesumei Sub County.

# **3.3 Sampling Procedure and Sample Size**

## 3.3.0 Introduction

Sampling is a statistical practice which concerns the selection of individual observations to yield some knowledge about a population of concern especially for purposes of statistical inferences (Ghoshi, 2002). Sampling frame which has the property that study can identify every single element and include any in the sample. A straight forward type of frame is listing of elements of the entire population and the sampling frame must be a representative of the population.

## 3.3.1 Sampling procedure

This research employed survey to collect data. The sample size of the research was calculated using the following formula (Yamane, 1967).

$$n = \frac{N}{(1 + N_{e^2})}$$

N is sample size, N is target population and e being error sampling which in this case was 5% since confidence level was anticipated to be 95%.

Therefore, with a target population of 1,000 the sample size was 286

## 3.3.2 Sample size

The sample size of a survey most typically refers to the number of units that were chosen from which data were gathered (Shapiro 2008). The study had a target population of 1000 residing in the proposed area of study. From the target population the subjects were chosen randomly from the population in particular the 286 participants. A non probability technique known as snowball was used to identify the illiterate respondents participating in the study.

## **3.4 Data Collection Instruments**

This research employed questionnaires to collect data. 286 questionnaires were administered to subjects by the researcher and her assistant. The researcher and assistant administered them personally so as to reduce instances where not all questions were answered as result respondents failing to understand the questions. The questionnaires contain both open ended and closed ended questions arranged systematically. Interviews were conducted for those not able to read and write and use of a research assistant.

## **3.4.1** Pilot Testing of Instruments

Before the study is done a pilot study of the questionnaires was carried out. Piloting entailed 15 subjects from the target population. The main purpose of piloting was to test the questions in the questionnaire and the items were based on the objectives. Testing was as a result of some questions becoming vague, comprehensive and difficult to answer. The arrangement may also not be systematic. When such questions were identified they were changed. The pilot study was also used to determine the amount of time used by each farmer to answer the questionnaire.

#### **3.4.2** Validity and Reliability of Instruments

Validity is the extent to which an instrument measures what it is supposed to measure and performs as it is designed to perform (Research Rundown 2014). Validity is defined as the ability of the instrument to capture what is required of it. It is regarded as a measurement of accuracy of the results. Therefore, validity of instruments is their capacity to capture accurately and present accurate data. The researcher will discuss the items with the supervisor to ascertain their effectiveness. According to Mugenda & Mugenda (2003) reliability is the extent to which a research instrument brings out regular data after several trails. Therefore, one of the ways to test instruments reliability is to use test-retest technique to confirm reliability of the instrument. The Cronbachs alpha was tested in Elgeyo Marakwet County a sample that was not part of the study.

## 3.5 Data Collection Procedure

Questionnaires were used to collect data. 286 questionnaires were selfadministered by the research. The questionnaires contained both closed ended and open ended questions. Other than questionnaires the research used the interview method and observation during data collection.

## **3.6** Data Analysis techniques.

Before analysis of data all the questionnaires were collected. The data in the questionnaire was then coded, classified and summarized. Descriptive analysis was done using SPSS to explain the relationship and allowed the researcher to retrieve percentages and count participant's views on the influence of infrastructure development on milk sales volumes in Chesumei Sub County, Nandi County, Kenya.

## **3.7 Ethical Considerations**

When conducting any research, certain guidelines should be followed to make the research ethical thus valid. Before the researcher did the study, consent from the farmers was sought. The researcher explained what the study was all about and benefit incurred after the findings. In addition, confidentiality of the respondents was adhered to and the data collected was used in this research only. The study also stuck to the principles of research which was only for academic reasons. The researcher obtained a research permit in order to comply with ethical standards.

## 3.8 Operationalization of variables.

Collection centers was described as a central place where all the gallons of milk is assembled for collection by the responsible marketers, buyers or processors which were mostly big organizations like Brookside or cooperative societies. Rural roads as the name states are roads that were found in the rural areas. Earth roads were roads whose surface is pure soil and are common in rural areas. Most earth roads are feeder roads to Bitumen and Gravel reads. Foot paths were narrow roads used by people walking on foot as they were not wide enough for vehicles to use. Rural roads access refer to the connectivity of the various roads and used by the farmers in transporting their farm produce to the markets. The type and quality of the road determine the price of the produce, the cost of transportation, the time taken to deliver the goods and the means of transport to be used.

