ASSESSMENT OF THE PERFORMANCE OF SMALL-SCALE DAIRY FARMING IN MERU COUNTY, KENYA

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A thesis submitted in partial fulfilment of the requirements for the degree of Master of Science (Agribusiness Management and Trade) in the school of Agriculture and Enterprise Development, Kenyatta University

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DECLARATION

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

Signature: ……. **Date:…….**

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Supervisors' Approval

We confirm that the work reported in this thesis was carried out by the candidate under our supervision and has been submitted with our approval as university supervisors.

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DEDICATION

I dedicate this work to my family. My loving husband, George Michuki for his immeasurable support; my dear sons Dan Murimi and Eddy Munene for their great understanding during the period of my studies.

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ABBREVIATIONS AND ACRONYMS

AI	:	Artificial Insemination
FAO	:	Food Agricultural Organization
ILRI	:	International Livestock Research Institute
Kshs.	:	Kenya Shillings
MCG	:	Meru County Government
GMA	:	Gross Margin Analysis
SDP	:	Smallholder Dairy Project

OPERATIONAL DEFINITION OF KEY CONCEPTS

Agricultural Extension services	:	Interventions targeting the small-scale dairy farmers that are aimed at helping the dairy farmers resolve the problems that they face in their dairy farming and also help improve profitability.
Cross	:	A cow which has parents of two distinct breeds.
Milk yield	:	Amount of milk produced by a cow or a cow herd in a dairy farm at a given time.
Production	:	As used in the study, this refers to the total dairy milk from a dairy cow in a dairy enterprise.
Profit	:	In this study profit is measured as the gross margin of the dairy enterprise. Where gross margin is measured as total revenue – total cost.
Profitability	:	As used in this study profitability refers to the measure of performance of small scale dairy enterprise.

ABSTRACT

Despite the apparent importance of the dairy sub-sector to Kenya's economy, the sector is plagued with low milk production. The general objective of the study was to assess dairy performance among the small-scale farmers in Meru County. The specific objectives were (i) to characterize small-scale dairy farmers; (ii) to assess the profitability of small-scale dairy enterprises; and (iii) to determine the factors influencing profitability among small-scale dairy farmers in Meru County. The research used cross-sectional design where 150 small-scale dairy farmers were selected from the subgroups using simple random sampling technique. Gross margin analysis was used to analyse profitability while multiple linear regression analysis using ordinary least square method was used to determine the factors influencing dairy profitability. The mean age of dairy farmers in Meru County was 45.7 years with 92% being men who are the household heads. 92% of the farmers had formal education and 68% had experience of more than 10 years. The average household size was 5 members. Only 29.3% of farmers had applied for a dairy enterprise development loan. Most of the farmers were members of groups and had attended dairy farming trainings. Dairy in Meru County was characterised by intensive farming technologies for instance zero grazing system. The average land size under dairy was 0.7 acres and the average herd size was 3 cows. Results also show that there is potential for increased small-scale dairy performance in Meru County. Dairy farming was profitable with farmers receiving an average gross margin of Ksh. 5,299 per cow per month. The model shows that herd size, education level and credit access have significant influence on dairy profitability. In view of the study findings the study recommends that the policy makers should take initiative in enacting laws aimed at lowering the cost of inputs thus reducing production costs. Secondly the study recommends that the government should prioritize investing in farming as a way of promoting employment to the population. The study also recommends use of alternative improved feed such as homemade dairy ration to reduce feed cost as one way of maximizing profits from small-scale dairy farming. Finally, the study recommends that policy intervention should be aimed at establishing breeding centers for dairy cows in order to enable farmers increase herd size, formulation of laws which can help farmers get access to loans in order to invest in dairy farming and transfer of knowledge through provision of extension services to educate farmers on dairy management.

CHAPTER ONE: INTRODUCTION

1.1. Background to the Study

Dairy industry plays a significant role in Kenya's economy. It plays a very important role especially in employment creation, manure provision and food security. In the year 2012 milk production was estimated at 54 tons. About 2 million of Kenyans earn their livelihood from the dairy sub-sector.With annual milk production in Kenya estimated at 54 tons of milk in 2012, the dairy sub-sector provides a means of livelihood to about 2 million Kenyan households. There are several studies which have estimated the employment created by the dairy industry. A study by (Muriuki, 2011) found out that for every 1000 litres of milk produced by famers in Kenya 77 jobs are created. These jobs include fulltime for self - employed, fulltime for the permanently employed and fulltime for casual laborers.

Kenya's dairy sector has many players: the producers, input and service providers, industries, development partners and consumers (Muriuki, 2011). Specific actors in the industry include milk processors, milk traders, farmers' cooperatives and farmers' groups, retailers, informal traders and distributors.

Dairy production in Kenya is undertaken through large scale or small-scale farming. The most dominant method of dairy farming in the sub-sector is small-scale. The small-scale farmers keep between 1 – 3 cows.

These farmers produce around 56 % of the total milk in the Country and supply 80% of Kenya's milk marketed (Majiwa et al., 2012). In addition, the dairy sub-sector is dominated by cow milk which in 2012 accounted for 33.1 per cent of all the milk output in the country (Figure 1). This is closely followed by camel milk 23.1 per cent.

These estimates are based on the most current comprehensive data set that is available with regard to trends in milk production in Kenya (i.e. up to the year 2012). Other sources of milk include sheep and goats. However, sheep accounts for a marginal portion of the total milk output in the country. This is partly because in some local cultures in Kenya, sheep milk is not consumed.

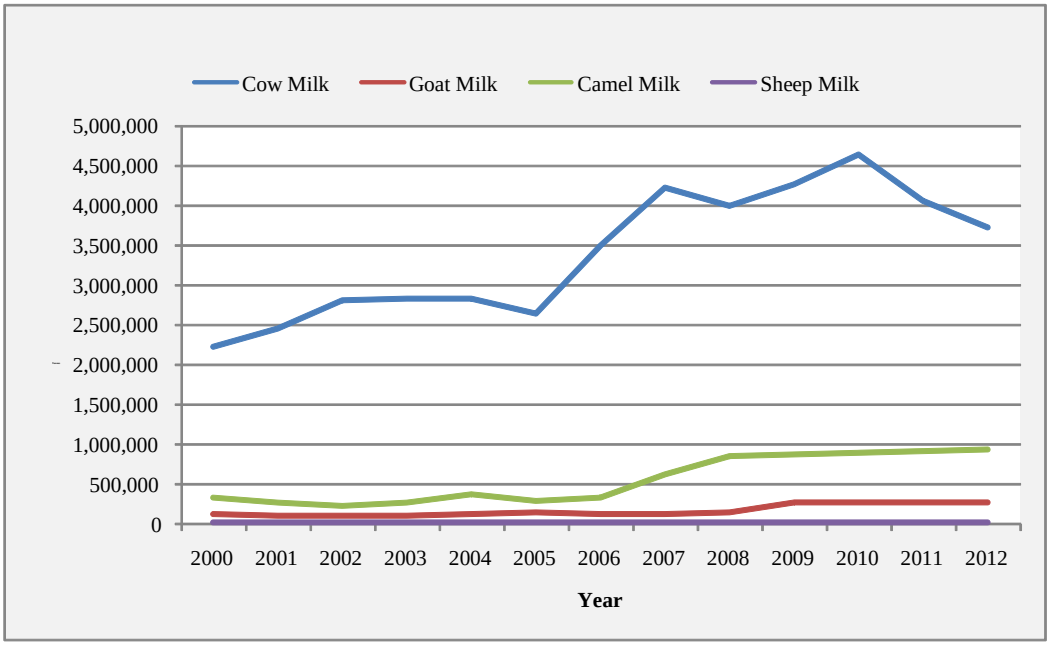

Figure 1: Trends in Milk Production in Kenya, 2000 - 2012

Source: Kenya Dairy Board, http://www.kdb.co.ke/ , accessed on October 8, 2014

In Kenya dairy production systems can be divided into four groups. These groups include: tethering, open grazing, zero and non–zero grazing. Tethering and open grazing are more pasture based systems in the Country. They are the primary production systems in several dairy producing units in the Country. Zero grazing is a system where cows are fed using rations that are relatively high in concentrates and stored forages. Milk production per cow depends on the level of intensification. The higher the level of intensification the higher the milk yield. This is dependent on the

nutrition. (Lanyasunya et al., 2006). Human population density and the agro ecological zone defines the production system adopted in a certain area. Mostly in highland areas smallholder dairy farmers practice intensive dairy production systems which involve stall feeding crop residues and planted fodder crops while supplementing with concentrates (Njarui et al., 2016). Majority of dairy farmers engage in other farming activities such as crop farming. Dairy production in this system is conducted in a small piece of land with a herd of pure and cross – bred cows ranging from 1 to 5 cows. The type of cattle kept are usually Friesian, Ayrshire or their crosses (Mugambi et al., 2015). This system has an advantage of interdependency and recycling of the resources. Semi intensive grazing system (Semi - zero grazing) is practiced in areas with moderate population densities. Semi–zero grazing is a combination of zero grazing and open grazing. This method is attractive because it allows the farmer to reduce cost while allowing concentrates feeding for better milk yield. This system is practiced in areas with large pieces of land.

In this system cattle are grazed at day time and stall fed at night. The cattle are supplemented during milking and farmers mostly keep crosses of the dairy breeds (Muia et al., 2011). A number of factors determines the production system to be used: genotype of the cattle, objective of production, geographical region and social-economic characteristics of the producer.

In spite of the apparent significance of the sub-sector to Kenya's economy, the sector is plagued with low milk productivity in comparison to the best performers in the African region. For instance, as of 2009, South Africa got around 3 billion kilograms of milk from an average of 0.5 million dairy cows as compared to 4 billion kilograms of milk from Kenya's 3.5 million dairy cows (Mugambi et al., 2014). Further,

Kenya's yield per cow remains low at an average of 6 kilograms over the last 30 years (MoLD, 2010).

Low production lead to low revenues and very high cost of inputs increase milk production costs (schantz; 2006) hence reducing its competitiveness compared to milk from other countries. These challenges impact the sector's ability to compete in the domestic and international market (Wambugu and Opiyos, 2011). Resources available affect dairy production. Factors such as feed cost, feed transportation cost and labour cost negatively affect the profitability of dairy sector. The sector is being faced by various challenges such as economic challenges, marketing challenges, institutional and processing challenges (Karanja, 2003).

Dairy production is relatively developing in Meru County due to its favourable climate. From the year 2011 to the year 2014 dairy cows increased from 162,000 to 171,000. Production per cow per day averaged 2.23 litres in the year 2014 (KNBS, 2015). Dairy in the county provides employment to thousands of the population as well as quality milk for consumption which is of very high quality. The County is marked by declining land sizes due to the increasing population which has led to land sub divisions hence cows are confined and feed materials are brought to them (Beltenweck et al., 1998, Staal et al., 1999). The small scale dairy farmers are faced by challenges such as the increased cost of milk production and low milk production per cow per day. Although the average production is known the profitability of the sector is not known. Hence this study is aimed at gaining insight on the prospects on performance of the small scale dairy farming in the County by assessing the profitability of small-scale dairy farming as well as the factors influencing

profitability. This will give insight to small-scale farmers and other stakeholders on ways of increasing dairy profitability in the County.

1.2. Statement of the Problem

Dairy sector is the second largest contributor to Kenya's agricultural gross domestic product (GDP) (Muriuki, 2011). Dominated by small scale dairy farmers the sector has been experiencing tremendous growth since 1980s. Some of the developments in the sector include increased intensification through adoption of zero grazing, expansion of markets for dairy products and increased commercialization. Despite this development it's apparent that the dairy profitability is very low with most of the farmers not making any profits. This may be attributed to high cost of production with an average of sh. 37 per litre of milk (Mugambi et al., 2014).

Meru is a County with relatively developing dairy sector In Kenya. In the year 2011 the county had 162, 000 dairy cows. In 2012 the number increased to 165,000 dairy cows and in 2013 and 2014 respectively the number increased to 171,000 and 175,000. On average the milk production per cow per day in 2014 was 2.23 litres (KNBS, 2015), comparing to the national average of 6kg (Mold, 2011), the county has very low milk production. Although average production per cow is known profitability in the county is not known. This research work therefore intends to fill this research gap by assessing dairy performance among the small-scale dairy farmers in Meru County, Kenya.

1.3. Research Objectives

The overall objective of this study was to assess dairy performance among the small-scale dairy farmers in Meru County, Kenya. The specific objectives are:

1. To describe the characteristics of small-scale dairy farming in Meru County
2. To assess the profitability of small-scale dairy enterprises in Meru County, Kenya.
3. To determine the factors influencing profitability of dairy farming enterprise among small-scale farmers in Meru County Kenya.

1.4. Research Question

In addressing the objectives the following research questions were used:

1. What are the characteristics of small-scale dairy farming in Meru County, Kenya?
2. What is the profitability of small-scale dairy farming in Meru County, Kenya?
3. What are the factors influencing profitability of dairy farming enterprises among small-scale farmers in Meru County, Kenya?

1.5. Hypotheses

For the second and third objectives, the following hypotheses were tested:

1. Dairy profitability does not differ among small-scale farmers in Meru County, Kenya
2. Factors such as age, education, household size, experience, breed type and grazing system have no significant influence on profitability among small-scale dairy farmers in Meru County, Kenya.

1.6. Significance of the Study

This study on the performance of dairy enterprises in the study area will be useful in informing the government and other stakeholders in the sub-sector on potential policy interventions for optimal profitability of dairy sector in the area and such similar settings. This is especially so given the increasing demand for milk in both rural and urban areas of Kenya associated with rising population and increasing purchasing power. This study is also important in informing the public and private extension service providers, the agri-based learning institutions and Agricultural Sector Development Strategy (ASDS) document. Finally, this study is important in enriching available literature on dairy farming and is helpful in identifying of opportunities for further research with respect to small-scale dairy performance.

1.7. Scope

The study focused on small-scale dairy farming performance specializing on dairy characterization, dairy farming profitability and factors influencing profitability. The study constituted small-scale dairy farmers in two sub-counties of Meru County, Kenya.

1.8. Theoretical Framework

Drawing from economic theory, the choices that people make are dependent on the constraints they face. The theory assumes that small-scale farmers are rational hence make decisions aimed at promoting efficiency in the production process and thus creating opportunities for maximizing profits. Small scale farmers fear taking risks and are often confronted with the challenge of enhancing family security as opposed to increasing profit (Snyder and Nicholson, 2008).

One of the ways in which the business owners can get satisfaction from their business is by getting as much profit as possible. In this case, profits refer to the variation between an enterprise's total revenue and the total costs. Total cost is inclusive of the costs of all inputs into the production process plus the value of the highest-valued alternatives to which owned resources could be put assuming that the overriding goal of the managers of firms is to maximize profit (P = TR – TC). The managers maximize profit by increasing total revenue (TR) or reducing total opportunity cost (TC) so that the difference rises to a maximum (Skaggs, 2010). To increase its output, a firm should ensure that the additional revenue that accrues from the additional investments is higher than the associated costs.

1.9. Conceptual Framework

This section explains the conceptual model applied in the study of the profitability of the small-scale dairy farming in Meru County. The model shows that farmers have different social- economic factors which together with the different farm characteristics interact with institutional factors hence influencing profitability. The farmers are faced with institutional environment which include issues such as the transaction cost involved in milk marketing like the cost for searching for market information and buyers. Institutional factors will influence the milk marketing and its products hence influence the enterprises profitability. Some of the social-economic factors include: access to credit; amount of income got from other activities other than credit; age of the household head, education level of household head, household size, experience of the household head and gender of the household head. The farm characteristics include farm size, herd size, breed type and grazing system.

Figure 2, shows how various factors (independent variables) interact with institutional factors hence influencing profitability (dependent variable).

