THE SOCIO-ECONOMIC IMPACT OF CAMEL STOCKING PROJECTS IN DROUGHT PRONE PASTORAL COMMUNITIES OF KAJIADO AND NGURUNIT

BY

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DECLARATION AND APPROVAL

DECLARATION

I hereby declare that this Thesis is my original work and has not been presented for a degree in any University

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APPROVAL

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LIST OF ABBREVIATIONS AND ACRONYMS

AEZ	Agro-Ecological Zoning
ALRMP	Arid Lands Resource Management Project
ANOVA	Analysis of Variance
ASALs	Arid and Semi-Arid Lands
AU – IBAR	African Union – Inter Africa Bureau of Animal Resources
CBOs	Community Based Organizations
CBPP	Contagious Bovine Pleuropneumonia
CCPP	Contagious Caprine Pleuropneumonia
DDP	District Development Plan
DFID	Department for International Development
DLPO	District Livestock Production Officer/Office
DVO	District Veterinary Officer/Office
EA	East Africa
ELMT	Enhanced Livelihoods in the Mandera Triangle
ELSE	Enhanced Livelihoods in Southern Ethiopia
FAO	Food and Agriculture Organization of the United Nations
FARM Africa	Food & Agricultural Research & Management Africa
FEWs NET	Famine Early Warning Systems Network
FGDs	Focus Group Discussions
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
GoK	Government of Kenya
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
HEA	Household Economy Approach
HHs	Households
HI	Heifer International
HS	Haemorrhagic Septicaemia
ICMP(II)	Integrated Camel Management Package (II)
ICRC	International Committee of the Red Cross and Red Crescent

	Societies
IIED	International Institute for Environment & Development
ILCA	The International Livestock Centre for Africa
IWGIA	International Work Group for Indigenous Affairs
KARI	Kenya Agricultural Research Institute
KASAL	Kenya Arid and Semi-Arid Lands Research Programme
KCA	Kenya Camel Association
KCC	Kenya Cooperative Creameries
KEPSA	Kenya Private Sector Alliance
Ksh	Kenyan Shilling
KJD	Kajiado
LPI	Livestock Policy Initiative
LSD	Lumpy Skin Disease
MDGs	Millennium Development Goals
MID-P	Merti Integrated Development-Program
MoLD	Ministry of Livestock Development
NALEP	National Agriculture and Livestock Extension Programme
NE	North Eastern
NEPDP	North Eastern province Development Programme
NGO	Non-Governmental Organization
Ngt	Ngurunit
NLMIS	National Livestock Marketing Information System
OCHA	Office for the Coordination of Humanitarian Affairs of the United Nations
ODI	Overseas Development Institute
PEAR Innovation	Participatory Education Awareness and Resources Innovation
PIA	Participatory Impact Assessment
PPR	Peste des Petits Ruminants
PROTA	Plant Resources of Tropical Africa

REAP	Rural Entrepreneur Access Project
RePAL	Rehabilitation of Pastoral Livelihoods
RVF	Rift Valley Fever
SACCO	Savings and Credit Co-operative
SACDEP	Sustainable Agriculture Community Development Programme
SDC	Swiss Agency for Development and Cooperation
SNV	Netherlands Development Organization
SPSS	Statistical Package for Social Science
TEAR Fund	The Evangelical Alliance Relief Fund
UAE	United Arab Emirates
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
VSF-Suisse	Veterinaires Sans Frontieres –Suisse
WFP	World Food Programme of the United Nations

OPERATIONAL TERMS DEFINITIONS

Food: Any substance that people eat and drink to maintain life and growth. The nutrition focus under food and nutrition security adds the aspects of caring practices, health services and healthy environments to this concept.

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996; FAO, 2002).

Household: A group of people, each with different abilities and needs, who live together most of the time, and make joint decisions on what to buy, how much to contribute to a common economy and share the food/other income from this.

Household economy: The sum of ways in which a household acquires its income, its savings and asset holdings and by which it meets its food and non-food needs

Household food security: Exists when the family, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets its dietary needs and food preferences for an active and healthy life (FAO, 2002).

ABSTRACT

Climate change is a reality and has impacted negatively on the Kenyan rangeland. Cyclic droughts continue to pose a threat to pastoralists whose livelihood is based on livestock. (Re) stocking of camels by various development agencies and partners was meant to address pastoralist's household food security and resilience. This study assessed the social-economic impact of camel stocking projects with emphasis on non-traditional camel keeping communities. The objectives of the study were: (i) to analyze the seasonal contribution of camel milk to the household food basket, (ii) to determine the seasonal contribution of camels and camel products in the household economy and (iii) to determine the impact of drought on livestock species. This study was conducted in Kajiado and Ngurunit, though a pre-test of the data collection instruments was done in Merti sub-county. The target population comprised of beneficiaries of camel stocking projects and their controls (non-camel beneficiaries). The overall sample size consisted of 73 and 204 respondents in Kajiado and Ngurunit respectively. In Kajiado, 42 beneficiaries and 31 controls were interviewed. On the other hand, 180 beneficiaries and 24 controls were interviewed in Ngurunit. A household questionnaire was administered to all the respondents and a total of 16 Focus Group Discussions (FGDs) were conducted. A mix of stratified, simple random sampling and purposive sampling were employed in the study areas. Data was analyzed using Statistical Package for Social Sciences (SPSS). The study revealed that a majority (>73%) of camel beneficiaries consumed camel milk in the wet and dry seasons. On average, cow's milk ranked first in livestock milk preference in both Ngurunit (75.5%) and Kajiado (80.8%). However, during the dry/drought period, camel milk ranked first in milk reliability in Ngurunit (59.8%), whereas goat milk ranked first in Kajiado (52%). Camel sales were not a major source of income in the short run. However, there was a