## **CHAPTER FOUR**

## PRESENTATION, DISCUSSION AND INTERPRETATION OF FINDINGS

## **4.0 Introduction**

This chapter presents the analysis, presentation, interpretation of the data collected in the study. The chapter also presents the discussion of the findings of the study. Findings are presented based on the research questions that the study sought to achieve. The research questions were: To what extent does transport influence milk sales volume by farmers in Chesumei Sub County, Nandi County, Kenya; how does telecommunication influence milk sales volume by farmers in Chesumei Sub County, Nandi County, Kenya; Does energy influence milk sales volume by farmers in Chesumei Sub County, Nandi County, Kenya; How does water and sanitation influence sales of milk volume of farmers in Chesumei Sub County, Nandi County, Kenya; and Out of a total of 286 questionnaires that were given out, 275 were filled and returned by the respondents, yielding a response rate of 96.15%. This was considered a reliable response rate appropriate for making generalizations from the findings of the study.

## 4.1 Response rate

A sample of 286 was selected from a population of 1000 respondents within Chesumei Sub County; table 4.1 shows the response rate.

Respondents	Sample	Response rate	Percent
HODs & Lecturers	286	275	96.15%
Total	286	275	

 Table 4.1 Response rate

The findings revealed that most of the respondents took part in the study, according to Fincham (2008) there are higher expectations for survey response rates. Response rates approximating 60% for most research should be the goal of researchers and certainly are the expectation of the Editor and Associate Editors of the *Journal*. For survey research intended to represent all schools and colleges of pharmacy, a response rate of  $\geq$  80% is expected. The response rate was therefore considered to be adequate for withdrawing conclusions from.

## 4.2 Respondents' Background Information

The background of the respondents determines a lot of factors such as experiences and understanding of procedures within their area of specialization and many more, the study therefore sought to investigate the respondents' background by identifying their age, gender and education level.

## 4.2.1Respondents' Age

Respondents' age is factor that reflects experience in various fields of study. The researcher therefore found it important to find out the respondents age. Table 4.2 shows the age distribution of the respondents within Chesumei Sub County.

Age Bracket (years)	Frequency	Percent
20-30	30	10.9
31-40	96	34.9
41-50	121	44.0
51-60	28	10.2
Total	275	100.0

**Table4.2. Age Distribution** 

The study found that 44.0% of the respondents were 41-50 year old reflected by 121 respondents, 96 of the respondents recorded to belong to31-40 years bracket represented 34.6% of the total sample, 10.9% of the respondents belonged to 20-30 years bracket while 28 of the respondents were between the bracket of 51-60 years old represented by 10.25 of the total sample population. From the findings it was evident that most of the people engaged in farming are not young and this could be due to the culture of people looking for education and greener pastures elsewhere.

## 4.2.2Respondents Gender

Gender equality is a factor considered in most developed nations as a factor that contributes directly to development of a nation. The study therefore sought to find out the gender distribution of the respondents within the sample area. Table 4.3 shows the gender distribution of the respondents.

Category	Frequency	Percent
Male	207	75.3
Female	68	24.7
Total	275	100.0

Table 4.3 Gender distribution.

According to European Union (2015) since 2012, gender equality is one of the key priorities of a "Reinforced European Research Area Partnership for Excellence and Growth" (ERA). The findings reveal that 75.3% of the respondents were male represented by 207 respondents of the sample while 24.7% of the respondents. The findings reflect that most of the famers are men, this could be due to culture of the people within the rift valley who mainly take men to be farmers, few of the women venture in this field as they perceive the work to be male job.

# 4.2.3Education level attained.

The level of education shows the knowledge and vast understanding of various programs that people specialize in. the researcher therefore sought to find out the education level of the respondents. Table 4.4 shows the findings of education level in the area of study.

