FACTORS AFFECTING SHEEP AND GOAT MILK CONSUMPTION IN ARID AND SEMI-ARID LANDS OF KENYA

BY

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DECLARATION

I understand that plagiarism is an offence and I therefore declare that this thesis is my original work and has not been presented to any other institution for any other award.

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DEDICATION

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ABBREVIATIONS AND ACRONYMS

ASALS	Arid and Semi-Arid Lands
BSDA	British Sheep Dairy Association
CBO	Community Based Organization
CCPP	Contagious Caprine Preulo Pneumonia
CLA	Conjugated Linoleic Acid
DGAK	Dairy Goats Association of Kenya
DLPO	District Livestock Production Officer
DNA	Deoxyribonucleic acid
DPCASS	Dual Purpose Cattle Small Scale
FAO	Food and Agriculture Organization
FGDs	Focused Group Discussions
IDF	International Dairy Federation
MCT	Medium Chain Triglycerides
MoLD	Ministry of Livestock Development
NAFIS	National Farmers Information Services
NGO	Non-Governmental Organizations
SEAG	Small East Africa Goat
SGSS	Sheep and Goats Small Scale
SPSS	Statistical Package for Social Sciences

DEFINITION OF TERMS

Deoxyribonucleic acid: – This is what makes up Genes and they serve as a carrier of genetic information in all organisms other than some viruses.

Conjugated Linoleic Acid: - This is a term used to refer to a mixture of fatty acids that have the general structure of linoleic acid (18 carbons in length, 2 double bonds) where the double bonds exist two carbons away from each other; they are all polyunsaturated fatty acids, and some may be trans fatty acids.

Sheep and Goats Small Scale: – This is a system whereby community members keep few sheep and goats mainly for subsistence purpose. They are used to supplement the family income in times of severe need.

Dual Purpose Cattle Small Scale: – This is a system of livestock production where community members keep livestock that are for meat, milk and even draught power

Focused Group Discussions: – These are people grouped together based on specific criteria well-tailored to the information required. It maybe a group of women, men or youth or even people with the same interest.

Doe: – This is a term used to refer to a female goat

Ewe: – This is a term used to refer to a female sheep

Xanthine Oxidase: – This is an enzyme that generates reactive oxygen species and catalyzes production of uric acid from xanthine.

Lactose intolerance: - This is a condition that is caused by a deficiency of an enzyme known as lactase which is used to digest lactose. This condition is due to carbohydrate sensitivity.

ABSTRACT

A study was carried out to determine the factors affecting sheep and goat milk consumption in arid and semi-arid lands of Kenya**.** Specifically the study sought to assess sheep and goat milk production, assess sheep and goat milk consumption, and identify sheep and goat management practices for optimal milk production in Kyawango and Kibauni Locations of Mwala Sub County of Machakos County. Data was collected from a sample of 120 respondents using questionnaires and observations and was analyzed using statistical package for social scientist software. The study established that sheep and goats are kept majorly for sell to earn income and production of milk and meat. Findings from this study have shown that goats produce more milk compared to sheep. On average, goats produce 1-2 litres of milk daily while sheep produce less than 1 litre per day. The study established that sheep and goat milk production is significantly affected by type of breeds and management practices such as deworming, supplementary feeding, watering and separation (p <0.05). It was also established that the levels of consumption of goat milk is higher than sheep milk where goat milk was consumed every day and by majority of family members. Sheep and goats milk is consumed raw, fermented and boiled. Goat milk is preserved by boiling and storing as well as pouring it into guards for fermentation. The different milk preservation measures are usually taken to ensure that goat milk smell among other characteristics which limits goats milk consumption are minimized and therefore increase its consumption. Mixed farmers were the majority (67.5%) where they kept crops and kept animals in the same farm although most households had land size of between 1-4 Ha which is quite limited for both crop and livestock keeping. Households had an average of 7 local breeds of goats in the farm and 1 local breed of sheep where women in the household were responsible for most of sheep and goat activities such as cleaning of the house, giving supplementary feeds, providing sheep and goats with water, milking of the sheep and goats and making decisions on the selling of the milk. It was established during the study that sheep and goat farmers practice extensive and semi-intensive methods of farming where in semi-intensive systems, sheep and goats are tethered at the garden for part of the day and taken to home and supplemented with crop by-products and in extensive system sheep and goats are left to graze or browse throughout the day and gathered to home at night. The major challenges associated with intensification of sheep and goats identified include limited grazing space and droughts. Capacity building farmers on proper sheep and goat management practices, genetic improvement by crossing local sheep and goats with improved breeds, creating awareness about the nutritional importance of sheep and goat milk, and on the public health concerns associated with sheep and goat milk consumption are recommended as practices that will lead to improved milk production and encourage consumption.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

1.1.1 Importance of Sheep and Goats in livelihoods improvement

Sheep and Goats play a vital role in the livelihoods of small-scale farmers in developing countries. They contribute to food security and can alleviate seasonal food variability and availability directly through milk and meat production and indirectly through cash earned from the sale of their products (Homann *et al.,* 2007). In semi-arid areas sheep and goats have comparative advantages over cattle. They are more resistant to droughts, they utilize a wider diversity of plants and or grass and have higher reproductive rates. As browsers, goats use different vegetation from cattle and thus allow farmers to make more efficient use of the available natural resources. Promoting goat/sheep production contributes to risk mitigation, particularly in drought-prone areas, and empowerment of vulnerable groups (Women, HIV/AIDS, poor) (Delgado *et al.,* 1999).

In Sub Saharan Africa, goats are used for customary rites in addition to meat production and religious purposes (Odeyinka *et al.,* 2004). It has been documented that sheep and goats are the principal domesticated small ruminants in terms of total numbers and production of food and fiber products. This attribute may partly be due to their lower feed requirements compared to cattle, because of their body size (Okunlola *et al*., 2010). This, however, allows for easy integration of small ruminants into different farming systems (Hirpa *et al.,* 2008).

Goat milk constitutes around 2.2% of the world's total milk production, sheep milk 1.3% and camel milk 1.3%. According to FAO (2009), goat milk was mainly produced in Asia (59% of world milk production), in Africa (21%) and in Europe (16%); whereas sheep milk production is in Asia (44%) and Europe (34%) and camel milk mostly in Africa (89%). In 2010 the increase narrowed to 0.2%. Development differs widely from country to country. While goat milk production was rather dynamic in Turkey (+3.5%) and in France (+6.4%), a downturn occurred

in Mexico (-1.0%), Spain (-2.9%) and the Netherlands (-8.6%) (IDF Bulletin No. 451, 2011). Kenya had 17,467,774 cattle and they produced 5,788,322,425 kgs of milk, while there were 25,250,865 heads of goats and they produced 1,292,844,288 kgs of milk and 17,129,606 heads of Sheep for the year 2009.

1.1.2 The Nutritional Merits of Milk

Milk from sheep and goats has been accepted in most parts of the world, especially in the developed countries as an alternative to cow milk and their contribution stands at 46% of the world total production of 7.3 million tons for sheep and 40% of the total world production of 7.2 million tons for goats in both the tropics and sub –tropics (Ochepo *at el*., 2010). The same authors stated that, Milk is obtained from cows, sheep and goats, buffaloes, camels but the most predominant milk is that from the cow.

The nutritional merits of milk are indicated by the fact that daily consumption of milk furnishes an individual with approximately one –half of protein, one – third of vitamin A, ascorbic acid and thiamine, fat, calcium, phosphorus, riboflavin; one –fourth calories and all the minerals except for iron, copper, manganese and magnesium needed daily. According to Jennes (1980), goats produce relatively more milk compared to cows and other ruminants, because of better feed utilization efficiency, higher lactation persistency, mammary tissue comprising of greater proportion of the body weight and a more pronounced milk ejection reflex. Goat and more so sheep milk production are not popular in Kenya however there are already existing efforts to promote goat milk production in the ASALs.

1.1.3 Nutritional Importance of Sheep and Goat Milk as Compared to the rest

Sheep and goat milk is said to have important advantages over cow milk for human nutrition. For example, Jennes (1980) and Devendra et al., (1983) reported that compared to cow's milk, sheep and goat milk has higher protein, energy and fat contents. The higher proportions of short-and medium-chain fatty acids are of greater significance for ease of digestion.

Sheep milk is highly nutritious, richer in vitamins A, B, and E, calcium, phosphorus, potassium, and magnesium than cow's milk. It contains a higher proportion of short- and medium-chain fatty acids, which have recognized health benefits. For example, short-chain fatty acids have little effect on cholesterol levels in people. They make milk easier to digest. The milk has more conjugated linoleic acid (CLA) than the milk from pigs, horses, goats, cattle, and humans. CLA is a cancer-fighting and fat-reducing (Schoenian, 2012). The fat globules in sheep milk are smaller than the fat globules in cow's milk, making sheep milk more easily digested (Schoenian, 2012).

Goat milk is an excellent source of calcium, phosphorus and chlorine. Although sheep and goat milk has excess potassium and chloride which cause acidosis, and is deficient in vitamins C, D and folic acid, the milk would be beneficial to children in early post-weaning periods. If supplemented with iron and folic acid, infants and pregnant mothers would benefit from these milk sources. Extant literatures have shown that goat milk is rich in basic food nutrients. It has been reported that goat milk contains more β – casein and less α – casein than cow milk, with a higher production of short and medium chain length fatty acid than cow milk. The fats in goat milk are easily digested, because of their smaller fat globules (Jennes, 1980). Vitamin A levels in goat milk is almost twice that of cow milk. Goat milk has higher medicinal value, high vitamin B content and high digestibility, which makes it helpful in relieving stress and constipation (James, *et al.,* 2005).

The protein content of goat milk is higher than that of human milk in terms of total calories. The protein differs in composition and in kind, but the total amino acid profile is similar (Jennes, 1980). The essential amino acids of goat milk are slightly more than infant requirement (Ochepo *et al.,* 2010). Goat milk is adequate for infants in essential fatty acids, with linoleic acid providing about 1% of total calories. The milk is rich in calcium, phosphorus as well as vitamins C and D which are not present in cows' milk. Hence goat milk can be used for infants as well as post weaning diets for children (Jennes, 1980). According to Thear and Fraser (1986), children and adults who are allergic to cow milk do not react to goat milk.

1.2 Statement of the Problem

Goats are deeply embedded in almost every African culture and are true friends to the rural poor. Despite this, they have received very little attention by African governments and there is little investment in their development (Peacock, 2005). Goat milk production in the world has been steadily increasing over the years, but this growth tends to be slowing. Sheep and goat which are good sources of animal protein in terms of meat and milk are available in Kenya. However, sheep and goat milk which is produced continuously over the lactating period of about 120 days is rarely consumed and ideally left for the kids and lambs to suckle. According to Thear and Fraser (1986), children and adults who are allergic to cow milk do not react to goat milk.

Notwithstanding these benefits, few studies have been conducted on the factors that affect the consumption of sheep and goat milk in Arid and Semi-Arid Lands of Kenya. Therefore, this study assessed the factors, which affect the consumption of Goat and Sheep milk among the communities in the Arid and Semi-Arid Lands of Kenya with specific reference to Kyawango and Kibauni Locations of Mwala Sub County in Machakos County.

The results of this study may be used by policy makers and other stakeholders in Project programming with the aim of improving livelihoods in Arid and Semi-Arid Lands.

1.3 Objectives of the Research

1.3.1 General Objective

The broad objective of this study was to assess the potential of sheep and goat milk as an acceptable source of animal protein for the nation through accessing the factors affecting goat and sheep milk consumption in Mwala Sub County in Machakos County.

1.3.2 Specific Objectives

i. To assess sheep and goat milk production in Kyawango and Kibauni Locations.
ii. To assess sheep and goat milk consumption in Kyawango and Kibauni locations.
iii. To identify sheep and goat management practices for optimal milk production in Kyawango and Kibauni Locations.

1.4 Research Questions

i. What are the current levels of sheep and goat milk production in Kyawango and Kibauni locations?
ii. What are the existing patterns and levels of goat and sheep milk consumption?
iii. What are the current management practices for the goat and sheep farmers in the study area and how do they affect milk consumption?

1.5 Justification/Significance of the Research

Research has shown that sheep and goat milk are indispensable in terms of nutrition and good source of animal protein. It has been documented that sheep and goats are the principal domesticated small ruminants in terms of total numbers and production of food and fibre products (Winrock, 1983). This attribute may partly be due to their lower feed requirements compared to cattle, because of their body size (Okunlola *et al.,* 1983). This, however, allows for easy integration of small ruminants into different farming systems (Hirpa *et al*., 2008).

Increased human population pressure, and the ensuing land subdivision in Kenya, has stimulated use of dairy goats in rural development efforts which were previously ignored in favour of cattle as cow's milk and beef constituted a larger share of consumption. Pure exotic or crossbred dairy goats and associated technologies are preferred as a fast means of improving animal production of smallholder farmers and, uplifting their economic status and diet quality (Kosgey *et al*., 2006).

Therefore, the research findings were expected to reveal the major barriers to the consumption of sheep and goat milk and the potential that exists for the same in the Arid and Semi-Arid Lands

and therefore the findings may be used by policy makers and other stakeholders in Project programming with the aim of improving livelihoods in Arid and Semi-Arid Lands.

1.6 Limitations

The study was assumed to run smoothly and that the respondents would be cooperative however hereunder were some of the limitations of the same;

i. After the study the community members and especially those participating expected a project to begin which was not part of this study.
ii. Poor infrastructure in the Sub County interfered with initial distribution and collection of questionnaires.

1.7 Scope

The study covered both local breeds and exotic sheep and goats only and respondents were sampled from all farmers with more than two goats (whether local breeds or exotic) and one sheep. The reason was because more farmers keep goats as opposed to sheep. The study was limited to sheep and goat milk production and consumption and was conducted in Kyawango and Kibauni Locations of Mwala Sub County of Machakos County.

