

**CHARACTERIZATION OF CAMEL PRODUCTION UNDER PASTORAL
MANAGEMENT IN BENADIR REGION, SOMALIA**

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DECLARATION

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

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Approval

This thesis has been submitted with our approval as university supervisors.

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DEDICATION

I dedicate this work to my beloved parents Arte Ali Farah, Fadumo Abdi Shurie and Mohamud Ali Farah for their guidance and support through difficult times. I also want to dedicate this work to my elder brother Mohamed Artan Ali who continually supported me both financially and morally.

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LIST OF ABBREVIATIONS AND ACCRYNOMS

ASALS	Arid and semi-arid lands
DMI	Dry matter intake
FAO	Food and agriculture organization
GDP	Gross domestic product
KG	Kilogram
KM	Kilometer
L	Liter
MM	Millimeter
UN	United Nations
°C	Celsius
SPSS	Statistical Package for Social Sciences
NGO	Non-Governmental Organization
PRIME	Pastoral Resilience Improvement through Market Expansion
EMMI	Ethiopian Meat and Milk Institute
ICC-GIC	International Camel Consortium Genetic Improvement Conservation
AI	Artificial Insemination

ABSTRACT

Livestock production has for many decades been the backbone of the Somali economy. It is the most important food and income source for both the large rural population and is the country's largest export product. Camels play several roles in pastoralists' livelihoods, including asset building, protection against unforeseen incidents, social and moral values, animal strength during the draught, supply of food and income. The aim of this study was documenting camel keepers' husbandry practices and constraints to production and recommend effective measures for improving their productivity. In the Benadir region, two districts namely of Dharkenley and Hodan were selected for data collection. A sample of 138 camel herders were randomly selected. Data was collected using semi-structured questionnaires. The data collected included milk yield, the amount of milk sold, amount of household consumed. The quantity of camel meat consumed the camel enterprise productivity status and camel diseases. The results showed that the mean amount of milk produced in both districts was 65.9 ± 33.08 litres per day, average household milk consumption was 13.5 ± 6.72 litres per day while the average amount of milk sold was 42.7 ± 21.46 liters per day. 31.2% of the households consumed camel meat once in a week whereas 68.8% of the households consumed camel meat once a month. Notably, the high price of the camel meat was the major influence on consumption compared with meat from goat and beef. In the study area, 27.5% of the pastoralists confirmed that camel products trade existed and had improved while 18.1% of the respondents noted a decline with 54.3% of the respondents not noticing any change in the enterprises. The majority (92%) of the pastoralists reported that camel diseases were the major obstacle to camel production. In conclusion, the Benadir camel production is low due to the poor camel husbandry practices and diseases. To enhance the

performance of dairy camels owned by pastoralists, interventions are required in the areas of husbandry practices and disease control and prevention.

Key words; Camel, Benadir district, Husbandry, Disease.

CHAPTER ONE

1.1 Introduction

For many decades, the Somali community has survived on livestock production as their main economic activity since it is their most important food source and that it is the largest export product of the country (Mirkena et al., 2018). Before 1991 when the civil war began, around 46% of the total population practiced nomadic pastoralism, this made livestock to account for 40% of GDP and at about 80% of all the earnings that came from exports (Randall, 2015). Due to its relative versatility, of the livestock industry it can be easily moved from regions facing conflicts to peaceful regions during civil war thus camel production remained the only system that was never affected (Thornton, 2010).

The camels play several roles in pastoralist livelihoods which include asset building, protection against unforeseen incidents, social and moral values, income generation and food supply and act as major contributor to the countries' export revenue. (Beletes et al., 2019). Camels are also major contributors to the survival of pastoralists and agropastoral living in vulnerable habitats in the semi-arid and arid areas of Asia and Africa. (Tura et al., 2010). There has been an urgent need to improve these marginalized resources in the arid and semi-arid areas to maximize their productivity by using a suitable system of livestock production. Improvement camel production is considered the best option due to rising human population and a decrease in food output per capita (Mehari et al., 2007).

Knowing the precise number of camels in the world is quite challenging. This is because camels are owned by shifting nomadic persons and are not subjected to mandatory vaccination,

therefore, an extensive camel count is difficult. (Ali, 2011). The latest FAO data estimates camel population at around 28 million heads with Somalia being lead producer of camel milk, followed by Kenya and Mali while the most crucial countries for the camel economy are Pakistan, Mali, Chad, Kenya, Niger, Ethiopia, Sudan, Somalia, and Mauritania with the population of the camels being more than 1 million (FAO, 2018).

The camel population has doubled since 1961 (the first data of FAO statistics) with an annual increase 3.4%, the growth rate differing between countries. The countries with fastest growth were Eritrea, Ethiopia, Yemen, United Arab Emirates, Syria, Qatar, Oman, Mali, Algeria, Chad and Mauritania. Senegal and Libya ranked as countries with stable population while China, India, Israel, Jordan, Mongolia and Afghanistan were countries with decreasing population (FAO, 2018)

Camels are raised for milk production in most regions of the world, in other nations however, camels are used as form of amusement, tourist attraction and as means of transport in the remote areas and along the beaches. (Gebremichael et al., 2019). Those camels that are kept for special purposes like packaging, milking, and riding, the genetic selection of camels is extremely poor. Few performance selection schemes have been introduced except for racing animals, possibly due to the higher importance associated with those. (Gebremichael et al., 2019). There were various camel farms that were developed in Northern America and the Western Europe, with similar farms introduced within the dessert of Kalahari however, their performance turned to be very poor (Oldenbroek, 2014).

The camel is a multi-purpose mammal as it offers milk, hides, meat, transportation, riding, racing, tourism and can be used for ploughing in farming. A lot of domestic animals cannot offer human beings with as many benefits as a camel does. (Faye, 2016). Consequently, the processing

of meat is related to the proper management of herds, the camels are selected depending on their age and gender for example the young males which are purposed for breeding or females or males that are culled to be slaughtered (Alary & Faye, 2012). For dromedaries, the main reason for camel rearing is milk production mainly to be consumed by the community as they are reared in remote areas (Mirkena et. al., 2018).

Eighty percent of the camel species are based in the African continent with more than 60% found in eastern Africa counties (Somali, Sudan, Kenya, and Ethiopia). Dromedary camels are known to produce a lot of milk over a long duration of time compared to other milk producing animals when maintained under the same unfavorable climatic conditions (Gebremichael et al., 2019). Camel milk, therefore, is a significant food source for persons living in the arid and semi-arid areas, for others it's the basic source of income, food, and nutrition and for others it has helped in improving their livelihoods and contributes to the GDP of the country (Faye, 2015).

1.2 Statement of the problem

Since the demand for camel products has escalated in Somalia, due to increased population, incomes and urbanization, therefore, Benadir pastoralist are in need of intensification to improve camel's performance in the region.

1.3 Justification

Pastoral communities in the Benadir region are the major source of camel products to individuals and national wealth in south central parts of Somalia. The camel plays an important role in livelihood and food security for the pastoral and even urban communities. The production of

milk and meat will increase to satisfy demand if pastoralists improve their production system to an intensive system.

1.4 Objectives

1.4.1 Overall objective

To characterize camel production system under pastoral management in Benadir region

1.4.1 Specific objectives

1. To document husbandry practices and production constraints of camel keepers in Benadir region.
2. To recommend appropriate interventions to improve camel productivity in Benadir region

1.5 Research questions

1. What camel husbandry practices are currently practiced in Benadir region and what production constraints are experienced?
2. What are the appropriate interventions to improve camel productivity in Benadir region?

CHAPTER TWO

LITERATURE REVIEW

2.1 History and classification of camels

Human settlement and farming of wild plants and animals can be traced back to the growth of human civilization, the domestication process encouraged the transition from gathering and hunting to agriculture thus providing a stable source of resources among them being clothing and food. Animal domestication is likely to have occurred by multi-stages processes (Bogoliubsky, 1959).

This depends on human needs (guided pathways and prey) or wild ancestor's anthropophyte (Commensal pathway) either promulgated by wild animal's ancestors or human beings deliberately or not, the primary factor for domestication emanated from a reduction of fear of humans such as tameness (Clutton, 1981). Camels that are old gives a good opportunity to study domestication since they have retained high genetic levels of diversity, they predominantly have more than a single purpose and lack the bottlenecks preferred with breed that are characterized as domestic species (Jensen, 2014).

Several people inclined that the early ancestors of camels before evolution were the rabbits since camels have a grooved upper lip just like a rabbit (Epstein, 1971). This reality is backed up by the camelids belonging to artiodactyl order (even-toed ungulates) under sub order tylopoda serving uniform suborders, camelids classified as ruminating animals listed closely to ruminants but not under the ruminant suborder like foot morphology, digestive system as well as the lack of horns (Schwartz et al., 1992). This happened roughly 40–50 million years ago, during the Eocene era (Indra et al., 1998).

There are three genera of Camelidae namely, new-world camels (Lama genus with *L. glama*, *L. pacos*, *Vicugna* genus with *V. vicugna* species and *L. guanicoe*) and old-world camels (*Camelus* genus), The two-humped camel (*Camelus Bactrians*) and the single-humped camel (*Camelus dromedarius*) are two domesticated species of old-world camels, and the new world Camelidae has smaller forms of camels that remain in the heights of South American highlands (Gautier, 1966).

In Iran, the Arabian Peninsula, and the semi-arid regions of northern and eastern Africa, the dromedary camel is the most popular livestock (Epstein, 1971).

The single-humped camel was most likely domesticated between 3000 and 4000 years ago in what is currently Yemen and Oman. The name "dromedary" is derived from the Greek "dromeus," which meaning to run or droma-running (Abdu & Mahmoud, 2013). This animal can be used for various purposes such as transport and production of milk, meat, and hides. In Asia's cold desert and dry steppes, the bactrian or the two-humped camel (*Camelus Bactrians*) is found (Burger et al., 2012). It got its name from the region of Bactrian which is Iran's old name (Fowler, 1998). About 37-24 million years ago, the open-wood areas of North Dakota were populated with these goats sized and not heavy weight and measured about 3 feet long, their head was just like that of a modern llama with its distinctive narrow snout and long neck (Rao et al., 1970).

In the book of sequencing analysis and notation of expressed sequence tag for *Camelus dromedarius* in 2010 pointed out that these animals were lightly constructed, goat sized and about 3 feet long. Around 17 million years ago, the modern types of camel i.e., the *Camelini* and *Lamini* diverged from each other (Abdulaziz et al., 2010). In about 5-3 million years ago, the *Camelini* had found its way through Eurasia via Bering Isthmus while about 3 million years ago,

the Lamini had spread to southern America through isthmus of Panama route, with several theories that camelus was linked with these apparent fossils from the African continent (Chapman, 1985).