significant effect of historical camel sales in Kajiado in the long run. Camel milk featured as a regular source of income in Ngurunit in the wet (67%) and dry (54.4%) seasons respectively. Additionally, camel milk nowdays ranked first by (48% HHs) in income generation from livestock species milk in Ngurunit, compared to (1%) held before camel stocking. Kajiado was hard hit by drought compared to Ngurunit although the latter was more affected by camel diseases. Over 99% of the camel beneficiaries ranked camels first among other livestock species in its ability to withstand drought. In conclusion, despite the fact that camels played a crucial role in the household food security, the communities still showed a strong attachment to cattle. Camels and goats also showed greater ability to withstand drought than grazers with the changing climate. The recommendations from this study are: (i) upscaling of camel stocking initiatives (ii) capacity building of camel keepers (iii) increasing centres for (camel) breeding stock and (iv) drought preparedness & mitigation measures. The findings can be used by livestock stakeholders and policy makers in developing sustainable strategies to enhance pastoralist's food security and drought resilience.

CHAPTER ONE

INTRODUCTION

1.1 Background

Livestock keeping is an enterprise of pastoral livelihoods in Kenya. These livestock consist of camels, cattle, goats, sheep, donkeys and poultry. The dominant species kept across the ethnic groups is largely dependent on cultural values attached to them and adaptability to climatic conditions. Cattle is the dominant livestock among the Maasai, Samburu and Kalenjin communities while camels are traditionally the most dominant among the Somalis, Rendilles, Gabbras and Turkanas. Camel keeping is spreading among non-traditional camel keeping communities i.e. the Maasai, Samburus and Pokot. Camels are highly valued and act as a symbol of wealth in traditional camel keeping communities. They have been used in the provision of milk, meat, blood, transport and many traditional rites such as payment of dowry (marriage), burial ceremonies among others. Besides, camel milk is believed to have medicinal value.

About 80% of the world camel population is found in Africa, with the highest concentration in North Eastern Africa. Kenya has the fifth largest camel herd in the world after Somalia, Sudan, Ethiopia and Mauritania (FAO, 2008; Musinga, Kimenye and Kivolonzi, 2008). Most of the pastoral rangeland is unsuitable for crop farming because of extreme variability in weather. This makes livestock production the most viable and sustainable economic activity in Arid and Semi Arid Lands (ASALs). Cyclic droughts as a result of climate change continue to pose a challenge to pastoralists, whose livelihood is livestock based. Camels stand out as unique animals with adaptive features that help them cope in ASAL environment. Camels can survive extreme heat, go without water for long periods and provide milk even during drought periods.

Camel stocking initiatives in pastoral areas had been geared towards enhancing food security, economic strengthening and drought resilience. Mohiddin (Undated) cites the advantages of (re)stocking as: helping livestock owners re-establish their familiar livelihoods, suitability for animal rearing (as it may be the only livelihood option), it re-establishes dignity and respect in the community. It was at the backdrop of learning from camel stocking initiatives especially in non-traditional camel keeping communities; that VSF-Suisse through Biovision funding, commissioned a camel study under its Integrated Camel Management Package II (ICMP II) project.

1.2 Statement of the problem

Climate change is a reality and ASALs have been the most affected. The frequency, severity and or intensity of droughts in Kenya has drastically increased. According to Kivoi (2012), the occurrence of droughts has increased from twenty years (that was before 1984) to a current span of one year. Huho *et. al*. (2011) revealed that drought is the greatest cause of livestock mortality, which is likely to reverse the gains made in the livestock sector. Despite livestock contribution to the national economy, pastoralists still show the highest level of poverty and lag behind other communities in development (IWGIA, 2012). Livestock losses accelerate poverty levels and food insecurity in the rangeland. This increases pressure to meet basic necessities and other obligations. Cyclic droughts have always been costly in terms of emerging transboundary animal diseases (as a result of livestock migration), death, high cost of fodder /water, herders pay, conflicts, distress and livestock treatment. Weak and emaciated animals are only sold at a throw away price during drought periods. According to Abdulkadir (2013), the magnitude of poverty among the counties in ASAL areas is testified by the fact that Marsabit and Samburu are ranked 44th and 45th (3rd last) respectively among the 47 counties of Kenya. The interior of Kajiado County is also as poor as any other marginalized area of the

country. The objective of this study was to evaluate the impact of camel stocking projects in non-traditional camel keeping communities. This will help establish the role that camels could play in addressing the problem of food insecurity and climate change challenges in ASAL areas.