The results are applicable in the sector of livestock development and especially for intensification of sheep and goat milk production which will ultimately lead to improved nutrition and livelihoods.

CHAPTER TWO

LITERATURE REVIEW

2.1 Brief Description of Sheep and Goat

Sheep and goats are considered small livestock animals, compared to bigger animals such as cattle, camels and horses, but larger than micro livestock such as poultry, rabbits and bees. They have a four-chambered stomach consisting of the rumen, the reticulum, the omasum and the abomasum. As with other mammal ruminants, they are even-toed ungulates. The females have an udder consisting of two teats, in contrast to cattle, which have four teats (Taylor *et al.*, 1999). Both belong to the same family and sub-family, that is *bovidae* and *caprinae* respectively. The domestic goat is of the genus *capra* and species *hircus* while the sheep is of genus *ovis* and species *aries.* Because both animals are of the same subfamily, they are said to be related. However, their genes differ greatly and cross-species hybrids do not occur (Muhammad, 2007).

Visual differences between sheep and goats include the beard and divided upper lip of goats. Sheep tails also hang down, even when short or docked, while the short tails of goats are held upwards. Sheep breeds are also often naturally polled (either in both sexes or just in the female), while naturally polled goats are rare (though many are polled artificially). Males of the two species differ in that buck goats acquire a unique and strong odor during the rut, whereas rams do not (Smith *et al.*, 1997).

The domestic goat (*Capra hircus*) is a subspecies of goat domesticated from the wild goat of southwest Asia and Eastern Europe. The Sheep are most likely descended from the wild mouflon of Europe and Asia and it is one of the earliest animals to be domesticated for agricultural purposes (Muhammad, 2007). The most recent genetic analysis confirms the archaeological evidence that the wild bezoar of the Anatolian Zagros is the likely origin of almost all domestic goats today (Naderi *et al.*, 2008).

Neolithic farmers began to herd wild goats and sheep for easy access to milk and meat, primarily, as well as for their dung, which was used as fuel, and their bones, hair/wool, and

sinew for clothing, building, and tools. The earliest remnants of domesticated goats dating 10,000 years before present are found in Ganj Dareh in Iran. Goat remains have been found at archaeological sites in Jericho dating the domestication of goats in western Asia at between 8,000 and 9,000 years ago, (Maisels, 1999).

The young female goat (doe) reach puberty in three to fifteen months of age, depending on breed and nutritional status while on the other hand, young female sheep (ewe) generally reach sexual maturity in six to eight months of age, and rams generally in four to six months (Payne *et al.*, 1999).

Ewes and Does of any breed or region come into estrus (heat) every 21 days for two to 48 hours and their gestation length is approximately 150 days. Less frequent are litters of quadruplet, quintuplet, and even sextuplet Kids or Lambs (Taylor *et al*., 1999). In terms of feeding, goats are natural browsers, preferring to eat leaves, twigs, vines and shrubs. Sheep on the other hand are grazers, preferring to eat short, tender grass and clover. They like weeds and can graze very close to the soil surface which can expose the soil and thereby causing erosion (Muhammad, 2007).

Sheep and goats are widely distributed all over the world with most of the population being in the tropics and subtropics. A large number of this population is found in Asia and Africa. They are also found in the temperate regions of Europe and America. In general, small ruminants are simple and cheap animals to keep. Due to their small size, even children can rear and manage them in some parts of Africa (Devandra *et al.*, 1970).

2.2 Economic Importance of sheep and goats

Sheep and goats are useful to humans when they are living and when they are dead, first as a renewable provider of milk, manure and fiber/wool and then as meat and hide (Mahmoud, 2010). Goats primarily produce meat, but also provide milk and their contribution to the nutrition of the rural poor is significant. They supply precious animal proteins of high biological value in the form of meat, milk plus essential minerals and fat-borne vitamins to poor people, pregnant mothers and young children. The small size of bodies enables easy slaughter of the animals

thereby making readily available sources of fresh meat for immediate consumption (Devendra, 1992).

Farmers and pastoralists in Africa are increasingly turning to small ruminants as a means of survival and a way of boosting their incomes (Peacock, 2005). The small ruminants and especially the goat is a main supplier of dairy and meat products for rural people around the world. Goat milk plays an important role in nutrition and socioeconomic wellbeing of developing and underdeveloped countries, where it provides basic nutrition and subsistence to the rural people, who are the majority of the populations (Park *et al.,* 2007).

Sheep and goats are kept as major sources of livelihood and contribute to the sustenance of landless, smallholder and marginal farmers especially to the poor in the rural areas throughout the developing countries (Devendra *et al*., 1983). Small ruminants are very important resource for resource-poor smallholder systems of rural Kenya due to their ease of management and significant role in provision of food (protein, essential micro-nutrients such as vitamin A, iodine and iron) and generation of cash income. They serve as a living bank for many farmers, closely linked to the social and cultural life of resource poor farmers and provide security in bad crop years (Ehui *et al.,* 2000).

Although small ruminants produce approximately 3.4% of the world's total annual milk supply, their contribution to the nutritional and economic wellbeing of mankind is tremendous in many parts of the world, notably in the Mediterranean countries and in the Middle East (Juàrez *et al.,* 1986). On the other hand, production of sheep and goat milk and its products of cheese and yoghurt is also a valued part of the dairy industry in developed countries where it provides diversity to sophisticated consumer tastes and supports people with medical afflictions such as allergies and gastro-intestinal disorders who need alternative dairy products (Park, 1992). These facts indicate that sheep and goat milk serves 3 general types of markets around the world, (a) home consumption, (b) specialty gourmet interests and (c) medical needs.

Dairy goats farming is an important source of animal protein in the high potential areas of central Kenya highlands where land fragmentation has resulted in the formation of small pieces of land that cannot support dairy cattle farming. This scenario has resulted in the rise in demand for

small ruminants, predominantly the dairy goat. In many developed countries, the consumption of traditional cow milk is declining. However, goat milk is a very fast growing product in the dairy sector (Farnworth, 2002).

2.3 The systems and current trends of sheep and goat production

Sheep and goats are kept in a wide range of agro-ecological zones and management systems in Africa (Peacock, 2005). Many different systems of keeping goats occur in different parts of the world, and they may be both appropriate and efficient. However, improvements in productivity may be achieved by simple changes in methods of management, nutrition, disease prevention and health care (Mmbengwa *et al.*, 2000). Small holder goat production systems in Africa have been reviewed. These systems are never static but are constantly evolving with changing internal and external circumstances. Currently there are many trends in Africa which appear to be giving increasing prominence to small ruminants (Wilson, 1992).

2.3.1 Pastoral systems and agro-pastoral systems

The increasing frequency of droughts, together with long-term environmental degradation is causing many pastoralists to move away from keeping cattle to keeping camels, sheep and goats e.g. the Samburu in Kenya (Peacock, 2005). There is a marked trend towards keeping more small ruminants as a proportion of livestock holdings than large ruminants. There are many reasons for this; sheep and goats are relatively cheap to acquire and reproduce quickly, enabling communities to use them to acquire larger animals like the cattle and camels. With more regular droughts, communities in the Arid and Semi-Arid Lands are in a constant state of ‘recovery’ from the last drought and seldom get a chance to re-establish the previous status quo based on larger stock. Overgrazing causing the loss of grass cover and invasion by bushy species also make rangelands increasingly suitable for browsing species. Pastoralists are increasingly realizing that that they need to rely on sheep and goats more and more (Peacock, 2005).

2.3.2 Mixed farming (humid, sub-humid and highland)

Sheep and goats are kept in small herds on mixed farms in Africa, from the humid coastal zones in West Africa to the highlands of Ethiopia (Peacock, 2005).

They may be allowed to graze freely during the day on communal pastures, or seasonally on fallow cropland. However, the increasing population pressure is limiting free grazing and goats are being tethered or housed more and more. As a result, feeding and fodder production is becoming more important. This switch from large to small ruminants is also driven by the decreasing farm size with each generation inheriting land. Small plots can increasingly be cultivated by hand rather than by draught animal power (Peacock, 2005).

2.3.3 Commercial systems

There are very few large-scale commercial sheep and or goat farms in Africa with most them found in South Africa. Several countries, for example Kenya, have a small number of commercial dairy goat farms supplying urban markets, or goat ranches, for example Uganda, supplying the meat market (Peacock, 2005).

2.4 Management of Small Ruminants

Management encompasses all the total care given to animals to enhance their productivity and survival. These include feeding, housing, health care, record keeping and several other practices. It determines the productivity of the animals being reared (Lakpini, 2002).

Three systems of small ruminant production are practiced in most of the sub-Saharan African countries including Kenya and these include extensive, intensive and semi intensive (Gefu, 2002).

2.4.1 Extensive Farming System

This system requires low input which consequently results to low productivity. Animals under this system are left to graze by themselves on natural pastures with no supplements being

provided. Housing and medical care is also not provided. In general, the animals are left to the nature and by this, they are exposed to a great deal of environmental hazards. It is the most predominant system practiced in the rural areas (Gefu, 2002). However, Devandra *et al.*, (1970) stated that such fully extensive system of small ruminants' management is hardly possible in the tropics since in most countries where they are kept, it appears customary to house them during rain. He also states that in some places, some form of ethno veterinary care is provided.

2.4.2 Intensive farming system

This system involves zero-grazing where the animals are not allowed to graze at all. They are completely confined in their houses where feed and water are taken to them. Good quality fodder such as hay, silage and foliage is fed and this is also supplemented with concentrates. Good health care is also provided for the animals (Muhammad, 2007). This involves taking preventive measures by vaccination, endo and ecto parasite control and therapeutic treatment. Proper records are also kept for planning and breeding purposes. This system involves high capital and labour but is usually very productive (Muhammad, 2007).

2.4.3 Semi Intensive farming system

This system is an intermediary between the intensive and extensive systems such that it combines features of both systems (Muhammad, 2007). Housing and other infrastructures are provided but the animals are not completely confined. The animals can graze on improved fenced pastures for some time and are later fed with concentrates as supplements. Health care and other management practices are also provided (Lakpini, 2002).

2.5 Sheep and goat Breeds in Kenya

Sheep and goats form an integral component of the livestock enterprise in Kenya with an estimated population of 44,869,759 composed of 27,740,153goats and 17,129,606 sheep (Kenya Bureau of Statistics, 2009 Population Census) and spread in all agro-ecological zones of the country.

According to Rangoma 2011, Kenya has various breeds of Sheep as follows; Merino, Corriedale, Southdown, Hampshire down, Romney marsh, Doper, Red Masai, and Somali sheep. All these are kept in various ecological zones in the country and are basically for muttons and wool.

2.6 Attributes and Composition of Goat Milk

2.6.1 Attributes

Goat's milk is a good source of protein, tryptophan, calcium, phosphorus, potassium and riboflavin (vitamin B2). Perhaps the greatest benefit of goat's milk, however, is that some people who cannot tolerate cow's milk can drink goat's milk without any problems. It is not clear from scientific research exactly why some people can better tolerate goat's milk. Some initial studies suggested that specific proteins known to cause allergic reactions may have been present in cow's milk in significant quantities yet largely absent in goat's milk. The alpha-casein proteins including alpha-casein and the beta-casein proteins were both considered in this regard (Youssef *et al.,* 2011). Allergy to cow's milk has been found in many people with conditions such as recurrent ear infections, asthma, eczema and even rheumatoid arthritis. Replacing cow's milk with goat's milk may help to reduce some of the symptoms of these conditions. Goat's milk is less allergenic compared to cows', naturally homogenized, easier to digest, lactose intolerant friendly and biochemically/thermodynamically superior to cow's milk (Cooke, 2010). These are attributes are as follows;

a) Goat milk is less allergenic than cows'.

In the United States, the most common food allergy for children under three years is cow's milk. The allergic reaction can be blamed on a protein allergen known as Alpha s1 Casein found in high levels in cow's milk. The levels of Alpha s1 Casein in goat's milk are about 89% less than cow's milk providing a far less allergenic food. In fact, a recent study of infants allergic to cow's milk found that nearly 93% could drink goat's milk with virtually no side effects (Freund, 1996).

b) Goat's milk is easier to digest.

Goat's milk has smaller fat globules as well as higher levels of medium chain fatty acids. This means that during digestion, each fat globule and individual fatty acid will have a larger surface-to-volume ratio resulting in a quicker and easier digestion process. Also, when the proteins found in milk denature (clump up) in the stomach, they form a much softer bolus (curd) than cow's milk. This allows the body to digest the protein more smoothly and completely than when digesting cow's milk (Cooke, 2010).

c) Goat's milk rarely causes lactose intolerance.

All milk contains certain levels of lactose which is also known as 'milk sugar' and which is digested by an enzyme known as lactase. Deficiency results in a condition known as lactose intolerance. Lactose intolerance and cow's milk allergy are two distinct conditions. Cow milk allergy is due to a protein allergen, while lactose intolerance is due to carbohydrate sensitivity. Goat's milk contains less lactose than cow's milk and therefore is easier to digest for those suffering from lactose intolerance. Now the interesting aspect to consider is that goat's milk isn't much lower than cow's milk (contains about 10% less than cow's milk) and yet, countless lactose intolerant patients can thrive on goat's milk. Although the answer for this is unclear, it has been hypothesized that since goat's milk is digested and absorbed in a superior manner, there is no "leftover" lactose that remains undigested which causes the painful and uncomfortable effects of lactose intolerance (Cooke, 2010).

d) Goat's milk matches up to the human body better than cow's milk.