Paracamelus, the probable ancestor of camelus which inhabited Asia, Europe, and Africa around 7.5 to 6.6 million years ago came to be known, however, most fossils have been found in North America, the initial evidence of the existence of a giant camel in Canada's High Arctic was discovered in the year 2010, the discovery was made by a team with Canadian museum of nature taking the lead. Later, it was compared to a database of collagen peptide markers from 37 species of current mammals as well as to a fossil that had been discovered in the Yukon (Cui, 2007).

As recorded in ancient history, one of the oldest animals domesticated is the camel (family Camelidae) and their name was derived from Latin language (camelus) and Greek (kamelos), the population of these animals was very important to those in the desert who had to survive, and they have been linked to major nomads' civilization (Knoess,1977). There are camels in two phenotypic types of the district, the bactarians, and dromedans, the former is mostly found in central parts of Asia, and the latter is commonly found Africa and Middle East. Majority of the animals grow in a climate change-based system of nomadic, sedentary and transhumance production (Tura et al., 2010).

The two thirds population of world's camel population, the dromedaries which are about 11 million are found in Africa's arid regions especially Eastern Africa i.e., Kenya, Ethiopia, Somalia, and Sudan (Knoess, 1976). Other countries are Mauritania with 4.7 million heads and Niger with 1.7 million heads. The specific physical and adaptive characteristics that the dromedary camel encounters in functions such as delivering essential services and giving to

people living in arid and neglected areas, thus it is an outstanding animal which has outperformed other domesticated animals (Lensch, 1999).

2.2 Economic importance of camels

To the pastoralist community, camels are very important as they form the pillars of subsistence economy. This is particularly true in the ASALs, where they provide transportation, meat and milk for households, as well as other byproducts including hides, hair, milk, and other byproducts, in addition to earning money from the sale of live animals. (Elhadi et al., 2015; Aujla, et al., 2013).

Camels survive in the ASALS due to the biological and physiological adaptations which makes them able to cope with environmental conditions that are harsh, due to their dehydration resistivity. Camels can go without water for several days and consume less water in comparison with other livestock (Sodienye et al., 2011). They have no food competition with other animals since they are hardy and consume less food, making them rare, and they can turn scant plant resources into fiber, meat, and milk. (Ahmad et al., 2010).

Climate change and prolonged drought limits access of pasture and water to livestock thus affecting the pastoral and dry livelihoods. This has led to diverse economic and ecological effect for the users of the rangelands especially in Africa's dry lands. (Abawi & Ritchie, 2003). Animal deaths and diseases, and other deteriorating livestock environment are a major issue due to recurrent droughts which causes pastoralist to effect change on the structure of animal's herd and livestock market collapsing (Opiyo et al., 2015).

The livestock production systems globally will continue to be affected due to expected increase in climate variability. These include the poor in the rural who have livestock as their main source

of livelihood. Terrestrial aridity can be increased by high evapotranspiration due to increased warming on earth which raises precipitation (Lickley & Solomon 2018).

Such outcomes have the potential to modify habitats, ecosystems, and living circumstances. For example, as aridity increases, more frequent droughts, soil moisture deficits, and reduced carbon uptake follow. If the environment continues to change globally, arid and semi-arid areas in Africa will expand by 5 to 8%. (Shemsanga, 2015).

The lack of frequent census and the fact that camel products rarely join formal market system, the importance of camels to survival of households and economy of developing countries is usually filled with unreliable number of population of camels. As such camel economic contribution is frequently underestimated, since the production of camel has been drawing a lot of attention as the main source of food in arid regions amid uncertain figures (Gebremichael et al., 2019).

Being a multi-purpose animal, the camel is a very crucial animal to the Pakistan people, their desert environment, plains and mountainous regions. The camel is basically kept in the subsistence production system by migratory pastoralists in Pakistan arid and semi-arid regions. However, its contribution to Pakistan agricultural economy is yet to be assessed (Raziq, 2009).

Camels are a stable source of milk, meat and the skin for people who live in extreme desert conditions (Schwartz & Dioli, 1992). The milk is often sold and the remaining shared with neighbors in small amounts, the most important value of camel milk is that it supplements the food shortages felt during dry seasons when other livestock cannot produce enough (Pasha et al., 2013).

In areas where other animals have been affected by harsh environmental conditions, the best source of meat and milk is the dromedary camel (Yaqoob & Nawaz, 2007). Its physiological features, which allow solar radiation, poor vegetation, high temperatures, scarcity of water, and rugged topography, make it a suitable animal. Due to these attributes, camel is considered as the animal with the unfathomed potential to meet the future dietary and medical needs of human beings. (Faye & Esenov, 2005). However, despite all these attributes, the camel has for long remained a neglected animal (Faye & Esenov, 2005).

In the basic diet of pastoral society, milk is shared and generates about 30% of the caloric diet annually. Camels also play an important role in traditional social relations, such as dowry payment and compensation of wounded persons in clan feuds (Elhadi et al., 2015). Camel ownership is also an indicator of social status in the Somali community, they also act as the basic reserve stock in the traditional economy of the Somali, therefore, acting as wealth stock and prevents starvation during a famine and other natural disasters (Lensch, 1999).

2.3 Importance of camels for food security

Due to increased human population growth, the issue of food security has come to the world's attention, with the camel, which has great potential in the food chain, being added (Faraz et al., 2013). The camel plays an important role in the food security and national economy of various countries in the world (Faraz et al., 2013). Camel is a potential of hope; for millennia, it has grown and impacted the nomads, Bedouins, and pastoral people. It also provides leisure, draft power, riding, and food production, and it's a possible future source of food for people in semi-arid and arid areas (Faraz et al., 2018).

The advantage of camel milk is its richness in nutrients and therapeutic peculiarities. Camels lactate for a period between 12-18 months with range production of 3-10Kg. They have a longer lactating period as they live in the desert, unlike other dairy animals (Wernery, 2008). In the desert, a camel is a crucial source of food as it is always ready for milking; with its milking frequency being higher than other milking animals, they offer up to 30% of the annual caloric diet to the pastoral community (Gebremichael et al., 2019).

The camel has a higher milk production potential in comparison with cattle and buffalo as they produce more milk in proportional to their weight. Its milk has three times more vitamin C and more than ten times iron compared to cow's milk (Alhadrami et al., 2016). It, however, lacks B Lacto globulins which are important allergens; but higher concentration of antimicrobial elements such as lactoferrin and lysozyme; further, low-quality forages can be used by camels with more effectiveness as it can keep fiber for 70h in its stomach (Knoess et al., 1986).

Demand for camel meat has been on the rise due to its curative nature in the treatment of diseases such as jaundice, bone pain, diabetes, arthritis, liver disorders, among others. This is because camel meat has low-fat carcasses than cattle meat and has high water content (Muhammad et al., 2018). The idea of “ship of the desert” has been modified to “A food security animal” for camels by the explosion of population, increasing needs, and evolving knowledge (Faye, 2015). Compared to other domestic farm animals, the total camel population in the world (35 million heads) is poor but constitutes a large portion of the domestic herbivorous biomass in arid countries (Kouniba et al., 2005). Dromedaries and Bactrian camels are large camelids that serve a variety of purposes, including packing, pulling, riding, and producing milk, meat, and wool. While their combined global production of meat (630,000 tons) and milk (2.85 million

tons) is 0.35. Africa may account for more than 10% of the world's consumption of milk and red meat, which currently accounts for 0.75 percent. (Faye Bernard, 2019)

Camel milk has been linked to the well-being of individuals in remote areas, and its meat is valued due to low cholesterol and low fat. It has a high amino acid index, positive effect on hypertension, unlike cattle products (Farah, 1993). Camel products contribute to pastoralist diets in desert areas such as Mauritania and Mongolia (Faye 2015). The “white gold of the desert” or camel’s milk is consumed by the Bedouins in rich gulf countries providing proteins where access to other proteins is challenging (Faye, 2015).

In the regional market, camel meat is involved with big live camel’s exports to North Africa and Arabian Peninsula from Sahelian countries. Its milk can exceed 70% of calories in pastoralist families; thus, in many remote areas of the old world, camel milk and meat contribute to food security, often as an exclusive source of animal protein (Faye, 2016). The demand for camel products and goods has increased, especially in the south and western urban nations. The products have health benefits; improve the global economy, and helps in the minimization of changes in global climate (Faye, 2015).

In Asia and Africa, the importance of camel in arid and semi-arid regions cannot be underestimated. Camels make a major contribution to the subsistence of pastoralists and agro-pastoralist that live in ecosystems that are fragile. Increased human population and decreasing production of food per capita have brought about an urgent need to bring back earlier marginal sources in semi-arid and rangelands and maximize their utilization for adequate production of livestock (Mehari et al., 2007).

A study conducted to find out camel production in Pakistan reports that camels can survive in hostile environment, the camels produce milk and meat consumed by the herders. And the community in general, other animal species cannot survive in Pakistan, unlike camels which were found to survive in the area and providing the people in the area with food hence equilibrating the food security chain (Faraz, 2020). They concluded that the camels in Pakistan were very productive and had a high milk and meat potential that meets the demands of the community (Faraz, 2020).

A study conducted in Pakistan Mankera tahsil district in Bhakkar aimed at evaluating the socioeconomics of camels and the constraints that affect camel production, The researchers reported that the pastoral community reared the Merecha camel breed, which is mostly used for milk since they are good milk producers (Faraz et al., 2019). They further stated that the herders slaughtered the young male camels for meat. The pastoral community benefits from camel milk and meat since they survive in the area no matter the environmental stresses. The camel has become an important food animal in the area since the desert communities depend on them for food.

According to a study done in the Ethiopian-Somali region to identify risk management and coping mechanisms for sustainable camel production, camels have contributed to the region's improvement in food insecurity. (Girmay et al., 2018). Most rural populations in the Somalia region still depend on camels as the main source of food.

2.4 Current Camel Production Systems

An important species of livestock, the one-humped camel (*Camelus dromedarius*) is adapted to hot, dry climates. It serves as a draught and beast of burden for farming, local transportation, and

riding in addition to producing milk, meat, wool, hair, and hides. Large domesticated camelids like dromedaries and Bactrians are thought to have a population around 28 million worldwide. (Admasu, 2008). In particular, Ethiopia and the Sahelian nations of Mauritania, Mali, Niger, Chad, and Sudan are likely to underestimate this figure. More than 80% of camels live in Africa, with 60% of them living in the Eastern African nations of Sudan, Somalia, Ethiopia, and Kenya, which are significant dromedary camel exporters to the Arabian Peninsula and Egypt. (Faye, 2015)

Somali, Oromo (Guji, Borana, Gabra, and Karayu), Kunama, and Irob are the main camel-keeping cultures in Ethiopia, as a matter of fact, the Somali and the afar are known for centuries in camel keeping practices, Borana and Guji just embraced the keeping of camels not so long ago (Aklilu & Catley 2010). The Gabra and Somali play an important role as they are known for rearing camels for decades by bringing them to the Borana plateau; agro-pastoral communities, as well as farmers, have also embraced camel production (Aklilu, 2011).