1.3. Objectives of the study

1.3.1 Overall Objective

To determine the impact of camel stocking as a long term strategy on the beneficiaries socio-economy and food security, in a changing climate.

1.3.2 Specific Objectives:

i. To analyze the contribution of camel milk to the household's food basket during the wet and dry seasons.
ii. To determine the contribution of camels and camel products in the household economy during the wet and dry seasons
iii. To assess the impact of drought on livestock species

1.4 Research questions

i. What is the availability and consumption of camel milk in the households during the wet and dry seasons?
ii. What are the household's livestock milk preferences in the wet season and milk reliability during the drought period?
iii. What is the contribution of the camel and camel milk sales in the household economy during the wet and dry seasons?
iv. What are the major causes of livestock mortalities in the households (from 1990 to date)?
v. How do the respondents rate their ability in coping with drought now (after the intervention)?

1.5 Hypothesis:

The following hypotheses, stated from the Null (H_o), were tested:

i. **H_o 1a:** Camel ownership has no effect on camel milk consumption in the households during the wet season

   H_o 1b: Camel ownership has no effect on camel milk consumption in the households during the dry season

ii. **H_o 2a:** There is no effect of camel sales on the households monthly income during the wet season

   H_o 2b: There is no effect of camel sales on the households monthly income during the dry season

iii. **H_o 3a:** There is no effect of milk sales on the household monthly income during the wet season

   H_o 3b: There is no effect of milk sales on the household monthly income during the dry season

iv. **H_o 4a:**There is no relationship between household monthly income and savings during the wet season.

   H_o 4b: There is no relationship between household monthly income and savings during the dry season.

1.6 Significance of the study

The following are key benefits expected to be derived from the findings of this study: It is hoped that the study will highlight the vital role played by camels in addressing food security and drought resilience among communities in ASALs. This study will help establish if the prediction made by (Ndikumana *et al*. 2000), that camels will be important in providing food for the pastoralists in the face of global warming and climate change, have started bearing fruits. It will also provide an opportunity for non-traditional camel

keeping communities to share out their new experiences with camels in comparison to the other livestock species that they have kept since time immemorial. This study helps to address (Hussein, 1989) concerns that camels are still neglected by scholars and planners. The study will provide new knowledge in the livestock sector, especially from the non-traditional camel keeping communities where camel studies are still minimal.

The findings will assist various stakeholders in Livestock Development (i.e. communities, NGOs, CBOs and Government) develop better strategies and best practices in enhancing sustainable livelihoods in ASALs. This study is expected to lay groundwork for a sound policy framework in key areas, including the current changes in the land tenure system in Kajiado. Such initiatives will help address concerns by IIED (2009) that many policy makers have a blind spot to pastoralists.

Any positive impact attributed to the projects will be of beneficial to the effort being made towards addressing the Millennium Development Goals (MDGs) in eliminating extreme poverty, hunger and environmental sustainability. Finally, the camel stocking projects impact will help ascertain if they are making any contribution towards vision 2030 social and economic pillars, from an ASAL perspective.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature. The first part comprise of a brief background on the three pastoralist communities (the Maasai, Samburu and Rendille). It also covers livestock population and camel (re) stocking projects in the study areas. The last item covered is camel milk in regard to: its importance in pastoralist households, its composition, medicinal value, production and milk preferences. The second part reviews the contribution of livestock in the household economy. Livestock trade as well as camels and camel products sales are reviewed. Lastly, case studies of groups involved in camel products are also discussed. Additionally, household income, expenditure and savings within pastoralist communities are also covered. The third part reviewed issues of: the negative effect of drought in ASAL areas, livestock adaptability and major challenges facing camels.

2.2 Pastoral communities in the study area

2.2.1 The Maasai community

Most researchers believe that the Maasai came from the Nile Valley of the present Sudan between 14^{th}-16^{th} Centuries. This is due to the Maa language, believed to be a sub-group of the Nilotic languages. They migrated Southwards towards the Great Rift Valley before reaching their present settlement in 17^{th} -18^{th} Centuries. By the time of European colonization in East Africa in the late 19^{th} century, the Maasai had occupied most of the Rift Valley in Kenya and Northern Tanzania (Africa Guide, 2012).

The Maa community keeps cattle, sheep, goats, donkeys and camels (ranked in descending order of importance). The community keeps livestock as a primary source of livelihood, prestige, bartering, medicinal uses, clothing, bedding and socio-economic security (Yiapan, undated). Morner (2006), stressed that cattle are the most valuable of all Maasai livestock, signifying wealth and status in society. The Maasai and livestock fates are intertwined. They are bestowed with a common fate (in distress and abundance; they both rise or fall). The Maa believe that cattle mirror the behavior of their owners (Yiapan, undated).

The Maasai women are involved in a day to day running of their household chores. They milk the cows, clean, prepare hides and build traditional houses (enkajis) with mud & dung. They also look after the young children, collect fire wood, fetch water and prepare food. Men are responsible for herd maintenance, building fences and sheds for the animals (Africa Guide, 2012).