 Table 4.4 Education level

<b>Education Level</b>	Frequency	Percent
Certificate	123	44.7
Diploma	95	34.5
Degree	45	16.4
None	12	4.4
Total	275	100.0

The findings reveal that 44.7% of the respondents had attained a certificate level of education, represented by 123 respondents of the sample, 34.5% of the respondents had attained Diploma level of education represented by 95 respondents of the sample, 16.4% of the sample represented those who had attained a degree level of education with 45 respondents while 4.4% of the respondents had recoded not to have attained any education. They were represented by 12 respondents of the sample. Most of the respondents had attained a complete primary and secondary education and thus most of them had attained a certificate in their various fields of study, this would be due to the early education systems that saw most people have a mentality of only achieving a primary and secondary certificate.

## 4.3 Transport and its influence on milk sales

Transport influences the quality of milk in various ways since milk is a perishable good thus need to be delivered in the shortest time possible to the consumer. In order to find out the influence and relationship that transport had on the sales of milk the researcher conducted a correlation analysis to find out the level of relationship between milk sold and transport.

## 4.3.1Transport

Depending on the distance from the farm where the milk is produced to the consumption centre, transport may be direct from the farm to the retailer or by road to the place of consumption, distribution being made by delivery vehicles to the retailer. Large road vehicles and railway wagons should be well insulated, and preferably refrigerated with the aid of ice, dry ice or a refrigeration compressor. Usually refrigeration is necessary only during part of the year. Table 4.5 shows the findings of the study with regards to the quality of roads that the farmers used in the area.

Quality of Roads	Frequency	Percent
Good	22	8.0
Poor	127	46.2
Average	112	40.7
Pathetic	14	5.1
Total	275	100.0

 Table 4.5 Road quality available

The findings reveal that 46.2% of the respondents recorded to have experienced poor quality of roads in the area, 40.7% of the respondents said to have an average quality of roads being developed and 8.0% of the respondents, the road quality that they use to be good, only 5.1% of the respondents said the

quality of roads is pathetic. The quality of road used was calibrated depending on the portholes, dents and tarmac road available thus the respondents had an idea of the good and poor quality of road. The findings revealed that the roads in this area are mostly rough roads and few had tarmac. To get a better view of the influence of transportation on the sales of milk, the table below shows the number of respondents who gave their feedback.

Dairy Farmers	Frequency	Percent
Positive Influence	191	69.5
No influence	84	30.5
Total	275	100.0

 Table 4.6Influence of road accessibility on milk sales

From the findings it is revealed that there is a high level of influence by road accessibility shown by the table 4.5 where 69.5% which is 191 respondents agreed that the road accessibility was a factor affecting the sale of milk. A smaller percentage of 30.5% by 84 respondents replied that road accessibility was not a factor affecting their milk sales. From the findings it can be concluded that most of the famers do use road as a means of transport and mainly bicycles and vehicles to deliver their products. This is evident as one of the respondents uses his pick up to deliver milk to the urban areas for sale.

Transport by heavy lorry to the retail delivery vehicles should be carried out under conditions that ensure that the milk does not remain exposed to air temperature or light. Depending on the organizations concerned and the timetables, a cold store may be necessary to hold milk between unloading and reloading. This made milk to be delivered not to be of high quality thus lowering the sales

## 4.4Telecommunication and its influence on milk sales

Telecommunication is key in development of many industries in any country. Introduction of more efficient transport technology and mobile communication has the potential of changing the logistics practices in the industry. Increasing competition and the low penetration of IT also implies that the scope for change is immense and imminent. The study therefore sought to find out various platforms of telecommunication that the farmers use and how it influences the sales of milk.

## 4.4.1 Telecommunication mobile banking

Mobile banking is one of the easiest and fastest ways of sending and receiving money, platforms such as Mpesa, Airtel money, Dubhill and many more transaction is efficient between traders. The researcher therefore sought to find out if the farmers transact to get paid during their delivery of milk through mobile banking. Table 4.7 shows the findings.