2.4.1 Pastoral production system

Although camels can survive and produce even in hostile environments, the quality of the milk and meat is affected by several other factors, such as the type of food and the management system. Management systems and parity order have a great impact on the camel production performance, especially in lactating camels (Mustafa et al., 2017). When the pastoral system is remarkable, it plays an important role in increasing milk production and yield.

The quality of the milk is also higher when compared to other pastoral systems, which can be proved by the evident levels of immunoglobulin in milk (Mustafa et al., 2017). Milk quality varies in camels in natural environments and those under favorable conditions. In Ethiopia,

livestock production can be classified as either traditional or modern methods. Traditional methods include pastoral transhumant, nomadic, agro-pastoral, and smallholder mixed crop-livestock (Mirkena et al., 2018). Modern methods include ranching, commercial production, and feedlot, peri-urban and urban; few male camels exist when it comes to the mixed crop-livestock system (Tadesse et al., 2013). The camels are classified under the pastoral and agro-pastoral production systems. Some male camels are, however, classified under the mixed crop-livestock system.

Household income helps pastoralists in securing more than half of livestock and its products. It helps them preserve other indigenous breeds making this scheme comparable to the highland mixed crop-livestock scheme. The scheme requires not only labor but also a few inputs (Tadesse et al., 2015). The composition of the herd is somewhat controlled (only several breeding males are retained), seasonal rainfall patterns and availability of water determine grazing management and the herd's movement (Tadesse et al., 2013).

Somali pastoralists observe the grazing pattern of the cooperative style where a range becomes a shared property belonging to everyone equally; herding groups contain units of herding derived from the sub-clans which make up a clan (Zerga et al., 2018). Even though clan grazing zones can be defined by common usage, the boundaries are not strictly adhered to and overlap with other communities during different times of the year (Bruzzone, 2019).

Camels play many roles in the Somali pastoral lifestyle, and the production of milk is the most important of all during festive seasons. In addition, in traditional social relations, camels have an important role in clan feuds, such as in the payment of dowry, and in compensation for injured parties. Male dromedaries act as transport means for water and household items when moving to

new grazing sites, the bigger the herd size, the higher social status one has. Camels are the main reserve stock in the Somali community, therefore, acting as a store of wealth and defense against natural calamities such as famine and diseases (Asaava et al., 2020).

Pastoralists in Somalia depend on livestock as a source of food and income, and their herds normally consist of goats, camels, horses, and cattle. When it comes to transport, male camels, donkeys, and horses are used (Ali, 2018). In northern Somalia, however, livestock is moved to greener pastures using trucks and water is fetched from water points and brought to the livestock. Semi-pastoralist has practiced south Somalia, and a few northern communities, the people who live in the south and central Somalia, are herders of both cattle and camels. (Ali, 2018)

Semi-pastoral groups have their lives upgraded by farming during rainy seasons, and it's through this that they can have plenty of millet, maize, beans, and sorghum (Blocher, 2018). Environmental degradation and lack of good rainfall are making farming difficult in the said areas (Blocher, 2018). In the Haud region, for instance, camels do without drinking water for long periods. People take milk as water and food source whenever their herds remained without water in Haud, and Sool plateau for those who rear goats and sheep stay close to water points as these animals can only go up to 15 days without water during the dry seasons. (Blocher, 2018).

2.4.2 Agro pastoral production system

In addition to the agro-ecological conditions of an area, other factors that determine the kind of crops and animals to be kept include the biotic and edaphic variables (Lewis, 1999). The extent of crop cultivation and crop type determine the amount and availability of high-quality feed resources throughout the year (Mirkena, 2018). Through the assessment of the area's animal

production method, it is possible to determine the threat of disease and feed resource base, the temporal and spatial rainfall distribution trend tend to indicate the arid areas (Mirkena, 2018).

Significantly, camels claim a major role of being the basic source of livelihood for people who live in fragile climates (Tura et al., 2010). A broader perspective takes account of social-political analysis in Ethiopian pastoral community; the communities tend to be marginalized and are not generally given consideration within the agricultural sector in Ethiopia. The livestock sector has been given very little priority traditionally (Tura et al., 2010).

Agro-pastoralism, pastoralism, and riverine crop farming are the key forms of subsistence strategies commonly known for Somalia in terms of agricultural production, and the rain-fed sorghum belt is also known as the region between river Juba and Shebelle. Agro-pastoralism forms the prevailing strategies for living. Rahanweyn communities largely occupy this area, while Marehan communities are becoming involved deeply with agro-pastoralism (Longley et al., 2001).

There are a lot of agricultural methods that come up with agro-pastoralism from small number retention (Longley et al., 2001). In the pastoral/ agro-pastoral culture, there are a lot of challenges that cause malnutrition to be a burden, including variability and climate change. Pastoralist communities refer to those people who depend on livestock to majorly cater for their life sustenance, whereas agro-pastoralist basic activity is the production and livestock sales the primary livelihood practice, complemented by livestock production and sales, is crop production and sales (FAO, 2018).

In Ethiopia, the camels are of major interest to pastoralists and agro-pastoralists. The camels are a source of food for most households since they can adapt to lowlands (Kirub et al., 2018). The

agro-pastoral areas of camel production are an area that requires further research to aid development. The pastoral and agro-pastoral communities mostly rear the one-humped camel, which majorly contributes to both their economy and social organizations. (Kirub et al., 2018).

The camel is, therefore, a very important animal in the pastoral communities due to their ability to produce even in areas with inadequate water and vegetation cover (Kirub et al., 2018). It is considered a major food source for pastoralists and is a symbol of power, wealth, and cash.

In the arid and semi-arid areas of Asia and Africa, camels contribute majorly to the agro-pastoral communities hence considered very important (Madalcho et al., 2019). In Somalia's drier parts, they are a source of milk and meat and a mode of transport to the pastoralists, while the agro-pastoral communities in Ethiopia produce agro-industrial products to feed the camels along with crop residues and improved pasture (Madalcho et al., 2019).

2.4.3 Intensive farming systems and camel production

Camel farming is taking a new shape in some countries, from traditional methods to more modern and intensive forms (Faye, 2013). The established perception about camel farming in that it is environmentally friendly could be reduced, for all camel stakeholders, the challenges of maintaining this picture and encouraging "sustainable development" include controlling the camel population, which needs to be at equilibrium (Faye, 2013).

Intensive camel production involves the use of a variety of camel species that are maintained because of the environmental carrying power, camel diversity preservation, alternative feeding systems to: protect desert water sources, environmental support, marketing of quality goods in the developing market, management of outbreak diseases in increasing mobile camel population and in consideration to a crucial role that camel plays in the modern lifestyle (Faye, 2013).

Under intensive farming, the camels do not move from one area to another, and they are instead kept in an enclosed place and they are fed twice a day on a monotonous diet (Faye, 2016). The impact of intensive farming on camel production has not been broadly researched. Further research is needed to establish the effects of this method of farming on the camel's milk composition and medicinal activities. The intensive farming method, however, requires higher amounts of water (Faye, 2016).

The intensive and semi-intensive methods of production are both non-economical and reduced the growth rate of the camels (Faraz et al., 2018). Intensive farming is used mostly in big towns as a food source for the people around (Bhakat, 2019). The camels are fed on feeds from the markets, and some pastoralists engage in agricultural activities during rainy seasons (Bhakat, 2019).

The expansion of camel dairy farms, particularly in the metropolitan areas of Saudi Arabia, is being driven by the rising demand for camel milk from the population that is becoming more urbanized. Camel milk output has reportedly been found to be theoretically higher than that of cows under the same farming and climatic conditions. The country's average per capita intake is roughly 33 L / year. The camel has a production capability of 3 to 10 l per day on average, which is not negligible. (Faye Bernard, 2013).

Far from the image of tradition typically associated with Sahelian society, the changes in the mode of land use as a result of interaction between government policy, rural and pastoral farmers, urban stakeholders, international development agencies, and other actors lead to the diversification of economic activities, even in pastoral communities related to their communities (Raynaut, 2001).

Diversification of economic activities has grown due to changes in the way land is used due to interactions between pastoral and rural farmers, international development agencies, and government policies (Sabyrbekov, 2019). The Sahelian community helps in diversifying economic activities, including the pastoral communities connected to theory camels, and it is, therefore, right to say that camel farming is gradually shifting from conventional (parking and riding) (Faye, 1997).

The use of camel has four major changes: 1) camel's population tend to grow in settled livestock systems of farming, 2) in agricultural work, camels are used, 3) the channel used by camel products is integrated closely to the market, 4) a significant role is played by camel in protecting old livestock farming systems, the competitive advantages of the species justify this new dynamic (Faye, 1997).

The dromedary camel is also kept as a dairy farm animal, whose dairy vocation speaks for it, but camel dairy products have only recently been introduced into the market (Maitha et al., 2019). In Agadez, the implementation of a mini-dairy facility has been sustained for several years. Considering the difficulties associated with the collection of milk between communities in constant mobility with mitigated performance in the pastoral climate, experiments to encourage cheese production have also taken place (Molina, 2020).

These developments, however, reflect a significant shift in culture as milk was traditionally used as a gift and now has become a commercial product that enables nomads to integrate into the market who usually feel excluded from the economic growth process (Molina, 2020). This trend could cause dynamic growth in the camel milk sector, especially in Mauritania, where under the primary influence of private initiatives (Abdeirrahman, 1997).

Well-known ethnic groups manage camel rearing in the pastoral areas of the Sahelian nations. In contrast to the Peul, who prefer cattle, the Tuareg, Toubou, and Arab communities in Niger are experts in this species. However, a notable trend has been noticed regarding the increased number of dromedaries found in the cattle herds of the Peul Wodâabe stockbreeders as a result of droughts for almost the last two decades. (Kassahun et al., 2007).

2.5 Constraints to Camel Production

The development of camel production still faces many challenges. The sector is significantly hampered by major problems of recurrent diseases, shortage of feed and water, tribal conflicts, regular droughts, calf mortality, among others (Alary & Faye, 2016). In arid and semi-arid areas, land degradation is rising because of various factors such as human activities and climatic changes, and rangelands get degraded heavily by palatable perennial grasses and shrubs, with most of them greatly reduced (Alary & Faye, 2016). It is necessary to reverse the depletion process as a strategy of a natural resource management system (Al-Osail et al., 2017).

2.5.1 Availability of Feed and Water

Feed, drought, disease, and water were stated as the four key camel production challenges in the Afar in Mille and Amibara areas and Somali in Jigjiga, Moyale, and Shinille areas (Mamo et al., 2017). The scarcity of water was not identified as a challenge in the Gode district; however, market was a serious constraint apart from other challenges (Mirkena et al., 2018).