The land rights of the Maasai have changed over the years. The Maasai lost some of their best grazing land that was important during critical times of drought (Morner, 2006). This land loss was to conservation areas inform of National parks and game reserves (Maasai Association, 2014). The British discovered the advantages of Maasailand nature and eventually started creating these reserves. Some of the tourist destination in Kenyan Maasailand include: Maasai Mara National reserve and Amboseli National Park. The Maasai have since then, been restricted from accessing critical water sources, pasture and salt licks. The initial communal land was subdivided into group and individual ranches.

2.2.2 The Samburu Community

The Samburus belong to the Eastern Nilotic people. They speak the Maa- language, very close to the Maasai dialect. They occupy Samburu County in Northern Central area of Kenya. Samburu society has for long been so organized around cattle. They also keep sheep, goats and in recent times camels. Samburus are nomadic pastoralists (Kenya Information Guide, 2012).

It is likely that the Samburu originated from Sudan, settling North of Mount Kenya and South of Lake Turkana (Kenya Information Guide, 2012). They have remained culturally authentic to their traditional way of life. The Samburu ethnic group is close to the Maasai in both language and cultural authenticity. Samburu diet include: maize, milk and blood. They only eat meat on special occasions and during ceremonies such as birth of a child, initiation and marriage. Samburus have traditionally been allies of the Rendilles. They have maintained protection and cultural alliance with the Rendilles; largely due to response on pressure from other communities.

2.2.3 The Rendille Community

According to (Kenya Information Guide, 2012), Rendille is a Cushitic tribe that inhabits the region between Marsabit hills and Lake Turkana in Northern Kenya. They originally migrated from Ethiopia due to frequent conflicts with neighboring communities. They are semi-nomadic pastoralists, whose most valued animal is the camel. The language originally spoken by the Rendille is somewhat similar to the Somali language, but currently many of them speak Samburu due to intermarriages.

The camel is their main source of livelihood because it is well adapted to the desert condition and is an important source of milk and meat. The Rendilles living in the southern part of Marsabit county and less dry parts, have historically had a good relationship with their Samburu neighbours. They rear other animals including cattle, sheep and goats (Kenya Information Guide, 2012).

2.3. The distribution of human population in the settlements within the study areas

Table 2.1: Population distribution per settlement in the study area

Sub--County	Settlements	Male	Female	Total	No. of HHs	Area in km^2	Persons/ km^2
Marsabit South	Ngurunit	1,467	1,569	3,036	682	449.5	7
Samburu North	Ngurunit	635	677	1,312	281	421.3	3
	Enkaroni	483	485	968	184	32.4	30
Kajiado Central	Torosei	1,566	1,539	3,105	616	462.6	7
	Namanga	7,899	7,600	15,499	3,508	285.9	54
	Bissil	4,647	4,995	9,642	2,363	250.2	39
	Lorngoswa	1,788	1,887	3,675	740	250.0	15
	Meto	2,165	2,505	4,666	1,005	203.5	23
	Magadi	2,307	1,954	4,261	1,156	178.8	24
Kajiado North	Olkeri	589	675	1,264	287	212.2	6
	Kora	1,001	905	1,906	387	337.8	6
	Nkeek pusi	567	355	922	179	77.6	12
	Oldonyo-nyokie	459	466	925	217	169.3	5

Source:*GOK, 2009 Kenya Population and Housing Census*

	Nkeek pusi	567	355	922	179	77.6	12
	Oldonyo-nyokie	459	466	925	217	169.3	5

2.3.1 The livestock population by species in Kenya and the study Sub-counties.

Table 2.2: Livestock population by species in Kenya and the study Sub-counties:-

Livestock species	Kenya	(%) of the national livestock population			
		Laisamis	Samburu North	Kajiado Central	Kajiado North
Cattle	17,467,774	0.35	0.40	0.55	0.87
Sheep	17,129,606	1.10	0.83	1.28	1.83
Goats	27,740,153	0.97	0.98	0.97	0.85
Camels	2,971,111	1.57	0.74	0.02	0.03
Donkeys	1,832,519	0.65	0.66	1.72	1.17

Source: *GOK, 2009 Kenya Population and Housing Census.*

2.4 Camel (re)stocking projects

This study was conducted in the larger Kajiado County of the former Rift Valley province and Ngurunit area that falls within Marsabit South Sub-County in Marsabit County of the former Eastern province (Marsabit County) and Samburu North Sub-County in Samburu County of the former Rift Valley province. Kajiado county is cosmopolitan especially in the urban centres, but it is originally a homeland of the Maasai community. Ngurunit too is a cosmopolitan area inhabited by the Samburus, Rendilles and Ariaal communities. Ngurunit town started in 1982 and was originally inhabited by Samburus before being joined by the Rendilles.

Kajiado county benefited from a camel stocking project implemented by the Netherland Development Organization (SNV- ASAL project) in collaboration with the Ministry of Livestock Development. This project was implemented in (1990) where an estimated 220 camels were distributed. This project targeted Maili 46, Maili Tisa, Meto, Namanga, Torosei, Magadi and Loitokitok. Camel beneficiaries cost shared with the organization by

contributing Ksh 1,500 each per stocking camel. The number of camels distributed per household, were not uniform, as it depended on beneficiaries contributions.