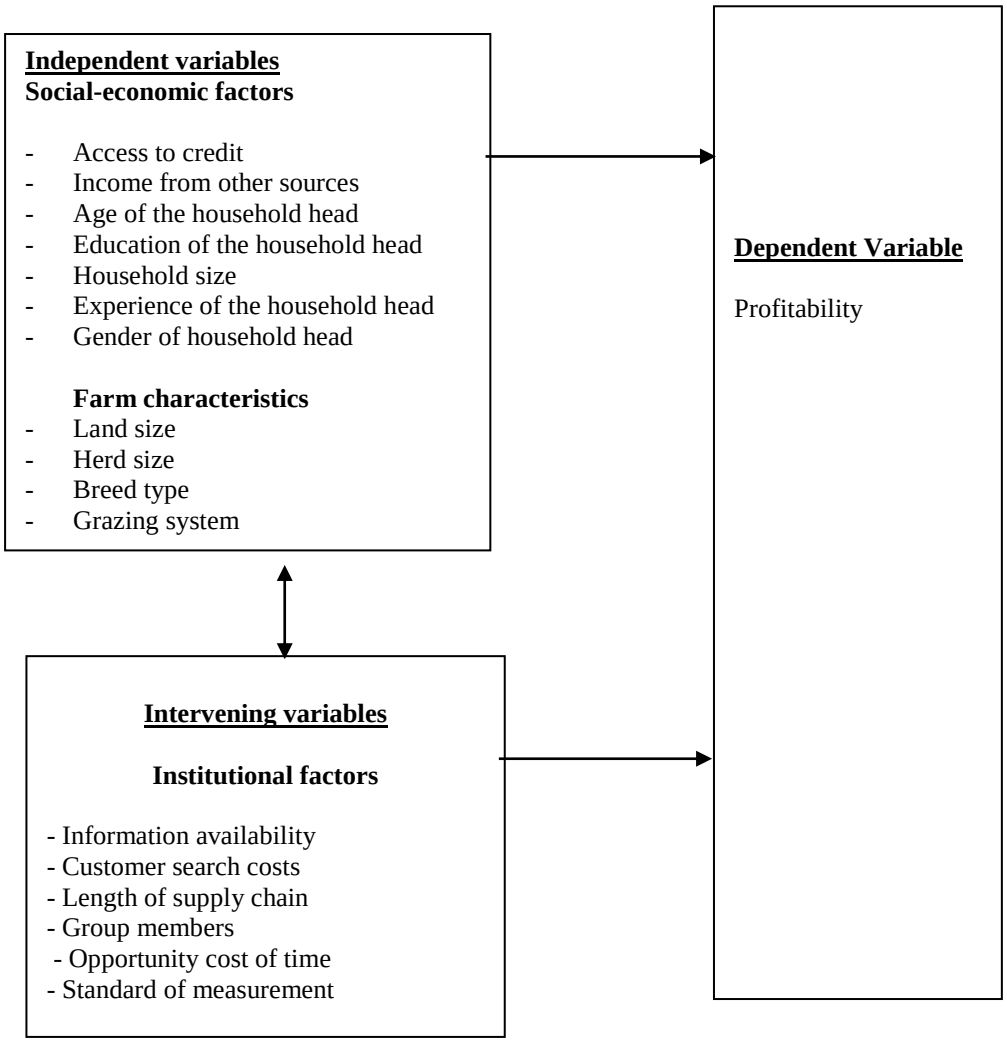

Figure 2: Conceptual Model for the Study of Small-scale Dairy Profitability in Meru County Modified from Kinambuga, (2010)

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This section presents a review of literature that informs the study. The literature focuses on the dairy sub sector with an emphasis on Kenya. The section begins with an overview of dairy production. Other issues addressed in the literature include: the concept of performance in dairy sector, dairy profitability, factors influencing dairy profitability; and finally the research gap.

2.2. Dairy Production

A report by FAO (2010) shows huge discrepancies in dairy production across the globe. The study shows that Asia owned 25.7% of the dairy cattle in the world and produced around 14.9% of the world milk, North America with 5.0% of the global dairy cattle population accounted for 16.3% of the world milk. The study shows that lowest dairy production is found in Africa where despite the continent being home to 14.2% of the world dairy cattle, their dairy production was only 4.7%. According to the same report, in North America, a dairy cow can produce over 5000 kilograms of milk per annum compared to 500 kilograms per annum per cow in Africa.

In Kenya dairy farming is the single largest sub-sector of agriculture. The agricultural sector accounts for 26% of the GDP and another of 27% GDP indirectly through linkages with other sectors (FAO, 2019).

Dairy sub-sector is the most rapidly expanding sub – sector in Sub – Saharan Africa. The sub-sector is very key in the livestock sector and is a very important source of livelihood for approximately 1 million small scale farmers (IFAD, 2006). Kenya's dairy population is estimated to be 4.3 million producing approximately 3.43 billion

litres of milk (RoK, 2015). Most households which practice dairy farming are also engaged in other agricultural activities. Some especially farmers in areas with high population density keep their animals confined in the farm and stall feed crop residues and planted fodder. Cattle are fed with planted fodder such as maize stover, weeds, napier grass and crop residues (Njarui et al., 2011) and also with concentrates like compounded dairy feeds. Feeds are also gathered from public land or purchased from other farms.

Small scale farmers using these more intensive systems produce in a few acres of land usually less than three with a herd size of 1 to 5 pure or crosses cows or a mixture of both. Less intensive systems combine stall feeding and some grazing. Dairy production is divided into large scale dairy production and small scale dairy production. The most popular is small scale with 80% of dairy cattle being owned by small scale dairy farmers. The major breeds kept by dairy farmers are Friesian, Ayrshire, Jersey, Guernsey and their crosses (Kibiego, 2015).

Milk production depends on the on the level of intensification (Mugambi et al., 2015). The differences in milk production is a result of high quality feeds in different production systems which are determined by the agro ecological zones and the differences in the type of breeds kept by the farmer (Muia et al., 2011). Milk production by dairy cattle in Kenya is far much lower than their genetic potential and thus there is potential for increased production (USAID / GOK, 2009).

Milk production cost increases with the level of intensification with profits per litre of milk decreasing with increased level of intensification (kibiego et al., 2011). Fodder

and feed make up the highest cost in dairy production. Cost of production varies based on the location of farm from the market, production system, input supply, use of purchased feeds, fodder availability etc.

From the time dairy industry was liberalized by the government in the early 1990s. Private processors came into the market and demand and supply controlled the market forces with uncertainty in milk payment. Due to the fluctuations in milk prices and delayed payment by some processors farmers sell a large amount of milk through informal milk market (Machira, 2014). Informal markets mostly handle raw milk.

2.3. The Concept of Performance in Agricultural Production

Business performance can be analysed in terms of financial performance or economic performance.

There are five categories of financial performance measures which include liquidity, solvency, profitability, repayment capacity and financial efficiency. Profitability is the most commonly used measure of performance. Economic analysis is critical in assessing the profitability and economic viability for agricultural enterprise. Farm performance can be determined through net returns (Nermes, 2009; Vongpaphane, 2009) or gross margins (Cobb et al., 1999). It can as similarly be determined using Return on Assets (ROA) and Return on Equity (ROE) (McCrory, 2001; Canavari et al., 2004, Shadbolt et al., 2009). Gross margin analysis is one of the approaches that can be applied in analysing the profitability of small-scale dairy enterprises. Gross margin is the difference between the value of enterprise's gross output and variable cost of production. Gross margins help the farmers assess their enterprises and for

those who wants to invest it provides guidance on which enterprise they can invest in for better returns.

Gross margin analysis calculates profits at an individual level. It is the most practical method profitability assessment and it has been used mostly in farm management economics. Gross margins are used to evaluate economic viability of an enterprise. Gross margin is one of the methods of assessing dairy performance. Through gross margin analysis profitability is determined.

Gross margins are used in planning, forecasting and evaluating the economic and financial viability of an enterprise.

Gross margins also help producers evaluate their existing enterprise performance and thus act as a guide to estimating the viability of planned or future investments. Gross margins do not consider net profits. Net profit figures per enterprise tend to ignore the interrelated nature of enterprises and thus less useful for most farm enterprise systems.

Though gross margin has been used in calculating enterprise profitability, it has its own limitations as an indicator of profitability. When comparing gross margins one should only consider firms with like features and production system. Comparing gross margins of firms with different characteristics can give misleading results (Firth, 2002).

2.4. Dairy Profitability

Dairy profitability is determined by the amount of milk the cow produces, the price per litre of milk and the cost incurred in production. If the cost of production per litre

of milk is higher than the revenue received per litre of milk then the farmers do not make any profits. In a dairy enterprise, variable costs include: milk transportation costs, fodder, veterinary services, artificial insemination, labour, maintenance and repairs in the dairy unit, consumables, electricity and water, concentrates and salt lick. Revenue is estimated through milk sales and value of milk consumed by the household.

Higher gross margins reflect greater efficiency in the dairy unit and thus higher milk yields and income. Therefore, higher gross margins are considered ideal for competitiveness of the enterprise.

2.5. Factors Influencing Dairy Profitability

A number of factors play an important role in determining the overall profitability of dairy enterprises. Such factors are varied and could be categorised as: financial factors such as access to credit and income from other sources; demographic factors such as age of the household head, education of the household head, experience of the household head, farm size and herd size; finally there are other factors such as the gender of the household head dairy breed and grazing system. With regard to gender, there is the issue of household division of labour as well as access to and control over critical production assets such as credit and land. Credit access by women is a big challenge because institutional and policy structures do not support women. This hinders the ability of women to acquire large ruminants.

Livestock production in parts of the world is undertaken by men and women though the latter tend to be more disadvantaged given the dominant patriarchal norms. In the livestock sector, research and many planning activities in most countries are

dominated by men. Official livestock practices are mostly controlled by men and extension personnel are primarily men.

Literature shows that in the developing countries if farmers obtain formal financing, the productivity from application of additional inputs would increase returns (Afande and Wachira, 2015). Small scale farmers are also constrained by limited access to business credit (FSD, 2009). According to the same study, 38% of Kenyans are excluded from the formal and informal credit financial services. This is due to small land holdings, scattered distribution of small scale farmers and lack of collateral. Faced with these challenges, small-scale farmers rely largely on their own savings and in needy situation result to informal borrowing so as to meet their farming obligations. All these factors constrain small-scale faming profitability.

From literature there exist a positive correlation between education and human survival (Ani, 2007). Increased productivity and profitability in agriculture depends primarily on the education of the rural farmers to understand and accept the complex scientific changes which are difficult for illiterate rural farmers. For social and economic improvement in rural areas, human capacity improvement is very significant. Based on the finding from these studies this study therefore aimed at analysing if credit access and education had a significant effect on profitability of small scale farmers.

A study by (Oduro et al., 2014) further reveal that education is significant in enhancing productivity among farming households. This was likely because household heads with education are more likely to adopt new technologies and new innovations which are vital for productivity enhancement. Governments all over the

world have acknowledged the importance of education in labour markets success of individuals by routinely advocating for further investment in education. In theory, improved education is positively related to productivity in all scopes of activities including agriculture. A number of reasons may explain a positive return to investments: educated farmers are better managers, adopt more modern farm inputs and prefer risky (high return) production technologies.

Experience of the household head is another factor that enhances dairy productivity. (Gitau, 2013), notes that the more experienced a dairy farmer is, the more the farmer applies best farm practices and consequently improves milk production. Further, the study found out that farmer experience was important in dairy breed selection and feeding practices as well as handling of the dairy farming challenges. Other factors determining dairy productivity include institutional set-ups such as the government policy and access to credit.

The type of breed is another factor that affects profitability. The type of breeds in Africa are of two main races of cattle which include indigenous and exotic. The two races can be cross bred and the crosses can be very productive both in terms of growth rate for beef, improved milk production and also disease resistance (Biovision, 2013). Kenya has a wide range of breeds.

In East and central Africa, Kenya has the highest number of exotic breeds. The major reason as to why farmers keep the dairy breeds is to produce milk, reproduce for replacement of cows and as a source of income through dairy business by providing the most milk at the least cost possible. All types of dairy cows can produce milk but not all are suitable for commercial milk production. The most important dairy breeds

in Kenya are Friesian, Ayrshire, Guernsey and Jersey. Others are good for beef or dual purpose (Xtalia farm, 2011). Exotic breeds were introduced in the country during the colonial era for provision of high quantities of milk. In some agro ecological zones exotic breeds do not do well hence resulting to keeping of their crosses with indigenous or indigenous. Pure and cross breeds need proper management which include provision of quality feeds, availability of plenty of clean water and reliable source of veterinary service for them to produce high quantities of milk.

A study on small-scale dairy farms in Butere –Mumias sub-region of Kakamega County of Western Kenya to establish the dairy production and practices and constraints in the industry by Musalia et al. (2007), revealed that milk production was low. The study further revealed that the average herd size was 4.2, those in milking produced 8.0 kg/ animal per day and the average land size was 8 acres.

The number of dairy animals in the area was limited by diminishing land size and scarcity of pasture and fodder crops. Although over 90% of the milk was consumed locally, the local demand was above supply (Musalia et al., 2007).

The proposed study builds on the work of Musalia et al. (2007) by characterising dairy farming in Meru County of Kenya as well as determining the profitability of small-scale dairy enterprises in the study area.

A study on herd characteristics on small-scale dairy farms in Western Kenya by Wanjala and Njehia (2014), investigated the type of breeds, herd composition, performance and feeding system. The study found out that farmers kept on average 2.5 cows. Lactating cows accounted for 36.0% and heifers accounted for 15.0% of the total number of cows kept. The mean yield per cow per day was 6.5 litres and 89.3%

of the farms were producing less than 10 litres of milk per day per cow. There was a significant difference in the means of the total milk produced by the exotic breeds and total milk produced by the crosses. Majority of the farms used Napier as the main fodder. The study concluded that one of the contributors to low performance is type of breed. The study recommended support to enable farmers keep commercial dairy stock. The study builds on this study by analysing profitability and determining the effect of various factors on profitability of small scale farmers.

A study on estimation of milk production efficiency of dairy farms in Embu and Meru Counties of Kenya by Mugambi et al. (2014) concluded that dairy cows were underfed and produced milk less than their genetic potential (9.3kg against 20kg).
The amount of milk produced by a cow was dependent on the number of cows that were being milked, the quantities of roughage, mineral supplements and concentrates fed. The study shows that if inputs were doubled, total milk production would more than double. This study however failed to analyse other factors apart from cost of production that may affect farms profitability.

A study on small-scale dairy farms in Butere –Mumias sub-region of Kakamega County of Western Kenya to establish the dairy production and practices and constraints in the industry by Musalia et al. (2007), shown that the amount of milk produced by dairy cows in the region was low. The study further exposed that the average number of cows kept by farmers was 4.2, those in milking produced 8.0 kg/ animal per day and the average land size was 8 acres. Decreasing land sizes and shortage of pasture and fodder limited the number of dairy cows kept by the farmer. Even though over 90 % of the milk was consumed locally, the local demand was

above supply (Musalia et al., 2007). The proposed study builds on the work of Musalia et al. (2007), by characterising dairy farming in Meru County of Kenya as well as determining the profitability of small-scale dairy enterprises.

Studies that have used gross margin analysis in estimating the performance of the small-scale dairy enterprises in Kenya include Kibiego et al. (2015); Mburu et al. (2007) and Omore et al. (1999). For instance, in a study of competitiveness of small-scale milk production systems in Uasin Gishu County of Kenya, Kibiego et al. (2015) shown that the gross margin and net margin in small-scale milk production were significantly influenced by the level of intensification. The authors indicate that the gross margin and profit per litre of milk reduced with an increase in the level of intensification. Free grazing system had higher gross margins and profits than zero grazing system. The study failed analyse other factors that might have contributed to the variations in profitability.

In a study on productivity trends and performance of dairy farming in Kenya, Wambugu et al. (2011) gross margin analysis showed that dairying is an economically viable enterprise in the short run with non - zero grazers having higher gross margins than zero grazers and therefore a financial advantage. Both variable cost and milk produced by lactating cow per month were higher in zero grazing. The high variable cost explains the lower margins. The study however other than the cost of inputs failed to assess other factors that may have been affecting the performance of dairy farming.