This matter is both an issue of biochemistry as well as thermodynamics. Regarding the biochemistry of the issue, we know that goat's milk has a greater amount of essential fatty acids, such as linoleic and arachidonic acid, than cow's milk as well as significantly greater amounts of vitamin B6, vitamin A and niacin. Goat's milk is also a superior source of potassium than cows' milk (Cooke, 2010).

Thermodynamically speaking, goat's milk is better for human consumption. A baby usually starts life at around 3-4 kgs, a baby goat (kid) usually starts life at around 3-4 kgs and a baby cow (calf) usually starts life at around 45 kgs. Now speaking from a purely thermodynamic position, these two animals have very significant and different nutritional needs for both maintenance and growth requirements. Cow's milk is designed to take a 45kgs calf and transform it into a 544 kgs cow. Goat's milk and human milk were both designed and created for transforming a 3-4kgs baby/kid into an average adult/goat of anywhere between 45-90 kgs. This significant discrepancy, along with many others, is manifesting on a national level as obesity rates sky rocket in the U.S (Cooke, 2010).

2.6.2 Goat Milk Composition

Unlike cow's milk there is no need to homogenize goat's milk. While the fat globules in cow's milk tend to separate to the surface, the globules in goat's milk are much smaller and will remain suspended in solution. When individuals have sensitivity to cow's milk, goat's milk can sometimes be used as an alternative. Compared to cow milk, goat milk is richer in some nutrients such as vitamin A, B8, niacin, choline and poorer in folic acid (Cooke, 2010).

Table 1: Basic composition of various milks (mean values per 100g)

Item	Goat	Cow	Human
Fat (g)	3.8	3.6	4.0
Protein (g)	3.5	3.3	1.2
Lactose (g)	4.1	4.6	6.9
Ash (g)	0.8	0.7	0.2
Total solids (g)	12.2	12.3	12.3
Energy (Calories)	70	69	68

Source: Park and Haenlein, 2006.

Table 2: Milk composition analysis, per 100 grams

Item	Unit	Cow	Goat	Sheep	Water buffalo
Water	g	87.8	88.9	83.0	81.1
Protein	g	3.2	3.1	5.4	4.5
Fat	g	3.9	3.5	6.0	8.0
Carbohydrate	g	4.8	4.4	5.1	4.9
Energy	kcal	66	60	95	110
Energy	kJ	275	253	396	463
Sugars (lactose)	g	4.8	4.4	5.1	4.9
Cholesterol	mg	14	10	11	8
Calcium	G	120	100	170	195
Saturated fatty acids	G	2.4	2.3	3.8	4.2
Monounsaturated fatty acids	G	1.1	0.8	1.5	1.7
Polyunsaturated fatty acids	G	0.1	0.1	0.3	0.2

Source: McCane et al., 2009

2.7 Attributes and Composition of Sheep Milk

As it is with goat milk, sheep milk is also known for its dietetic and therapeutic value. It is a good substitute for people allergic to cow or goat milk. The milk has more total solids than cow and goat milk and produces more cheese than both milks (Muhammad, 2007). Sheep milk has higher amount of calcium, phosphorus, zinc, magnesium and potassium than cow milk. The calcium: phosphorus ratio is nearly perfect thus aiding absorption (Muhammad, 2007).

Sheep milk is also rich in vitamins A, D, and E much more than cow and goat milk. These are all essential for good health. The milk is also well enriched with vitamins B complex, B12 and Folic acid which are sold as expensive supplements in chemists and health food shops (Muhammad, 2007)

Sheep milk is rich in protein and fat. The milk contains a high proportion medium/short chain saturated fatty acids which has several therapeutic values. Research has also found that the milk has more conjugated linoliec acid (CLA) - a cancer-fighting, fat-reducing fat - than most other milk. The fat globules of sheep milk are also smaller than cows' milk, thus, making it more easily digestible (Haenlein, 2002).

2.8 Consumption of Goat Milk

Goat milk is consumed in most countries where goats are kept and the value of milk as an important source of nutrients is widely recognized, particularly in areas such as the Far East (Devendra *et al.,* 1970). Generally, it can be said that in developing countries, Kenya included, milk still constitutes an important feeding resource for the rural population. In most countries (Near East, Africa, Asia, South America) goat milk production is not commercially marketed. Goats are kept on small farms at subsistence level and most of the milk produced is supplied immediately to households and neighbors for personal consumption as fresh milk or processed (Rubino *et al.,* 1996).

In developed countries like US, Canada, France, goat milk is produced commercially in large quantities. In these countries, the milk is processed into different products and sold in stores. In USA, approximately 1 million liters of goat's milk are processed into cheese by more than 130 licensed farmers. Several cooperatives handle between 2000 and 4000 litres of goat's milk weekly for cheese making (Rubino *et al.,* 1996).

This production still does not meet the demand and so, more than 500,000 kg cheese, worth more than $15million is imported into the US usually from France, not considering imports from several other countries (Teh, 1991). In France, more than 95% of goat's milk is used to produce soft cheese. Other products which are produced and consumed include yoghurt, fresh milk, ice cream, evaporated milk and powder milk. Approximately 4 million litres of goat milk is processed annually into powder and evaporated milk in USA (Teh, 1991). Over 21 million litres of goat milk was estimated to be produced in Canada in year 2004 (Agriculture and Agri-food Canada, 2006).

Kipserem *et al.,* (2011) studied the socio-economic issues of the dairy goat in Kenya and revealed that about 57% of the milk produced was consumed in the household. Thus, dairy goats enable households to access milk especially for the children, the sick and the old. Surplus milk is sold despite the little amount of goat milk produced. The same authors established that the farm gate prices for the milk ranged from Kenya Shillings 120.00 to 150.00 per liter in hospitals, hotels, church congregation and dairy processors who purchase goat milk for making cheese for the dairy goat milk market in Nairobi.

2.9 Consumption of Sheep Milk

Sheep have been raised for their milk for thousands of years and were milked before cows. A traditional sheep dairy industry existed for such a long time in Mediterranean countries where most of the milk is processed into cheese. Such traditional dairy industry still exists in some parts of Europe. Milking is usually done by hand under extensive and unhygienic conditions and the milk is processed by the farmers themselves or by small family businesses. However, well developed industry also exists in some industrialized countries of Europe and in Israel. Hence, the largest production of sheep milk comes from these countries. The industry is relatively new in North America, Australia and South Africa where the industry is still young. In the US, there are approximately 100 sheep dairy farms (Muhammad, 2007).

Sheep milk is mostly consumed in cheese form as most of the milk produced all over the world is processed into cheese. Some popular cheeses made from sheep milk include Feta, Ricotta, Pecorino Romano, Roquefort and Manchego. Sheep milk products like yoghurt and ice cream are also produced and consumed. Fresh sheep milk is rarely consumed except in the UK where it serves as a substitute for cow or goats milk (Muhammad, 2007).

Sheep milk products are the perfect alternative for people who are allergic to cow or goat milk. They are very healthy with high, easily absorbed calcium and zinc with a Calcium/Phosphorus ratio that is ideal for human health and wellbeing (Halliday, 2006). In 2001, 7.8 thousand million litres of sheep milk was produced. It constituted 1.3% of all kind of milk produced that year. Estimates reveal that Australia imports approximately 2000 tons of sheep milk cheese annually,

valued at about $20 million. The US too imports 75 million pounds of sheep milk cheese annually. In Cyprus, one third milk produced is from sheep and goat (Muhammad, 2007).

2.10 Sheep and goat husbandry practices

Sheep and goats are versatile animals and can be valuable and enjoyable additions to many farms, providing meat, milk and fiber products, as well as bush control and pasture improvement services (Linda *et al.,* 2008). As such good husbandry practices are important to derive the best from the Sheep and Goats.

Linda *et al.,* (2008) goes ahead and points out that before beginning the business of Sheep and Goat production, the following aspects should be considered;

Selection of the breeds - sheep or goat business will be much more enjoyable and successful if you begin with healthy animals with proper conformation. These are characteristics that are considered when selecting stock;

- Good body conformation
- Well balanced udder with two functional teats
- Good teeth and proper bite

Feeding and Pasture - Goats prefer to browse or eat things such as brush, leaves, and small trees. Sheep prefer to eat broadleaf plants (forbs) and grasses. Sheep and goats can select the most nutritious parts of a plant. Having multiple pastures or paddocks to rotate animals through will use forages more efficiently. Occasionally hay or grain must be fed. Use proper feeders to keep feed clean and off the ground. Use a hay feeder to reduce waste. There are various options for feeders (Linda *et al.,* 2008)

Health - Healthy, productive animals are more profitable and enjoyable to raise. It is important to have a working relationship with a veterinarian. A veterinarian can help with prevention, diagnosis, and treatment of disease (Linda *et al.,* 2008)

Equipment and Handling - Sheep and goats are easy to handle and do not require a lot of equipment. Milking containers must be sterilized before and after milking using warm water and must remain covered. All milking containers must be made of aluminium. Milk must be sieved and boiled (pasteurized) before drinking. In preparation for milking, the udder must be washed before milking and milking salve (ointment/oil) applied to the udder when it is too dry (Achariya, 2015). You should provide a shelter to protect animals from rain, snow, and cold winds. There are many different shelter options, from simple structures to more complex barns (Linda *et al.*, 2008).

Other routine practices (Achariya, 2015)

- Timely vaccination of sheep and goats is essential to the prevention of diseases such as contagious caprine pleuro- pneumonia and pestedes petits ruminants. Sick animals must be identified, isolated and treated as soon as possible to avoid spreading disease to other animals within the flock;
- Animals should be regularly dewormed using a deworming agent (e.g. Dexamethasone);
- Sheep and goats should be sprayed or dipped to remove ticks and other ecto-parasites;
- The condition of any sick animals should be closely monitored on a daily basis;
- General hygiene, including the cleaning and maintenance of animal housing, is important;
- Any humans who tend the animals must be clean and wear full working attire;
- Each animal in the flock should be observed and checked for changes in behavior or composure;
- Sheep and goats should be debudded, dehorned and their hooves trimmed when necessary;
- Males that show undesirable genetic characteristics should be castrated in order to prevent the inheritance of such genes by the next generation.

Most people find the strong smell in goat's milk revolting, perhaps the reason why the product is not widely consumed.

To begin with, most people believe that having a buck in the same pen with the doe is the source of the smell.

Goat milk has a high amount of lactic acid which multiplies faster especially if the milk is stored in temperatures above 38degrees centigrade. This affects the flavour and smell of milk (Daily Nation., 10, Sept 2016)

Therefore, once milking is done, the milk should be promptly cooled to about 170degrees Centigrade. This is necessary to stop enzyme action and prevent lipolysis (the breakdown of fats and other lipids to release fatty acids), which contributes to the goaty flavour (smell) of milk.

Does normally produce a lot of pheromones and when kept close to the bucks, they get affected by the latter's odour, which is passed into milk. Therefore, it is safer not to take the risk and keep them yards apart, especially when milking. If possible, the farmer can only allow the does and bucks to meet during the breeding season. This helps in eliminating the goaty flavour in milk.

Another reason goat milk may have a strong taste is the breed. Some breeds are known for their pungent body smell, for instance, the Toggenburg and Oberhasi. Diet also plays a big role. For instance, if the goat is fed a diet high in onions and garlic, the crops' smell filters into the milk. Drinking water may also affect the flavour of milk. If the water is extra high in copper or iron, this results into the 'bad' flavor. (Daily Nation, 10, Sept 2016).

Health issues such as mastitis can also contribute to the flavour. Mastitis, which is inflammation of the udder, results in chemical and physical reaction in milk giving it a bitter taste and it also gives the milk the nauseating flavour.

Sanitation is also key during milking. The udder needs to be cleaned thoroughly with warm water and the coat brushed before milking.

This is to avoid foreign matter from the skin or fur getting into milk to affect its taste. The milk also needs to be filtered and the buckets and jar being used sterilized (Daily Nation., 10, Sept 2016).