Table 4.7 Awareness of mobile banking

Awareness	Frequency	Percent
Positive Influence	232	84.4
No influence	43	15.6
Total	275	100.0

The findings reflect that 84.4% of the farmers were aware of mobile banking services represented by 232 respondents of the sample, 15.6% of the sample did not know if there was any mobile banking. The researcher therefore sought to know which specific services that the farmers used in order to transact their day to day business and 68.75% of the respondents were recorded to have said Mpesa as the main means of transaction, 19.6% of the respondents said Airtel money while 7.3% of respondents recorder Yu cash. 2.5% of the respondents had not respondents to this question. Table 4.8 shows the findings as per the specific mobile banking service that the farmers used.

Banking Service	Frequency	Percent
Mpesa	189	68.7
Yu Cash	20	7.3
Mobi Cash	4	1.5
Airtel Money	54	19.6
No Response	8	2.6
Total	275	100.0

 Table 4.8 Mobile banking services used

In order to find the influence of telecommunication to milk sales the researcher further sought to analysis the level of influence of telecommunication and milk sales.

<b>Banking Service</b>	Frequency	Percent
Very High	72	26.2
High	98	35.6
Moderate	54	19.6
Low	51	18.6
Total	275	100.0

 Table 4.9 Influence of telecommunication on milk sales

To tallied relationship level between the different levels of influence indicate that a high number of respondents agree that telecommunication influence milk sales through the 26.2% and 36.6% representing very high and high influence respectively and both giving a total of 170 respondents out of the 275 total respondents. Those who stand for moderate and low influence are 19.6% and 18.6% representing 54 and 51 respondents respectively. Table 4.9 shows the findings of the relationship between telecommunication and milk sales.

## 4.5 Energy use and its influence milk sales

The amount of energy consumed reflects the products being produced. The amount of electricity consumed is usually a significant reflect of the industrialization level within the society. The study therefore sought to find out the influence of energy use on the sale of milk and how it influences its production. The table 5.0 below shows the relationship between energy use and milk sales.

Dairy farmer	Frequency	Percent
Positive influence	102	37.1
No influence	173	62.9
Total	275	100.0

Table 5.0 Influence of energy use on milk sales.

The respondents feedback indicated that 37.1% represented by 102 were positive that energy use influenced the volume of milk sales while 62.9% represented by 173 dairy farmers were of the opinion that energy use did not influence the volume of milk sold.

# 4.5.1 Type of energy used

The type of energy used and the amount consumed is paramount to the products it is used to produce. The study therefore sought to find out the type of energy that the farmers use in the production process of milk. Table 5.1 shows the findings of the study.

Type of energy	Frequency	Percent
Solar	100	36.36
Hydro Electric	109	39.64
Biogas	4	1.45
Wind Power	54	19.64
None	8	2.91
Total	275	100.0

 Table 5.1 Energy type used
The findings revealed that 39.64% of the respondents used hydro electric energy represented with 109 respondents from the total 275 sample, 100 respondents used solar energy representing 36.36% of the total sample, 19.64% used wind power to supply energy represented by 54 respondents of the total sample, 2.91% did not use any power source of energy while 1.45% used biogas energy. From the findings it was evident that most of the farmers did use hydroelectric power. This was because it is easily available provided by the Kenya power and lighting company in the nation, this was closely followed by solar energy users, this would be due to the availability of sun in the region and the installation process of solar energy is easier to understand. Fewer respondents used biogas energy and wind power, this would be due to the cost needed during installation of biogas and wind power. A respondent reported that it was too expensive to get biogas digester from Kengen which he had consulted but realized that he could not afford and resorted to solar energy.

### 4.6 Water and sanitation and its influence on milk sales

Many diseases are associated with inadequate water and at any one time close to half the urban population in Africa, Asia and Latin America are suffering from one or more of the main diseases associated with inadequate water and sanitation (WHO 1999). Water has nutrients that when used effectively will improve the quality of milk and thus improve the sales of milk and its products. The study therefore sought to find out the relationship between water and sanitation with its influence to sales of milk.

## 4.6.1 Water and sanitation

Many factors influence the composition of milk, the major components of which are water, fat, protein, lactose and minerals (Looper, 2012). This means the quality of milk can be influence by water. The researcher therefore sought to find out the source of water that the farmers obtained their normal duty water from. Table 5.2 shows the findings of the study with regards to water source.