In a study on profit efficiency of dairy farmers in Kenya; a case study of smallholder farmers in the Rift Valley and Central province (Leone, 2013), the study found out that small scale farmers on average received gross margins of ksh. 17 having deducted total costs from unit revenue. The study however failed to look at the factors which influenced the profitability.

A study on characterization and profitability assessment of dairy farms in Central Kenya, (Mugambi et al., 2015) the average production cost was higher than the revenue per unit. The resultant gross margins on average were negative with only a few farmers making any profits. This was attributed to high input prices. There is need to assess other factors that may be contributing to negative profitability.

2.6. Research Gap

From literature it is apparent that dairy sub-sector is very important to Kenya's economy. The studies reviewed in this chapter focused on dairy production, dairy profitability, dairy production efficiency, dairy characterization and dairy profit efficiency. However it is evident that no study had been conducted to determine the performance of small-scale dairy farming in Meru County by analysing the sub-sectors characteristics, profitability and factors influencing profitability. This study aimed at filling the existing information gap and further contribute to the body of knowledge.

CHAPTER THREE: METHODOLOGY

3.1. Introduction

This section discusses the research methodology used in this study. It covers the study area, study design, population and sampling technique, sample size, research instruments, variables, model specification, data collection procedure, data processing, data analysis and empirical model specification.

3.2. Study Area

The study was done in Meru County. The County comprises of nine sub - Counties namely: North Imenti, Tigania East, Tigania West, Igembe North, Igembe Central, Igembe South, South Imenti, Buuri and Imenti Central (Figure 3). In the year 2015 the County population was projected to be 1,536,422. It borders Mt. Kenya and the region is perfect for dairy farming. It is an area of high altitude and high human population. Due to high human population it is characterised by land subdivision which reduces its economic viability. The main livestock in the area are cattle, goat, pigs, sheep poultry and rabbit. The region enjoys a good climate and well established dairy. It has diverse climatic conditions ranging from the escarpments of Mt Kenya which are very fertile to semi - arid areas bordering Tharaka Nithi and Ukambani.

Three of the sub-counties of Meru County (Imenti Central, Imenti North and Imenti South) have similar climatic characteristics (they all boarder Mt. Kenya). They are the sub-counties with relatively developed dairy farming compared to the other sub – counties in the County. In the year 2014 Imenti Central produced 32.3% of the total milk produced in the County followed by Imenti South and Imenti North with 27.5% and 15.0% respectively. In total the three Sub Counties produced approximately

75.0% of the total milk produced in the County (KNBS, 2015). The study was conducted in Tigania East and Imenti Central sub-counties of Meru County (Figure 3). Imenti Central was selected as a representative of the other two sub – Counties which border Mt. Kenya due to their similarities in climatic condition while Tigania East was to represent the sub – Counties which do not boarder Mt. Kenya and are milk deficient Sub Counties. In 2014 the Sub County only produced 0.7% of the total milk produced in the County. The two sub-counties operate in different social-economic, and agro-climatic environments which will offer opportunity for both comparison and possible wide regional applicability for the study results.

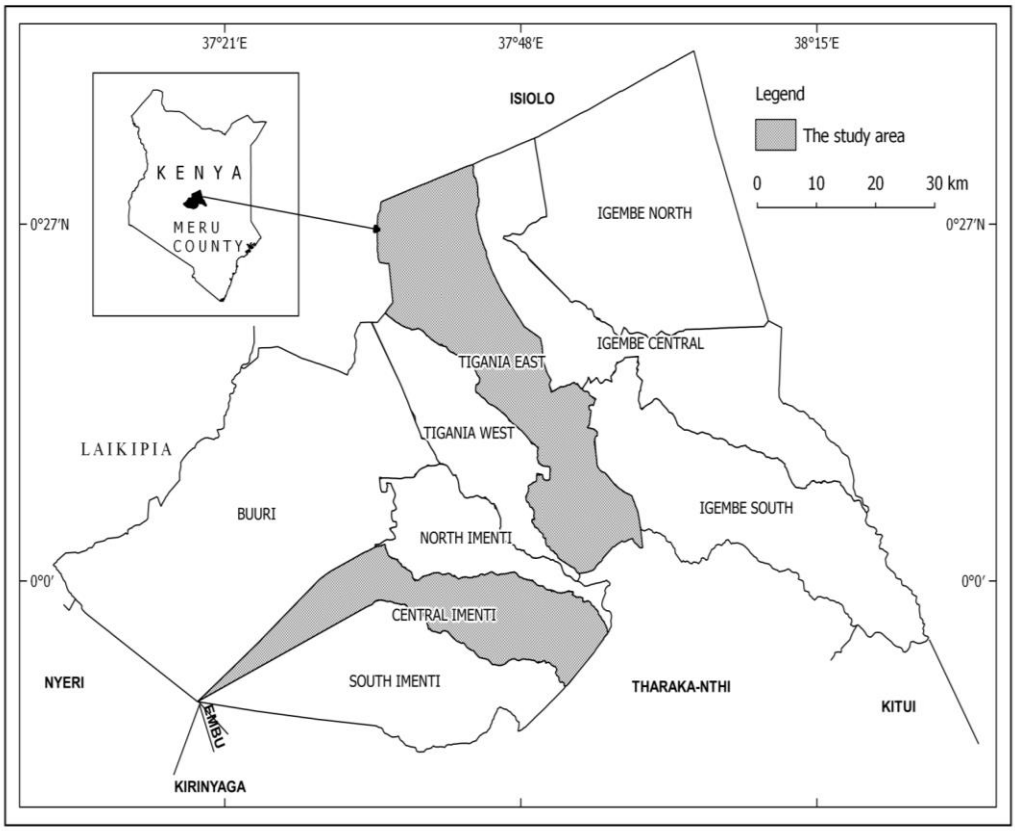

Figure 3: Map of Meru County Showing the Location of the Study Area.

Source: Meru County Government, 2013

3.3. Study Design

The study used a survey design employing quantitative methods. Bell (1993) indicated that quantitative approach has the advantage of getting responses on the same question from a large pool of respondents and these can be quantified in order to make the appropriate conclusions.

3.4. Population and Sampling Technique

The target population in this study comprised of small-scale dairy cattle farmers in the County since they produce 95% of milk in the County. The two stage sampling technique was employed where the first stage involved purposively selecting Imenti Central and Tigania East sub-counties from the nine sub- counties in the county. The second stage involved stratified random sampling where the population was divided into three subgroups depending on the number of dairy cows owned by the farmer. From each sub-groups 50 small scale farmers were randomly picked. This method ensured that there was no over or under representation of small-scale farmers in the different stratas.

3.5. Sample Size

Sample size was determined using a sampling methodology developed by Cochrain (1963) and explained by Israel (1992) as in the equation:

$$N = \frac{Z^2 pq}{e^2} \qquad \text{…………………………………………………………….}\textit{Equation 1}$$

Where N = desired sample size; Z^2= is the standard normal deviation at the required confidence level; p = proportion in the target population estimated to have the

characteristic (dairy cattle farmers); q = 1 – p; e = desired level of precision. For this study:

z = 1.95 (standard level of confidence at 92 % required confidence level)

p = 0.5 (since the population is not known)

q = 1 – p (1 – 0.5)

e = desired level of precision 8% (standard value at 0.08)

Using the standard formula listed above the required sample size becomes:

$$N = \frac{1.96^2 \times 0.5(1-0.5)}{0.08^2} = 150.0625 \text{ farmers (approximately 150 farmers)}$$

The 150 small-scale dairy farmers were equally distributed in the two sub-counties.

3.6. Research Instruments

The study used primary data. Primary data was collected through interviews with selected small-scale dairy cattle farmers from the two sub-counties. The research instrument contained both closed and open ended questions in an attempt to adequately address the research hypotheses. The questionnaire sought to generate data on the age of the household head, gender of the household head, education level of the household head, the number of dairy cattle kept by farmers, the type of grazing system practiced, size of land owned by farmers, type of dairy breeds kept, type of dairy feeds given to dairy animals, veterinary services and credit services in the study area.

The questionnaire also contained detailed information on each of the farmers' costs and returns in relation to dairy farming with an aim of determining farmer's enterprise

profitability. Once the questionnaire was finalized, a pre-test was done to enhance reliability.

3.7. Variables

The dependent variable in this study was profit from a dairy cow per month while the independent variables were: age of the household head, gender of the household head, education level of the household head, experience of the household head, land size, herd size, income from other sources, credit access, breed type and grazing system. Table 1 shows the study variables and their measurements.

Table 1: Definition and measurement of variables

Variable	**Unit of measurement**
Dependent	
Profit	Kshs. (Total revenue – Total variable cost)
Independent variables	
Age of the household head	Number of years
Gender of the household head	Dummy variable (male or female)
Education level of the household head	Categorization (no formal education, primary education, secondary education, post-secondary but not university and university level)
Experience of household head	No of years
Land size	No of acres
Herd size	No of dairy cows
Source of income	Categorization (1. Crop 2. Livestock 3. Non-farm income)
Access to credit	Likert scale (easily accessible, accessible, not easily accessible)
Breed type	Categorization (Friesian, Ayrshire, Guernsey, Jersey, Cross, Indigenous)
Grazing system	Categorization (Zero grazing or Semi zero grazing)

3.8. Data Collection Procedure

Primary data was used in this study. The data set was obtained by administering the questionnaire to 150 household heads of farming families who were randomly selected from the sub – groups. This was done with the help of trained enumerators.

3.9. Data Processing

Data was first processed before carrying out analysis. This entailed editing, coding, classification and tabulation of collected data to make it amenable for analysis (Kothari, 2011). Data editing was done to ensure that the data was accurate, complete as possible, arranged to facilitate coding and tabulation and consistent with other facts gathered. Coding was done to ensure that a specific answer could be placed in one and only one cell in a given category set (Kothari, 2011).

3.10. Data Analysis and Empirical Model Specification

Data analysis was performed using Stata version 13. Descriptive statistics of the survey data were done. Simple descriptive statistics such as measures of tendency (mean, frequency distribution and % ages) and measures of dispersion (standard deviation and range) were used to characterize dairy farming in Meru County. The descriptive statistics covered all response variables and provided the basic features of data collected thus laying the basis for further analysis.

To determine dairy enterprise profitability, the study applied gross margin analysis. The difference between the value of an enterprise's gross output and variable costs is defined as the gross margin (Ergano and Nurfeta, 2006). In dairy production, gross output are those products which routinely become available through the production

process. Examples of these products include milk and breeding stock. In Kenya highlands, the livestock production system deal with products which do not have a clear market value e.g. calves reared at different intensity levels to be used for breeding later on and to a certain extent heifer (Staal et al., 2003) hence not included in gross margins of the study.

The value of manure and purchased animals was not included in the gross margins. Gross margins vary with the size of production. It is the total revenue derived from an enterprise less the variable cost. Due to lack of reliable data, fodder cost were estimated on the basis of the value attached to bought fodder.

Labour costs were also estimated on the basis of casual labour payments. Fixed costs were ignored because they are not related to higher milk production and do not affect the optimal combination of variable inputs used and outputs obtained whether sold or consumed by the household (Mburu et al., 2007). A t-test was used to test differences in gross margins. The following formula based on Benard and Nix (1979) was used to calculate the gross margins:

Total cost (TC) = TVC + TFC……*Equation 2*

Gross Margin (GM) = TR –TVC……..*Equation 3*

π = GM – TFC……..*Equation 4*

Where

Total Fixed Cost (TFC) = Summation of all fixed costs (land, loans)

Total Variable Cost (TVC) = Summation of all variable costs.

Total Revenue (TR) = Total amount realized from sale of milk

π = Profit

To determine the factors that influence dairy profitability among the small-scale dairy farmers in the study area, multiple linear regression model using ordinary least square (OLS) method was used.

$$LnY=\beta_0+\beta_1 AH+\beta_2 GH+\beta_3 ELH+\beta_4 EH+\beta_5 HS+\beta_6 lS+\beta_7 HS+$$

$$\beta_8 IOS+\beta_9 CA+\beta_{10} BT+\beta_{11} FS+\varepsilon = Equation\ 5$$

LnY will be the natural logarithm of gross margins expected to change by a certain β coefficient if any explanatory changes. Gross margins were the dependent variable.

β_0 is *the* constant or y intercept. β_1 to β_{11} are parameters for explanatory variables,(AH= age of the household head, GH = gender of the household head, ELH = education level of the household head, EH = experience of the household head, HS= household size, LS = land size, HS = herd size, IOS = income from other sources apart from credit, CA = credit access, BT= breed type and FS = farming system).

In the regression analysis gender, education, access to credit, breed type and grazing system were treated as dummy variables. For Gender (1= male 0 = otherwise), Education (1=primary and below 0 = otherwise), Access to credit (1 = access 0 = Otherwise)

ε is the error term which was included in the model to account for other factors which were not included in the model but affected the profit levels.

The level of statistical significance of the variable was tested using a t–test at 5% level of significance. To measure the goodness of fit, (R^2) the multiple coefficient of determination was used to measure the amount of variation in the dependent variable explained by the independent variables. The closer the $R^2$is to *1*, the better the fit of the regression line to the actual data but only if there is no multi-collinearity (Gujarati,

2007). In presence of multi-collinearity the standard errors of affected coefficients tend to be large.

Breusch-pagan/ Cook-Weisberg test was used to test for heteroscedasticity in the variables. Heteroscedasticity is a violation of one of the requirements of ordinary least squares (OLS) in which the error variance is not constant (Gujarati, 2007). The consequences of heteroscedasticity are that the estimated coefficients are unbiased but inefficient. The variances are either too small or too big. Heteroscedasticity can be caused by model misspecification, measurement errors, and outliers in the dataset and sub-population differences.

For multi-collinearity, the degree of tolerance or the variance inflation factor (VIF) was applied (Gujarati, 2007). Multi-collinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. Multi-collinearity does not reduce the predictor power or reliability of the model as a whole, but the standard errors of the affected coefficients tend to be large. In that case, the test of the hypothesis that the coefficient is equal to zero leads to a failure to reject the null hypothesis (Gujarat, 2007). Thus an analyst might falsely conclude that there is no linear relationship between an independent and a dependent variable.

Ramsey also called Regression Specification Error Test (RESET) proposed by Ramsey (1976) for checking whether no relevant explanatory variable has been omitted in the model was used to test for the omitted variables. This test is a general test for linear regression model.

The test is based on F- distribution and the null hypothesis to be tested. Ho: Model has no omitted variables. Rejection of the null hypothesis implies that there are possible missing variables and the model suffers endogeneity, causing biased estimates. Table 2 shows the operationalization of the study variables.

Table 2: Operationalization of the Study Variables

Study Objective	Research question and hypotheses	Variables	Methods of analysis
To characterize small-scale dairy farming in Meru County, Kenya	What are the characteristics of small-scale dairy farming in Meru County, Kenya?	Farmer characteristics (age, gender, level of education, household size, experience of the farmer, access to credit, source of income, membership to a group and training) Farm characteristics (type of breed, herd size, type of dairy feed, veterinary services, land size , type of grazing, milk yield and milk marketing)	Descriptive statistics T-test
To assess the profitability of small-scale dairy enterprises in Meru County, Kenya.	Dairy profitability does not differ among small-scale farmers in Meru County, Kenya	Total revenues Total costs (e.g. cost of feed, electricity, labour, veterinary service)	Gross margin analysis T-test

To determine the factors influencing profitability among small-scale dairy farmers in Meru County , Kenya	Factors such as age, education, household size, experience and access to credit have no influence on profitability among small-scale dairy farmers in Meru County, Kenya	Dependent variable: gross margins Independent variables: age, gender, education level, experience, household size, land size, herd size, credit access, other sources of income, breed type and grazing system.	Multiple regression model

CHAPTER FOUR: RESULTS

4.1. Characterization of Small-scale Dairy Farming in Meru County

Table 3 presents the difference in means of the characteristics of the small-scale dairy farmers under study where t – test was carried out to determine significance difference.