CHAPTER THREE

METHODOLOGY

3.1 Conceptual Framework

The main concept of the study is that faced with challenges of climate change, population pressure leading to further subdivision of land and increase in urbanization, there is a huge demand of animal protein. Factors hindering the rearing of the large ruminants are shortage of land and feed resources; hence the only alternative left are the small ruminants. The small ruminants and especially sheep and goats are kept mainly for meat and customary purposes not necessarily for milk. According to research, the milk of goats and sheep are consumed in various forms due to their nutritional aspects in other parts of the world. This study therefore considered the assessment of sheep and goat milk production, consumption and identification of sheep and goat management practices for optimal milk production in Kyawango and Kibauni Locations of Mwala Sub County in Machakos County. The conceptual framework is as below;

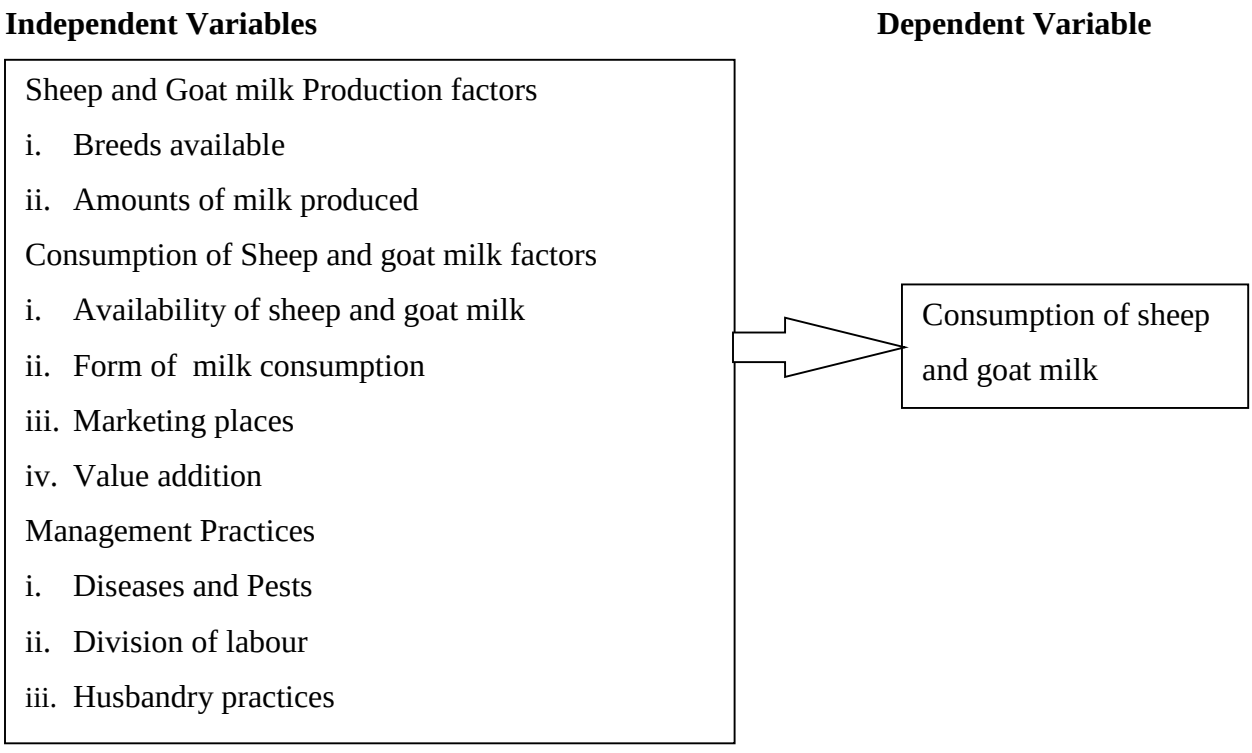

Figure 1: Conceptual framework

Source: Author's Conceptualization

3.2 Description of the Study area and Study Population

The study was conducted in Mwala Sub County which is part of Machakos County, Kenya. The County is one of the 47 Counties of Kenya. It lies between latitudes 0.45'S and 1.31'S and longitudes 36.45'E and 37.45'E and has a total area of 6,850 km^2. The average annual rainfall in the County ranges from 500-1,300 mm. The mean temperature range is 18-25^{0}C. The County consists of small hills and plateaus varying in altitude from 1,800 to 2,100 Meters above sea level (Wesonga *et al.,* 2010).

Mwala Sub County falls within Lower Midlands agro-ecological zone 4 (LM4) (Jaetzold *et al.,* 1983). The altitude ranges from 1100 Meters above sea level on the eastern side in LM4 to 1550Metres above sea level on the northern region in UM4. The regions receive bi-modal rainfall ranging from 700 - 900 mm/annum and mean temperature of between 17 - 24ºC. Population density varies with the agro-ecological zones, and ranges from 40 to 100 person/km^2 (Jaetzold *et al.,* 1983).

There has been previous interventions by the Ministry of Agriculture and Livestock, Mwala district in Kyawango and Kibauni locations through supporting the farmers with improved goat breeds (Toggernburgs and Germany Alpine) to upgrade the local ones. Information from the Ministry indicated that despite the support there was no efforts to establish whether the milk was being used and the factors associated with the consumption. It was for this reason that this areas was chosen in order to assess the sheep and goat milk production, consumption and the management practices for optimal milk production.

The study population consisted of smallholder farmers from the study area. Indigenous cattle mainly Zebu and the small East African goats are the predominant domestic animal species kept in the Sub County. However, based on the information obtained from the Ministry of Livestock production in the Sub County, Exotic cattle and goats have been introduced in the area and currently according to the statistics, the following livestock types are available; Indigenous cattle – 47,800, Exotic cattle – 11, 406, Small East African goat – 76,500 and Exotic goats – 1,475. Among the Exotic goats, the following types are kept; Toggernburgs – 572 and Germany Alpine – 903. The Exotic breeds and especially the goats have been introduced by NGOs and the

Government in efforts to boost goat production. The farming system in the Sub County is Dual Purpose Cattle Small Scale (DPCASS)/ Sheep and goats Small Scale (SGSS) (Peeler et al., 1997). The grazing system is predominantly traditional free grazing (Kinuthia, 2001) but a few farmers practice zero grazing.

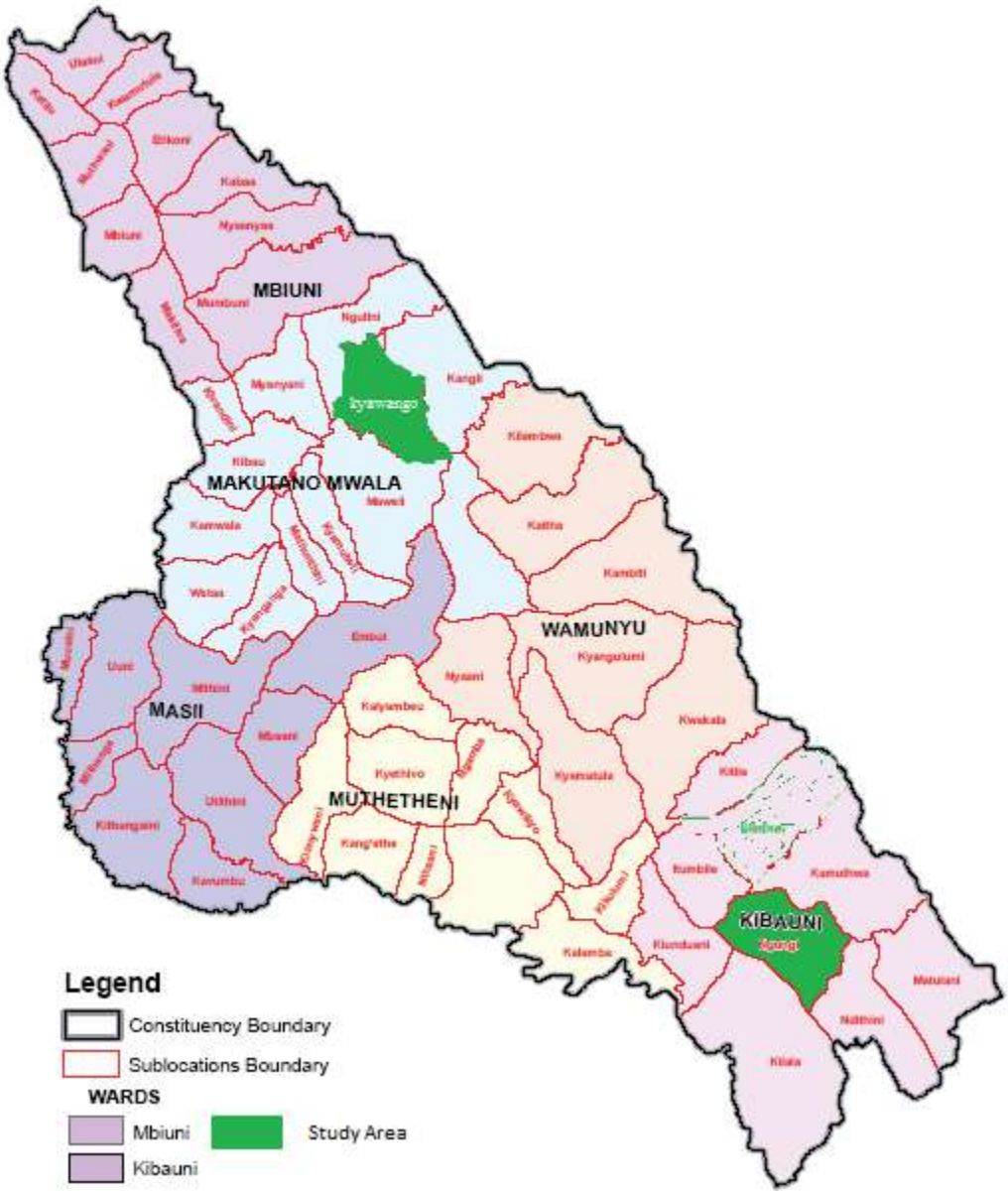

Figure 2: Map of Mwala Sub County
Source: Google Maps

3.3 Research design

This study considered the assessment of factors affecting sheep and goat milk production, consumption and identification of management practices for optimal milk production. Therefore it employed a descriptive survey design since it mainly looked at phenomena, events and the way things are (Mugenda *et al.,* 2003). The descriptive survey design is also concerned with making accurate assessment of the inference, distribution and relationship of phenomenon. Two Locations in Mwala Sub County were studied and the results were used to make inference about the whole population.

3.4 Sampling Procedure and Sample size

Since the study was about the socio-cultural and husbandry factors affecting Goat and Sheep milk consumption, it affects almost everybody and therefore to ensure that there is no bias in the results, a Simple random sampling was used to generate sample size required for the study. This method was preferred because it ensures that all members of a population have an equal chance of being selected for study (Mugenda *et al.,* 2003). The two Locations have a total population of 7689 households (Kenya Population and Housing Census, 2009). The researcher used a sample of 120 respondents as supported by Kathuri *et al.,* (1993) who contends that a minimum sample of 100 is sufficient to infer the whole population. The extra 20 respondents were necessary to cater for attrition. With this, each location gave 60 respondents chosen randomly.

3.5 Instruments/Tools to be used for data collection and their Validity and Reliability

Both primary and secondary data sources were utilized during the research. The secondary data was mainly obtained from the existing documentary records from the relevant sources like the Ministry of Livestock Development and other literature materials that have been done on Goat and Sheep milk and its consumption. Since this research employed a descriptive survey design, it utilized both quantitative and qualitative data collection methods. Survey questionnaires was used to collect quantitative data, while Focus Group Discussions (FGDs) and case narratives were used to collect qualitative data. This was done using a Checklist. The questionnaires and the checklist were structured to solicit information regarding the social cultural and husbandry

factors affecting Goat and Sheep milk consumption. The Validity and Reliability of the data collection instruments was tested by pretesting them with a sample of the population. Feedback from the pretest was incorporated in the main tool. The researcher also proof read and requested friends to review the instruments to address aspects of validity including content, construct and face validity. The testing of the validity and reliability of the instrument was done to ensure that the instruments measure what they are intended to measure (Kathuri *et al.,* 1993).

3.6 Data collection

For this study, primary data and secondary data was collected and analyzed. Information required was collected using a semi structured questionnaire that was administered by the researcher assisted by trained enumerators. Key informant interviews were conducted as wells as Focused group discussions (FGDs) with various groups for the qualitative data. The questions were clearly interpreted in an easy to understand language that ensured that the correct and relevant answers were obtained.

3.7 Data analysis

Statistical package for social sciences (SPSS) was used to analyze the data. The study analyzed data on production and management factors affecting consumption of milk from sheep and goat within the study area. The relationship between dependent and independent variables was analyzed. The dependent variable for this study was sheep and goat milk consumption levels, which depended on production factor (availability of breeds and amount of milk produced), sheep and goat milk consumption patterns and sheep and goat management practices (disease and pest control, division of labor and husbandry practices)

3.7.1 Descriptive Statistics

Descriptive statistics was used to analyze the data on household characteristics, sheep and goat management and production factors influencing milk consumption. Descriptive analysis provides guidance for more advanced quantitative analyses.

3.7.2 Cross tabulation Chi-Square Tests

A chi-square test was done to determine the level of association among categorical variables representing the dependent and the independent variables. Variables which are statistically significant are considered associated, while those which are insignificant are not associated.

3.7.3 Regression Analysis

The regression analyses were done to address the inadequacy of descriptive analyses in showing how sheep and goat production and management factors affect milk consumption. Regression analysis provides the direction and magnitude of the variables that influences the dependent variable. The regression model helped to determine the factors that influenced sheep and goat milk consumption within the study area. The regression analysis involved studying the prediction of outcome/dependent variable (sheep and goat milk consumption) from a set of several predictor/independent variables.

The linear regression model is an analytical model in which the outcome variable (Yi) is predicted from a combination of each predictor variable (Xi) multiplied by its respective regression coefficient (βi). This regression model can be summarized as:

$$Yi = \beta 0 + \beta 1\ (x1)i + \beta 2\ (x2)i + \beta 3\ (x3)i + \ldots + \beta K\ (xK)i + \varepsilon i\ (i)$$

Where: Yi = Variable. Yi is designated as the "dependent variable." X1, X2 ……, XK are predictor / explanatory variables used in the model. β0= Constant value of the model for different variable. β1, β2……. βK are coefficients of the variables, X1, X2 ……, XK used for each dependent variable in the model. In this model, the coefficients (β's) are non-random values but of unknown quantities. The noise terms ε1, ε2, ε3, …, εn are random and unobserved and it is further assumed that these ε's are independent, each with mean 0 and (unknown) standard deviation σ (Field, 2006). Therefore, the fitted multiple regression model was: $Yi = \beta 0 + \beta 1\ (x1)i + \beta 2\ (x2)i + \beta 3\ (x3)i + \ldots\ldots\ldots\ldots\ldots + \beta K\ (xK)i$

The following data sets were fed to the regression model and used for analysis in this study.

Data: Prediction factors affecting consumption of sheep and goat milk.