Arid Lands Resource Management Project (ALRMP) currently NDMA implemented camel stocking projects in three financial years, distributing a total of 90 camels. The targeted sites for ALRMP camel Project were: Lorngoswa (2008-2009), Ngatatai (2009-2010) and Loitoktok (2010-2011). The beneficiary groups were registered by the Ministry of Gender and Social services. Each beneficiary contributed Ksh. 5,000 in a cost sharing arrangement. National Agriculture and Livestock Extension Programme (NALEP) also distributed 20 camels in December 2011 in Torosei, Ngatatai and Meto. The NALEP program was implemented by the Ministries of Agriculture and Livestock Development.

Another camel stocking project was done in Ngurunit area of Samburu North and Marsabit South Sub-counties. It was implemented by Participatory, Education, Awareness and Resources Innovation (PEAR Innovation), an NGO based in Maralal. This project was funded by Heifer International (HI) with the aim of economically empowering women groups. It was implemented in two phases in 1998 and 2007. One hundred and five camels were distributed in Ngurunit during the first phase and a total of 285 camels during the 2nd Phase. Each beneficiary in Ngurunit received 1 camel per household during the stocking period.

Other camel stocking projects in Marsabit South and Samburu North Sub-counties were: ALRMP distributed 40 camels in Ngurunit area in 2006; TEAR fund distributed 20 camels in Ngurunit in 2009 and Christian Blind Mission (through the Lutheran Church), 50 camels in Arsim location of Samburu North. GTZ through Wamba Food Security

Project in Samburu County also distributed some camels. Another camel stocking project was implemented in 2012 by Caritas, an Australian Agency in Marsabit.

In Kenya, the following organizations intervened in camel stocking programs: VSF-Suisse in (Isiolo County), Kenya Camel Association (KCA) in Pokot, Freedom from Hunger/Catholic Mission in East Pokot at Kositei, Merti Integrated Development-Program (MID-P) in Merti and Farm Africa in Northern Kenya.

2.5. Camel milk: Importance, composition, medicinal value and household utilization in pastoral areas

2.5.1 The importance of camel milk in the provision of food security in pastoralist households

The mainstay of the desert nomad's food is camel milk (Mares, 1954; Gast *et. al*., 1969; Yagil, 1982, Perry *et. al*., 2002). Dromedaries are the most important livestock species in terms of food security in hot arid environment particularly Somalia, Sudan, Ethiopia, Kenya and Djibouti where camels are numerous (Wilson, 1984; Schwartz and Dioli, 1992). (Belayneh *et al*. 2009) appreciated camels in the provision of long-term security in terms of milk production and improved social status. Camels in ASAL areas contribute about 11.5% of the milk produced in Kenya (Davies, 2007). The Kenyan camel population is capable of producing over 350 million litres of milk every year (Kenya Camel Association, 2012). FAO statistics (2012) reveals that the one humped dromedary (*Camelus dromedaries*) camels in Kenya, produce more milk than the Zebu cows during the wet season. The common camel breeds found in Kenya are the: Somali, Rendille, Turkana and Pakistani breeds. Somali camels provide higher milk yields at the end of the Gu (long rainy season) and Deyr seasons (short rainy season). At the end of these rainy seasons, plants have matured and there are various types of vegetation (Farah *et al*.,

2004). This study assessed the seasonal household food basket putting emphasis on the quantity of camel milk obtained and consumed in the households. This helped fill the information gap on the current household dietary trends and established the camel milk impact in non-traditional camel keeping communities.

Galvin (1992) reviewed dietary composition of eight pastoral populations and concluded that dietary differences were quantitative rather than qualitative. Milk products and cereals were the major components of the diet. Some pastoralists utilized wild foods, whereas others purchased food such as tea, sugar and cooking oil. Milk and milk products accounted for more than 60% of the dietary energy of East African pastoralists (Galvin, 1992). Musinga *et. al.* (2008), in a camel milk study in Isiolo pointed out that an average pastoralist household with camels require about $^{7}/_{17}$ litres (41%) of milk per day, for their own need as a major part of their diet. Sadler and Catley (2009) reported that milk in the pastoralist set up provide about 67% of the children's energy and 100% of their protein requirement.

2.5.2 The composition of camel milk

Camel milk contain less short-chained fatty acid (SCFA) compared to cow's and ewe's milk fat. SCFA is the preferred food for the human large intestines. It is crucial to the health of the colon, feeds the cells and kills harmful micro-organisms. Gast *et. al*.(1969) reported that camel milk had a high concentration of volatile fatty acid as well as linoleic acid and other polyunsaturated fatty acids essential for human nutrition. The milk is rich in iron, non-saturated fatty acid and B complex vitamins. The milk protein content of camel milk range from (2 - 5.5%). The protein content of the feed directly affects that of the milk composition. Camel milk is rich in chloride (El-Bahay, 1962). Studies done on

dehydrated camels showed an increase in sodium and chloride (Yagil and Etzion, 1980) that could be attributed to the salty taste found in camel milk. Camel milk is rich in vitamin C (Kno, 1959; Knoess, 1979; Field *et. al*, 1997; Kappeler, 1998; Laylin, 2011; Jassim and Naji, 2002) and it is important nutritionally, especially where fruits and vegetables are scarce. Vitamin C level in camel milk is three times that of cow's milk (Farah, 2004) and a half that of human milk (Gast *et al,* 1969). Camel milk is similar to goat milk and is important for human nutrition (Davis and Mc Donald, 1953). According to Laylin (2011), camel milk is a close substitute of the human milk, reiterating the fact that camel milk is low in fat and high in vitamin C; thus recommending it's suitability in ASAL areas. The comparative composition of camel, cow, goat, sheep and human milk is shown in Table 2.3 and Table 2.4.