Table 3: Means Characteristics of Farmers in Meru County

Sample characteristics	Unit	Imenti Central	Tigania East	$X^{2,}$ /T-test
Age	No of years	49	42	3.11*
Gender	% of female headed	5.3	9.3	1.08
Education level	% with secondary education	38.7	41.7	2.01
Experience	No of years	19	15	2.84**
Household size	Average no of household members	4.7	5.4	-2.51*
Total land size	Acres	2.5	3.9	-2.34*
Total income	% of the farmers with the highest levels of income	6.8	25.7	-2.86**
Use of veterinary services	% provided by both private and government providers	40.5	33.3	0.03
Source of income	% from crop income	48	44.1	9.84
Total herd size	% with one cow	25	20	9.48

*Note: Significance level of mean difference is at * = 10%, **=5% and ***=1% standard errors in the parenthesis*

Source: Author (2018)

4.1.1. Farmer – Related Social and Economic Characteristics

The farmer-related characteristics examined are: age of the farmer; gender of the farmer; level of education; household size; experience of the farmer; access to credit; sources of income; membership to a group and training.

4.1.1.1. Age of the Farmer

Results show that the age of the small-scale dairy farmers ranged from 20 years to 95 years. The average age of the dairy farmers was 45.7 years. Based on age distribution farmers' age were categorized. 22.7% of the farmers were aged between 20 and 35 years (Table 4). Most of the farmers were aged between 36 years and 55 years, accounting for 56.7% of the total sample.

Table 4: Age of the Dairy Farmer

Age Category	Age (%)
20 – 35 Years	22.7
36 - 45 Years	32.0
46 - 55 Years	24.7
55 - 65 Years	12.7
Above 65 Years	8.0
Total	**100.0**

Source: Author (2018)

The findings also show a higher concentration of older small-scale dairy farmers in Imenti Central as compared to Tigania East. In Imenti Central, the average age of the small-scale dairy farmer is 49 years with the minimum age being 21 years and a maximum of 80 years.

This is in comparison with Tigania East where the average age of the small-scale dairy farmer is 42 years, with a minimum of 20 years and a maximum of 95 years. T-test results indicated that the mean age was significantly different for the farmers in

the two Sub – counties (Table 3). Majority of farmers in Imenti Central are between the age of 46 and 55 years and in Tigania East are between 36 and 45 years. Findings showed that 56% of the farmers in Imenti central are above 46 years and only 35% of farmers are above 46 years in Tigania East.

4.1.1.2. Gender of the Household Head

Results indicate that most of the small-scale dairy farms in Meru County are male headed. Out of the dairy households studied, 92.7% were male headed while 7.3% were female headed. There are more female small-scale dairy farmers in Tigania East than in Imenti Central, with 9.3% and 5.3% respectively. This finding is shown in Figure 4. From Chi – square results there was no significance difference in gender between the farmers from the two sub-counties (Table 3).

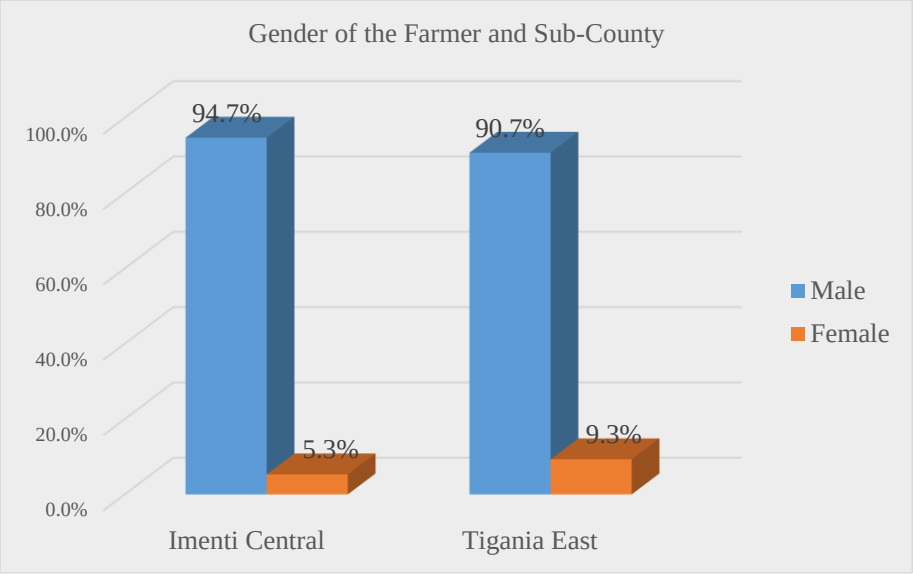

Figure 4: Gender of the Farmer and Sub-County

Source: Author (2018)

4.1.1.3. Level of Education of the Farmer

On education, results show that there was only a small fraction of the small-scale dairy household heads who had no formal education. Majority of household heads had secondary level of education followed by primary level of education. Household heads with post-secondary but not university level education were more than those with university level education (Table 5).

Table 5: Education Status of Household Heads

Level of Education	%
No formal education	8.0
Primary education	35.3
Secondary education	40.0
Post-secondary but not university	9.3
University	7.3
Total	**100.0**

Source: Author (2018)

There are substantial variations in regards to the education of the farmer by sub-county. For instance, in Imenti Central, 38.7% of the household heads had primary level of education compared to 32% in Tigania East sub-county. Further, Imenti Central had 38.7% of the household heads having secondary level of education as compared to 41.3% in Tigania East. In both sub-counties, 8.0% of the small-scale dairy household heads had no formal education. The findings show that there was a high % age of household heads who had attained university level of education in Tigania East sub-county than in Imenti Central sub-county (Table 6). From Chi –

Square results there was no significance difference between the education levels for household heads from the two sub – Counties (Table 3).

Table 6: Level of Education of the Dairy household heads by Sub-County

Level of Education	Imenti Central (%)	Tigania East (%)	All (%)
No formal education	8.0	8.0	8.0
Primary education	38.7	32.0	35.3
Secondary education	38.7	41.3	40
Post-secondary but not university	9.3	9.3	9.3
University	5.3	9.3	7.3
Total	**100.0**	**100.0**	**100.0**

Source: Author (2018)

4.1.1.4. Household Size

The small-scale dairy farming households under study have between 2 to 11 family members with an average of 5 members. The bulk of the dairy households under study had between 1 and 5 household members (68.7%). A further 8.0% had 8 or more household members. Those with household sizes of between 1 to 5 household members were clustered around Imenti Central than in Tigania East sub-county. For instance, in Imenti Central around 77.3% of the studied households had 1 to 5 members, while in Tigania East, this category accounted for 58% of the total households.

Larger household sizes are also clustered around Tigania East sub-county. For instance, compared to Imenti Central, households with 6 members or more accounted

for 41.4% of the total households in the sub-county (Table 7). T-test results indicate there was a significance difference in means of the household members between farming families in Imenti Central and farming families in Tigania East (Table 3).

Table 7: Household Sizes of the Small-scale Dairy Households by Sub-County

Household Size	Imenti Central (%)	Tigania East (%)
1 - 4 Members	47.3	32.8
5 Members	29.7	25.7
6 Members	10.8	17.1
7 Members	8.1	11.4
8 or More Members	4.1	12.9
Total	**100**	**100**

Source: Author (2018)

4.1.1.5. Experience of the Farmer

Experience of the small-scale dairy farmer was gauged through the number of years that a farmer has been practicing dairy farming. Results show that the duration that farmers have practiced dairy farming was varied and ranged from 1 year to 45 years. The average duration that farmers have kept dairy cows is 16.7 years across the two sub-counties. In Imenti Central, the farmers had kept cows for an average of 19 years. The minimum age that the farmer had kept dairy cattle was 2 years while the maximum period was 45 years. In Tigania East, the average number of years farmers kept dairy cows was 15 years. In Tigania East sub-county, the minimum period that a farmer had kept dairy cattle was 1 year while the maximum was 40 years. T-test results indicate that mean farmers experience was significantly different for the two

sub – counties (Table 3). Most of the farmers had practiced dairy farming for between 10 to 20 years (44.7 %), followed by 1 – 10 years (32%). Those with 31 years or more accounted for 7.3% of the sample while farmers with 21 – 30 years in dairying were 16%. From the chi square test experience was significant between the two sub-Counties for only farmers who had experience of between 11 and 20 years (p = 0.07) (Table 8).

Table 8: Years of Experience in Dairy household heads by Sub-County

Number of Years in Dairy Farming	Imenti Central (%)	Tigania East (%)
1 – 10	32.0	32.0
11 – 20	33.3	56.0
21 – 30	21.3	10.7
31 or more	13.3	1.3
Total	**100.0**	**100.0**

Source: Author (2018)

4.1.1.6. Access to Credit by Dairy Farmers

At the point of starting the dairy enterprise, most of the farmers (82.5%) financed the dairy investment from their own savings. Further, 16.8% financed their dairy investment through a loan, with 8.4% getting a loan from a SACCO, 7.0% got a loan from a bank, while 1.4% got a loan from a microfinance institution. Around 0.7% of the small-scale dairy farmers in the County got financial support from their parents to start their dairy enterprise. Ten out of the twelve dairy farmers who cited loan from a SACCO are from Tigania East sub-county while eight out of the ten farmers who cited loan from a bank are also from Tigania East Sub-county.

Among the small-scale dairy farmers who financed their initial investment in dairy through their own savings, 34.5 have ever applied for a loan. For those that have ever applied for a loan facility for their dairy enterprise, the SACCO was the most common (45.0%) followed by bank with 35.7%. The other source of loan facility are the microfinance institutions (19.0%). Virtually all the dairy farmers who said they have ever applied for a loan for their dairy enterprise, their request was granted (93.0%).

On the rating of accessibility of the various sources of loan facilities available to small-scale dairy farmers in Meru County, the responses were as varied as the various loan sources.

Overall credit from self-help groups was perceived as the most easily accessible to the small-scale dairy farmers followed by shylocks and SACCOS. Credit from banks was rated by nearly half of the small-scale dairy farmers as not easily accessible, followed by microfinance institutions. From Chi square results there was a significance difference at 1% in the rating of credit accessibility by farmers for banks and SACCOS between the two sub – Counties. The rate of accessibility for credit from shylock was significant at 10%. There was no significance difference in accessibility for credit from deposit taking micro – finance institutions and self – help groups between the two sub - Counties. These findings are presented in the Table 9.

Table 9: Household heads Rating of Accessibility of Credit by Source

Source of Loan	Easily Accessible (%)	Accessible (%)	Not Easily Accessible (%)	X^2
Banks	27	21.6	51.4	44.35***
SACCOS	30.2	47.0	22.5	42.77***
MFIs	14.9	47.3	37.8	4.26
Shylocks	30.8	31.5	37.7	18.65*
Self-help groups	45.7	37.7	15.0	2.94

Source: Author (2018)

On the factors that constrain access to credit by small-scale dairy farmers in Meru County, a number of factors were cited. These are: Fear of property being attached in case of default in repayment, lack of guarantors, high interest rates, lack of collateral and lack of information about the creditors. Majority of the farmers cited fear of their property being attached as the major factor constraining access to credit among small-scale dairy farmers. Only 3.7% cited lack of information on credit as a constraint (Table 10).

Table 10: Factors Constraining Access to Credit

Factors Constraining access to credit	Frequency	(%)
Fear of property being auctioned	44	35.0
Lack of a guarantor	42	32.0
High interest rate	35	26.7
Lack of collateral	26	19.0
Lack of information on credit	5	3.7

4.1.1.7. Sources of Income for the Dairy Farming Household

This study also investigated the various sources of income for the small-scale dairy farming households in Meru County. The main source of income for these households is income derived from crops (44.1%) followed by income from dairying (30.8%). Non-farm income was cited as the main source of income by 25.2% of the studied households. Non-farm income accrues from either various forms of employment or business ventures.

In Imenti Central sub-county, income from crops was cited by 48.0% of the farmers as the main source of income as compared to 40.0% from the same source in Tigania East sub-county. Income from dairying was cited as the main source of income by 34.3% of the households in Tigania East compared to 27.4% in Imenti Central sub-county. This finding is illustrated in Figure 5. From the Chi-square results there was no significant difference in the sources of income for the farmers from the two sub – Counties (Table 3).

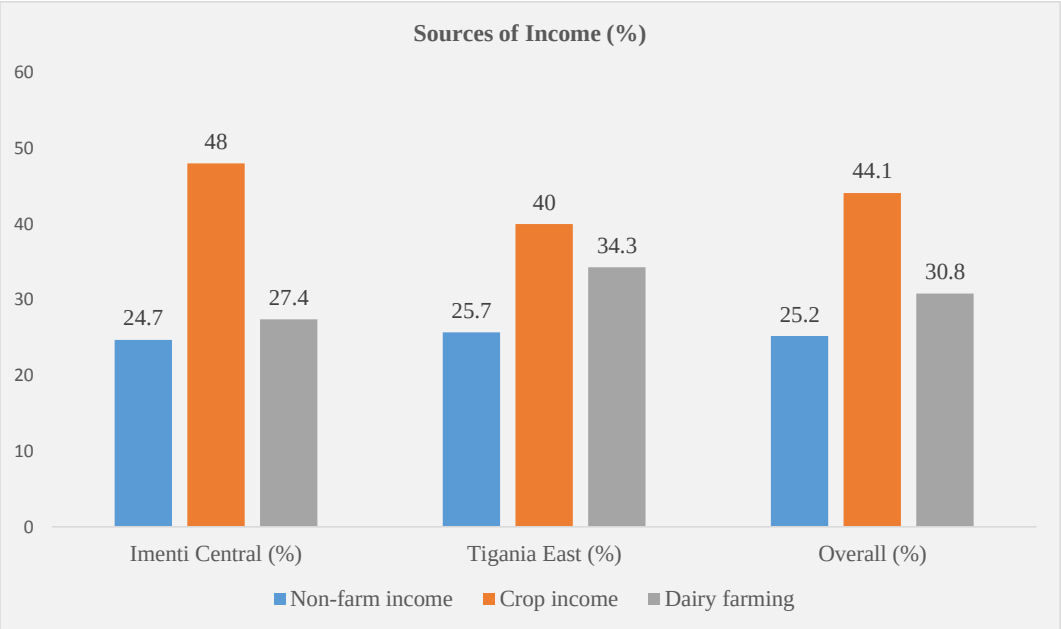

Figure 5: Sources of Income for Dairy Farming Households

Source: Author (2018)

The estimated monthly income ranged from Kshs. 3,000 to Kshs. 500,000 with an average of Kshs. 66,347. Most of the dairy households had a monthly income of Kshs. 45,001 or more (52.8%).

Further, 21.5% had a monthly income of Kshs. 20,000 or less, while 18.1% indicated that their monthly income is between Kshs. 20,001 and Kshs. 35,000. Only 7.6% of the studied households had a monthly income of between Kshs. 35,001 and Kshs. 45,000.

An assessment of the distribution of the small-scale dairy farming households by income quintile shows that Tigania East sub-county accounts for the bulk of the households in the highest income quintile (25.7%) compared to 6.8 % for Imenti Central. Chi-square results indicated there was a significance difference in income for the farmers from the two sub-counties at 5.0% (Table 3). Overall, the distribution of household income among the dairying farms is more even in Imenti Central compared to Tigania East sub-county, save for the households in the highest income quintile (Table 11).

Table 11: Distribution of the Dairy Households by Income Quintile and Sub-County

Income Quintile	Imenti Central (%)	Tigania East (%)	Overall (%)
1 (Bottom)	23.0	20.0	21.5
2	25.7	11.4	18.8
3	21.6	18.6	20.1
4	23.0	24.3	23.6
5 (Highest)	6.8	25.7	16.0

Source: Author (2018)

4.1.1.8. Group Membership

Membership to a group by the small-scale dairy farmers was another feature that was assessed in this study. Results show that 60.7 % of farmers were members of an association or a group.