$Y= \beta 0 + \beta 1X1 + \beta 2X2+ \beta 3X3 + \beta 4X4 + \varepsilon$

Where:

Y= Sheep and goat milk consumption levels and patterns

$\beta 0$ = Constant factor

X1 = Breeds available (Local breeds, Improved)

X2 = Amounts of milk produced (Less than 1 liter, 1-2 liters, 3-5 liters, 6-7 liters, Above 8 liters)

X3= Availability of sheep and goat milk (Everyday, Once per week, Two times per week, Once per month, occasionally, none at all)

X4 = Form of milk consumption (Raw, Fermented, Processed, Packaged)

X5 = Marketing places (home place, local market centers, at a milk bar at the local market centers, hawking at the local market centers, a cooperative where we take our milk)

X6 = Value addition (ghee, Yoghurt, cheese)

X7 = Diseases and Pests (yes, no)

X8 = Division of labour (Women, Men, Children, Family)

X9 = Husbandry practices (Tethering, Intensive farming, Semi-Intensive farming, Extensive farming)

βi = coefficient

ε = error term

CHAPTER FOUR

RESULTS

4.1 Introduction

This study sought to access the factors affecting sheep and goat milk consumption in Mwala Sub County in Machakos County. The specific objectives were to examine the current levels of sheep and goat milk consumption; identify the factors affecting goat/sheep milk consumption; examine the existing patterns of sheep and goat milk consumption; establish the available opportunities for intensification of both sheep and goat production; and explore the current husbandry practices for the sheep and goat farmers in the study area and how they affect milk consumption.

4.2 Social and demographic characteristics of the respondents

The researcher sought to understand the nature and composition of the study sample by collecting information on social and demographic characteristics of the respondents. Table 3 shows that majority of the respondents in the study area were female (60.8%) and 39.2% were male. It was however established that most households in the study area were headed by men as reported by 83% of the respondents while about 17% of the households were female headed. Respondents were further characterized by their age and it was established that their ages ranged between 22-77 years with an average of 46 years. This was good indication as all age categories were consulted in this study. Majority of these respondents were married (84%) while 11% were widowed and the rest were either single or separated (5%). Regarding their level of education most of the respondents had attained primary and secondary levels of education (90%) and the rest had tertiary education with a few having not gone to school. Further, it was established that 76% of the households in the study area comprised of 3-6 members and about 16% comprised of 6 members and above. All the respondents in the area were Christians. Majority of the respondents were farmers (67.5%) and business people (24.2%). Others were civil servants (6.7%) and casual laborers (1.6%) as shown in table 3.

Table 3: General characteristics of the respondents'

Variable	Frequency	Percentage	Mean
Gender of respondent			
Male	47	39.2	
Female	73	60.8	
Head of household			
Male	100	83.3	
Female	20	16.7	
Age of the respondent (Yrs)			46
Household head marital status			
Married	101	84.2	
Divorced/Separated	4	3.3	
Widowed	13	10.8	
Never married	2	1.7	
Respondents level of education			
None	8	6.7	
Primary	60	50.0	
Secondary	48	40.0	
Tertiary	4	3.3	
Number of dependents in the family			
1-2	8	6.7	
3-4	53	44.2	
5-6	40	33.3	
Above 6	19	15.8	
Occupation			
Farmer	81	67.5	
Civil servant	8	6.7	
Business	29	24.2	
Casual laborer	2	1.6	

Source: Data Analysis

4.3 Assessment of sheep and goat milk production in Kyawango and Kibauni Locations.

The main method of farming in the study areas as reported 95% of the respondents was mixed farming where households grow crops and keep animals in the same farm. This showed that land in the area was highly committed with agricultural activities. Majority of the respondents (91%) reported to have land size of between 1-4 sq. km which is quite limited for both crop and livestock keeping (Table 4).

Table: 4: Methods of farming

Variable	Frequency (n=120)	Percentage
Method of farming		
Crop farming only	6	5.0
Crop and livestock	114	95.0
Land size		
Less than acre	3	2.5
1-2 acres	60	50.0
3-4 acres	50	41.7
5 and above acres	7	5.8

Source: Data Analysis

With regard to sheep and goats production, the study established that majority of households in the study areas kept goats and sheep as reported by 88% of the respondents (Table 5). The main reasons why households kept sheep and goats was mainly for meat, milk and selling to earn income.

Table 5: Households which keep sheep and goats

	Frequency (n=120)	Percentage
Yes	105	87.5
No	15	12.5

Source: Data Analysis

It was however established that majority of households kept local breeds of sheep and goats breeds as reported by 95% of the respondents (67% keep local breeds of goats and 28% keep local breeds of sheep). Improved sheep and goats were less common among the respondents in the study area as only about 5% of the respondents reported to have kept improved goats with none of the respondents keeping improved sheep. It was further established that households had an average of 8 local breeds of goats and 3 improved goats in the farm during the time of the study. It was also established that households had an average of 4 sheep in their households (Table 6).

Table 6: Sheep and goat breeds kept

	Frequency (n=120)	Percentage	Number Kept (Average)
Goat – local breeds	81	67	8
Improved goat	6	5	3
Local breeds of sheep	33	28	4

Source: Data Analysis

Findings from the study further showed that goats were much more productive compared to the sheep. About 80% of the respondents reported that they produced an average of less than 1 litre of goat milk per day while about 20% reported that they produced an average of 1-2 litres of goat milk daily. All the respondents (100%) reported that they produced an average of less than one litre of sheep milk every day (Table 7).

Table 7: Quantity of sheep and goat milk produced per day

	Goat		Sheep	
	Frequency	Percentage	Frequency	Percentage
Less than one Litre	96	80.0	120	100.0
1-2 Litres	24	20.0	0	0.0

Source: Data Analysis

Further analysis of the data using chi-square statistics showed that there was a significant association between the amount of goat milk produced per day and the type of goat (X2=62.03, p

<0.05). This showed that goats' milk productivity was highly dependent on the type of goat reared. It was observed from the findings that all the improved goats produced between 1-2 litres of milk a day (Table 8).

Table 8: Association between the type of goat reared and productivity.

	Quantity of milk produced per day					
	<1 litre		1-2 litres			
Goat type	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**X^2**	**p-value**
Local breeds of goat	90	75.0	24	20.0	62.03	0.001
Improved goat	0	0.0	6	5.0		

Source: Data Analysis

Regression analysis was done to determine the factors affecting goat milk production. It was established that the type of goat and management practices such as deworming, supplementary feeding, watering and separation significantly affected the amount of milk produced by goats per day ($p < 0.05$). Keeping more local breeds of goats significantly reduced the amount of milk produced (B= -0.514). Therefore, farmers are highly recommended to keep more improved goats than local breeds. It is also established that increasing the frequency of goat management practices such as deworming, supplementary feeding, watering and separation increases the amount of goat milk produced per day. Other factors affecting goat milk production, though not statistically significant ($p>0.05$), include number goats kept, number of family members who consume the milk, system of production practiced and availability of animal health service providers in the areas under study (Table 9)

Table 9: Factors affecting amount of goat milk produced

Variable	**B**	**Std. Error**	**t**	**p value**
Constant	1.433	0.173	8.262	0.000*
Type of goat kept (local breeds)	-0.514	0.066	-7.83	0.000*
Type of goat kept (improved)	0.084	0.125	0.667	0.506
Total number of local breeds of goat kept	-0.002	0.006	-0.275	0.784

Total number of improved goats kept	0.017	0.019	0.924	0.358
Number of family members who consume goat milk	0.026	0.017	1.551	0.124
System of production practiced	-0.003	0.025	-0.126	0.900
Availability of animal health service providers	-0.024	0.172	-0.142	0.887
Management practices (deworming)	0.031	0.035	0.9	0.007*
Management practices (spraying)	0.035	0.038	0.907	0.366
Management practices (dipping)	0.005	0.051	0.105	0.916
Management practices (docking)	-0.046	0.068	-0.683	0.496
Management practices (toe peering)	0.026	0.053	0.482	0.631
Management practices (Culling)	-0.018	0.134	-0.134	0.894
Management practices (supplementary feeding)	0.109	0.13	0.842	0.002*
Management practices (watering)	0.294	0.185	1.589	0.005*
Management practices (separation)	0.122	0.041	2.946	0.004*
Dependent variable: quantity of milk produced				

* significant at 0.05 level of significance

Source: Data Analysis

4.4 Assessment of sheep and goat milk consumption in Kyawango and Kibauni locations.

To explore the levels of consumption of sheep and goat milk consumptions in the study area, the researcher first sought to understand whether the respondents had tested milk from either goats or sheep. Responses were as presented in Table 10.

Table 10: Respondents who have tested sheep and goat milk

	Goat		**Sheep**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Yes	98	81.7	6	5.0
No	22	18.3	114	95.0

Source: Data Analysis

It was reported that 81.7% of the respondents in the study area had at least tested goat milk compared to only 5% of the respondents who reported to have tested sheep milk (Table 10). This was a clear indication that sheep milk was not commonly consumed in the study area and ascertained why goat milk is a very fast growing product in the dairy sector (Farnworth, 2002). The different forms in which sheep and goats milk was consumed included raw, fermented and boiled. Majority of the respondents (90%) consumed it raw and boiled as presented in table 11. A small percentage of the community in the study area consumed fermented goat milk. None of the respondents processed or packaged milk from either goats or sheep.

Table 11: Forms in which sheep and goat milk is consumed

	Goat		**Sheep**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Raw	41	34.2	2	1.7
Fermented	2	.8	0	0.0
Boiled	67	55.8	2	1.7
None response	10	9.2	116	96.6

Source: Data Analysis

Further, it was reported that 88% of the respondents preserved goat milk majorly by boiling before selling and storing (Table 12). A few others poured the milk into guards for fermentation. None of the respondents reported to have preserved sheep milk.

Table 12: Forms in which goat milk is preserved

	Frequency	**Percentage**
Purring in guard for fermentation	14	11.7
Boiling before selling or storing	106	88.3

Source: Data Analysis

The different milk preservation measures are usually taken to ensure that goat milk smell among other characteristics which limits goats milk consumption are minimized and therefore increase its consumption. Findings from the research showed that 36.7% of the respondents consumed

goat milk everyday while none of the respondents reported to consume sheep milk on daily basis. This was a clear indication that sheep milk was not very common consumed in the study area. About 2% of the respondents said that they occasionally consumed sheep milk (Table 13).

Table 13: Frequency of consumption of sheep and goat milk

	Goat		Sheep	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Every day	44	36.7	0	0.0
Occasionally	52	43.3	2	1.7
None	24	20.0	118	98.3

Source: Data Analysis

4.4.1 Factors affecting sheep and goat milk consumption

The study sought to understand the factors affecting the goat milk consumption and responses were as presented in table 14.

Table 14: Factors affecting goat milk consumption

Factor	Frequency	Percentage
Unavailability	7	5.8
Strong Smell	20	16.7
Allergy	2	2.5
Lack of Interest	17	14.2
None	74	61.7

Source: Data Analysis

According to table 14, milk consumption at household level was highly affected by its strong smell, scarcity and its lack of interest by many as reported by 16.7%, 5.8% and 14.2% of the respondents respectively. Other respondents reported that they were allergic to goat milk. Kipserem *et al.*, (2011) studied the socio-economic issues of the dairy goat in Kenya and revealed that about 57% of the milk produced was consumed in the household. Similarly, it was

also established that sheep milk consumption was highly affected by its unavailability as reported by about 17% of the respondents and lack of interest as reported by the majority (78.3%) of the respondents. Another reason that affected consumption of sheep milk was that it was a religious taboo to consume sheep milk (Table 15).

Table 15: Factors affecting sheep milk consumption

Factor	Frequency	Percentage
Unavailability	20	16.7
Unawareness	3	2.5
Traditional Taboo	3	2.5
Lack Of Interest	94	78.3

Source: Data Analysis

Data collected was analyzed using regression analysis to establish the how the different the variables under the study influenced the consumption patterns of sheep and goat milk. It was established that the level of education and the reasons for keeping goats significantly influenced consumption of sheep milk ($p < 0.05$). Other factors such as gender, whether the respondents kept goats and forms in which goat milk was consumed were also examined but were found not to significantly affect goat milk consumption (Table 16).

Table 16: Regression analysis showing factors influencing consumption of goat milk

Variable	B	Std. Error	t	p value
(Constant)	1.142	.255	4.480	.000
Gender	-.036	.071	-.510	.611
Level of education	.102	.052	1.975	.051
If the respondents keeps goats	.110	.105	1.049	.296
Reasons for keeping goat	-.063	.022	-2.899	.004
Form in which the goat milk is consumed	-.003	.017	-.156	.876

Dependent variable: Consumption of goat milk

** significant at 0.05 level of significance*

Source: Data Analysis

On the other hand regression analysis showed that consumption of sheep milk was significantly influenced by several factors such as gender, level of education, whether the respondents kept sheep, reasons for keeping the sheep and forms in which the sheep milk is consumed ($p<0.05$) as shown in table 17.

Table 17: Regression analysis showing factors influencing consumption of sheep milk

Variable	B	Std. Error	t	p value
(Constant)	1.091	.203	5.367	.000
Gender	.125	.048	2.585	.011
Level of education	.074	.034	2.177	.032
If the respondents keeps sheep	-.010	.070	-.144	.006
Reasons for keeping sheep	.025	.014	1.776	.048
Form in which the sheep milk is consumed	.066	.021	3.146	.002
Dependent variable: Consumption of sheep milk				
** significant at 0.05 level of significance*				

Source: Data Analysis

4.5 Sheep and goat management practices for optimal milk production in Kyawango and Kibauni Locations

The study established that tethering was the main system used in sheep and goat production in the study area as reported by 80% of the respondents. The main reasons why farmers practiced this system were because farmers had few sheep and goats, lack labour force and because of the small land size that cannot support many animals. Other production systems reported by goat and sheep farmers included extensive and semi-intensive farming as reported by 12% and 5% of the farmers respectively (Table 18). Farmers practiced intensive farming because they had enough land to keep many goat and sheep.

Table 18: System of sheep and goat production

	Frequency	Percentage
Tethering	96	80.0
Semi-intensive farming	6	5.0
Extensive farming	14	11.7
None response	4	3.3%

Source: Data Analysis

In order to identify the opportunities for intensification of dairy sheep and goat production, the researcher sought information on how sheep and goat were utilized within the household. Responses are shown in Table 19.