Water and feed shortages in Ethiopia were the main responses from the respondents in the study areas (Isag, 2009). This finding concurs with the findings of the Rashaidi camel study that established Sudanese camels having a similar morphological feature that is capable of surviving under precarious conditions of water and food (Isag, 2009). In Gezera, a state of Sudan where

food and water are a great challenge, calf mortality (43.3%), reduced milk production (28.33%) were the main results of water and feed shortage (Isag, 2009).

The feed and water provided have been clarified as essential for camel maintenance respondents further stated that higher prices (39.17%) and lack of supply (40.67%) as the reasons for the existing shortages, which are the main factors, accompanied by lack of resources (19.16%) (Isag, 2009). Due to the factors mentioned, it was noted that low quantities of milk were sold by camel herders as intermediaries were involved partially (Mirkena et al., 2018). Rangeland-based animal feeds are decreasing due to the continuous cutting of trees for charcoal and firewood production and drought persistence (Macharia et al., 2001). Feed availability, therefore, becomes very critical; hence low milk productivity; diseases also contributed to low milk productivity in Ethiopia and the Somali region (Macharia et al., 2001).

2.5.2 Marketing challenges to camel and its products

2.5.2.1 Milk issues

Restricted support has been commenced to provide financial support and necessary training for the creation of handling milk, the potential to market, and pastoralist capacity. This is being done by Ethiopian Meat and Milk Institute (EMMI) and Pastoral Resilience Growth (Kebede et al., 2015). Few support services are rendered to camel keepers and herders in consideration to technical facilities, camel health, and milk safety, in the Afar region (Kebede et al., 2015). Incidentally, herders and informal cooperatives store milk in plastic containers for selling, which could highly contaminate and spoil milk (Kebede et al., 2015).

In addition, bad milk storage and processing facilities in the Somali community resulted in milk loss (Kebede et al., 2015). Camel herders are forced to sell their camel milk at farm gate due to

lack of transport to market areas that are long distances away (Girmay, 2019). In Somali, the region, women sell milk by the roadside due to underdeveloped marketing networks (Gebremichael et al., 2019).

2.5.2.2 Cultural Beliefs about Camels

The main persons that consume Camel milk are the Muslims; however, others have reservations based on diarrhea phobia (Kebede et al., 2015). Christians from Ethiopia are, however, banned from taking this milk due to traditional beliefs that camel milk would reduce and die eventually if camel milk was turned into a commercial product, some herders are still not fully in agreement with the idea of selling milk, they did not sell milk because they feared that if the milk is boiled would decrease its medicinal and nutritional value (Kebede et al., 2015).

2.5.2.3 Market distance for camel producers

Agricultural extension interventions and markets access are some of the major concerns surrounding the implementation of strategies to solve issues due to market access (Abdulahi et al., 2020). The distance from the market is a major determinant of development among the pastoral communities (Abdulahi et al., 2020). Camel herders face difficulty in selling the milk produced to far-away markets. They do not have transport services, forcing them to sell the milk at their farms. Additionally, the Somali region had poor infrastructure; hence the women are left with the option of selling milk only on the roadsides (Girmay et al., 2019). In Kenya, the pastoral systems are affected by poor infrastructures (Girmay et al., 2019) and this is evident in the lack of conventional milk value addition.

2.5.2.4 Competition with other sources of milk

Pastoral and agro-pastoral communities produce both camel milk and cow milk, although most of the population in the pastoral community benefit by including camel milk in their diets, most people still choose cow milk whenever there is cow milk scarcity (Demissie et al., 2017). The benefits of camel milk in nutrition make people prefer drinking camel milk. Camel milk gives people higher energy, stamina, and endurance (Demissie et al., 2017). Cow milk, on the other hand, is known to cause obesity. The competition is, however, stiff such that most people still prefer traditional milk to camel milk. Additionally, it is hard changing the consumers' minds since very little research has been done on camel milk (Demissie et al., 2017).

2.5.3 Challenges of Camel Genetic Improvement

Relatively less attention has been given to camels in comparison to other livestock species in terms of their specific ability to increased contribution to food production (Faye, 2015). Research regarding their genetics and genomics is currently being carried out by International Camel Consortium for the improvement of genetics and conservation initiative (Faye, 2015).

Currently, the improvement of camel genetics is hampered due in part to the absence of a published commercial genotyping platform for camel genome reference. There is also difficulty in the dissemination of superior genetics due to the challenge of performing artificial insemination reducing genetic development (Skidmore et al., 2013). This is partially due to the challenge of collecting and handling semen, although various groups have attempted the use of different buffers as media for freezing semen from camels (Skidmore et al., 2013).

2.5.4 Camel Diseases

The influence of climate change on animal health can be classified in three ways: 1) effects that are directly linked to heat stress, 2) favorable conditions for the growth of bacteria, parasites, and pulling vectors affect indirectly; 3) water-deficient animals and resources adaptation mechanisms (Nardone et al., 2006).

The severe health risks associated with camel rearing are well known and have long been categorized as gastrointestinal parasitism, mange, trypanosomiasis, or other major classical diseases (Curasson, 1947; Wernery and Gaaden, 2002). However, during the past ten years at least, several Sahelian countries have seen an increase in new cases marked by severe symptoms, high mortality, and then the inability to make a proper diagnosis.

In 1995-1996, a highly contagious respiratory syndrome (epizooty) prevailed in the horn of Africa. It is characterized by febrile attacks and high morbidity (up to 90%), and its mortality range was between 5 to 70% (Roger et al., 2000). Symptoms close to the above and high prevalence in the peste des petits ruminants (PPR) have been linked to similar data that has been published in Sudan, where lots of epizooties were recorded in early 2000's as well as in Kenya where viruses related to PPR have been recorded without clearly identifying causative agent (Khalafallah et al., 2005). Pastoralists considered these diseases as new names were attached to them, e.g., Firaanfir, Laaba (Khalafallah et al., 2010).

The blood parasitism symptoms (hemolytic anemia and hemoglobinuria) were never verified. Various cases of extreme xerophthalmia were connected to purulent or bilateral sinusitis leading to loss of eyesight was noted, but the cause was never identified in Niger, prior to the main viral diseases (PPR, Rift valley Fever, foot and mouth disease, and bluetongue) were highlighted but

not confirmed (Matei et al., 2019). A high mortality rate was reported in northern Kenya, Ethiopia, and Somalia, and plant intoxication and mineral inadequacy were presumed as the course (Matei et al., 2019).

Somalia's economy greatly depends on livestock production, which is a source of food and income for most families. The livestock industry contributes to the gross domestic products, income, foreign currency, and employment of most people (Mohamud et al., 2018). Somalia also has the highest number of camels in the world and is an essential part of the Somali culture.

Despite the high numbers of camels, the country still has a very low income from camel production (Mohamud et al., 2018). This is mostly contributed by the diseases attack, which lowers milk production in camels. One of the most common camel diseases in Somalia is Mastitis (Mohamud et al., 2018). Mastitis causes the camel's udder to swell and causes the camel's milk quality to reduce and lower their efficacy (Mohamud et al., 2018).

CHAPTER THREE

Materials and Methods

3.1 Study Area

Two districts in the Benadir region, namely Dharkenley and Hodan were selected for the study (Fig 3.1). The Benadir region was selected for this study since it has a potential for rearing camels due to its vegetation. Benadir region is an administrative district to the southeastern part of Somalia. It borders the same region as Mogadishu, the capital of Somalia. The climate is mostly humid, semi-arid-arid as a rainfall of between 50- 150 mm along the coast and up to 500 mm in the northern highlands. (UNFPA, 2016). In Somalia, the coordinates are latitude $2^{\circ} 2'13.6'$ N, and longitude $45^{\circ} 20'37.5E$, where the Benadir region is situated.

The common types of soil in most parts of the country are the deep lime-rich soils and the shallow sandy or rather stony soils. The central region of the country where the Benadir region is located is dominated by averagely deep loamy soils that have high calcium carbonate content and majorly sandy soils (UNFPA, 2016). Additionally, the type of vegetation found in the Benadir area is mostly acacia species and xerophilous pastures, which are shrubs. This makes it an area of interest since it lies in the arid and semi-arid region where crop farming and other types of livestock farming practices are not successful. Furthermore, the area only has one permanent water source, River Shabelle which is densely populated and has various agricultural activities ongoing.

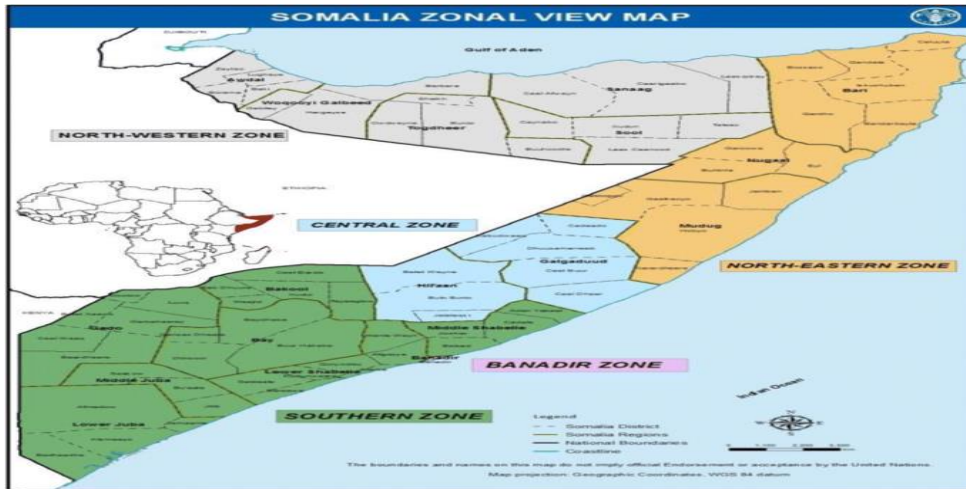


Figure 3. 1: Map of Somalia

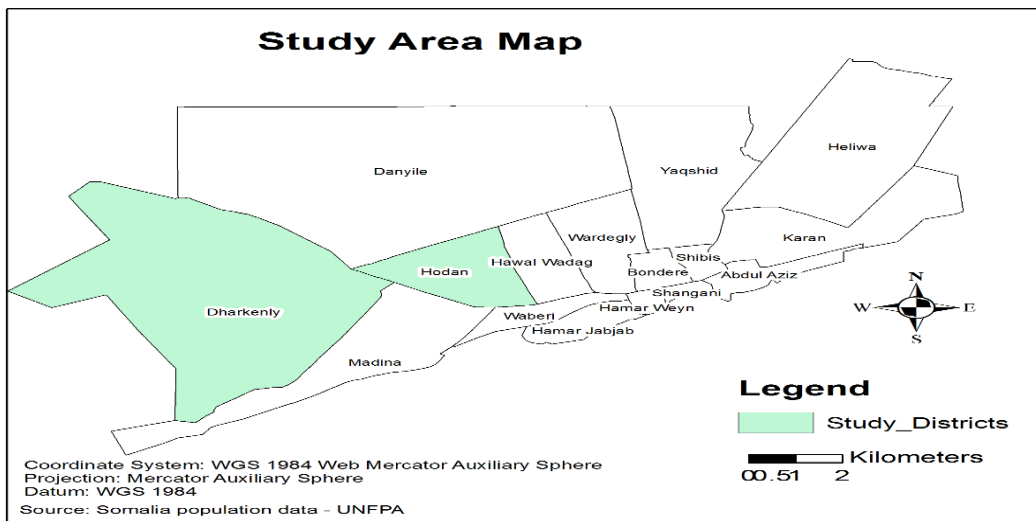


Figure 3. 2: Benadir region showing selected districts

3.2 Sample size and procedure

Information was collected from pastoralists keeping camels purposively selected in Dharkenley and Hodan districts of Benadir region. Benadir region was selected as the study area due to its potential for camel rearing based on type of vegetation. The calculated sample size is 138 from formula by Pfeiffer (2010).