Table 2.3: Average composition of camel, cow, goat, sheep and human milk

Species	Composition (%)				
	Moisture	Fat	Lactose	Protein	Ash
Camel	86-88	2.9-5.4	3.3-5.8	3.0-3.9	0.6-1.0
Cow	86-88	3.7-4	4.8-4.9	3.2-3.8	0.7-0.8
Goat	87-88	4.0-4.5	3.6-4.2	2.9-3.7	0.8-0.9
Sheep	79-82	6.9-8.6	4.3-4.7	5.6-6.7	0.9-1.0
Human	88-88.4	3.3-4.7	6.8-6.9	1.1-1.3	0.2-0.3

Source: *Farah and Fischer, 2004*

Table 2.4 Nutritional value of camel milk (Approximate minimum per 100g)

Energy, Kj	202 Kj
Milk fat, g	2.5g
Protein, g	3.0g
Carbohydrates, g	4.8g
Calcium, 132mg	0.132g

Source: *Vital Camel Milk Limited, Kenya*

2.5.3 The medicinal value of camel milk

Camel milk has been used in India against dropsy, Jaundice, spleen problems, asthma and anaemia (Rao *et al*, 1972), lung ailments (Gast *et al,* 1963) and tuberculosis (Akundov *et al*, 1972). Camel milk is given to the sick, elderly and the young; for it works well in bone formation (Gast *et al.,* 1969) as it is rich in minerals such as calcium. Lactoferrin in

camel milk has antibacterial, antiviral and anti-tumor properties (Medical Daily, 2014). It is important to do more research to authenticate the medicinal value of camel milk claimed by many (Musinga *et al,* 2008). It is argued that camel milk has anti- bacterial components that suppress bacteria and pathogens from inducing diseases. It is also argued that this milk could be a good solution to diabetes. The limited knowledge on camel milk notwithstanding, it is still acknowledged that camel milk has beneficial effects on diabetes, tuberculosis, heart diseases and stomach ulcers among other ailments. This can be managed by dietary manipulation and doing exercise to reduce body fat levels. Camel milk contain high levels of insulin that passes through the stomach without being destroyed and helps reduce reliance to injections in Type 1 diabetes (Medical Daily, 2010). Diabetes mellitus needs insulin supplementation injection. The following examples, attest to the medicinal value of camel milk; testimonies in Arizona on diabetes, autism, prostate cancer, breast cancer (Medical Daily, 2014), KEMRI clinical trials response in Nairobi on tuberculosis (KEPSA, 2012) and research conducted by India Bikaner Diabetes Care Research Center on diabetes as well as allergies (Camel milk USA, undated). Seifu (2007) reported that camel milk was used to treat malaria and constipation in Shinile and Jijiga zones of Ethiopia. This is attributed to the fact that camels browse on various plants species and active agents with therapeutic properties that could be secreted into the milk of camels. The medicinal value of camel milk has also been reported by (Yagil, 1982; Yagil, 1985). This study only sought to know the camel milk medicinal value awareness levels among non-traditional camel keeping communities. Even though camel milk is strongly believed as medicinal in camel keeping communities and many authors have cited diseases managed by it, there is still insufficient scientific evidence to prove the many cases mentioned.

Odhiambo (2006) and (Laylin (2011) have recommended the use of camel milk because it is allergen free as opposed to cow's milk, that creates allergies among many consumers due to a variant *g* α –albumin protein called s-albumin. According to Shabo, Barzel, Margoulis and Yagil (2005) milk protein allergy is a reaction to these proteins commonly found in cow milk due to the activation of the immune system. Camel milk does not contain ß-lactoglobulin and its α-casein content is much lower than that found in the milk of the other herbivores (Restani *et al*, 1999; Shabo *et al.*, 2005 and Eberlein *et al*., 2007). Specific immunoglobulins to human rotavirus were noted in camel milk by a study conducted by (El-Agamy and Nawar, 2004), though Sadler and Catley (2009) expressed caution and recommended further investigations. Eberlein et al., 2007 cited public health importance due to pathogenic bacteria when dealing with raw milk that is mostly consumed by pastoralists, a finding that is in agreement with (Younan, 2004).