Table 19: Reason for keeping sheep and goat

Reason for keeping sheep and goat	Frequency	Percentage
For milk	25	20.8
For meat	21	17.5
As an income generating venture	103	85.8

Source: Data Analysis

Table 19 shows that almost all the households in the study area kept sheep and goats for income as reported by 86% of the respondents. Other reasons for keeping sheep and goats include production of milk and meat as reported by 21% and 18% of the respondents respectively.

Different goat and sheep management practices such as deworming, supplementary feeding, watering and separation were found to significantly affect milk production capacity. The frequency of utilization of the management practices either increased or decreased the amount of milk production. It was established that farmers practiced the different management practices at different intervals. Important practices such watering was practiced by majority of farmers on daily basis as reported by 88% of the respondents. Spraying was mainly practiced on weekly basis (as reported by 74%) while deworming was mainly practiced on yearly basis as reported by

63% of the respondents. Majority of the respondents never practiced dipping, docking, toe peering, culling, separation of bucks from milking does/ewes and supplementary feeding (Table 20).

Table 20: Frequency of utilization of sheep and goat management practice

Management practice	Never	Daily	Weekly	Yearly
Deworming	11.7%	0.0%	25.8%	62.5%
Spraying	20.8%	0.0%	74.2%	5.0%
Dipping	85.0%	0.0%	0.0%	15.0%
Docking	79.2%	0.0%	0.0%	20.8%
Toe Peering	75.8%	0.0%	0.0%	24.2%
Culling	75.8%	0.0%	0.0%	24.2%
Supplementary Feeding	82.5%	0.0%	0.0%	17.5%
Watering	12.5%	87.5%	0.0%	0.0%
Separation of buck from milking Does/Ewes	76.7%	0.0%	0.0%	23.3%

Source: Data Analysis

The researcher sought to understand the roles of the different categories of family members regarding keeping of sheep and goats. The response were as presented in Table 21.

Table 21: Distribution of sheep and goat roles among different categories of family members

	Women		Men		Children		Family	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Own goats and sheep	15	12.5	91	75.8	0	0.0	0	0.0
Constructs shelter for shoat	20	16.7	78	65.0	5	4.2	3	2.5
Cleans shoat house	80	66.7	14	11.7	8	6.7	4	3.3
Gives shoat supplementary feed	84	70.0	6	5.0	5	4.2	4	3.3

Gives shoat water	88	73.3	9	7.5	5	4.2	4	3.3
Sells the shoat	58	48.3	46	38.3	1	.8	0	0.0
Milks shoat	97	80.8	2	1.7	1	.8	0	0.0
Does docking for sheep	15	12.6	3	2.5	1	.8	0	0.0
Makes decision for selling shoat	43	35.8	59	49.2	0	0.0	0	0.0
Makes decision for selling milk	91	75.8	8	6.7	0	0.0	1	.8
Makes decision for home consumption of shoat	44	36.7	61	50.8	0	0.0	0	0.0

Source: Data Analysis

It was established from table 21 that women in the household were responsible for most of sheep and goat activities such as cleaning of the sheep and goats house, giving sheep and goats' supplementary feeds, providing sheep and goats with water, milking of the sheep and goats and making decisions on the selling of the milk. Men on the other side owned the sheep and goats constructed the sheep and goat houses and were majorly responsible for decisions such as when to slaughter/home consumption and selling of the sheep and goats. However, it was reported that women were the ones who took the sheep and goats to the market. Children supported their parents in construction and cleaning of the sheep and goats house and giving sheep and goats' feeds and water.

4.5.1 Challenges associated with keeping of sheep and goats

The researcher sought information about the challenges associated with the intensification of sheep and goats in the area and the responses were as presented in table 22.

Table 22: Challenges associated with the intensification of sheep and goats

	Frequency	**Percentage**
Diminishing land size	58	48.3

Traditional beliefs that negate the consumption of some shoat products like sheep milk	6	5.0
Lack of market for shoat products like milk	1	.8
Frequent droughts	47	39.2
Destruction of fruit trees by goats and sheep	3	2.5

Source: Data Analysis

Challenges associated with intensification of sheep and goats as reported by majority of the respondents were limited grazing space and droughts as reported by 48.3% and 39.2% of the respondents respectively (Table 22). Other challenges hindering intensification of sheep and goats were that they destroyed fruit trees in the farm, lack of markets for their milk and other products, as well as traditional beliefs that sheep milk was not fit for human consumption. Sheep and goats are natural browsers, preferring to eat leaves, twigs, vines and shrubs. They are very agile and will stand on their hind legs to eat vegetation. They are also regarded as destructive animals because of their feeding habit.

CHAPTER FIVE

DISCUSSION

5.1 Introduction

This chapter summarizes the findings based on the three stated objectives of the study. In each case, the researcher briefly stated the general assessment of the current levels of sheep and goat milk consumption in the study area, the factors affecting sheep and goat milk consumption, the existing patterns of sheep and goat milk consumption, opportunities for intensification of both dairy sheep and goat production in the area and the current husbandry practices for the sheep and goat farmers in the study area and how they affect milk consumption. At the end of the chapter, the research recommends and highlights areas that need further research.

5.2 Social and demographic characteristics

Majority of respondents in this study were female (60.8%) and 39.2% were male. This is in agreement with (Bitende et al., 2001) who reported that there was a strong bias against women among communities keeping livestock in Africa. Sheep and goats are easily managed by women and children and therefore women being majority of the respondents provided more elaborate information about the study subject. Regarding their level of education most of the respondents had attained primary and secondary levels of education (90%) and the rest had tertiary education with a few having not gone to school. The presence of large proportion of literate respondents could be considered as an opportunity for easy training and accepting of improved management practice of livestock and other agricultural activities (Tassew and Seifu, 2009). Respondents' ages ranged between 22-77 years with an average of 46 years. Findings by (Doss and Morris, 2001) found that age determines experience of an adopter of a technology and older farmers use their wealth of experience in making decisions in adopting an innovation. Majority of the respondents were farmers (67.5%) and business people (24.2%). Others were civil servants and casual laborers (table 3).

5.3 Assessment of sheep and goat milk production in Kyawango and Kibauni Locations.

Households in the study area majorly practice mixed farming where households grow crops and keep animals in the same farm. Majority of the respondents (91%) reported to have land size of between 1-4 sq. km which is quite limited for both crop and livestock keeping (Table 4). This showed that land in the area was highly committed with agricultural activities. With regard to goats and sheep production, the study established that majority of households in the study areas kept goats and sheep as reported by 88% of the respondents (Table 5). The main reasons why households kept goats and sheep was mainly for meat, milk and selling to earn income. This agrees with findings of (Oyesola, 2008) that farmers are engaged in crop and livestock activities to be able to generate income and for household consumption. The study established that majority of households kept local breeds of sheep and goats breeds as reported by 95% of the respondents (67% keep local breeds of goats and 28% keep local breeds of sheep). Improved goats and sheep were less common among the respondents in the study area as only about 5% of the respondents reported to have kept improved goats with none of the respondents keeping improved sheep (Table 2). A study by (MoLD, 2011) showed that ninety eight percent (98%) of all the goats in Kenya are local breeds of with main breeds being the small East Africa goat (SEAG) and the Galla reared under extensive systems in arid and semi-arid areas (ASAL).

Findings from the study further showed that goats were much more productive compared to the sheep. About 80% of the respondents reported that they produced an average of less than 1 litre of goat milk per day while about 20% reported that they produced an average of 1-2 litres of goat milk daily. All the respondents (100%) reported that they produced an average of less than one litre of sheep milk every day (Table 7). It was also established that there was a significant association between the amount of goat milk produced per day and the type of goat ($X2=62.03$, $p<0.05$). This showed that goats' milk productivity was highly dependent on the type of goat reared. Findings from the study further showed that all the improved goats produced between 1-2 litres of milk a day (Table 8). Previous studies have shown that goats reared in the ASAL lands of Kenya, including Machakos and Kitui counties produce an average of less than 2 litres of milk per day (DLPO, 2006). This is contrary, to the normal expectation from improved dairy goat whose milk production vary between 2 to 4 litres (DGAK, 2009). Currently many community

based organizations (CBOs) working with resource poor livestock keepers in medium to high potential areas are encouraging them to keep improved goat genotypes, which are cross bred between exotic temperate and local breeds of tropical goats (Ahuya et al., 2009).

Factors affecting sheep and goat milk production as established during the study include type of breeds and management practices such as deworming, supplementary feeding, watering and separation ($p < 0.05$). Keeping more local breeds of goats significantly reduced the amount of milk produced ($B = -0.514$). Therefore, farmers are highly recommended to keep more improved goats than local breeds. It is also established that increasing the frequency of management practices such as deworming, supplementary feeding, watering and separation increases the amount of sheep and goat milk produced per day. According to (DLPO, 2012) the average milk production per goat has remained low where in 2012, extension officers reported a production level of between 0.5 litres to 0.75 litres of milk per goat per day signifying a decreasing trend. This decline may relate to the type of land ownership, farm sizes and rainfall pattern and distribution that has resulted to the failure in fodder establishment, inadequate feed supplementation, poor routine animal husbandry practices and inaccessibility to high value breeding material (Verbeek et al., 2007).

5.4 Assessment of sheep and goat milk consumption in Kyawango and Kibauni locations.

A sheep as well as goat is useful to humans when it is living and when it is dead, first as a renewable provider of milk, manure, and fiber/wool, and then as meat and hide (Mahmoud, 2010). Goats primarily produce meat, but also provide milk, and their contribution to the nutrition of the rural poor is significant. The study established that 81.7% of the respondents in the study area had at least tested goat milk compared to only 5% who reported to have tested sheep milk (Table 10). This was a clear indication that sheep milk was not commonly consumed in the study area and ascertained why goat milk is a very fast growing product in the dairy sector (Farnworth, 2002).

The different forms in which sheep and goat milk was consumed included raw, fermented and boiled. Majority of the respondents (90%) consumed it raw and boiled (Table 11). Further, it was reported that 88% of the respondents preserved goat milk majorly by boiling before selling and

storing as well as pouring it into guards for fermentation. Sheep milk was never preserved. The different milk preservation measures were usually taken to ensure that goat milk smell among other characteristics which limits goat milk consumption were minimized and therefore increase its consumption. Milk consumption at household level was highly affected by its strong smell, scarcity and its lack of interest by many. Kipserem et al., (2011) studied the socio-economic issues of the dairy goat in Kenya and revealed that about 57% of the milk produced was consumed in the household. Similarly, it was also established that sheep milk consumption was highly affected by its unavailability as reported by about 17% of the respondents and lack of interest as reported by the majority (78.3%) of the respondents. Another reason that affected consumption of sheep milk was that it was a religious taboo to consume sheep milk (Table 15).

5.5 Sheep and goat management practices for optimal milk production in Kyawango and Kibauni Locations

The study established that tethering was the main system used in sheep and goat production in the study area as reported by 80% of the respondents. The main reasons why farmers practiced this system were because farmers had few sheep and goats, lacked labour force and small land size that cannot support many animals. Other production systems reported included extensive and semi-intensive farming as reported by 12% and 5% of the farmers respectively (Table 18). Farmers practiced intensive farming because they had enough land to keep many sheep and goat. In the semi-intensive system, the goats are tethered at the garden for part of the day and taken to home and supplemented with crop by-products. The extensive system is practiced commonly in lowland agro-ecology, and in this system goats are left to browse throughout the day and gathered to home at night. According to (Midau et al., 2010) farm size holding is the single most important indicator that dictates the kind of grazing and management systems that households can adopt. In some ASAL areas of Kenya, though rapid increase in population has resulted to high demand for milk, it has also led to diminishing land sizes associated with acute fodder shortage thus necessitating farmers to rear high producing livestock breeds under zero grazing and tethering systems.

Findings from the study shows that almost all the households in the study area kept sheep and goats for income as reported by 86% of the respondents. Other reasons for keeping sheep and goats include production of milk and meat as reported by 21% and 18% of the respondents respectively. With agreement to these results of the study, Takele (2008) reported that, not only goats are important sources of milk but they produce different products and by-products, the major ones including meat, skins and manure that contribute economic values.

Different sheep and goat management practices such as deworming, supplementary feeding, watering and separation were found to significantly affect milk production capacity. The frequency of utilization of the management practices either increased or decreased the amount of milk production. It was established that farmers practiced the different management practices at different intervals. Important practices such watering was practiced by majority of farmers on daily basis as reported by 88% of the respondents. Spraying was mainly practiced on weekly basis (as reported by 74%) while deworming was mainly practiced on yearly basis as reported by 63% of the respondents. Majority of the respondents never practiced dipping, docking, toe peering, culling, separation of bucks/rams from milking does/ewes and supplementary feeding (Table 20). Previous studies have established that different management and socio-economic environment can have positive or negative effects on levels of sheep and goat milk production. Improved capacity of farmers has a long-term effect on milk productivity (Kaberia et al., 2003) since challenges in relation to breeding, disease control, housing, watering and feeding regimes that have negative effects on milk production can be successfully addressed (Ahuya et al., 2009). The main management activities practiced by farmers include, feeding which also involves watering and supplementation, disease management, housing and breeding management (Ahuya et al., 2009).