Out of these, 60.2% were in welfare groups and 39.8% were members in farmers groups. Further, 39.3% of the dairy farmers were not involved in any group or association.

The farmers cited various benefits of being involved in groups in relation to dairy farming. Those in welfare groups cited access to loans as one of the benefits where they could get money to buy inputs such as feeds for their animals. Farmers involved in farmers' groups cited having more benefits in relation to dairy farming. Most indicated that they got free trainings on dairy farming, easy access to loans which they could use to develop dairy farming, access to farm inputs such as feeds on credit, marketing of their products and also advances depending on the amount of milk the farmer produced. Overall, most of the dairy farmers cited it was beneficial for a small-scale dairy farmer to be a member of a group.

4.1.1.9. Farmer Training

This study also investigated whether the small-scale dairy farmers attend training to enhance their skills in the area of dairy farming. Results show that 38.7% of the farmers had attended a business course aimed at improving their knowledge and skills on dairy farming. Analysis by sub-county, shows that 47.3% of the small-scale dairy farmers in Imenti Central had attended a business training course as compared to 28.6% of farmers in Tigania East.

This means most of farmers involved in dairy farming have never been trained on how to run dairy enterprise as a business. The findings further show a significant correlation between milk yield and attendance to business course. Through such training initiatives, farmers are trained on dairy cattle husbandry including: making silage, dairy hygiene for enhanced milk productivity and improved animal health and record keeping for the dairy enterprise.

4.1.2. Farm-Based Characteristics

4.1.2.1. Breed Type

The study also sought to determine the type of breed kept by farmers in the area. Results show that most farmers in the County keep Friesian breed followed by Ayrshire breed. The third most common breed is Guernsey and jersey with a similar proportion of farmers indicating that they keep the breeds. Only a small % age of farmers kept Cross breed and indigenous breeds.

As Table 12 shows, Friesian is the dominant breed in the two sub – Counties. 63% of the farmers in Imenti Central indicated that they keep the breed. This is in comparison to 45% of the farmers who indicated that they kept Friesian in Tigania East.

In both sub-counties, Ayrshire was the next popular breed with 52% of small-scale dairy farmers in Imenti Central and 29% of the dairy farmers in Tigania East keeping the breed. The Guernsey breed is popular in Tigania East (14%) as compared to 11% in Imenti Central.

The Jersey breed is also popular in Imenti Central (15%) compared to Tigania East (12%). Both the cross breeds and indigenous breeds are commonly kept in Tigania East sub-county compared to Imenti Central sub-county.

Table 12: Type of Dairy Cattle Breed and Sub-County

Breed Type	Imenti Central (%)	Tigania East (%)	Overall (%)
Friesian	63	45	54
Ayrshire	52	29	41
Guernsey	11	14	13
Jersey	15	12	13
Cross	4	9	7
Indigenous	1	3	2

Source: Author (2018)

Farmers have varied reasons for the type of breed they keep. Friesian was associated with high milk production with an average of 8 litres of milk per day which is closely followed by Ayrshire breed with an average of 5 litres per day.

Another reason cited for keeping Friesian is the existence of favourable agro-climatic conditions. However, Friesian was cited as a heavy feeder hence a deterrent to some of the dairy farmers. Those who preferred keeping Ayrshire indicated that Ayrshire produced quality milk and did not consume a lot of feed.

Thus compared to Friesian, farmers with small land sizes, find this breed more attractive. Another factor that was cited as a determinant for the type of breed kept is the cost of buying the breed. Breeds that produce more milk (e.g. Friesian and Ayrshire) cost relatively more than Guernsey, Jersey and cross breeds. The advantages of keeping a cross breed include: less susceptible to diseases, cheap compared to Friesian and Ayrshire, adoption to the prevailing agro-climatic conditions (especially the drier part of Tigania East).

4.1.2.2. Herd Size

Around 56% of farmers interviewed kept between 1and 2 animals. The average herd size was 3 cows. The number of lactating cows per farm ranged between 1 and 7 with 52.1% of the farmers only having one lactating cow. The average of those lactating was 2 cows. In Imenti Central, 25% of the farmers kept 1 cow, 33% kept 2 cows, 17% kept 3 cows, 12% kept 4 cows and 12% kept between 5 and 10 cows. In Tigania East 20% kept 1 cow, 32 % kept 2 cows, 13% kept 3 cows, 19% kept 4 cows and 16% between 5 and more cows. There was a positive and significant correlation between the milking herd size and the total farm milk yield.

Table 13 shows the distribution of the total herd size among the small-scale dairy farmers in Meru County and selected dairy farmers' characteristics. Results show that 27.3% of the female dairy farmers had five or more dairy cows compared to 13.5% male farmers in the same category of herd size.

On age of the farmer, the findings indicate that farmers aged 55 years or more have fewer number of dairy cows compared to the younger farmers. Finally, dairy farmers in the lower income quintile were clustered between 1 – 3 dairy cows, compared to the fourth and the fifth quintile who kept 4 or more dairy cows. From the Chi^2 results there was no significance difference in total herd size owned by farmers from the two sub – Counties (Table 3).

Table 13: Total Herd Size by Selected Dairy Farmer Characteristics

	Number of Dairy Cows (%)				
Indicator	**I**	**2**	**3**	**4**	**5 or More**
Gender of the farmer					
Male	22.6	31.6	15	17.3	13.5
Female	9.1	36.4	27.3	0	27.3
Age					
35 Years or below	28.1	28.1	25	9.4	9.4
36 - 45 Years	12.5	35.4	6.3	18.8	27.1
46 - 55 Years	12.1	42.4	15.2	18.2	12.1
55 - 65 Years	42.1	21.1	15.8	21.1	0
Above 65 Years	33.3	16.8	33.3	8.3	8.3
Land size					
One acre or less	29.7	35.1	16.2	8.1	10.8
1.1. - 2.0 acres	24.4	42.2	13.3	8.9	11.1
2.1 - 4.0 acres	11.6	27.9	16.3	30.2	14.0
Above 4 acres	26.7	13.3	26.7	20	13.3
Income Quintile					
1 (Bottom)	48.4	16.1	22.6	6.5	6.5
2	40.7	33.3	18.5	3.7	3.7
3	3.5	65.5	13.8	13.8	3.5
4	8.8	26.5	8.8	26.5	29.4
5 (Highest)	4.4	17.4	17.4	30.4	30.4

Source: Author (2018)

4.1.2.3. Type of Feeds

Results show that 95.1% of the dairy farmers use concentrates. A slightly higher number of farmers in Imenti Central use concentrates (97.3%) compared to 92.3% of farmers in Tigania East sub-county. Most of the dairy farmers (88.9%) bought the concentrates from stockists in the local markets, while another 6.7% indicated that they got the concentrates from the dairy cooperative society. All the farmers who used concentrates bought commercial dairy meal.

The range of distance covered by dairy farmers to get concentrates ranged from 0 to 22 kilometres with an average of 3.1 kilometres. Dairy farmers in Imenti Central cover an average of 1.5 kilometres to get concentrates while those in Tigania East cover an average of 5 kilometres. The average cost of concentrates is Kshs. 1,535 per cow per month with a range of between Kshs. 250 and Kshs. 7,200 per cow per month.

Farmers interviewed for this study had used concentrates for a period ranging from 1 year to a maximum of 40 years with an average of 12.1 years. Farmers in Imenti Central have a long experience in using concentrates with an average of 14 years compared to 10 years for Tigania East.

Napier grass, natural grass, hay and silage were cited as the commonly used dairy fodder types among the studied households. Napier grass is used by 97.9% of the dairy households under study, natural grass 90.3%, hay by 19.3% and silage by 2.2% of the dairy farmers.

Natural grass is used by 95.7% of the dairy households under study in Tigania East, while in Imenti Central, the figure is 85.1%. Use of napier grass is uniformly spread across the two sub-counties with Tigania East estimate at 98.6% while that of Imenti Central is 97.3 %. The use of hay is more prevalent in Imenti Central (23.9%) compared to Tigania East (14.1%), while a similar pattern can be discerned for silage with more prevalence in Imenti Central (2.8 %) compared to 1.6 % for Tigania East.

Most of the farmers who indicated that they use natural grass, got it from their own farms (96.2%) while less than 2.3% indicated that they bought natural grass to

supplement their dairy feeds. Further, 82% of the farmers indicated that they get the napier grass from their own farms, with 17.3% indicating that they bought napier grass.

The average duration that farmers have used hay and silage is 10.4 years and 10 years respectively. The average cost of fodder per dairy cow among the studied households is Kshs. 1,635, with the average cost in Imenti Central (Kshs. 2,148) being higher than in Tigania East (Kshs. 1,084).

A total of 96.5% of the dairy farmers in the study sited use mineral supplements for their dairy cattle. The average cost of supplement averaged Kshs. 223 per cow per month, with the average of Kshs. 295 in Imenti Central and Kshs. 145 in Tigania East. The average distance in getting the mineral supplement was 2.9 kilometres ranging from less than 0 kilometres and a maximum of 22 kilometres. The average distance to get dairy mineral supplements for farmers in Imenti Central is 1.5 kilometres while in Tigania East, the average distance is 4.4 kilometres. The average number of years that the farmers have used mineral supplement is 13.1 years, with a range of 1 year to 40 years.

Farmers in the study area cited a number of challenges in regard to dairy feeds. For commercial feeds, the most cited challenge is the questionable quality of concentrates in the market. The farmers pointed out that there were very many suppliers of commercial feeds, and some of these feeds did not enhance milk production. Thus farmers, have no way of differentiating between genuine and counterfeit commercial feeds.

To increase chances of getting genuine commercial feeds, a number of dairy farmers in Imenti Central get their concentrates through their respective dairy cooperative societies. Other challenges cited include: the high cost of buying commercial feeds, high cost of transporting animal feeds especially where the source is far from the dairy enterprise, scarcity of fodder during the dry season, and declining land sizes hence limited space for cultivating fodder.

4.1.2.4. Veterinary Services

This study also assessed the use of veterinary services by small-scale dairy farmers in Meru County. Results show that 96.8% of the farmers use veterinary services in their dairy enterprises.

There is no variation in the use of veterinary services between the two sub-counties, with 97.3% of dairy farmers in Imenti Central indicating that they use the service compared to 97.1% in Tigania East. From T-test results use of veterinary service was not significantly different for the farmers from the two sub – counties (Table 3). Farmers sought veterinary services for artificial insemination, treatment of the dairy cows as well as routine vaccination. Other farmers sought the services of veterinary offices for general advice regarding dairy animal husbandry.

Dairy farmers across Kenya get veterinary services from varied providers. In the study area, the main providers of veterinary services to dairy farmers are trained private providers (57.3%), followed by sourcing from both government and private providers (37.1%) (Table 14). A further 5.6% get veterinary services from a trained government provider. In both Imenti Central and Tigania East, dairy farmers result to

government veterinary officers in case of an outbreak of diseases or another issue where the private providers are unable to cope. This is for instance, when there is an outbreak of foot and mouth disease, a problem that requires direct government intervention for it to be contained.

Table 14: Use of Veterinary Services and Sub-County

Provider of Veterinary Service	Imenti Central (%)	Tigania East (%)	Overall (%)
Trained government provider	2.7	8.7	5.6
Trained private provider	56.7	58	57.3
Both private and government providers	40.5	33.3	37.1

Source: Author (2018)

Most farmers felt that private veterinary officers are reliable as compared to the government providers who rarely come when the farmers need them. Farmers said that while a private provider will visit the farmer at least within one day following placement of a request, the government provider may even come after two days. In Imenti Central, dairy farmers who belong to a dairy farmer's cooperative society also benefit from being linked to veterinary service providers, thus increasing the chances of receiving the service from a trained provider.

As Table 15 shows, the use of veterinary services by dairy farmers in Meru County varies with gender, age of the farmer, level of formal education as well as the main source of household income. For instance, use of veterinary service declines with the rising level of education, but rises with the age of the farmer. Further all farmers who cited dairy farming as their main source of income use veterinary services. From Chi – Square and t – test results gender, education and source of income had no significant influence on use of veterinary service. However age had a significance influence at 5% to use of veterinary service.

Table 15: Use of Veterinary Services and Selected Dairy Farmer Characteristics

Indicator	Proportion Using Veterinary Service (%)	t-test / X^2
Gender of the farmer		0.34
Male	97.0	
Female	100.0	
Age		3.11**
35 Years or below	96.7	
36 - 45 Years	95.8	
46 - 55 Years	97.0	
55 - 65 Years	100.0	
Above 65 Years	100.0	
Level of Formal Education		3.29
No formal education	100.0	
Primary level of education	98.0	
Secondary level of education	98.3	
Post-secondary level but not university	92.9	
University	90.0	
Main Source of Household Income		1.08
Non-farm income	94.4	
Crop income	96.8	
Dairy income	100	

Note: ** Means *significance level of mean difference is at 5%*

Source: Author (2018)

Farmers cited a number of challenges with regard to veterinary services in the County. Some of the often cited challenges include: prohibitive charges by the veterinary service providers, delays in response especially the government veterinary service providers, in some areas, veterinary offices are unavailable, and finally questionable quality of some of the private veterinary service providers. Some of the farmers pointed out that in the case of artificial insemination some of the private veterinary officers seem to engage in trial and error in timing for the farmer's desired dairy breed and often dairy cows deliver a different breed from the desired breed by the farmer.

4.1.2.5. Land Size

Land is a key variable in dairy farming. This study assessed the amount of land held by the farmer as well as the proportion of land that is used for their dairy enterprise. Table 16 reveals that 25.3% of the farmers in the study area had land sizes of 1 acre or less, 31.3% had farm sizes of between 1.1 and 2 acres, 30.0% had between 2.1 and 4 acres, and 13.3% had above 4 acres. This shows that dairy farmers in the area have small land sizes. The average acreage in the area was 2.9 with a standard deviation of 3.2 while the minimum and maximum land holding was 0.25 and 30 acres respectively. Further, 52.7% of the farmers had their land sub-divided and had some part of land situated some distance away from the homestead.

An assessment of land holding by dairy farmers in the two sub-counties shows that 28% of farmers in Imenti Central owned only 1 acre or less, 34.7% owned between 1.1 and 2 acres, 26.7% owned between 2.1 and 4 acres, 10.7% owned more than 4 acres.

In Tigania East, 22.7% of the farmers owned 1 acre or less, 28% owned between 1.1 and 2 acres , 33.3% owned between 2 and 4 acres and only 16% owned above 4 acres (Table 16). From the findings the land sizes are larger in Tigania East compared to Imenti Central. Chi^2 values (30.88*) indicated that land sizes had significant difference at 10% between the two sub – Counties.

Table 16: Dairy Farmers Land Sizes

Land Size (Acres)	Imenti Central (%)	Tigania East (%)	Average (%)
One acre or less	28.0	23	25.3
1.1 - 2.0	34.7	28.0	31.3
2.1 – 4.0	26.7	33.3	30.0
Above 4.0	10.7	16.0	13.3

Source: Author (2016)

Asked about the proportion of land that the farmer had allocated to dairy farming, results show that 23% of the farmers had 0.5 acres or less under dairy, 61% of the farmers had farms ranging from 0.5 - 1 acre under dairy, 6% of the farmers had 1- 2 acres under dairy and 11% of the farmers had more than 2 acres under dairy farming (Table 17).

The average land sizes under dairy farming was 0.7 acres with a standard deviation of 0.4 and minimum land size under dairy of 0.1 acre and a maximum of 2 acres. The portion of land reserved for dairy farming is used for the dairy shed, planting of fodder crop and in some instances a portion left for grazing.