2.5.4 Camel milk production, utilization and pastoral communities' livestock milk preferences

Before presenting data on milk production, one must consider in detail all the relevant information about camels in order to ascertain the full value that this animal plays in human nutrition (Yagil 1982). Unfortunately, literature on camel milk production is controversial and often muddled by the failure to distinguish between the total yield and the actual off take for human consumption that allows the calf to grow. Mares, (1954) and Gast *et al.* (1969) were also in agreement that data on the actual amount of milk produced by camels is not very accurate as it depends on a number of factors. Herren (1992) found that the actual daily off take depends on the presence or absence of the calf, the condition of the calf and mother, the stage of lactation, the pasture situation and the needs of the households. This was re-emphasized by Farah *et al*. (2004) who stated that camel milk

production depend on the breed, age, lactation period, the season of the year, availability of browse and water. Yagil (1982) noted that at the height of the dry season, camel milk scarce and therefore doubts its status as a staple food to some pastoral communities. Its contribution to the daily energy requirement under such circumstances was very small. Other researchers have also claimed that data on camel milk production is therefore not very accurate. This study only limited itself to the ultimate quantity of camel milk obtained daily in the households.

Kedija *et al*. (2008) estimated that the average cow milk yield per day in the wet and dry season was 3.26 ± 0.07 litres and 1.63 ± 0.04 litres, respectively. On the other hand, camel milk yield per head per day in the wet and dry seasons was 7.12 ± 0.33 litres and 3.85 ± 0.203 litres, respectively. Therefore, camels provide more milk than other herbivores under the same environment (Farah *et al*., 1990; Onono *et al*., 2010). However, during the first 3 months of lactation, camel milk yield increases significantly but after a peak (4 - 5 month), it starts to decrease (Basmaeil & Bakkar, 1987, Simpkin *et al*., 1997a, Gaili *et al*., 2000; Wernery *et al*., 2004 and Eberlein *et al*., 2007). Herren (1990) noted that during the driest season, the daily off take per dam can be as low as 1 litre whereas it can be as high as 5 litres in the wet season. Camel lactation persists in the dry season and rarely ceases in extended dry spells. This is of great significance to pastoralists in terms of food security, as they help seal the hunger- gap during the drought period by ensuring a constant supply of milk.

According to (Sikana *et al*., 1993), pastoralists make several choices when making decisions on milk utilization. After milking; they either consume the milk at the household level or sell it. However, a study by Wabekbon Development Consultants (2009) showed that milk obtained in the households can be sold, given away for labour, used to build goodwill or reputation among friends. The role of camel milk in building social support networks in food security among the Maasai community was cited by (Rutten, 1998). This was through assistance from (friends and relatives) in terms of money, labour, animals and food.

The preference of different pastoralists owning certain animal species is well researched (Al-Najim 1991; Nauheimer 1993; Fratkin and Smith, 1994; Degen, 2007; Sadler and Catley, 2009). The use of camels in ensuring milk supply during the dry season as well as drought is well documented among the Somali pastoralists (Baumann *et al*., 1993; Barrs, 2000 and El-Agamy 2006). It helps explain the vital role played by camels in the Somali culture. Sadler and Catley (2009) cited that the perceived *health, strength and taste benefits* of different animal milk are less documented besides being important in any milk intake intervention strategy. The current study assessed the respondent's milk preferences across the livestock species in the wet season and livestock milk reliability during the dry/drought period. The findings are meant to add value, by filling the knowledge gap on community milk preferences. The milk reliability findings during the critical drought period will assist in future contingency planning, while laying out better drought coping strategies.

2.6. The contribution of livestock to the household economy with a major focus on camels

2.6.1 The economic potential of camel products and livestock trade in the region, with emphasis on camels

The current Kenyan camel population is capable of producing over 350 million litres of milk and 10,000 tonnes of meat every year (Kenya Camel Association, 2012). If camel milk is packaged well and distributed, it can be transformed into a 10 billion dollar industry (FAO, 2012). It is estimated that 130 million litres of milk intended for sale goes to waste before reaching the market (KARI, 2012). To fully exploit camel milk/meat potential, there is need for stakeholders in the livestock sector to support pastoralists in the area of breeding, nutrition, animal health, milk hygiene, value addition and marketing such as to improve the camel meat and milk value chain.

Trade in live animals (cattle, sheep, goats and camels) between the Horn of Africa countries, Middle East countries as well as North African countries, has been ongoing for centuries. Such trade has also been on-going between the Horn of Africa and the Indian Ocean Island of Mauritius (AU-IBAR and NEPDP, 2006).

According to Mahmoud (2012), the involvement of camels in the Horn of Africa livestock trade was not very significant in the past. Camels were valued in the pastoralist communities as pack animals and a source of meat and milk, but not as a saleable commodity. Prices paid for pastoralists' camels were historically poor, earning no more than a single cow. About seven years ago, new markets for camels were established in Ethiopia and this transformed camel marketing in the region. In northern Kenya, more animals are taken, via the border town of Moyale, to camel ranches near Addis Ababa, Mojo and Nazareth. Moyale has become an important regional and international market,

with buyers from Sudan, Ethiopia and Middle East. This trade has boomed in recent years with prices for camels rising as much as ten-fold and as a result, pastoralists' attitude to their animals has changed. Demand for a cheap source of protein in the Middle East has soared, prompting massive exports from the Horn of Africa. As more camels are diverted to Moyale market for export in the Middle East, regional markets such as Garissa have been deprived of their share of camels due to this diversion. This has a serious implication on camel meat consumption in Kenya's major urban centres.