Challenges associated with intensification of sheep and goats as reported by majority of the respondents were limited grazing space and droughts as reported by 48.3% and 39.2% of the respondents respectively (Table 22). Other challenges hindering intensification of sheep and goats were that they destroyed fruit trees in the farm, lack of organized markets for their milk and other products, as well as traditional beliefs that sheep milk was not fit for human consumption. Goats are natural browsers, preferring to eat leaves, twigs, vines and shrubs. They

are very agile and will stand on their hind legs to eat vegetation. They are also regarded as destructive animals because of their feeding habit. These findings are similar to those identified by Ahuya et al, (2009) including management related issues such as inadequate husbandry, inadequate and ready supply of most appropriate type of breeding stock and how they can be improved, lack or poor supply of inputs, including drugs, feed, water, unavailability of appropriate markets, poor market organization, poor infrastructure and lack of efficient information networks, poor public policy on environment, poor administration of animal health policies , frequent droughts and lack of preparedness of such calamities.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

Findings from this study have shown that goats produce more milk compared to sheep. On average, goats produce 1-2 litres of milk daily while sheep produce less than 1 litre per day. Previous studies have shown that goats reared in the ASAL lands of Kenya, including Machakos and Kitui counties produce an average of less than 2 litres of milk per day (DLPO, 2006). However there has been a decreasing trend in the average milk production which is associated to different factors such as type of land ownership, farm sizes and rainfall pattern and distribution that has resulted to the failure in fodder establishment, inadequate feed supplementation, poor routine animal husbandry practices and inaccessibility to high value breeding material (Verbeek et al., 2007). Findings from this study showed that sheep and goat milk production is affected by type of breeds and management practices such as deworming, supplementary feeding, watering and separation. Keeping local breeds of goats significantly reduce the amount of milk produced. Therefore, farmers are highly recommended to keep improved goats. Results from this study showed that the levels of consumption of goat milk was higher than sheep milk. Sheep and goat milk is consumed raw, fermented and boiled. Goat milk is preserved by boiling and storing as well as pouring it into guards for fermentation. The different milk preservation measures are usually taken to ensure that goat milk smell among other characteristics which limits goat milk consumption are minimized and therefore increase its consumption. Milk consumption at household level was highly affected by its strong smell, scarcity and its lack of interest by many of the respondents.

Mixed farmers were the majority where they grew crops and kept animals in the same farm. Most households had land size of 1-4 ha which is quite limited for both crop and livestock keeping. Households had an average of 7 goats in the farm and 1 sheep where women in the household were responsible for most of sheep and goat activities such as cleaning of the house, feeding, providing sheep and goats with water, milking and making decisions on the selling of the milk. It was established during the study that sheep and goat farmers practiced extensive and

semi-intensive methods of farming where in semi-intensive systems, sheep and goats are tethered at the garden for part of the day and taken to home and supplemented with crop by-products and in extensive system sheep and goats are left to graze or browse throughout the day and gathered to home at night. Sheep and goats are kept majorly for sell to earn income and production of milk and meat. Major challenges associated with intensification of sheep and goats include limited grazing space and frequent droughts. Other challenges were that they destroyed fruit trees in the farm, lack of organized markets for their milk and other byproducts, as well as traditional beliefs that sheep milk was not fit for human consumption. They are also regarded as destructive animals because of their feeding habit.

6.2 Recommendation

Based on the findings of this study, the following recommendations are forwards;

1. Doing genetic improvement work by crossing local sheep and goats with improved breeds is encouraged and the Ministry of Agriculture, Mwala Sub County of Machakos County in conjunction with KARLO and Universities should introduce improved breeds of sheep and goats or train on the improved goats and sheep production practices to in Mwala Sub County for increase productivity.
2. Management practices such adoption of improved breeds, disease and pests control and feeding and watering practices were all found to influence sheep and goat milk productivity. There should be concerted effort by Ministry of Agriculture in Mwala Sub County to increase extension services for the sheep and goat farmers to exploit their potential and reap the benefits of sheep and goat farming.
3. To avert feed scarcity, it is recommended that, conservation of fodder for dry season during the periods of plenty should be adopted and farmers should be assisted with hay harvesting equipment and knowledge on feed supplementation.
4. Ministry of Agriculture and other stakeholders in Mwala Sub County should intensify awareness creation about the nutritional importance of sheep and goat milk to increase its consumption.

REFERENCES

Ahuya, C.O., Ojango, J.M.K., Mosi, R.O., Peacock, C.P. and Okeyo, A.M. (2009) Performance of Toggenburg dairy goats in smallholder production systems of the eastern highlands of Kenya. *Journal of Small Ruminant Research*. 83: 7-13.

Achariya., (2015) Handbook of Animal Husbandry. *Tamil Nadu University of Agriculture*, India.

Agriculture and Agri-food Canada, (2006): An analysis of the current Goat industry with a focus on Alberta; *Tradex AgriSystems Inc*. Pg 15

Berger, Y. M. (1998): Breeds of Sheep for Commercial Milk Production. 10th Annual Report. *Spooner Agricultural Research Station*. University of Wisconsin-Madison. Pg 14-20

Bitende, S. N., Njombe, A. and Semgalawe, Z. S. (2001) Women and food security reduction. A brief overview for Tanzania. *Tanzania Society of Animal Production*. 28: 39 – 60.

Cooke, T. (2010): Benefits of Goats' Milk vs Cows' Milk. *Mt. Capra whole food Nutritionals*, Pg 3-6

Daily Nation. (Sept 10, 2016): *Why goat milk has strong odour and how to get rid of it*.

Dairy goats association of Kenya (2009) *Annual report*

Delgado, C.M., Rosegrant, H., Steinfeld, H., Ehui, S. and Courbois, C. (1999): Livestock 2020: The next food revolution. *Discussion Paper 28, International Food Policy Research Institute*, Washington DC, USA.

Devendra, C. and Burns, M. (1970): Goat production in the tropics. Technical communication No. 19. *Edinburgh, Commonwealth Bureau of Animal Breeding and Genetics*; Farnham Royal, Commonwealth Agricultural Bureaux

Devendra, C. and Burns, M. (1983): Goat Production in the Tropics. *Commonwealth Agricultural Bureau,* Farnham House, Slough, UK. Pg183.

Devendra, C. (1992): Goats and rural prosperity. Pre-conference Proceedings, *International Conference on Goats,* New Delhi, Pg 625.

District livestock production office – Kenya (2006) *Annual report* small stocks section

District livestock production office – Kenya (2012) *Annual report* small stocks section

Doss, C. R. and Morris, M. L. (2001) How does gender affect the adoption of agricultural innovation? The case of improved maize technologies in Ghana: *Journal of Agricultural Economics.* 25: 27-39.

Ehui, S.K., Benin S. and Nega, G. (2000): Factors affecting urban demand for live sheep: The case of Addis Ababa, Ethiopia. *Socio-economic and Policy Research Working Paper 31*. ILRI, Nairobi, Kenya. Pg32.

FAO, IGAD (2011): Contribution of Livestock to the Kenya Economy. *The livestock policy initiative*

Farnworth, E. (2002): Goat Milk – *A dairy products with Special Properties?*, No.148

Freund, G. (1996): Use of goat milk for infant feeding: *Experimental work at Creteil* (France); INRA, 119–21

Gefu, J. O. (2002): Socio economic considerations in small ruminant production, in *Manual for Small Ruminant Product in Nigeria*, Pg 8 – 11

Haenlein, G.F.W. (1996): Status and prospect of the dairy goat industry in the United States. *Journal of Animal Science*, 74: 1173–1181.

Haenlein, G.F.W. (2002): Nutritional Value of Dairy Products of Ewe and Goat Milk; *University of Delaware*. Pg 3-10

Halliday, J. (2006): The healthy potential of Sheep Milk; *Nutraingredients.com*. Pg 3.

Hirpa, A. and Abebe, G. (2008): Economic Importance of Sheep and Goats. *Sheep and Goat Production Handbook for Ethiopia*, Addis Ababa, Pg 1-4.

Homann, S., van Rooyen, A., Moyo, T. and Nengomasha, Z. (2007): Goat production and marketing: Baseline information for semi-arid Zimbabwe. *International Crops Research Institute for the Semi-Arid Tropics*. Pg 84.

Hubpages International, (2013): Counties in Kenya; *Hubpages.com*. Pg 2.

Jaetzold, R. and Schmidt, H. (1983): Natural conditions and farmer management information - Part C, Eastern Kenya. (Eastern and Coastal Provinces) *Ministry of Agriculture, Kenya*. Pg 411

James, I. J., Osinowo, O. A. and Ajegbile, L. T. (2005): Factors affecting Milk yield in West African Dwarf Goats. *Proceedings of 30th Annual Conference of Nigerian Society of Animal Production*, Volume 30, Pg19-21.

Jennes, P. (1980): Composition and Characteristics of Goat Milk. Review 1968 – 1979. *Journal of Dairy Science*, 63: 1605 – 1630.

Jordan, R. M. and Boylan, W. J. (1988): The Potential for a dairy sheep industry in the Midwest Minnesota: *Minnesota Extension Service, University of Minnesota*. AG-FO-3430.

Juarez, M. and Ramos, M. (1986): Physicochemical characteristics of goat's milk as distinct from those of cow's milk. *International Dairy Federation Bulletin;* 202, Pg 54–67

Kaberia, B. K., Mutia, P. and Ahuya , C. (2003) Meru and Tharaka Nithi Dairy Goat and animal Healthcare Project funded by FARM Africa

Kathuri, N. J. and Pals, D. A. (1993): Introduction to educational research Njoro, *Kenya Educational Media Centre*, Egerton University

Kenya National Bureau of Statistics, (2009): Kenya Population and Housing Census

Kinuthia, N. R. (2001): Climate and forecast information: the status needs and expectations among smallholder agro-pastoralists in Machakos district, Kenya. *International Research Institute for Climate and Society Technical Report*.

Kipserem, J., Sulo, T., Chepng'eno, W. and Korir, M. (2011): Analysis of factors affecting dairy goat farming in Keiyo North and Keiyo South Districts of Kenya; *Journal of Development and Agricultural Economics* Vol. 3(11), Pg. 555-560,

Kosgey, I. S., Baker, R. L., Udo, H. M. L., Van Arendonk, J. A. M. (2006): Successes and failures of small ruminants breeding programs in the tropics: 61: Pg 13-28.

Lakpini, C. A. M. (2002): Management of Sheep and Goats, in Manual for Small Ruminant Product in Nigeria, *National Agricultural Policy Research Institute*, Pg 12 – 16

Mahmoud, A. A. M. A. (2010): Present status of the world goat populations and their productivity, *Lohmann Information*, Vol. 45 (2), Pg 43.

Maisels, C.K. (1999): The Near East: *Archaeology in the Cradle of Civilization Routledge*; pg 124

Midau, A., Kibon, A., Moruppa, S. M. and Augustine, C. (2010) Influence of season on milk yield and milk composition of Red Sokoto goats in Mubi area of Adamawa state, Nigeria. J. *Dairy Sci*. 5(3): 135 – 141.

Ministry of livestock development – Kenya (2011) *Annual report* small stocks section.

Mmbengwa, V.M., Schwalbach, L.M., Greyling, J.P.C. and Fair, M.D. (2000): Milk production potential of South African Boer and Nguni goats. 38th Congress of the South African Society of Animal Science. *South African Journal of Animal Science*, 30(Supplement 1)

Mugenda, O.M. & Mugenda, G.A. (2003): Research methods Quantitative and Qualitative approaches. Nairobi, - *Acts Press*, 1999.

Muhammad, L.W. (2007): Factors affecting sheep and goat milk consumption in Minna Metropolis Nigeria: *Agricultural economics and extension technology*. Pg 4-18

Naderi, S., Rezaei, H.R., Pompanon, F., Blum, M.G., Negrini, R., Naghash, H.R., Balkiz, O., Mashkour, M., Gaggiotti, O.E., Ajmone-Marsan, P., Kence, A., Vigne, J.D., Taberlet, P. (2008): The goat domestication process inferred from large-scale mitochondrial DNA analysis of wild and domestic individuals. *Pnas* 105 (46): 17659–17664.

Ochepo, G.O. and Momoh, M. (2010): Developing the Dairy Goat Industry in Nigeria: A Review. Proceedings of 35th Conference, *Nigeria Society for Animal Production. University of Ibadan*, Nigeria, Pg. 530 – 532.

Odeyinka, S.M. and Ajayi, D.A. (2004): A Survey of Feedstuffs for Goats in Osun State. *Tropical Journal of Animal Science*. 7(1): Pg161 – 168.

Okunlola, O. O., Amuda, A. J. and Ayanwamide, F.M. (2010): Farmers perception of Livestock Farming in Oyo state; A case study of small ruminant farmers. Proceedings of the 35th Conference; *Nigeria Society for Animal Production*, University of Ibadan; Pg 14-17

Oyesola, O. B. (2008) Changes in crop and livestock activities of Yoruba and Fulani women in Saki-West local government area of Oyo State, Nigeria. *Studies Tribes Tribals*. 6: 13 – 19.

Park, Y.W. (1992): Advances in manufacture of goat cheese. *5th Proceedings of International Conference on* Goat, New Delhi, India, Volume II, Part II, Pg382.

Park, Y.W. and Haenlein, G.F.W. (2007): Goat Milk, Its Products and Nutrition. In: *Handbook of Food Products Manufacturing*. Y.H. Hui ed. John Wiley & Sons, Inc., New York, Pg 447–486.

Park, Y. W. and Haenlein, G.F.W. (2006): Basic Composition of Various Milks. In: *Handbook of Milk of Non-Bovine Mammals.* Blackwell Publishing. Pg 59, 407

Payne, W. J. A. and Wilson, R.T. (1999): An Introduction to Animal Husbandry in the Tropics, 5th edition, Oxford (Blackwell Science).

Peacock, C.P. (2005): Goats**,** Unlocking their potential for Africa's farmers. In: *FARM Africa Working Paper series*. Seventh Conference of Ministers Responsible for Animal Resources, Kigali, Rwanda. Pg 3

Peeler, E. J. and Omore, A. O. (1997): A manual on cattle, sheep and goat systems in Kenya prepared for the Kenya Agricultural Research Institute (KARI) and the Department for International Development (DFID) *National Agricultural Research Project II*.