$$n = Z^2 [p(1-p)/L^2]$$

where

N: the sample size Z: 1.96, the standard normal deviate at the desired confidence interval, 95%

P: 0.9 (90 %) the assumed proportion (prevalence) of the households who own livestock and engage with the other segments of the value chain; L= 0.05 (5 %), the precision. The calculation of the sample size is shown below;

$$\begin{aligned} \text{Sample size} &= 1.962[0.9(1- 0.9)/ 0.05^2] = 3.84[0.9 (0.1/0.0025)] = 3.84[0.9(40)] = 3.84 [36] \\ &= 138.24 \end{aligned}$$

3.3 Data collection

The primary data were collected using a questionnaire which was prepared in accordance with the objectives. The questionnaire was administered to the sampled households. The interviews were conducted in local language “Somali “through face-to-face interviews with the help of trained enumerators. Data collected from the selected farms included; camel herd dynamics, milk yield, husbandry practices, source of water and camel watering frequency, camel diseases.

3.4 Data Analysis

Questionnaires will be checked for completeness and obvious errors. Data will be cleaned, edited, sorted and entered into the Excel. Descriptive statistics consisting of means, standard errors, frequencies and cross-tabulation for various parameters stated below will be computed using the Statistical Package for Social Sciences (SPSS), version 21.0

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Respondents Demographic characteristics

The summative composition of the divisions in the districts of Hodan and Dharkenley (Table 4.1) the numbers of respondents were as follows, Hodan 79 (57.3%), Dharkenley 59 (42.7%). In the Hodan district, the Weydow division had the highest number of respondents at 23 (16.7%), while the Sarkuusta Division only had 1 (0.7%) as the lowest. In Dharkenley district, the highest numbers of respondents were realized in Daara salaam division with 22 (15.9%) while the lowest was at Macalin nuur with only 5 (3.6%).

Table 4. 1 Number of respondents in selected districts and divisions

District	Division	No of Respondents	Percent (%)
Hodan	Garasbaley	15	10.9
	Roob Da'ay	19	13.8
	Sarkuusta	1	0.7
	Tabeelaha shiq	21	15.2
	Weydow	23	16.7
Total		79	57.3
Dharkenley	Daara salaam	22	15.9
	Macalin nuur	5	3.6
	Nuur Aduunyo	17	12.3
	Xoosh	15	10.9
Total		59	42.7

4.2 Gender Distribution

Gender composition of the respondents in the 2 districts is shown in Table 4.2. The proportion of respondents who took part in the survey was dominated by male respondents. Since camels in all the study areas are only owned by males, a larger proportion of the respondents were male. The male respondents were chosen over the female respondents since they have more knowledge on camel production and management making them the target respondents. In Ethiopia, a similar pattern was observed where only male adults and children were the only family members in charge of managing camels (Salamula et al., 2017). In a different study conducted by Simenew et al., 2013, the researchers explained that due to the strong cultural prohibitions in the society, wives and daughters were not allowed to do the camel milking. There is a dominant difference in the gender roles as well as inequality in these communities; the main reason why the respondents turned out male was because they herded the camels (Tadesse et al., 2014). In a similar study by Wubishet et al., 2013 in Yabello district Ethiopia reported that the respondents were primarily males (83.33%) while the females were (16.67%).

Table 4. 2 Gender Distribution of respondents in the study area

District	Hodan		Dharkenley	
	Male	Female	Male	Female
Gender				
No of Respondent	56	23	45	14
Percentage (%)	70.8	29.1	76.2	23.7

4.3 Age of the respondents

The age distribution of the respondents is shown in Table 4.3. The age-range of the respondents from Benadir region ranged between 21-63. The age bracket of 21-30 years were 12.3%

respondents, between 31-40 years there were 37.7% respondents, between 41-50 years there were the highest percentage of respondents approximately 38.4% and finally, 51-60 years had the least percentage of respondents of about 11.6.

Table 4. 3 Age distribution of respondents in the study area

Years	Frequency	Percentage
21-30	17	12.3
31-40	52	37.7
41-50	53	38.4
51-60	16	11.6
Total	138	100.0

4.4 Camel Herding Management responsibilities among household members

The involvement of family members in camel management (herding) is shown in Table 4.4. In the management of the camels, the household head had the highest responsibility (68.8) followed by the spouse (21.0). At the age of 11, the sons are permitted to herd the camels, at 8.0% with the daughters having the lowest responsibility at 2.2%. It is within cultural practices which expressly allow heads of households to oversee camel rearing. This agrees with an earlier observation that camel management was a responsibility allocated to the husbands and sons in the Afar community (Simenew, 2013). In Afar area, Ethiopia, husbands, their sons as well as hired laborers were the main players in managing camels, while the wives' duties entailed milking the camels and marketing the products (Gebremichael et al., 2019).

Table 4. 4 Camel Herding Management responsibilities among household members

Family members	Daughter	Head	Son	Spouse	Total
Districts					
Dharkenley	1	38	7	13	59
Hodan	2	57	4	16	79
Total	3	95	11	29	138
Percentages (%)	2.2	68.8	8.0	21.0	100

4.5 Level of Education of the Household Respondents

The level of education of the respondents in the study area is shown in Table 4.5. In Benadir region, very few of the respondents (3.6%) had attained secondary school. The majority (55.1%) had reached the primary level with 41.3% respondents without formal education. During data collection, a trend of lack of good record keeping in the camel production systems was noted. This is because of the levels of education of majority of the respondents. Similar study done in Ethiopia reported that majority of the camel farmers were illiterate, those who had a primary level education were moderate whereas university graduates were less than 2% (Isag, 2009). The main reason camel pastoralists lack formal education is because they often move from one place to another as they search for water and pasture. In a similar study done in Ethiopia, it was reported that 94% of the study male participants were illiterate while the remaining received primary education (Grades 1-7) (Simenew, 2014).

Table 4.5 Level of Education of Household in the study area

	High school	No formal education	Primary	Total
	Count	Count	Count	Count
Division				
Daara salaam	0	8	14	22
Garasbaley	1	7	7	15
Macalin nuur	0	2	3	5
Nuur Aduunyo	0	6	11	17
Roob Da'ay	1	7	11	19
Sarkuusta	0	0	1	1
Tabeelaha shiq	0	10	11	21
Weydow	0	13	10	23
Xoosh	3	4	8	15
Total	5	57	76	138
Percentage (%)	3.6	41.3	55.1	100

A study conducted by Lamuka et al., (2017) on camel health management and pastoralists knowledge and information reported that lack of education and knowledge among the pastoralists had an impact on a few traits of the production systems. Low levels of education affected the pastoralists' ability to understand and interpret information regarding camel health management and food safety awareness. Additionally, lack of formal education led to a barrier between the professional veterinary staff and the pastoralists hence difficulty in offering services. There were no valid records kept on the animal's treatment programs due to low education levels.

4. 6 Animals bought and sold during the past 12 months by households in the study area

The type of animals sold or purchased by respondents during the last 12 months is shown in Figure 4.1. All the respondents bought and sold goats however, the camels were only bought, and none was sold, sheep were also rarely sold.

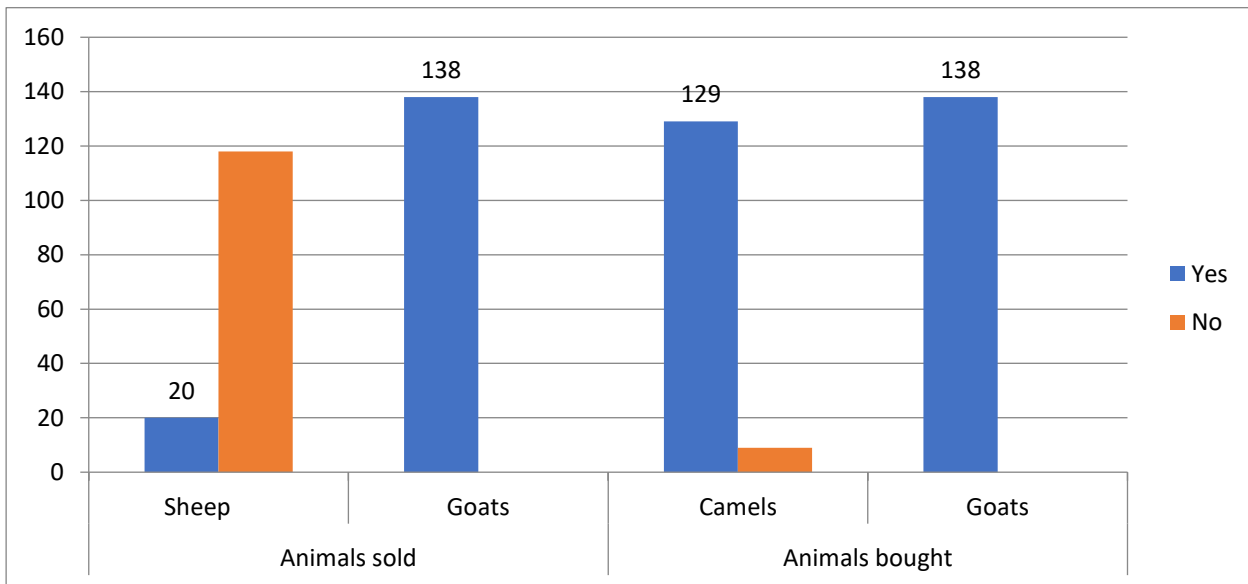


Fig 4.1 Animals bought and sold by respondent for 12 months.