From Table 17 Imenti Central farmers allocated more land to dairy farming than farmers in Tigania East. For instance, 16% of farmers in Imenti Central allocated less than 0.5 acres to dairy farming, 50.7 allocated 0.5 – 1 acres in dairy farming, 12% allocated 1 -2 acres to dairy farming and 21.3% allocated more than 2 acres to dairy farming. In Tigania East, there was no farmer who allocated more than 1 acre to dairy farming. For instance, 29.3% of the farmers in the sub- County allocated less than 0.5 acres of land to dairy farming and 70.7% allocated 0.5 - 1 acre to dairy farming. There was a significant difference at 10% level for land allocation between the two sub – Counties ($Chi^2 = 18.22$*).

Table 17: Land Sizes under Dairy

Land Size (Acres)	Imenti Central (%)	Tigania East (%)	Average (%)
Less than 0.5	16.0	29.3	23
0.5 – 1	50.7	70.7	61
1.1 – 2	12.0	0	6
More than 2	21.3	0	11

Source: Author (2018)

4.1.2.6. Grazing Mode

Most of the farmers in the study area practiced zero-grazing (77.9%), 10.7% practiced semi – zero grazing, 4.3% practiced open grazing with supplements while 7.1% practiced tethering (Figure 6). For most farmers practicing zero grazing, the cattle were poorly housed. For instance, most of the cow units had poorly finished floors, others were not well shaded, others were poorly drained and others were smaller than the recommended housing dimensions. Most housing units harboured many biting flies that kept on disturbing the cows.

Zero grazing is common among dairy farmers in Imenti Central (90.3%) compared to Tigania East where 64.7% of the farmers practice zero grazing. Semi-zero grazing, tethering and grazing with supplements are also more common in Tigania East than in Imenti Central (Figure 6). Semi-zero grazing, grazing with supplements and tethering requires relatively more land than zero grazing hence their prevalence in Tigania East an area with relatively more land than the densely populated Imenti Central.

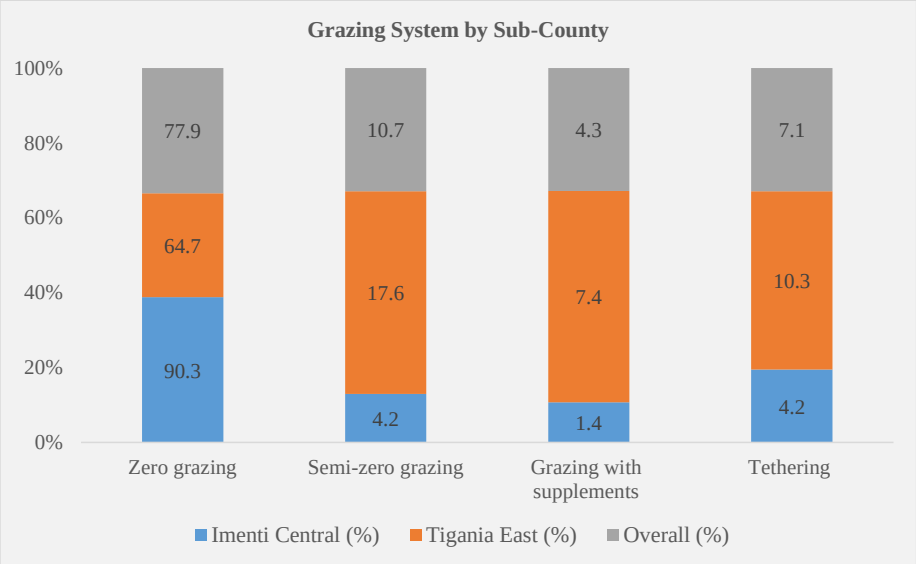

Figure 6: Distribution of Dairy Farmers by Grazing Mode and Sub-County

Source: Author (2018)

4.1.2.7. Milk Yield

Another characteristic of dairy farming examined in this study is the issue of milk production. The average milk yield by all the lactating cows owned by the interviewed farmers was 21.1 litres with a range of between 3 and 84 litres per day. In addition, 29.9% of the households produced between 3 and 10 litres, 35.4% had between 10.1 and 20 litres, 14.6% had between 20.1 and 30 litres and 20.1 had above 30 litres of milk per day.

The average milk yield from all the lactating cows differed among the farmers from the two sub-counties with an average of 18.5 litres varying between 3 and 49 litres per household per day in Imenti Central and an average of 24.2 litres varying between 4 and 84 in Tigania East sub - county. Around 30% of farmers in Imenti Central sub – county got between 3 and 10 litres per day, 44.6% got between 10.1 and 20 litres per day, 18.9% got between 20.1 and 30 litres per day and 13.5% got above 30 litres per day. In Tigania East there were more households getting between 3 and 10 litres and those getting above 30 litres per day compared to those from Imenti Central. At least 37.1% of the farmers in Tigania East produced between 3 - 10 litres per day, 25.7% had between 10.1 to 20 litres, 10% had between 20.1 and 30 litres and 27.1 had above 30 litres per day (Table 18). From Chi – square results ($Chi^2 = 11.31^*$) there was significant difference at 10% level in total milk yield from the two sub – Counties.

Table 18: Total Milk Yield by All Lactating Cows by Sub-County

Milk per cow (litres)/ day	**Imenti Central (%)**	**Tigania East (%)**	**Average (%)**
3 – 10	30.0	37.1	29.9
10.1 – 20	44.6	25.7	35.4
20.1 – 30	18.9	10.0	14.6
Above 30	13.5	27.1	20.1
Total	**100.0**	**100.0**	**100.0**

Source: Author (2018)

Besides the overall milk production per day, this assessment also examined the milk production by lactating cows. The average milk yield per lactating cow per day was 10.8 litres, with a range of between 3 and 24 litres and a standard deviation of 4.3. At least 7.6% of the lactating cows produced between 3 and 5 litres of milk per day, 43.1% produced between 5.1 and 10 litres, 35.4% between 10.1 and 15 litres and 13.9% produced above 15 litres (Table 19).

Table 19: Milk Per Cow Per Day

Milk per cow (litres)	**Age (%)**
3 – 5	7.6
5.1 – 10	43.1
10.1 – 15	35.4
Above 15	13.9
Total	**100**

Source: Author (2018)

The findings show that there were differences in average milk yield per cow per day between the two sub- counties. The average yield per lactating cow per day was higher in Imenti Central than in Tigania East with an average of 11.9 litres ranging between 3 and 24 litres per lactating cow per day in Imenti Central and an average of 9.5 ranging between 4 and 19 litres in Tigania East.

Further, only 4.1% of lactating cows in Imenti Central reported getting between 3 and 5 litres, 37.8% produced between 5.1 and 10, 36.5% produced between 10.1 and 15 litres and 21.6% produced above 15 litres.

In Tigania East 11.4% of lactating cows got between 3 and 5 litres per day, 48.6% got between 5.1 and 10 litres, 34.6% got between 10.1 and 15 litres and only 5.1% got above 15 litres. This finding is shown in Table 20

Table 20: Milk Per Cow Per Day by Sub-County

Milk per cow (litres)	Imenti Central (%)	Tigania East (%)
3 – 5	4.1	11.4
5.1 – 10	37.8	48.6
10.1 – 15	36.5	34.3
Above 15	21.6	5.1

Source: Author (2018)

4.1.2.8. Milk Marketing

Farmers interviewed in the County sold their milk to different types of buyers. The most popular channels of marketing were through dairy cooperative society and local kiosks or market centres. Around 37% of the farmers sold their milk in the local kiosk or market centre, 48.2% sold in the dairy cooperative society, 1.5% sold to other homes and 13.3% sold to the hawkers who buy milk and go to sell in other places (Table 21).

Results show that the choice of milk marketing channel varied with the sub-county. In Imenti Central 55.6% of the farmers take their milk to dairy cooperative societies, 20% sell to hawkers, 20.8% sell in local kiosks and only 1.4 % in other homes. The main dairy cooperative societies in Imenti Central are Kithirune Dairy and Katheri Dairy. In Tigania East (55.6%) sell to local kiosks or market centres, 39.7% sell to

dairy cooperatives, 1.6% sell to other homes and only 3.2% to hawkers (Table 21). The findings show that dairy milk marketing is more organized and formalized in Imenti Central than is the case in Tigania East.

Table 21: Dairy Farmers by the Milk Marketing Channel

Market Outlet	Imenti Central (%)	Tigania East (%)	Average
Local kiosk/market center	20.8	55.6	37
Dairy cooperative society	55.6	39.7	48.2
Other homes	1.4	1.6	1.5
Hawkers	22.2	3.2	13.3

Source: Author (2018)

The dairy farmers cited various reasons for the choice of their marketing channel. Those who sold their milk in cooperatives cited benefits such as getting loans which can be used in other development activities and getting payment advances which they use to buy feeds for the animals. Other advantages cited for selling milk through dairy cooperatives are the monthly payments which enable farmers to plan for their income, provision of inputs on credit and free trainings on best practices in dairy keeping. Some of the dairy cooperative societies also give farmers an annual bonus, which is calculated on the basis of the amount of milk sold through the society in a year.

However, those who sold their milk to hawkers, local kiosks/market centres and other homes pointed out that they are paid on delivery as opposed to taking their milk to a dairy cooperative society where farmers pay gets delayed. Farmers who sold milk to the hawkers cited pricing as the major factor that influence their decision. They explained that hawkers are willing to negotiate prices hence offering higher prices. Most farmers who sold to local kiosks or market centres are from areas where there are no dairy cooperatives in the area. Different buyers offered different prices with an average of Ksh. 40 per litre.

4.2. Profitability of the Small-scale Dairy Enterprises, Meru County

There are different ways in which farm level performance can be described. Performance can be described through cost benefit analysis, variable cost structure or estimation of gross margins. The average total number of cows kept by farmers in the County was 3 cows. On the other hand the average number of cows which were being milked was 2 cows. The average milk production was higher in Imenti Central than in Tigania East sub-county. The average milk production was estimated to be 324 litres per cow per month.

4.2.1. Cost Structure

Data on various components of the variable cost of production was classified into various categories for ease of analysis (Figure 7). The method used to calculate majority of the variable costs of production was based on prevailing market rate. The different variable costs that were considered included: concentrates and fodder, salt lick and minerals, maintenance and repairs, consumables (e.g. fuel and milking jelly), water and electricity, veterinary and insemination, labour, and milk transportation.

The cost of own produced fodder was estimated using the market rate for buying fodder. The opportunity cost for own land and capital as well as fixed costs associated with dairy production were not included in the analysis.

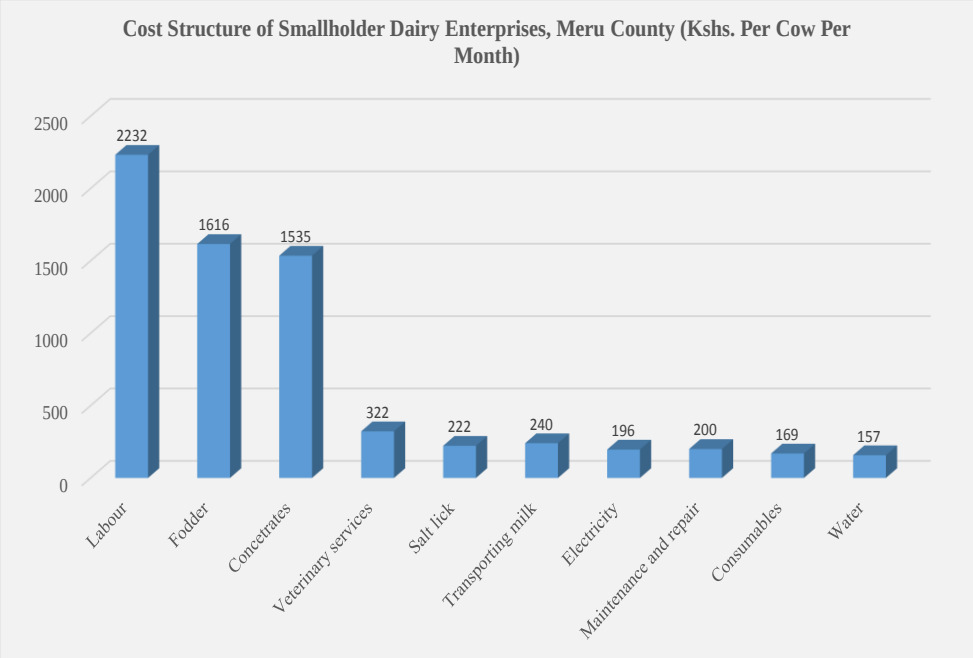

Figure 7: Cost Structure of the Small-scale Dairy Enterprises, Meru County

Source: Author (2018)

Results on the cost structure of the dairy enterprises show that labour accounts for the bulk of the cost of the small-scale dairy enterprises among the studied households. The average labour cost per dairy cow per month was Kshs. 2,232. The next significant cost is fodder with an average of Kshs. 1,616 per dairy cow per month. Fodder in this case comprised of costs associated with natural grass, napier grass, hay and silage that the farmer used to feed the dairy cows. The third largest expenditure was on concentrates with an average of Kshs 1,535 per dairy cow per month. Other costs incurred by the dairy farmer per cow per month are: veterinary services (Kshs. 322), maintenance and repair (Kshs. 200), salt lick (Kshs. 222), transporting milk

(Kshs. 240), electricity (Kshs. 196), consumables (Kshs. 169) and water (Kshs. 157). This finding is presented in Figure 8.

There are substantial variations in the cost structure of the small-scale dairy enterprises between Imenti Central and Tigania East sub-counties. The main source of variations were: Concentrates and water with Chi^2 values of 84.95*** and 34.33*** significant at 1%, labour, veterinary services and transporting cost with Chi^2 values 0f 36.63**, 38.24** and 25.4** significant at 5%, salt lick, fodder and maintenance cost with Chi^2 values of 42.09*, 62.73* and 25.71* significant at 10%. From Chi square values all the costs except the cost of consumables and cost of electricity had a significance difference between the two sub – Counties. The average cost of production per cow per month was Kshs. 5,652 in Tigania East sub – county and Kshs. 7,969 Imenti Central sub-county. In Tigania East the largest cost component for the small-scale dairy farmers was labour at a cost of Kshs. 2,220 followed by concentrates, fodder, veterinary service and AI, transporting milk, electricity, maintenance and repair, salt lick, water and the lowest cost component consumables. This finding is show in Figure 8.

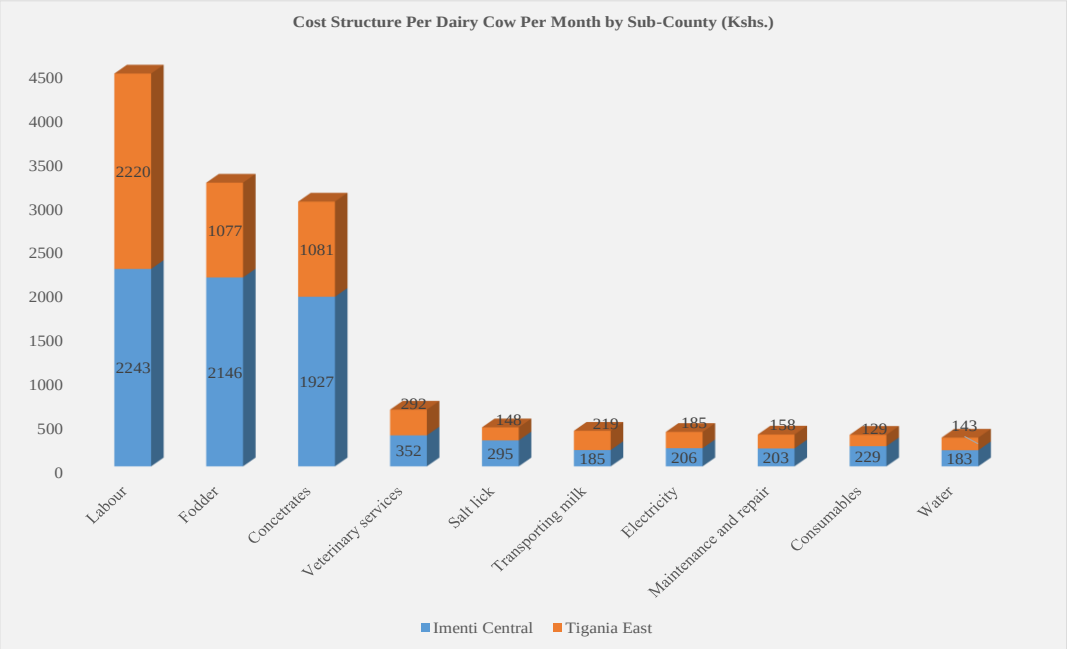

Figure 8: Cost Structure Per Cow Per Month by Sub-County

Source: Author (2018)

In Imenti Central the largest cost component was also labour at a cost of Kshs.2,243 followed by fodder, concentrates, veterinary services and AI, salt lick, consumables, electricity, maintenance and repair, transporting milk and water takes the lowest cost. Figure 9 indicates that in both sub-counties labour was the largest cost component and almost equal with Kshs. 2,220 in Tigania East and Kshs. 2,243 in Imenti Central sub-county.