Water Source	Frequency	Percent
Bore hole	120	43.64
Rain Water	59	21.45
Piped / Tap water	38	13.82
River Water	54	19.64
Buy water	4	1.45
Total	275	100.0

 Table 5.2 Water source

Findings reveal that 43.64% of the farmers did use Bore hole water to do their day today routines represented with 120 respondents from the total sample, 59 respondents recorded to be using rain water which accounted for 21.45% of the total sample, 19.64% of the respondents recorded to be using river water while 13.82% said that they used piped or tap water to run their day to day activities. Only 1.45% agreed to be buying water. From the data it was evident that a large number of the famers used water that had not been assessed to be fit for daily activities, rain water may contain acid particles as it was evident during the observation data collection most of the houses roofs were rusty which is mainly

caused by acid rain, river water contains nutrients from the soil but also some farmers do dispose the effluents into the farm which are eroded to the river thus affecting the aquatic life of the marine organisms. This water is the same water that the cattle drink and is used to clean containers for packaging during delivery to the various clients. The researcher therefore decided to find out a clear picture of the relationship between sanitation practices and sales of milk. Table 5.3 shows the findings of the relationship analysis.

Dairy farmerFrequencyPercentPositive influence4817.5No influence22782.5Total275100.0

Table 5.3Presence of drainage system and influence on milk sales.

The numbers indicate that most dairy farmers did not have proper drainage systems in the farm which is a reflection of lack of sufficient water installed in the farms to run the drainage systems. The same also reflect the level of hygiene practices by the farmers which could not be practiced at high level as shown by low level of water supply in the dairy farms. The farmers were not able to assess the influence of sanitation on milk sales volumes but accepted that availability of sufficient clean water for drinking by livestock affected the volume of milk produced.

### **CHAPTER FIVE**

## SUMMARY, CONCLUSION AND RECOMMENDATIONS

## **5.1 Introduction**

This chapter presents the summary, conclusions and recommendations of the study. These are derived from the findings of the study. The summary, conclusions and recommendations are presented based on the findings of the research questions that guided the study.

## 5.2 Summary

A response rate of 96.15% was achieved for the study with 44.0% of the respondents being in the age group of 41-50 years. Most of the farmers in the study were male represented with 75.3% of the respondents while 24.7% of the respondents were female. The study also found that 44.7% of the respondents had undergone through certificate education and only 4.4% did not attain any education background.

Transport influences the sales of milk as the more the milk is delayed on the highway the more customers the farmers loose. This is evident from the study showed how the roads were not well constructed in the area with most of the respondents saying that they do have poor roads. From the research findings, road accessibility determines the ability of farmers to deliver milk to the purchasing centers. The accessibility determinants are on road quality and lengths. It is evident that few farmers are linked to good roads while a big number are linked to poor, average and pathetic roads.

Communication is key in any industry, and with telecommunication development gaps are filled and ease of transactions in many industries. The growth of mobile banking, Mpesa and many more show that industrialization is taking place. The findings showed a great influence of telecommunication indicators to the sale of milk from the farmers. There was great number of famers using the Mpesa platform to send and receive their money represented by 68.75 of the total sample. The relationship between the different levels of influence indicate that telecommunication influence milk sales as represented by 170 respondents under very high and high influence category out of the 275. Those who stand for moderate and low influence are 19.6% and 18.6% representing 54 and 51 respondents respectively.

Water is very heavy to carry so the distance it has to be carried will influence consumption levels. Therefore, limited quantities due to the distance it has to be carried mean inadequate supplies for washing and personal hygiene, washing, food, cooking utensils and clothes. It is also a known fact that eye and ear infections, skin diseases, scabies, lice and fleas are very difficult to control without sufficient supplies of water. The same water is to be used to clean containers that are used in carrying milk. It was evident from the findings that sanitation was not practiced to the level it is preferred by the poor significant positive relationship between water and the sales of milk.