A study conducted with camel pastoralists in Ethiopia in Afar region showed that most of the camel owners sold other domesticated animals 12 months prior to the survey period and for different purposes (Isag, 2009). The camels in Gedaref state were sold to purchase sorghum residue after the harvests, to cater for family expenses and to pay taxes. The camels in Gezira were sold to handle financial problems arising from agriculture, to cater for family basic needs, to pay taxes and to buy female camels after selling the males as well as to buy the residues from sorghum harvesting (Mehari et al., 2007). Additionally, the camels in Sinnar were sold to allow proper care of other animals and to cover the cost of herding camels. The primary aim of purchasing camels in the aforementioned areas was for purposes of breeding with the female

camels claiming larger numbers (Ishag & Ahmed, 2011). From the results represented in Figure 4.1 above, it is evident that very few camels are sold while many camels are bought by the respondents. Additionally, camels are the least sold livestock in various households. Camels are the most preferred due to their ability to resist long periods of drought and thirst since they can adapt physiologically and anatomically (Simenew et al., 2013).

4.7 Types and Purpose of Slaughtered Animals

Table 4.6 shows the types of animals that were slaughtered by the respondents. Goats ranked higher than slaughtered camels with 91.3 % indicating that they mostly slaughtered goats and (22.5 %) had slaughtered camels. This difference could be attributed to the cultural practices of the Benadir pastoralists, the gestation time, the growth rate, and the social value of camels contributed to the pastoralist's preference for goat slaughter. Camel was slaughtered for different reasons, in some special circumstances camel was slaughtered during circumcision of children (Foxwell, 1999).

Table 4.6 Slaughtered livestock by households in the study area

	Goats		Camels	
	Respondents	Percent (%)	Respondents	Percent
Yes	126	91.3	31	22.5
No	12	8.7	107	77.5
Total	138	100.0	138	100.00

Table 4.7 shows that the highest slaughter reason was for sale. Only 14.3% of the slaughtered animals were for household consumption while 84.3% were for commercial purposes.

Pastoralists tend to slaughter sheep and goats because they have a short generation interval due to short gestation time, faster growth rate, and are cheaper than camels. Camels have been slaughtered for various reasons such as injury owing to an accident or animal wrestling, for special festivities and lastly for sale as meat (Amene et al., 2012). However, most camel keepers do not slaughter camels since their diet comprises of milk, the camels being too precious to be slaughtered thus only the sick or aged camels are eaten (Jaji et al., 2017).

Table 4.7 Purpose of Slaughtered Animals

	Frequency	Percent (%)
Home consumption	20	14.3
Sale	118	84.3
Total	138	100

4.8 Role of camels to the Household economy in the study area

Table 4.8 shows the respondents perception on the role of camels in their economy. 83.3% (Yes) of the pastoralists reared camels for economic purposes while the 16.7 % (No) rear the camels for subsistence and for status recognition in the community. A study conducted on the role of camels in pastoralist's livelihoods reported that at household and community levels, milk production from camels largely contribute to the local community's economy (Elhadi et al., 2015). The households that rely on cash produced from selling camel milk for food security throughout the year mostly rely on the camels as the primary source of income and food. The cash obtained from selling of camel milk aids several households to maintain their properties

such as other domestic animals which would have to be sold for food in the absence of camels (Elhadi et al., 2015). Money obtained from the sale of camel products is used in accumulating and sharing properties with other pastoral households hence ensuring improved economic state within the areas under research. A different study about camel milk production and marketing in Afar pastoralist showed the trade terms between the purchased products and the pastoral milk marketing are the reliable interfaces for analyzing the economics in camel milk (Nori et al., 2018). Another study has acknowledged that the camels' economic potential with their milk increasingly recognized in the arid as well as the semi-arid lands (Wako, 2015). Camel milk has been recognized to sustain the economic growth and the rural livelihoods as well as the inclusion of the pastoral community into the world economy (Faye et al., 2011).

Table 4.8 Role of camel keeping to economic activity in study area

Respondents	Frequency	Percent
No	23	16.7
Yes	115	83.3
Total	138	100.0

4. 9 Camel herd demography

The camel herd composition in the surveyed households in the study area is shown in Table 4.9. The total number of camels in the areas of study, Dharkenley and Hodan districts were found to be 1111 females, 322 calves, 816 lactating camels, and 137 male camels. As expected, the female camels were more due to their role in reproduction while the male camels were few due to their

sole purpose as breeding. Among the male camels in the herds, those not selected for breeding were either sold at a young age or separated for fattening and selling afterwards. Additionally, the old and the young camels were often slaughtered for purposes of meat consumption.

The adult, immature and calves in Jigjiga accounted for 61.2%, 21.1% and 17.7% of the herd, respectively, while in the Shinille site they accounted for 58.2%, 26.1% and 15.7%, respectively (Kekses et al., 2013). In both study areas, there was a higher proportion of female calves compared to male calves due to the stringent method of selecting breeding bulls from camels in a line of female-bearing ancestors as reported by the informants (Kekses et al., 2013). This research also recorded a higher number of female camels which is agreement with the other studies.

Table 4. 9 Camel Herd Demography

District		Fertile Female	Lactating	Calves	Mature Male
		camels	female camels		camels
Dharkenley	Sum	442	315	128	46
	Mean	7.49	5.34	2.17	1.24
	Std. Deviation	3.087	2.316	0.746	0.495
Hodan	Sum	669	501	194	91
	Mean	8.47	6.34	2.46	1.47
	Std. Deviation	3.281	2.987	0.984	0.620
Total	Sum	1111	816	322	137
	Mean	8.05	5.91	2.33	1.38
	Std. Deviation	3.225	2.756	0.899	0.584

Attempts to ensure a consistent supply of milk for household consumption may also reflect the large number of adult fertile female camels compared to that of lactating female camels. In the

pastoral areas of Eastern Africa just as the selected study region, the camels have been reared majorly for producing milk (Abdelatif & Elnageeb, 2014). Milking usually begins three days after calving and the camels have long lactating periods. This makes it more economical to have fertile female camels for milking (Mirkena et al., 2018).

4. 10 Source of water and watering frequency for camels by Benadir pastoralists

The source of water and watering frequency in the study area are shown in Figure 4.2. There were 2 sources of water in the Benadir region for watering the camels, namely water ponds and the wells. The wells were mostly used as a water source during dry seasons and drawing water from the wells is difficult and tiring. The ponds on the other hand were also a watering point for other wild animals making it a possible source of disease spread and transmission (Mirkena et al., 2018). The watering frequency ranged from twice weekly to twice a month. Additionally, pastoralists who watered their camels 1-2 times a week usually opted for the wells while those who watering only twice in a month or 3/week preferred to use the ponds for watering due to the proximity.

Water ponds are the most common water supply sources that accommodated the great numbers of the pastoralists since certain divisions lacked wells to use for watering their camels.

As such, lack of adequate water in the Benadir region contributed greatly to the low productivity of the camels. In southern Ethiopia, the major constraints that hinder the camel development in the areas studied were shortages of water and inadequate feeds (Wubisher et al., 2017). A similar study on constraints to camel production in Ethiopia reported 80% of respondents claimed inadequate feeds was the critical limiting factor to the increase of camel productivity thereafter shortage of water in the region (Mirkena et al., 2018). However, 61.7% of the respondents in this selected study area consider the production constraint factors as feed shortages, water shortages

and shortages. A study in Ethiopia reported that the key water issue faced by the camel milk producers was water scarcity (Gebremichael et al., 2019).

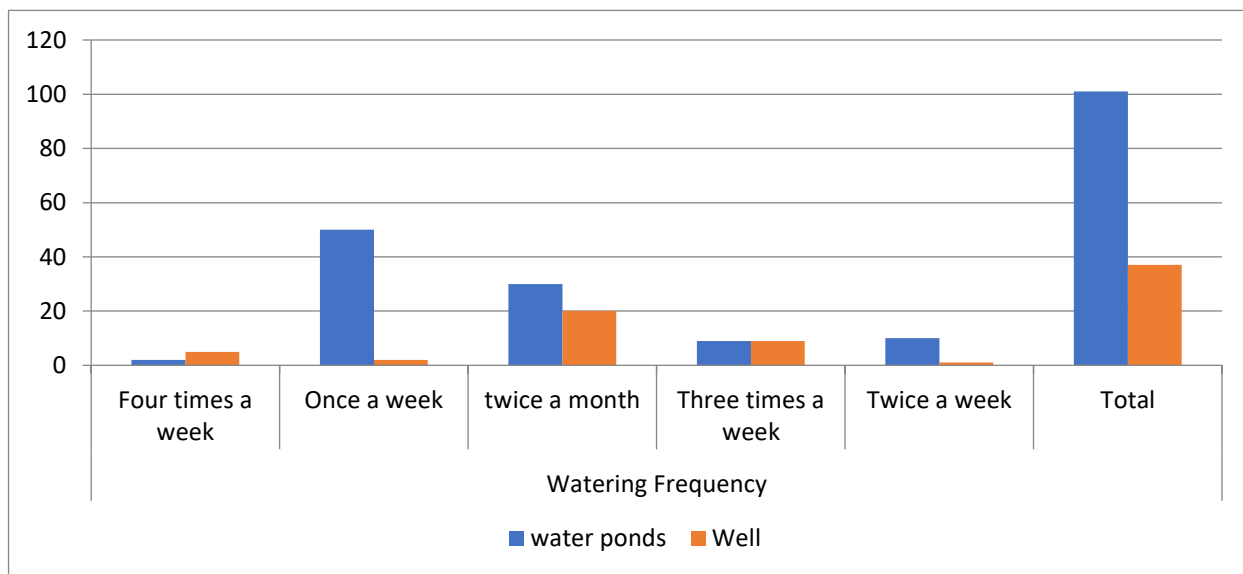


Figure 4.2 Source of Water and Watering Frequency in Benadir Pastoralists

4. 11 Occurrence of Camel Diseases in the study area

Table 4.10 shows the percentage of respondents reporting disease as a main challenge facing Benadir. Most camel diseases are because of low quality veterinary drugs, poor knowledge of animal diseases among pastoralists increases the chances of diseases on camels, thus this attribute the productivity of camels either production of milk or growth rate of the animal. The response on whether disease was the main constraint to camel production is shown in Table 4.10.

Table 4. 10 Occurrence of Camel Diseases in study area

Respondents	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percentage
Yes	127	92.0	92.0	92.0
No	11	8.0	8.0	100.0
Total	138	100.0	100.0	

4. 12 Common Camel Parasites & Diseases and their Frequency

The common diseases and frequency of occurrence is shown in Figure 4.3. In Benadir region, the most common problem was ectoparasites followed by Trypanosomiasis. Mastitis and sarcoptic mange, however, also had a high occurrence. In another study in Afar region in Ethiopia reported the main disease amongst pastoralists was trypanosomiasis followed by camel pox (Simenew, 2014). Furthermore, in another study in Ethiopia owners, of camels have identified trypanosomiasis as the most significant disease in the states of North Kordofan, Sinnar and Gedaref (Ishag et al., 2009). In comparison, camel owners in the state of Gezira stated that the most significant parasite was mange (Ishag et al., 2009). In a different study the main health problem in camels Ethiopia were identified as Camel pox, Dermatormycosis, Trypanosomiasis, infectious ecthyma, pneumonia, internal parasites, and mange mite infestations (Mirkena et al., 2018).