4.2.2. Gross Margins

Results of the gross margins of the farmers interviewed in selected sub – counties of Meru County are presented in Table 22. The gross revenue included the value of milk sold and that consumed by the household.

Results indicate that the total value of milk produced by each lactating cow per month was higher in Imenti Central sub-county than in Tigania East sub -county. Small-scale

farmers in Imenti Central incurred higher variable cost per lactating cow (Kshs. 7,969) compared to Kshs. 5,652 for small-scale farmers in Tigania East sub-county. These costs translated to variable cost of production per litre of milk of Kshs. 22.3 and Ksh.19.8 for small-scale farmers in Imenti central Sub county and Tigania East sub-county respectively. T-test results indicate a mean difference of -1.4775 at 142 degrees of freedom. The mean difference was not statistically significance (p value = 0.1418).

The cost of production was higher for farmers in Imenti Central compared to Tigania East. Consequently, the gross margin for farmers in Imenti Central was lower with a monthly return over variable cost of Kshs. 4,917. In Tigania East, the gross margin was Kshs. 5,844 which was 1.2 times higher than that in Imenti Central sub-county. Therefore, there is evidence of higher gross margins per cow and per litre of milk for small-scale farmers in Tigania East sub - county.

Although the revenue per cow was lower for farmers in Tigania East, the much lower cost compensated for this resulting to higher gross margins per cow and per litre of milk. The ratio of gross margin to variable cost was low for all households regardless of the area.

The average cost of concentrates per litre of milk was lower for farmers in Tigania East indicating that an addition of a shilling in dairy farming in Tigania East would return more than an addition of a shilling in buying concentrates in Imenti Central sub-county.

Table 22: Gross Margins by Sub- County

	Revenue and Variable Costs (Kshs)		
Revenue and Variable Costs	**Imenti Central**	**Tigania East**	**Combined**
Revenue			
Milk sales	10,949	9,756	10,350
Value of milk consumed at home	1,937	1,740	1,838
Total revenue	**12886**	**11496**	**12188**
Variable costs			
Concentrates	1927	1081	1535
Salt lick	295	148	222
Electricity	206	185	196
Water	183	143	157
Labour	2243	2220	2232
Veterinary service	352	292	322
Fodder	2146	1077	1616
Consumables	229	129	169
Transporting milk	185	219	240
Maintenance and repair	203	158	200
Total variable cost	**7969**	**5652**	**6889**
Gross margins per cow per month	**4917**	**5844**	**5299**
Summaries			
Gross margin rate (%)	38	50	43
Gross margin/variable cost (Kshs.)	0.62	1.03	0.77
Gross margin/concentrate cost (Kshs.)	2.6	5.4	3.5
Average milk produced per cow per month (litres)	357	285	324
Variable cost of production per litre of milk per month (Kshs.)	22.3	19.8	21.3
Gross margin per litre of milk (Kshs.)	13.8	20.5	16.2
Average milk selling price (Kshs.)	40	40	40
Concentrate cost per litre of milk (Kshs.)	5.4	3.8	4.7

Source: Author (2018)

4.3. Factors Influencing Profitability of Small-scale Dairy Enterprises

The third objective of this study was to assess the factors influencing the profitability of small-scale dairy enterprises in Meru County. The dependent variable in this study is the natural logarithm of the gross margin and the independent variables considered are: age, gender, level of education, experience, household size, land size, herd size,

other sources of household income, access to credit, grazing system and breed type. The influence of the various factors on gross margins of small-scale dairy enterprises in the study is shown in Table 23. Eleven variables were used to explain and predict the influence of the different factors on profitability of small-scale dairy enterprises. The multiple coefficient of determination, R^2 was 0.4446 which was highly significant.

Among the regressors, only herd size was statistically significant at 1 % level, Education level and credit access were significant at 5% level. This means that only herd size, education level and credit access had a significant influence on gross margins for small-scale dairy enterprises in the study area.

Table 23: Regression Results on Factors Influencing Profitability of Small-scale Dairy Enterprises

Variable	Coef.	Std. error	P>t
Age	-0.0047	0.0097	0.631
Gender	0.3525	0.3727	0.347
Education	0.5489	0.2707	0.045*
Experience	-0.0035	0.0129	0.788
Household size	0.0217	0.0624	0.729
Land size	-0.0105	0.0316	0.740
Herd size	0.4695	0.0615	0.000***
Other sources of income	1.7E-07	2.36E-06	0.943
Access to credit	0.5000	0.2295	0.032*
Grazing system	0.1758	0.2495	0.483
Breed	0.4205	0.4977	0.400
Constant	14.0611	0.2277	0.013

Number of observations = 112

F(11,100) = 7.28

Prob>f=0.000

R-squared = 0.4446

Source: Author (2018).

CHAPTER FIVE: DISCUSSION

5.1. Introduction

This chapter presents a discussion of the study findings. The chapter is organized as follows: the first part discusses the characteristics of small-scale dairy farming in Meru County, the second part is on the profitability of small-scale dairy farming in Meru County, while the last part is a synthesis of the factors that influence profitability of small-scale dairy enterprises in Meru County.

5.2. Characterizing Small-scale Dairy Farming in Meru County

Small-scale dairy farming in Meru County can be characterized by examining both farmer-related and farm-related features. The farmer-related characteristics considered are: age, gender, level of formal education, household size, experience in dairy farming, credit access, main sources of household income, membership to a group, and farmer training. The farm-related characteristics considered are: type of dairy breed, herd size, type of feeds, veterinary services, land size and the size of land under dairy farming, grazing mode, milk yield and milk marketing.

The mean age of the dairy farmers was 45.7 years. This suggests that the small-scale dairy farmers are slightly above the most productive age. In Imenti Central, the average age of small-scale dairy farmers was 50 years which was higher than the average age of small-scale dairy farmers in Tigania East (42.3 years).

This suggests that farmers in Imenti Central were older than farmers in Tigania East sub-county. Freeman, Jabbar and Ehui (1998) linked age to productivity and argued that the most productive age is between 35 and 45 years. In Imenti Central only 44% of the farmers were below 45 years. This means that most farmers in Imenti Central

are past the most productive age meaning there is low involvement of youth in dairy farming. This means that as the old generation ages, there are few new and younger farmers to take over and this will hamper dairy productivity growth in the sub county.

In Tigania East sub-county, 65.3% of the farmers are below 45 years. This means that there is youth involvement in dairy farming and thus as old generation ages, there are more new and younger farmers to take over and thus there is potential for growth of dairy production in the sub-county. In general, 54% of the farmers in the county are below 45 years which implies that there is potential for increased performance in the sector.

Further, 94.7% and 90.7% of farmers in Imenti Central and Tigania East respectively were male and only 5.3% and 9.3% respectively were female. This means there were more male dairy farmers than female dairy farmers in both sub-counties though there are more female dairy farmers in Tigania East than in Imenti Central. In general, 92.7% of the farmers were male and 7.3% of the farmers were female in the county.

Men are more involved in dairy farming than women. This can be attributed to the fact that men have more access and control over land and other factors of production compared to women. In Meru customs, land and cattle ownership is seen as a preserve for men. In many African cultures, it is seen as a responsibility of men to take care of cattle as women are engaged in domestic work.

The levels of education for the small-scale dairy farmers in the two sub counties were quite varied. Around 92% the farmers in both sub-counties had formal education. Most of small-scale dairy farmers had either primary or secondary education hence

they are able to make informed decisions relating to dairy farming. Such farmers with a basic education can easily adopt to new technologies leading to increased dairy productivity. Generally, the more educated people are, the more efficient producers they become (Battese and Coelli, 1995). Dairy productivity can therefore be hampered by low literacy levels.

Only 22.6% of the households in Imenti Central had 6 or more members. In Tigania East, 40% of the households had 6 or more members. The number of household members is very critical in dairy farming because of the labour required in dairy farming. Households with smaller household size have to hire more than those with larger household sizes. Even in instances where a household has hired a worker to take care of the dairy cattle, more often this responsibility is shared with other household members.

In some of the households, dairy farming is not taken as the main economic activity, hence a shared responsibility among household members. This supports Tariku (2006) findings that production on small-scale farms relies heavily on family labour. A study by Central Statistics Authority (2003) reveals that unpaid workers constitute the highest proportion (56%) of the population in agricultural households who are engaged in agricultural activities.

On average, 68% of the small-scale dairy farmers in the County had dairy experience of more than 10 years. This means that these farmers are knowledgeable and need to adopt new technologies in order to improve dairy productivity. More dairy farmers in

Imenti Central had engaged in dairy farming for more years than their counterparts in Tigania East. As farmers gain experience through many years of dairy farming, they learn how to become better dairy farmers, better dairy husbandry as well as cost-cutting strategies critical for profitable dairy farming.

Out of all the interviewed farmers only 29.3% have ever applied for loans to enhance their dairy farming. This indicates that farmers in the county are not using loans. Most cited various reasons for not using loans e.g. high interest rates, lack of guarantors probably because nobody is willing to guarantee or those willing have guaranteed others, fear of being unable to service the loan hence putting ones property at risk because of lack of guaranteed monthly payments and short repayment periods.

Most of the farmers felt that loans were easily accessible in self-help groups followed by shylocks, Saccos, banks and microfinance institutions. Those farmers who were members of cooperative society were able to get loans from the Sacco although there was a limit of the amount the farmer could be given depending on the amount of milk that the farmer gets. Very few farmers indicated that loans from micro finance institutions were easily accessible. Most explained that there were no microfinance institutions in the area.

Access to credit creates opportunities for the small-scale dairy farmers to scale up their dairy enterprises. Some of the farmers cited lack of funds as the main reason for keeping dairy breeds that do not produce a lot of milk e.g. Jersey and cross breeds. Availing affordable credit to such farmers can encourage them to invest in more milk yielding dairy breeds such as Friesian and Ayrshire. However, it is also important that

farmers are sensitized on prudent use of credit so that such resources are used for the appropriate use.

Overall, dairy farming was cited as the second leading source of household income among the studied households (30.8%). Around 44.1% of the small-scale dairy farmers cited crop as their major source of income, while non-farm income came a distant third.

This finding implies that with enhanced investments, the small-scale dairy sector has the potential of improving income earning opportunities for rural communities within the County as well as employment generation.

Some of the strategies that can be used to enhance small-scale dairy farming performance in the County include strengthening the small-scale dairy cooperative societies across the County, educating dairy farmers on modern dairy farming techniques as well as encouraging dairy farmers to adopt a business model for their dairy enterprises. This last point implies that creating awareness among dairy farmers to take their dairy enterprises more seriously and not just as any other business in the household.

Membership to a group by the small-scale dairy farmers was another feature that was assessed in this study. Results show that 60.7% of farmers were members of an association or a group. Out of these, 60.2% were in welfare groups and 39.8% were members in farmers' groups. Further, 39.3% of the dairy farmers were not involved in any group or association. Membership to an association and especially a farmer's association creates opportunities for the dairy farmer to interact with other dairy

farmers and share experiences on better dairy farming practices. Through such groups, dairy farmers are also able to access loans that are often guaranteed by the other group members.

Through such groups farmers also get access to dairy inputs at a negotiated price and are also assured of the quality of the inputs. Some of the farmers' groups (e.g. the dairy cooperatives) organize for the milk marketing which relieves the farmer the struggle of marketing the milk.

On farmer training, results indicate that more dairy farmers in Imenti Central have undergone some training to enhance their dairy farming skills. For enhanced milk productivity, farmers require training. They need training on dairy breeds, dairy hygiene and improved animal health, record keeping, making various feeds (e.g. hay, silage) as well as opportunities to reduce cost in the dairy enterprise. Such kind of training is critical in the modernization of the small-scale dairy sub-sector.

In this study, majority of the farmers were rearing between 1 and 2 dairy cows, with around 90% of the breeds kept in both sub-Counties being exotic. The exotic breed kept by most of the farmers was Friesian and this is in agreement with the study by (Kinyenje, 2013) who found out that majority of the farmers in Meru central Kenya kept Friesian.

Results indicate that farmers are highly knowledgeable of the various dairy breeds and their milk production potential. The type of a breed that a farmer kept was based on various factors such as affordability, expected milk productivity, feed consumption, susceptibility to diseases and the prevailing agro-climatic conditions.

The average herd size was 3 dairy cows and the average number of lactating dairy cows was 2. Few farmers in Tigania East had one cow compared to their counterparts in Imenti Central. The herd sizes were higher in Tigania East than in Imenti Central though the average production per cow was higher in Imenti Central than in Tigania East.

This may be attributed by the fact that most crosses and indigenous breeds were found in Tigania East and that these two types of breeds are associated with low milk production. The study also revealed that most farmers preferred Friesians because of high milk production.

The average milk production per lactating cow per day was 11.9 litres in Imenti Central and 9.5 litres in Tigania East. The high production in Imenti Central may also be attributed to high use of concentrates compared to dairy farmers in Tigania East. This could also be linked to the experience of the farmers in Imenti Central compared to those in Tigania East.

The study also established that almost all farmers rearing exotic breeds preferred breeding using Artificial Insemination. Farmers cited challenges such as high cost of AI and loss of AI which as to be repeated as a major challenge. AI and veterinary

services were provided mostly by the private personnel. Most farmers indicated that AI and veterinary service providers were not highly responsive.

Farmers explained frustrations especially during wet seasons when most poor roads are too muddy hence making accessibility to farmers' residential areas inaccessible.

The study also revealed that in case of serious livestock diseases, private personnel were unable to offer treatment hence need for government intervention which sometimes is not available due to lack of enough government officers leading to animal deaths.

Further, 76.7% of all the farmers in the study area practiced zero grazing system. They owned land sizes averaging 2.9 acres. This means that land sizes in the county are small. Of all the land owned the average land size under dairy farming was 0.7 acres. Farmers practiced mixed farming where they practiced crop farming and livestock keeping where they reared dairy among other livestock. Competition among the enterprises was very stiff being determined by the input prices and the outputs from the enterprise.

The probable reason for practising crop-livestock farming is that farmers are more food secure in this kind of system or because they lacked incentive to specialize. This system has advantages such as allowing diversification of risks and recycling of wastes to avoid nutrient losses, adding value to crops and crop products while providing cash for inputs purchase.

The study found out that farmers feed their cows using Napier grass, natural grass, hay and dairy meal. For instance, 96.3% of the farmers used Napier grass, 83.3% used hay, only 3.0% used silage and almost all the farmers used natural grass. Most farmers got Napier grass from their own farm. Only a small % of farmers purely bought Napier grass. Most of those who bought combined with Napier grass from their farms. Almost all farmers used own made hay from their farms. Farmers had used Napier grass for an average of 14.7 years and hay for an average of 13.7 years. This means that farmers had used Napier grass for longer period than hay. Farmers cited challenges in getting feeds especially during the dry season.

This means that most of the farmers depended on rain fed fodder. Farmers got dairy meal from the nearest market centres. They cited a major challenge in using the dairy meal as quality. Almost all farmers indicated that there were so many companies offering the product in the market and some offered very poor quality dairy meal.