The findings revealed that 39.64% of the respondents used hydro electric energy represented with 109 respondents from the total 275 sample, 100 respondents used solar energy representing 36.36% of the total sample, 19.64% used wind power to supply energy represented by 54 respondents of the total sample, 2.91% did not use any power source of energy while 1.45% used biogas energy. From the findings it was evident that most of the farmers did use hydroelectric power. This was because it is easily available provided by the Kenya power in the nation, this was closely followed by solar energy users, this would be due to the availability of sun in the region and the installation process of solar energy is easier to understand. Fewer respondents used biogas energy and wind power, this would be due to the cost needed during installation of biogas and wind power.

### Conclusion

The study found milk farming to be a male dominated area with 75.3% of the respondents being male, it also found that most of the respondents were of the age bracket between 41-50 years old represented with 44% of the population.

The study also found a great influence of transportation on the milk sales as this was proved with191 respondents agreeing that the transportation network influenced milk sales in the region. The few who did not realize any influence of milk sales by the transportation network were found to be either delivering to the consumer markets by themselves, nearer to the roads or selling their milk to the traders who collect their milk from the homestead.

Telecommunication was one of the most effective key pillars that the study found to be of great influence with more than half the farmers using various platforms to send and receive money for their services. Various options have been availed for ease of payments either through the mobile phones or from banks to the mobile phones thereby making more farmers to make sales at their homes and receive payments while at the homestead. The 232 dairy farmers interviewed agreed that telecommunication played an important role of information on prices, markets and time saving in their trade.

Water and sanitation needs to be practiced in the level required so as for the sales of milk to be improved in order to sell good quality and maintain high herd health level. Water is an important commodity for several uses in the farms from the houses, dairy units and irrigation where water is not enough. Good hygiene for both the human beings and livestock is easily achieved where there is clean sufficient water. Production by the livestock especially the dairy cows depend on the enough supply of clean water. Therefore, enough water and healthy dairy cows positively improve the amount of milk produced by a dairy cow. Consumption of energy was directly related to the quality of milk sold. This is due to the preservation through refrigeration which means use of electricity thus power consumption. Energy was found to be necessary to a dairy farmer for preservation of milk which was not collected was milked. Most of the milk buyers collect milk in the morning while some farmers did have some extra afternoon milk which was meant for sale but since the buyers were not available, they preserve the milk by use of fridges and others boiled and preserved using cold water.

## Recommendations

The study clearly indicated that transportation, telecommunication, energy and water & sanitation did influence the amount of milk sales during the study. The study therefore came up with the following recommendations in order to improve the sales of milk within the region.

The farmers should be enlightened in order to understand the importance of sanitation since clean products is a way of reducing diseases in the nation and thus their products will be of high value. The method of disposing their products has to be environmental friendly in order to reduce cases on environmental pollution. The communities also are to be challenged to work as a team in improving the water projects which will improve the availability of clean sufficient water to all dairy farmers in order to increase milk volumes.

The county and national government should collaborate and see on various methods that they can use in order to improve the road systems in the area. This will greatly improve the products being sold not only milk but also other perishable products.

More energy needs to be supplied to the farmers so as to have a good power grid and thus calls for the Kenya power firm to educate farmers on importance and use of electricity in various products that the farmers produce and improve the availability of other power sources.

The new technology is growing positively in all areas as evident by mobile banking and communication. The mobile service providers should be advised to reduce the cost of transacting in order for the mobile services are affordable to all the dairy farmers. This will enable the farmers to get trainings through their phones and improve dairy productivity.

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## **APPENDICES:**

## **APPENDIX 1**

## LETTER OF TRANSMITTAL TO WHOM IT MAY CONCERN

Dear Sir/Madam,

## RE: PERMISSION TO CARRY OUT RESEARCH IN YOUR SUB-COUNTY.

My name is Domtila Jebet Birgen from the University of Nairobi. I am carrying out this research for the partial fulfillment of the requirement for the award of Masters Degree in Master of Arts Project Planning and Management. My research shall be based on investigating the influence of infrastructure development on milk sales volumes in Chesumei Sub-County, Nandi County, Kenya. The factors you are going to give is for academic purposes and your identity and information will not be shared with anyone hence will be treated as confidential. Findings of the study shall upon request be availed to you.