The main diseases affecting the reproductive and production performance of the camels were identified by the respondents in order of their relevance. Diseases associated with the respiratory system and the endoparasites infestations were the major concerns in the study areas. Also, the livestock diseases reported by pastoralists in Ethiopia are trypanosomiasis, brucellosis, and internal parasite infestation (Simenew, 2014).

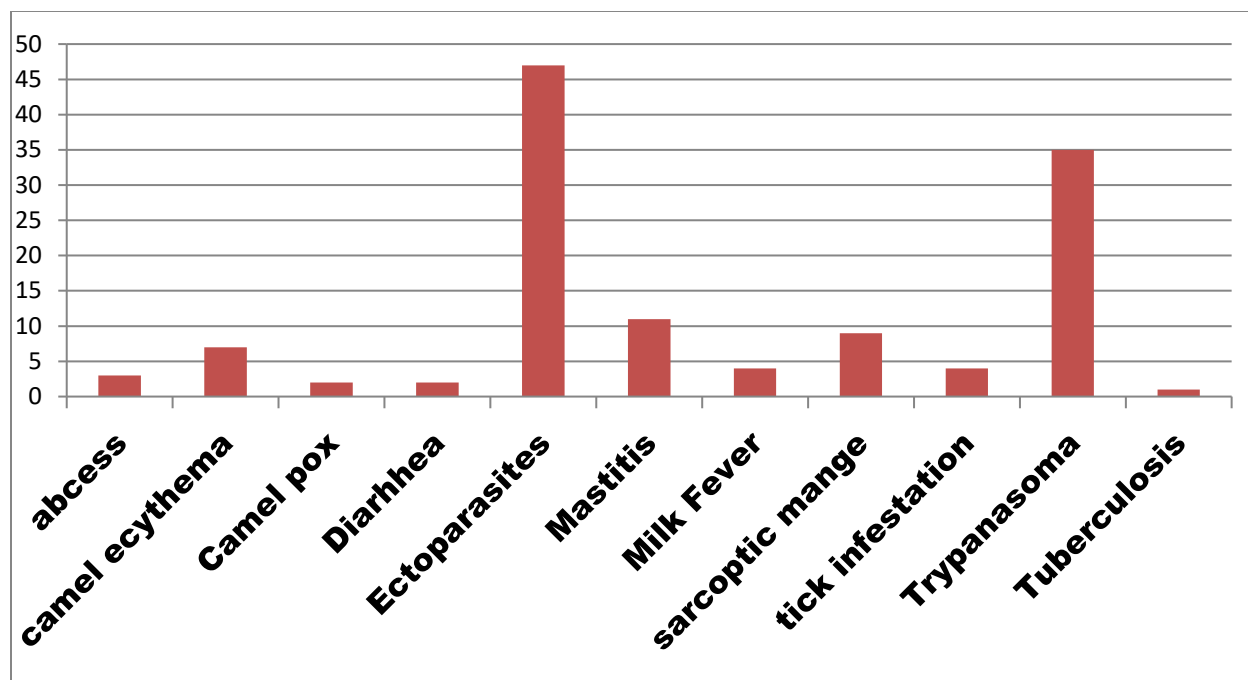


Fig 4.3 Common diseases and frequency of Occurrence

Respiratory system complications and the ecto-parasitic infestations were the main diseases in the selected areas of study followed by brucellosis, trypanosomiasis and Endoparasites (Keskes *et al.*, 2013). Another study reported that camel trypanosomiasis was a critical disease that has caused a great economic loss to the camel farmers in Ethiopia and has caused 30% morbidity and a mortality rate of 3% in camels (Mohammed *et al.*, 2015). However, close to 51.8 percent of participating Afar pastoralists said in the current study that water and feed shortages are the major problems, yet this appears to be lower compared to the survey in Sudan by (Ishag & Ahmed 2011).

In this study trypanosomiasis was the most significant disease followed by mastitis and sarcoptic mange. In Ethiopia specifically in Somali Region trypanosomiasis had a prevalence of 5.4%-20.6%-followed closely by the sarcoptic mange mite lesions. Strong ticks and parasites however were persistent all through the year with a higher outburst during the dry months compared to the

moths with rain (Farah et al., 2007). Similar findings in eastern Ethiopia and found that the prevalence rate of *Trypanosoma evansi* was 8.1% in the regions of East Hararghe and Babile (Mirkena et al., 2018).

4. 13 Disease control, disease incidence and drug information

Figure 4.4 shows three attributes of disease occurrence, action taken and medication. The diseases on attacking the camels are regulated by all participants, except two. Most pastoralists performed administration of treatment and drugs directly, thus documenting the best, although few pastoralists favored slaughtering. However, a few pastoralists do nothing about it.

Information on camel drugs was obtained from different sources; through fellow farmers, from the media as very few obtained the information from members of NGOs. Pastoralists in the study region treated camel diseases on their own with knowledge thus increasing the mortality of the camel herds. The behavior recorded among most of the pastoralists when it comes to treating the animals may have been a cause of more disease outbreak and persistence, hence affecting the camel productivity. A study conducted in Isiolo County, Kenya, reported self-medication for the camels and other livestock as the main practice by the pastoralists. (Lamuka et al., 2017). Approximately 12.5% of veterinary officers who offer services do not work under the government supplied clinical services (Lamuka et al., 2017). Most of the pastoralists know what to do before they can be guided by the government veterinary officers. As far as proper veterinary drug use is concerned, only 18.5% had the relevant knowledge obtained from the informal trainings done. Additionally, 80% of the pastoralists said that the drugs were obtained from the agro-vet stores while 8.6% got their drugs from the donor (Lamuka et al., 2017).

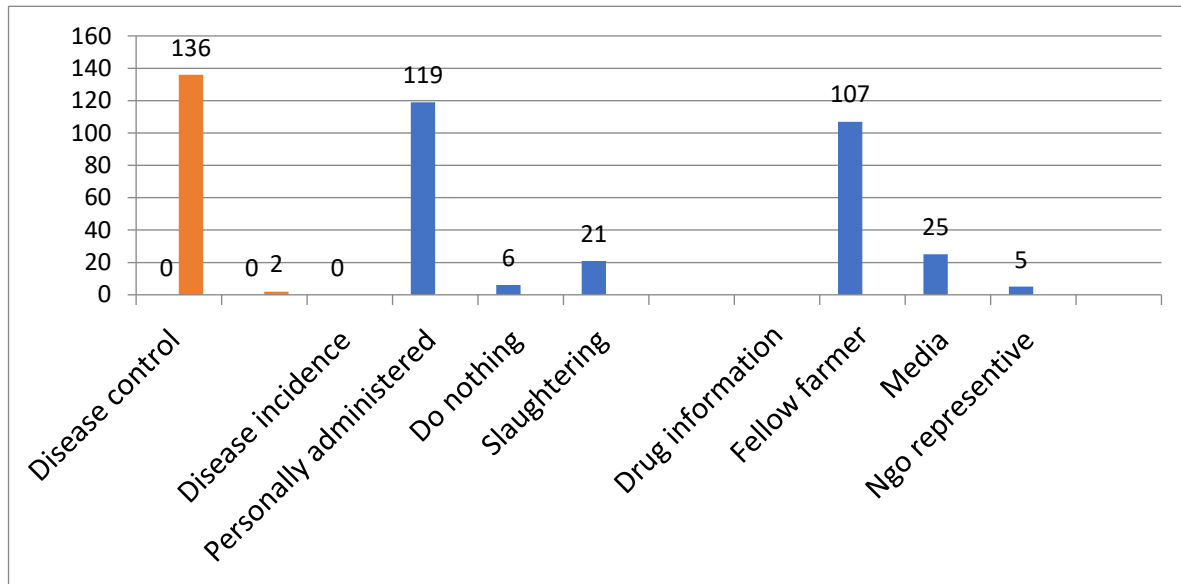


Fig 4.4 Disease occurrence, action taken and source of information

4. 14 Household Camel Meat Consumption

The household camel meat consumption in the study area is shown in Table 4.11. Camel meat consumption in the two districts of Hodan and Dharkenley was 43 (31.2%) only 1/week while camel meat was consumed once a month by 95 (68.8 %). Camel meat costs are higher compared to other species, thereby impacting the rate of consumption of camel meat since it is not quite affordable. Sudan, Egypt, Saudi Arabia (KSA) and Somalia are the most important producers of camel meat (Faye et al., 2020). However, some countries such as Somali and Sudan primarily export, while others such as Egypt import (Kadim et al., 2013). However, camel meat contribution to the overall production of red meat varies between regions. It accounts for 3 percent of the entire meat market, 4.1% of Eastern Africa’s total red meat market, 2.7% and 4.8% in Northern Africa, 2.0% and 2.9% in Western Africa (Kadim et al., 2013).

Camels have a potential of assuming a great meat supply in the arid areas where most meat producing animals cannot thrive, when optimal management conditions are given, their growth is efficient and they produce great weight carcasses in comparison to beef cattle (Khan *et al.*, 2016). Meat from camel is suitable for consumption by humans and may take over meat supply from other domestic animals in some cultures (Khan *et al.*, 2016). Compared to other farm animals, camels produce large amounts of meat hence camels can considerably produce great amounts of meat with high qualities, in the year 2011, 62.2 % camel meat was provided by Africa, 35.8% by Asia and 5.3% by South America (Kadim *et al.*, 2013).

Table 4. 13 Household camel meat consumption

District	HOUSEHOLD CAMEL MEAT CONSUMPTION		
	Once a week	Once a month	Total
Dharkenley	17	42	59
Hodan	26	53	79
Total	43	95	138

4.14 Milk production, home consumption and sale

The mean milk production, home consumption and sale in the 2 districts is shown in Figure 4.6. Milk sales exceeded home consumption, and indication that camels provided income to improve their livelihoods. The total quantity of milk produced in Afar was 4565 liters; however, the average household milk sold was relatively higher than the average consumption. 927 Liters of milk is consumed by the households at an average of 6.72% while the average quantity of milk

sold is 2961 litres at an average of 21.46% (Gebremichael et al., 2019). A different study conducted by (Wako, 2015) in Yabello and Borana found out that during the wet season, the total household milk produced was 1334 Liters while in the dry season the milk produced was 902 Liters. The overall average volume of milk is 1,118 liters a day or 408,070 liters a year for the two seasons or 365.25 days. All respondent households sold a higher percentage of the milk that was produced than they consumed with percentages of 71 and 29, respectively. Annually, in all income classes, all households sell a higher proportion of the milk produced during the dry spells than during the rainy seasons with percentages of 72 and 69 in the respective seasons (Elhadi et al., 2015).

The mean milk production, home consumption and sale in the 2 districts is shown in Figure 4.6.