They used dairy meal to boast milk production. Some of these sub- standard dairy meal products did not boost milk production. Another challenge in getting the dairy meal was the distance. Some farmers could travel for as long as 11 km to get to the market centre where they could get the dairy meal and this led to an increase in cost.

5.3. Profitability of Small-scale Dairy Farming in Meru County

Small-scale dairy farming in Meru County was found to be profitable. The results indicated an average gross margin of Kshs. 5,299 per cow per month. The estimated average sale price by the small-scale dairy farmers was Kshs. 38.7. The estimated

average cost of production per litre of milk was Kshs. 21.9 representing 56.6% of the sale price. The returns per litre was Kshs. 16.8 representing 43.4% of the sale price.

The profits calculated was gross margins and not net profit. One of the reasons for this is that some of the fixed costs could not be added due to lack of reliable data on their market values. This study is consistent with Mburu et al., (2007) who experienced related challenges.

The other reason for ignoring fixed costs in this study is because they are not related to higher milk production and do not affect the optimal combination of variable inputs used and outputs obtained whether sold or consumed by the household (Mburu et al., 2007).

Nevertheless, gross margins are still useful in assessing enterprise profitability and are widely used in farm management economics (Dijkhuizen and Huirne, 1997).

Based on the findings by Mburu et al., (2007), production costs are expected to be higher in the most intensive systems and lowest in the most extensive systems reflecting the high amounts of concentrate feeds used.

In this study, this assumption was correct as the total cost of production was highest in Imenti Central (Kshs. 7,969) and lowest in Tigania East (Kshs. 5,652). Total cost in Imenti Central were 1.4 times total costs in Tigania East. Almost all the costs were lower in Tigania East except the cost of transporting milk. This is because in most parts of Tigania East there are no organized dairy cooperatives hence farmers have to transport their milk to very far places.

In Imenti Central sub-county, concentrates per litre of milk were Kshs. 5.3 while it was only Kshs. 3.8 in Tigania East. This means that cost of concentrate was 1.4 times higher in Imenti Central than in Tigania East. Low costs of fodder in Tigania East may be attributed by the fact that they have larger farm sizes where they get fodder hence the value of fodder is rated at a lower price than the prices in Imenti Central. The high cost of production per litre of milk in Imenti Central may be associated to the intensive systems being practiced in the area where high amounts of concentrates are being used.

This study is in agreement with a study by Baltenwek et al. (1998) whose study findings showed that the cost of a dairy production is dependent on the level of intensification, with less intensified sub-district having relatively high levels of cash flows. Land sizes are very small in Imenti Central due to the population pressure, hence the high level of intensification.

There was a significance difference in gross margins per litre of milk between the two sub -counties with Tigania East having gross margins of Ksh. 20.5 per litre of milk and Imenti Central having gross margins of Kshs. 13.7 per litre of milk. This is in agreement with the study by Kibiego et al. (2015) on competitiveness of small-scale milk production system in Uasin Gishu County, Kenya which concluded that gross margins per litre of milk decreased with the level of intensification due to higher feed and labour costs in more intensive systems.

Despite the high milk quantities (358 litres) produced per cow per month in Imenti Central, small-scale dairy farmers in Tigania East with average production of 285

litres per cow per month on average made more profits. This is due to high milk prices offered in Tigania east since most farmers sell their milk in market centres and local kiosks where they are offered as high as Kshs. 60 per litre of milk.

High milk prices in Tigania East may be associated with low milk production in the area which is inadequate for the large population.

In Imenti Central there is a lot of milk being produced hence well-developed formal milk marketing channels. Most farmers sell their milk to dairy cooperatives which offer very low prices. This may be associated to longer marketing channels associated with cooperatives. Though results indicate dairy cooperatives offered lowest prices they have had contribution to rural development in Kenya. The cooperatives provide assured market for farmers, transport milk on behalf of the members and also offer other services such as provision of inputs on credit. Cooperatives also enjoy significant economies of scale.

5.4. Factors Influencing Dairy Profitability in Meru County

From the analysis of variance for the regression analysis, results indicated F-value was 7.28 and p-vale was 0.000. This is an indication that the model was highly significant at 1% level. The coefficient of determination (R^2) was 0.4446, concluding that 44.5% of variations in the dependent variable (profits) was as a result of the independent variables in the model. In determining model adequacy features such as R^2 and F-value are observed (Gujarati, 2007). Thus the model was adequate. The remaining 55.5% could be due to measurement errors of factors not accounted for in the regression model.

The coefficient of herd size was significant at 1%. On the other hand the coefficients of Education level and credit access were significant at 5%. All the significant coefficients were positive.

Positive coefficient in herd size means that for any unit increase in herd size profitability increases. In this regression analysis a unit increase in the herd size of milking cows, results in an increase in profit of small-scale dairy enterprise by 0.47% when other things are held constant. This is in agreement with Cain et al. (2007) who stated that profitability of a dairy enterprise is highly correlated with herd size. Coefficient of Education level of the household head was statistically significant with a p-value of 0.045 and its coefficient was 0.5489 meaning that as the farmer attains a higher level of education he has better understanding of the dairy enterprise as a business and is able to make more profits. It is also assumed that educated farmers have proper management of dairy animals, feeding and good hygiene, and thus improving profitability. Credit access was statistically significant p=0.032 and its coefficient was (0.5000) meaning that an increase in credit access by 1 unit , holding all other variables constant led to an increase in farmers profits by 0.50%. This means that if farmers are able to get loans they can invest more into dairy farming hence increasing their chances of getting more profits.

Gender of the farmer was not statistically significant p=0.347. This means that there was no difference in profitability whether the farmer was male or female. Experience of the farmer was not found to be statistically significant (p=0.0035).

It was expected that experience would have a statistically significant effect on profitability since farmers with more years of experience have more knowledge in dairy farming.

Household size was not statistically significant (p=0.729) in this study. Household has been described as the most important determinant of labour investment for family farms because in addition to being a source of labour, it influences need for home consumption as well as for market (Ngongoni et al., 2006).

Land size was also not statistically significant p=0.740 though there was a negative coefficient (-0.0105) implying that farmers with smaller farms are more profitable. Breed type was not statistically significant p = 0.811 though it had a positive coefficient of 0.0545 implying that farmers who kept Friesian were more profitable.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

This chapter provides a summary of conclusion and recommendations. The first part provides a brief conclusion of the study and finally recommendations.

6.2. Conclusion

Farmers in Meru County practice mixed crop - livestock farming. The probable reason for this kind of farming is that the farmers are more food secure in this kind of system. The findings from this study pointed out that there was potential for increased milk yield in the region given the large numbers and the type of breeds kept in the county. Majority of the farmers practised zero grazing and kept exotic breeds such as Friesian, Ayrshire, Guernsey and jersey. Almost all farmers rearing exotic breeds preferred breeding using artificial insemination which was very expensive. Farmers sourced veterinary and AI services from the private personnel who were very expensive and unable to offer treatment in case of serious diseases.

The results of this study on cost and revenues indicated that small-scale dairy farming was profitable in Meru County. The profitability per cow per month differed among the small-scale farmers. The average gross margins per cow per month was Kshs. 5,299.

The average price received by the farmer from milk was Kshs. 38.7 per litre of milk with an average production cost of Kshs. 21.8 resulting in an average return of Kshs. 16.8 per litre of milk. The cost of feeds constituted the highest proportion of the total variable cost.

Findings based on multiple regression analysis indicated that factors that surround the small scale dairy farmers have an influence on profitability. Herd size, education level and credit access have significant effect on profitability. Factors such as gender, experience, house hold size grazing system and breed type were expected to have a significant effect on profitability but the results indicated they had no significant influence on profitability.

6.3. Recommendations

Small-scale dairying in Meru County plays a key role in creation of employment opportunities and wealth. Policy makers should take initiative in enacting laws aimed at lowering the cost of inputs thus reducing production costs.

From the findings dairy farming in Meru County is profitable. The study recommends that the government should prioritize investing more in dairy farming as a way of promoting employment to the population.

From the findings the main costs contributing to high production costs are costs of feeds. The study recommends use of improved feed sources such as homemade dairy marsh because these could significantly reduce the feed costs hence increasing profitability.

From regression herd size, education level and credit access have a positive relationship with profitability. The study recommends that policy interventions should be aimed at establishing breeding centers for dairy cows in order to enable farmers increase herd size, formulation of laws which can help farmers get access to credit in

order to invest in dairy farming and transfer of knowledge through provision of extension services to educate farmers on dairy management.

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Appendix 1: The Questionnaire

Introduction:

Hallo. My name is Saberah Kainda. I am a student at Kenyatta University, School of Agriculture and Enterprise Development. As part of my studies, I am conducting a study on dairy performance among small-holder farmers in Meru County. The findings of this study will contribute to a better understanding on the factors influencing dairy profitability as well as shed light on the profitability of small-scale enterprises in the area. You have been randomly selected to participate in this study. Participation in the study is voluntary. All the responses generated will be confidential and will only be used for the purposes of this study. Thank you.

Background Information

1. Gender of the farmer 1. Male 2. Female
2. Age in years of the farmer *(record actual age in completed years)* _____
3. Level of education of the farmer:

   1. No formal education

   2. Primary level

   3. Secondary level

   4. Post-secondary but not university

   5. University level
4. If beyond secondary level did you attend a business course?
5. Household size _____
6. Number of household members aged 15 – 64 years _____
7. Total land size owned by the household _____acres

1. What activities do you undertake in your land? (specify proportion under each activity)
2. Is your land sub- divided into small plots?
3. If yes in q6b, do you get animal feeds e.g. Napier grass from any plot away from where you keep your dairy animals?
4. If yes in q6c, what are the challenges?
8. Estimated monthly household income (from all household members including farming activities). Kshs. _____
9. Main source of income for the household: 1. Non-farm income 2. Crop income 3. Livestock income 4. Other (specify)

Dairy Breeds

10. What are the dairy cattle breeds that you are aware of:

1. Pure (Jersey, Ayrshire, Friesian, Guernsey)
2. Cross breeds
3. Indigenous cattle

11. How many years have you been keeping dairy cattle? *(record actual number of years)*

_____

12. When you started keeping dairy cattle, what type of dairy breed did you start with?*(Multiple response possible)*

1. Pure breed
2. Cross breeds
3. Indigenous breed

13. How many dairy cows did you start with? _____

14. A. What kind of dairy farming system do you practice?

1. Zero grazing
2. Semi zero grazing
3. Open grazing with supplements
4. Tethering

B. Explain your answer (prove for condition, challenges etc.)

_____

_____

_____

_____

C. If zero grazing, what is your feeding routine?

_____

_____

_____

_____

15. What type of dairy cattle breed do you currently keep?

Dairy cattle Breed type	Specify the breed	No. of animals	Duration the farmer has kept the breed (years)
Pure			
Cross			
Indigenous			

b. Explain the reason for keeping the breed type:

16. How many lactating cows do you currently have? _____

17. How much milk do your dairy cattle produce in a day? _____(litres)

18. Of the milk produced, how much of it is consumed at home in a day _____(litres)

19. Of the milk produced, how much of it is sold in a day _____(litres)

20. Where do you sell?

21. If in dairy cooperative society, what are the benefits and challenges?

22. What is the price of milk that you sell: Kshs._____(per litre)

Dairy Feeds

23. I would like us to talk about the type of dairy feeds that you use in your farm:

Type of dairy feed	Source: 1. Market / stockist; 2. Make own feeds; 3.I use own made and also buy; 4. From the farm; 5. Other (specify)	Physical proximity of getting the feed: *(estimate in kilometres).*	Cost of the feed per unit*(state unit)*	Duration the farmer has used the feed *(in years)*

Concentrates e.g. dairy meal				
Natural grass				
Nappier grass				
Hay				
Silage				
Mineral supplements				
Other (specify)				

24. What are some of the challenges in getting the dairy feeds in this locality?

Veterinary services

25. Do you use veterinary services for your dairy cattle? 1. Yes 2. No

26. If yes in q25, what kind of veterinary services do you use for your dairy cattle?

27. Where do you source the veterinary services that you use for your dairy cattle

1. From a trained Government provider
2. From a trained private provider
3. From both Government and private providers

28. What are some of the challenges with regard to veterinary services for dairy farmers in this area?

_____

_____

_____

_____

_____

Access to credit

29. How much money have you invested in your dairy enterprise (including the cost of buying the dairy cows) Kshs. _____

30. When you started dairy cattle farming, how did you first finance the investment?

1. From own savings
2. Loan from a bank
3. Loan from a microfinance institution
4. Loan from a SACCO
5. Other (specify)_____

31. If q30, is "from own savings", have you ever applied for a loan for your dairy enterprise?

1. Yes
2. No

32. If yes in q31, from which type of lending institution?

1. Loan from a bank
2. Loan from a microfinance institution
3. Loan from a SACCO
4. Other (specify)_____

33. If yes in q31, was the request granted? 1. Yes 2. No

34. Kindly rate your accessibility to loan facilities from the following sources:

	Easily accessible	Accessible	Not easily accessible
Banks			
SACCOS			
Deposit taking MFIs			
Community money lenders			
Shylocks			
Chamas			
Family members			
Friends			

35. What factors constrain access to credit for your dairy enterprise?

Cost structure of the dairy enterprise

36. How much do you spend on each of the following in a typical month in your dairy enterprise:

Item	**Estimated cost in Kshs. (monthly)**
Concentrates	
Salt lick	
Electricity	
Water	
Labour	
Veterinary services and insemination	
Fodder	
Consumables	
Transporting milk	
Maintenance and repair	

37. Any other comment on the dairy sector in the sub – county?

Appendix 2: Summary of Heteroskedasticity Results

Variable	Chi^2	Prob<chi^2
Age	6.06	0.134
Experience	0.45	0.504
Education	0.65	0.419
Household size	1.62	0.504
Herd size	2.05	0.152
Land size	0.86	0.352
Access to credit	0.67	0.413
Other sources	1.14	0.286
Gender	1.58	0.209
Grazing system	7.60	0.158
Breed	0.61	0.436

Appendix 3: Summary of Multicollinearity Results

Variable	VIF	Tolerance = 1/VIF
Age	1.61	0.62
Experience	1.47	0.68
Household size	1.33	0.75
Herd size	1.32	0.76
Breed	1.26	0.79
Education	1.21	0.83
Access to credit	1.19	0.84
Land size	1.19	0.84
Other source	1.18	0.85
Gender	1.07	0.94
Grazing system	1.06	0.94
Mean VIF	***1.26***	

Appendix 4: Regression Test

```
. regress profit2 age Gender Educationlevel Experience  Householdsize Landsize HerdSize OtherSource  creditaccess breed grazingmethod
```

Source	SS	df	MS		
Model	84.9943935	11	7.72676305	Number of obs	= 112
				F(11, 100)	= 7.28
Residual	106.164908	100	1.06164908	Prob > F	= 0.0000
				R-squared	= 0.4446
				Adj R-squared	= 0.3835
Total	191.159301	111	1.72215587	Root MSE	= 1.0304

profit2	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	-.0046927	.0097283	-0.48	0.631	-.0239934	.014608
Gender	.352494	.3727117	0.95	0.347	-.3869553	1.091943
Educationlevel	.5488827	.2707011	2.03	0.045	.0118194	1.085946
Experience	-.0034757	.0128625	-0.27	0.788	-.0289945	.0220432
Householdsize	.0217058	.0623724	0.35	0.729	-.1020392	.1454509
Landsize	-.0105205	.0315598	-0.33	0.740	-.0731341	.0520932
HerdSize	.4695459	.061547	7.63	0.000	.3474385	.5916533
OtherSource	1.70e-07	2.36e-06	0.07	0.943	-4.51e-06	4.85e-06
creditaccess	.5000196	.2294896	2.18	0.032	.0447188	.9553204
breed	.4204908	.497699	0.84	0.400	-.5669298	1.407911
grazingmethod	.1758407	.2495414	0.70	0.483	-.3192424	.6709238
_cons	6.463933	.9204164	7.02	0.000	4.637853	8.290013

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