Thanks.

Yours faithfully,

Domtila Jebet Birgen The University of Nairobi

## **APPENDIX: II**

## QUESTIONNAIRE

## **INSTRUCTIONS:**

1. The information given on this questionnaire will be held in strict confidence and will be used only for the purpose of the study.

2. If any of the questions may not be appropriate to your circumstance, you are under no obligation to answer.

## PART A: GENERAL INFORMATION

1. Please indicate your gender

A. Male ()

B. Female ()

2. Please indicate your age from the categories below

A. 20-30 years	(	)
B. 31-40 years	(	)
C. 41-50 years	(	)
D. 51-60 years	(	)
E. above 61 years	(	)

3. Kindly indicate your highest academic qualification.

A.	Certificate	(	)
ъ	D' 1		``

B. Diploma ()

- C. Degree ()
- D. Masters ()
- E. Others (Specify)

## 4. How long have you been Delivering Milk?

Less than 1 year	(	)
1 year to 2 years	(	)
2 years to 3 years	(	)
3 years 4 years	(	)
Over 4 years 52	(	)

## 5. How can you describe accessibility to your rural roads?

A.	Efficient	(	)
B.	Good	(	)
C.	Fair	(	)
D.	Bad	(	)

# PART B: INFLUENCE OF TRANSPORTATION ON MILK SALES VOLUMES

- 1. How can you describe the road that you use to transport your milk?
  - i. Easily Accessible
  - ii. Moderately Accessible
- iii. Inaccessible
- 2. In your own view, has the accessibility of the roads improved the volume of milk you sell?

YES ( ) NO ( )

**3**. In a scale of 1 to 4, please indicate which number best describes the how presence of roads has assisted in improving milk volume for sell (1 represents high , 2 represents moderate, 3 represents moderate, 4 represents 1

(i) Very High	(	)
(ii) High	(	)
(iii) Moderate	(	)
(iv) Low	(	)

# PART C: INFLUENCE OF TELECOMMUNICATION ON THE VOLUME OF MILK SOLD.

- 1. Do you know what mobile communication is?
- 2. If yes, name the type of mobile communications related to agriculture you are aware of?

.....

.....

3. How has knowing the applications assisted to increased the milk volume you sell to factories and processing companies

.....

4. In a scale of 1 to 4, please indicate which number best describes the how mobile communication has assisted in improving milk volume for sell (1 represents high, 2 represents moderate, 3 represents moderate, 4 represents low.

(i) Very High

(ii) High

(iii) Moderate

(iv) Low

Briefly explain your choice from the above

.....

.....

- 5. Which of the following Mobile banking services do you use
- i. Mpesa ()
- ii. Airtel Money ()
- iii. Yu Cash ()
- iv. Orange Money ()
- v. Mobi Banking ()

# PART D: THE INFLUENCE OF ENERGY ON THE VOLUME OF MILK SOLD

- 1. What is your main Source of Energy?Solar( )Hydro Electric Energy( )Wind Power( )Biogas( )
- 2. Do you Experience any power related problems frequently such as blackouts

YES (	)	NO (	)
· · · · ·			

3. Please Indicate the amount of voltage on average that you use on a weekly basis

4. Has the presence of many companies improved the amount of milk you deliver?

5. If yes, explain how?

.....

- 6. In a scale of 1 to 4, please indicate which number best describes the how presence of factories has assisted in improving milk volume for sell (1 represents high , 2 represents moderate, 3 represents moderate, 4 represents low.
  - (i) Very High
  - (ii) High
  - (iii) Moderate
  - (iv) Low

## PART E: THE INFLUENCE OF WATER AND SANITATION ON THE VOLUME OF MILK SOLD

- 1. What is your main water source?
  - Rain water ()
  - River water ()
  - Tap water ()
  - Bore holes ()
  - Others \_\_\_\_\_

2. Do you have a drainage system that you use to dispose effluents?

YES ( ) NO ( )

3. How do you dispose your waste materials for instance in the shamba, river, burning e.t.c

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Thank you for answering all the questions.