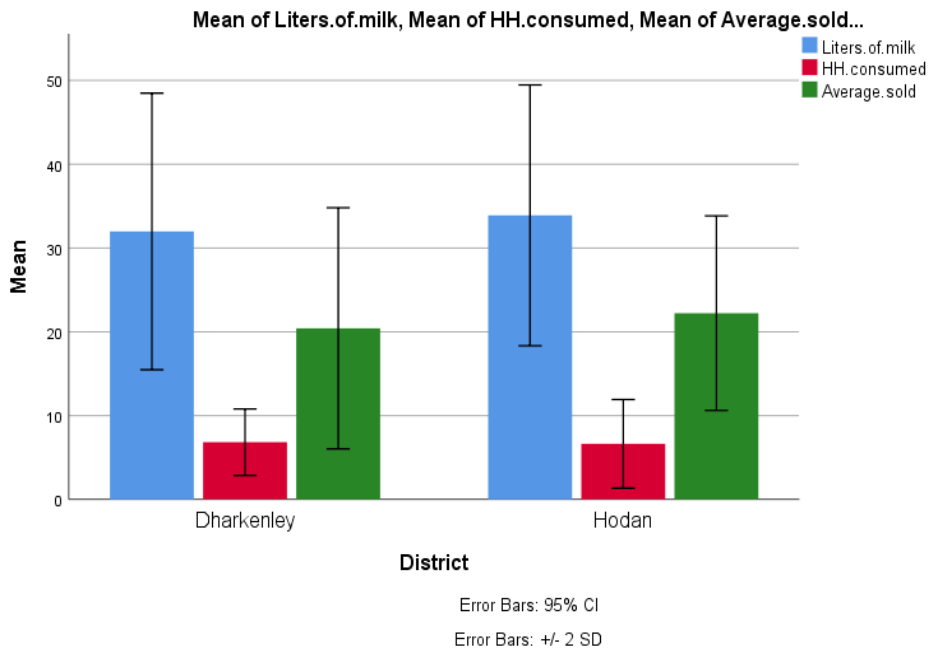


Figure 4.5. Average Camel milk production, home consumption and sale Per Household

4.15 Respondent view on the camel enterprise productivity status in the study area

The respondent perception on the status of the camel enterprise is presented in Figure 4.7. There were 27.5% of the camel pastoralists who believed it was enhanced, however, (18.1 %) found it was worse and (54.3 %) no improvement. Lack of proper animal husbandry practices such as disease control, poor breeding animal selection, and lack of adequate feed throughout the year, as well as water shortage and animal movement, all these factors have led to lack improvement of the camel enterprise. A study conducted in Marsabit and Isiolo reported that the pastoralists, as far as the generation of revenue is concerned, produced KES 10,292- 4,888 each month from the sale of live camels and milk in Isiolo and Marsabit, respectively.

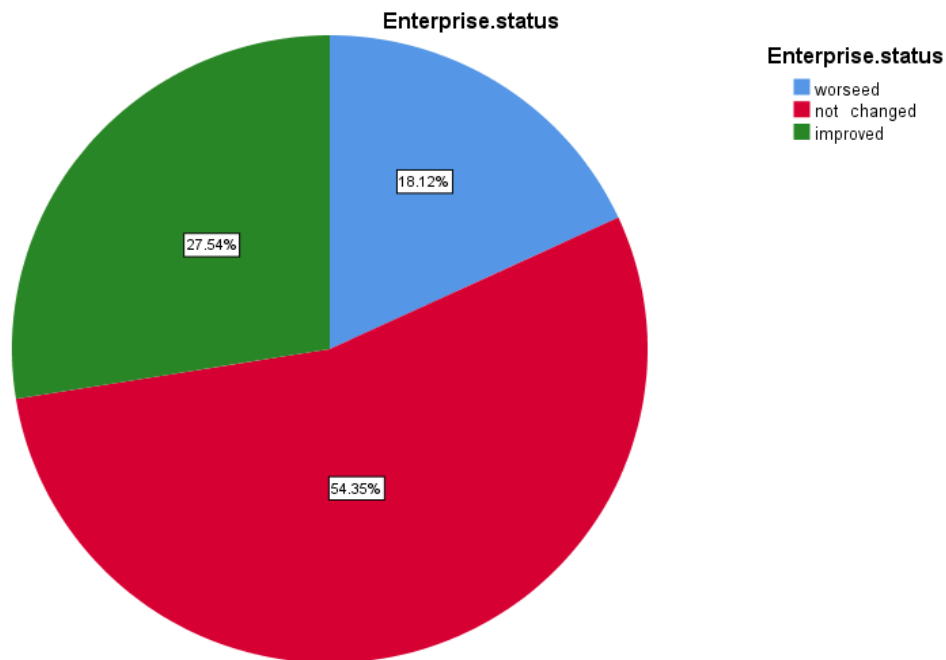


Fig 4.6 The respondents perception on the status of the camel enterprise

In peri urban Isiolo and Marsabit, the rapidly expanding commercial rearing of Somali camels was profitable for pastoralists (Elhadi et al., 2015). Another study conducted reported that the

sales are on the rise in part due to pastoralist settlement and market demand for camel milk, as well as a split in conventional beliefs (Nyariki et al., 2019).

Some evidence of camel milk sales has been seen on Afar's main roads as a way of earning an income, the local cities, and towns in the Somali region of Ethiopia have centers for collecting and selling milk (Simenew et al., 2013).

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The main aim of this study was to characterize the camel production systems that are under management of pastoral communities within the selected districts of Dharkenley and Hodan districts in Benadir region of Somalia. This study concludes that:

1. The main challenges facing camel pastoralists in Benadir were the poor camel husbandry practices, camel diseases, and the absence of a strong marketing system.
2. Improvement of camel performance through proper diseases control methods and increased feed availability.

5.2 Recommendations

The study recommends the following:

1. To improve the dairy camels' performance among the pastoralist communities, interventions should be made to improve areas such as breeding, nutrition, disease control and the existing marketing system.
2. The camel farmers ought to be trained on the essence of keeping records to assess performance. Additionally, they should be trained on feed conservation techniques such as silage and hay making to ensure that there is abundance of feed annually.

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QUESTIONNAIRE

Project: Characterization of camel production under pastoralist management in Benadir region

Date of interview: -----

Interviewers name: -----

Supervisors name: -----

Part (1) General information

Farm Details:

District name: -----

Division name: -----

Respondents Details:

Name of Respondents: -----

Phone number: -----

Gender: -----

Age: -----

Farmers information:

1. What is your relationship to the head of household?

Head spouse son/daughter other (specify) -----

2. What is the highest level of education reached by the household head?

No formal education

Primary school

High school

University

Part (2) farm production

3. During the past 12 months has the household raised or owned?

Local cattle

Sheep

Goats

Poultry

4. How many [animals] of all ages are owned by your household presently?

Cattle -----

Sheep -----

Goats -----

Camels -----

Poultry -----

5. During the past 12 months has member of your household sold any?

Local cattle

Sheep

Goats

Poultry

Camel

6. During the past 12 months has member of your household bought any?

Local cattle []

Sheep []

Goats []

Poultry []

Camel []

7. How many animals have you bought?

Local cattle -----

Sheep -----

Goats -----

Poultry -----

Camel -----

8. Did you receive [animal] as gift in the last 12 months?

YES NO

9. From whom did you receive most these animals?

Relative

Friend

10. Did you slaughter any animals in the past 12 months?

Local cattle []

Sheep []

Goats []

Poultry []

Camel []

11. If yes, how many animals did you slaughter?

Local cattle -----

Sheep -----

Goats

Camel

12. What was the purpose of slaughter?

Home consumption Sale Other (specify) -----

13. For how long have you been keeping camels?

Years -----

14. What is your main objective of keeping camels?

15. Do you consider camel keeping as an important economic activity?

YES NO

16. If Yes, why?

Part 3 Camel breeds, Number and Classification

17. Now I would like us to distinguish the number of camels and the breed

How many female camels are currently keeping?

How many of them are currently lactating?

How many calves do you have as young stock?

How many male camels are currently keeping?

18. What breed(s) of camels are you keeping?

Part 4 feeds and feeding system

19. What do you mainly use to feed your camels?

Natural grazing other (specify) -----

20. List at least five (5) local shrubs and trees camels prefer to eat?

.....

.....

.....

21. During which season of the year is feed availability for camels constrained?

22. From your experience are there some [trees and shrubs] that are harmful to camels?

YES

NO

23. If yes, which trees and shrubs are harmful to camels?

24. Do you preserve feed for Camels?

YES

NO

25. If yes, How?

26. What is your source of water for the camels?

Dam []

River []

Well []

Borehole []

27. How often do you water the camels?

Daily []

Once every two days []

Others indicate -----

Part 5 Diseases

28. Are camel diseases a problem in your herd?

Yes

NO

29. Please list in order of importance the diseases that occur frequently among your camels?

.....
.....

30. In your assessment which of the [disease/s] listed above is/are most serious?

31. What do you do when there is a disease incidence among your herds?

Personally administered treatment []

Call an animal health professional []

Do nothing []

Slaughter []

Any other (specify) -----

32. Have you practiced disease treatment/control in the last 6 months?

YES

NO

33. What methods of disease treatment/control did you use?

Modern drugs []

Indigenous technical knowledge []

Both []

34. From where did you get information on the appropriate drugs to administer for diseases?

Fellow farmer []

Media (Radio, Tv, Print) []

Veterinarians []

NGO representative []

Other (specify) -----

35. In these set questions you are required to ask the respondent to respond with Yes and No to answer.

Are veterinary services available? YES NO

Are drugs to treat camel diseases readily available? YES NO

Is information to farmers on camel diseases readily available? YES NO

Is the cost of drugs and veterinary services too high? YES NO

Part 6 consumption and market

36. How much milk are you currently obtaining from the camels?

Indicate the amount -----

37. Of this total how much is consumed by the household?

38. In the past month how much milk on average do you sell per day?

39. How far is the camel milk market from your home? -----

40. Is this a walking distance? Yes NO

41. If not walking distance how do you get the milk to the market?

42. Have you ever lacked a market for the milk?

43. If yes, what did you do with the milk?

44. How frequently do you or your household consume camel meat?

Once every week []

Once a month []

Once a year []

Other frequency specifies -----

45. Do you maintain any records?

Yes

NO

46. If yes, which records do you keep?

Mating records []

Birth records []

Health records []

Sales []

Weight records []

Any other specify -----

47. If not, why you do not keep records? List the reasons?

48. Do you or does anybody in the household belong to a camel producer group or association?

YES

NO

49. What is the name of this group or association that you are member of?

50. Considering the last year would you say that your enterprise producing (camel milk and meat) has maintained, lost or improved in terms of turnover?

Worsened []

No change []

Improved []

Closing Remarks

51. In your opinion what do you think needs to be done to make the camel keepers more successful in Somalia?