Rangoma, M. (2011): Sheep Breeds in Kenya; Livestock Kenya.com. *Connecting Livestock farmers and Professionals.*

Rubino, R. and Haenlein, G.F.W. (1996): Goat milk production systems: sub-systems and differentiation factors. In: Proceedings of the Sixth International Conference on Goats, vol. 1. Beijing, China, 6–11 May 1996. *International Academy Publishing*, Beijing, China, pp. 9–15

Schoenian, S. (2012): A beginner's guide to raising sheep: *Sheep 101 and 102*

Smith, M.S., Barbara, M. A. and Gerald, K. (1997): Beginning Shepherd's Manual, Second Edition. Ames, Iowa: *Iowa State University Press*.

Tassew A and Seifu E (2009). Smallholder Dairy Production System and Emergence of Dairy Cooperatives in Bahir Dar Zuria and Mecha Woredas, Northwestern Ethiopia. *World J. Dairy Food Sci.* 4 (2): 185-192.

Taylor, R.E. and Field, T.G. (1999): Growth and Development, Scientific Farm Animal Production: *An Introduction to Animal Science*, 6th Ed. Upper Saddle River (Prentice Hall); pg 324-325.

Teh, T.H. (1991): Goat production in the Asian humid tropics. *In Proceedings*,

Thear, K. and Frazer, A. (1986): The Complete Book of Raising Livestock and Poultry; *Small Holders Guide, University Service Ltd:* Yaba. Pg. 86 – 86.

Upton, M. (1984): Models of Improved Production Systems for Small Ruminants, *Sheep and Goats in humid West Africa.* ILCA, Addis – Ababa, Ethiopia, Pp.55 -67.

Verbeek, E., Kanis, E., Bett, R.C. and Kosgey, I.S. (2007) Socio-economic factors influencing small ruminant breeding in Kenya

Wesonga, F. D., Kitala, P. M., Gathuma, J. M., Njenga, M. J. and Ngumi, P. N. (2010): An assessment of tick-borne diseases constraints to livestock production in a smallholder livestock production system in Machakos District, Kenya.

Wilson, R.T. (1992): Goat and sheep skin and fiber production in selected Sub-Saharan African countries. *Small Ruminant Research* 8, pp 13-29

Winrock International, (1983): Sheep and Goats in Developing Countries: Their Present and Potential Role. *A World Bank Technical Paper, Winrock Int'l*., Morrilton, Arkansas, U.S.A 72110 – 9537.

Youssef, B.Y., El-Senaity, M.H., El-Sheikh, M. M., Abd-Rabou, N.S. and Nadia, M. S. (2011): Manufacture of Cultured Butter Milk Beverage from Whole and Skimmed Goat's Milk. *Journal of American Science*; 7(1), Pg 491

APPENDICES

Appendices 1: Household questionnaire

MSC, AGRICULTURAL RESOURCE MANAGEMENT SURVEY QUESTIONNAIRE

Hello

Good morning/Good Afternoon my name is _____ I am collecting data on behalf of Mr. John Mutua who is a student undertaking a masters degree programme in Agricultural Resource Management at South Eastern Kenya University. Part of the Masters Programme is to do a research on a certain aspect and write a thesis that will be presented to the University to facilitate completion of the same. Mr. John Mutua is doing a study on the factors affecting goat and sheep milk consumption in this region and therefore your frank answers to the questions will help him in finalizing his Masters and at the same time develop recommendations that can be followed to make the goat and sheep milk acceptable as part of the animal protein and especially in the Arid and Semi Arid Lands of Kenya. The information collected will be confidential and only used for purposes of study. I request for your permission to be interviewed, it will not take more than 30 minutes

Consent	I Agree Proceed to Interview Signature of …….	I decline, Stop the interview and thank the respondent

SECTION A: LOCATION DETAILS

1. Date of the interview----------Questionnaire No ----------
2. Name of enumerator----------
3. Name of respondent----------
4. Gender of the respondent: (1) Male (2) Female
5. District----------Location----------
6. Sub-Location----------Village----------

SECTION B: HOUSEHOLD HEAD DETAILS

7. Head of Household (HH) (1). (M) Male (2). (F) Female (3). (CH) Child headed
8. If the HH head is (2) above what happened to the Male head and if (3) what happened to both parents? (1)HH traditionaly headed by female (2) Died naturally (3) Died in conflict (4) Died in an accident (5) Illness (6) Conflict (7) Others specify_____
9. Age (estimated in years)----------Tel/Mobile No----------
10. Marital status of the HH head:

    (1) Married (2) Divorced/separated (3) Widowed (4) Never married

SECTION C: SOCIO-ECONOMIC ASPECTS OF THE RESPONDENT

11. What religion do you belong to? (Tick where appropriate)

    (1)Christianity (2) Muslim (3) Traditionalism (4) No religion (5) Other (Specify) _____

12. Education level of respondent (a) None (b) Primary (c) Secondary (d) Tertiary

13. Number of dependents in the family? (Tick where appropriate) (1)1-2 (2)3-4 (3)5-6 (4) Above 6

14. What is your primary occupation? (Tick where appropriate)

(1) Farmer (2) Civil servant (3) Business (4) Retired (5) Other (Specify) ----------

15. What is the total size of your land?(Tick where appropriate)

(1) Less than an acre (2) 1-2 acres (3) 3-4 acres (4)5 and above acres (5). None

16. What are the major activities on the farm?

(1) Crops farming only (2) Crops and livestock (3) Livestock only (4) Other (specify) _____

17. Did you belong to a community group in the last one year?(Tick where appropriate) (1) Yes (2) No

18. If yes, what is the type of the group? (tick where appropriate)

(1)Women group (2) Youth group (3) Self help group (4) cooperative (5) other (Specify) _____

19. What are the main activities of the group in the last one year? (Tick where appropriate)

(1) Cultivation of horticultural crops (2) Cultivation of staple crops (3) Keeping goats and sheep (4) Doing merry go rounds

(5) Other (specify) _____

20. Do you keep Shoats (Goats and Sheep?(Tick where appropriate) (1)yes (2) No

21. If question 20 is yes, what is the type and number of the breeds kept at the household and how are they utilized?

Type of animal/bird		**Total # of heads/birds**	**How do you use these animals**	**Animal use codes…**
1	Goat – Indigenous			**1.**100%Ownconsumption **2.**100% sale for cash 3.Special ceremonies only 4.We sell some, we eat some 5. To buy food.
	- Improved			
2	Sheep - Indigenous			
	- Improved			
3	Pig			
4	Poultry			
5	Ducks			
6	Cattle			
7	Rabbit			

22. Specifically why do you keep goats and sheep? (tick appropriately)

(1) For milk (2) For meat (3) For skins (4) As an income generating venture

(5) For leisure (6) other (specify) _____

SECTION D: GOAT AND SHEEP MILK CONSUMPTION DYNAMICS

23. Have you tested Goat milk? (Tick where appropriate)

(1)No (2) Yes

24. In your family, are there some members who don't consume Goat milk? (Tick where appropriate) (1) Yes (2) No 3) How many?_____

25. If the answer in the above question is yes, what are some of the factors that make them not consume goat's milk? (Probe and circle all the options in this BOX below that apply to this household)

Factors affecting goat milk consumption	
1	Unavailability
2	Affordability
3	Un awareness
4	Strong smell
5	Allergy
6	Religious prohibitions
7	Traditional taboo
8	Nausea
9	Not interested
10	Not used to
11	Other (Specify)

26. In what form is the goat milk consumed? (Tick where appropriately)

(1) Raw (2) Fermented (3) Processed (4) Packaged

(5) Other (Specify) _____

27. Have you tested Sheep Milk? (Tick where appropriate)

(1)No (2) Yes

28. In your family, are there some members who don't consume Sheep milk? (Tick where appropriate) (1) Yes (2) No 3) How many?_____

29. If the answer in the above question is Yes, what are some of the factors that make them not consume Sheep's milk? (Probe and circle all the options in this BOX below that apply to this household)

Factors affecting sheep milk consumption	
1	Unavailability
2	Affordability
3	Un awareness
4	Strong smell
5	Allergy
6	Religious prohibitions
7	Traditional taboo
8	Nausea
9	Not interested
10	Not used to
11	Other (Specify)

30. In what form is the Sheep milk consumed? (Tick where appropriately)

(1) Raw (2) Fermented (3) Processed (4) Packaged

(5) Other (Specify)_____

31. How often do you consume goat milk? (tick where appropriate)

(1)Everyday (2) Once per week (3) Two times per week (4) Once per month

(5) occasionally (6) none at all

32. How often do you consume sheep milk? (Tick where appropriate)

(1)Everyday (2) Once per week (3) Two times per week (4) Once per month

(5) Occasionally (6) none at all

33. A) What System of Shoats production do you practice? (Tick where appropriate)

(1) Tethering (2) Intensive farming (3) Semi-Intensive farming

(4) Extensive farming (5) Other (Specify) _____

B) Why do you practice the system mentioned in (A) above?

(1)I have few animals (2)Lack of labour force (3)My land is small and hence cannot support many animals (4) I have enough piece of land that can support many animals

(5)Other specify_____

SECTION E: GOAT AND SHEEP HUSBANDRY PRACTICES

34. What is the goat/sheep husbandry practices practiced and what is the frequency? (Probe and circle all the correct responses as per the table below. In order to get the frequency, ask how many times a week they do each practice) Mark the responses using the following Frequency codes:

(1)Daily (2) 1-2 times a week (3) 3-5 times w week (4) none

(5) other (specify) _____

Husbandry Practice		**Frequency**
1	Deworming	
2	Spraying	
3	Dipping	

4	Castration	
5	Docking	
6	Toe Pearling	
7	Culling	
8	Supplementary feeding	
9	Watering	
10	Separation of bucks from the milking does/ewes	

35. a) Are there Animal Health Service Providers in your area?

(1) Yes (2) No

b) If the answer to above question is yes, what is the level of their training?

(1) Never attended formal education but inherited from their parents/grandparents

(2) Standard Eight dropout

(3) Form four drop out

(4) Diploma

(5) Degree and above

(6) Any other (Specify)_____

36. Who treats your livestock in case they fall sick?

1) I normally call a veterinarian from the Government office

2) I rely on the trained Paravets in our locality

3) I call a herbalist

4) I don't treat and just watch for natural healing

5) I pray to God for healing

6) Any other (Specify)_____

37. Indicate the member of the household who perform the roles under the table below with respect to goats and sheep

	Women (1)	**Men (2)**	**Children (3)**	**Family (4)**
Ownership				
Labour profile				
Shelter construction				
Cleaning goat/sheep house				
Supplementary feeding				
Providing water				
Selling the goats/sheep				
Milking of goats				
Milking sheep				
Docking				
Toe Pearling				
Selling milk				
Treatment				

Decision making				
Selling goats/sheep				
Selling milk				
Home consumption of goats/sheep				

38. What is the source of the labor force involved in taking care of your livestock?

    (1) Hired (2) Family (3) Clan (4) Any other (Specify)_____

SECTION F: VALUE ADDITION AND MARKETING

I) Goat Milk

39. How many liters of goat milk do you normally get per day? (tick where appropriate)

    (a)Less than 1 liter (b) 1-2 liters (c) 3-5 liters (d) 6-7 liters (e) Above 8 years

40. Do you sell some of the goat milk? (tick where appropriate) (a) Yes (b) No

41. If your answer in above question is yes, how do you sell the milk?

    (a)People come for it at home (b) I service orders at the local market centre (c) I have a milk bar at the local market centre (c)I hawk it at the local market centre (d) We have formed a cooperative where we take our milk (e)Other (Specify)_____

42. After milking, is there any form of preservation done to the goat milk? (tick where appropriate) (a)Yes (b)No

43. If the answer in above question is yes, what form of preservation do you do? (tick where appropriate)

(a)I normally put in a guard for fermentation (b) I boil before selling or storing (c) I add some chemicals for preservation (d) I add some herbal materials for preservation (e) Any other (Specify)_____

44. Do you any form of value addition to the milk?

(1)Yes (2)No

45. If the answer to question 44 above is yes, what value addition do you do?

(1) I make ghee (2) I make Yoghurt (3) I make cheese (4) Any other (Specify)_____

II) Sheep Milk

46. How many liters of sheep milk do you normally get per day? (tick where appropriate)

(a)Less than 1 liter (b) 1-2 liters (c) 3-5 liters (d) 6-7 liters (e) Above 8 years

47. Do you sell some of the sheep milk? (tick where appropriate) (a) Yes (b) No

48. If your answer in above question is yes, how do you sell the milk?

(a)People come for it at home (b) I service orders at the local market centre (c) I have a milk bar at the local market centre (c)I hawk it at the local market centre (d) We have formed a cooperative where we take our milk (e)Other (Specify)_____

49. .After milking, is there any form of preservation done to the sheep milk? (tick where appropriate) (a)Yes (b)No

50. If the answer in above question is yes, what form of preservation do you do? (tick where appropriate)

(a)I normally put in a guard for fermentation (b) I boil before selling or storing (c) I add some chemicals for preservation (d) I add some herbal materials for preservation (e) any other (Specify) _____

51. Do you do any form of value addition to the milk?

(1)Yes (2) No

52. If the answer to question 44 above is yes, what value addition do you do?
(1)I make ghee (2) I make Yoghurt (3) I make cheese (4) Any other (Specify)_____

53. What are the challenges associated with Keeping Shoats?

(1)Diminishing land sizes (2) Traditional beliefs that negate the consumption of some shoat products like sheep milk (3) Lack of market for shoats products like milk (4) Frequent droughts (5) Any other (Specify) _____