Mahmoud (2010) found out that whereas cattle largely remained for local consumption, camels were being exported in large numbers to Middle Eastern countries. There has been a general decline in the number of cattle offered in the markets following prolonged droughts. However, the number of goats and camels offered in the market continued to rise (GoK, 2011). This implies that browsers are drought tolerant and therefore, they could be of importance in sustaining pastoralist's household income in this changing environment.

2.6.2 Case studies on income generation from camel meat and milk trade in Kenya

Mwihoti farmers group (MF) in Central Kenya's Nyeri area is a typical group outside ASAL that deals with camel meat. They rear 200 camels mostly for commercial purposes and has found a lucrative local market in surrounding hospitals. The demand for camel milk and meat has grown due to its high nutritional value. The group earns around Ksh 630 per kg for the camel meat, which is double the price of a kilogram of beef in Nairobi butcheries (KEPSA, 2012). This statement is supported by a butchery operator in Kangemi (Nairobi) who cited the price of beef per kilogram to be between Ksh 300 – 320

before the increment in April 2013 (Waitathu, 2013). In a day, this MF group sells over 200 Kgs of meat (KEPSA, 2012).

Camels play an important role in the local economy of the Somali community. They provide milk and meat within the subsistence economy and are used as beast of burden for transporting milk to the market, water from wells and household belongings (Farah *et al*., 2004). Camels are the only means of payment of blood money to the lineage of the deceased during feuds (Hussein, 1993; Farah *et al*., 2004). Camels are recognized for providing long-term security to beneficiaries in terms of milk production and improved social status (Belayneh, Wondimu, Simachew and Stevens, 2009). This study assessed both the short and long- term contribution of camels in the household income focusing on camel sales among the beneficiaries. A regression analysis was done to determine the significance of camels on the household monthly income on the short and long term basis.

Anolei women group in Isiolo with 64 members collects camel milk, stores it in freezers and sells the milk in Nairobi (FAO, 2012 and Africa Procasur, 2012). On daily basis, the group sends up to 5,000 litres of milk to Nairobi, where the milk is sold at Ksh. 100 per litre. The venture has been so lucrative that members of the group earn up to Ksh 60, 000 a month, which led to a complete change in their lifestyle. Africa Procasur (2012) documented that traders in Isiolo County bring in more than Ksh. 19,000,000 annually from the trade. Lumadede, Owuor, Laqua and Gluecks (2010) noted that Anolei members deal with suppliers and customers on individual basis but benefits as a group in terms of infrastructure and trainings. However, they also mentioned women group milk traders in Elwak (Mandera Central Sub -county) who pool their milk and sell it jointly in a milk bar business.

Another case of camel milk trade was cited by Bosire (2012) who reported that Ukasi Village in Tana River County has a flurry of camel milk activities daily from 5.00 am. The village has a camel milk depot and traders purchase camel milk from local herders and dispatch more than 5,000 litres of milk to Nairobi and Garissa every day. They organize private and public service vehicles for transport. Most families earn more than Ksh. 50,000 per month from the business, being boosted by unprecedented demand for camel milk.

Camel milk value addition is being promoted by Camel Dairy Milk Limited, a Company based in Nanyuki town that was established in 2005. It recently added to the supermarket shelves the Vital camel milk (pasteurized camel milk) which is sold in half litre packs, with a ten-day guaranteed shelf-life. This half litre pack retails at Ksh 150 in Tuskys supermarket chains. Camel farmers living in the vast Arid and Semi Arid areas of Kenya are steadily abandoning the practice of supplying milk to vendors and opting to supply to the factory. The company is now eyeing export market for its products. Products have been expanded to include pasteurised milk, ice cream and fermented milk, which are particularly popular with the Somali community (Odhiambo, 2006).

The demand for camel milk in Kenya may be categorized into four largely distinct market segments: home consumption by camel-owning households and camel herders; rural households in camel keeping communities (largely restaurants and households with dry camel herds or no camels at all); raw milk urban consumers largely from camel keeping communities and a high-end health market segment of consumers (niche market) both in the national and international market (Musinga *et. al.*, 2008).

Wabekbon Development Consultants (2009), in the women's milk and small ruminant marketing study, appreciates the various options in milk utilization in pastoral communities. Milk sales depend on the size and wealth of the production units, time of the year, amount of milk available and availability of food substitute's i.e. grains. (Sikana *et al*., 1993) added other determinants of milk sales as market prices and access to the market. As stated by Nori *et al* (2006); camel milk trade, showed a high degree of complexity, flexibility and effectiveness in relation to changing agents, interests, relationships and seasonal changes. Pastoralists' carefully consider economic-trade-offs before selling their milk, as they are limited in their choice by the need for cash to address households and other needs. Sadler and Catley (2009) are in agreement that milk is an important source of income in exchange of other food commodities. This study assessed milk as a source of income and ranked income from livestock milk sales '*before camel stocking*' and the current situation after stocking. This helped determine the camel stocking impact on the household economy.

2.6.3 Camels as a tourist attraction in Kenya

Camels are being used for tourist attraction and community development in Kenya. For instance, the Maralal camel derby, an annual event attracts many tourists who come to watch the graceful camel racing. Tourists and visitors sample the culture of nomadic communities in Samburu County. They also buy some of the traditional materials provided. There is also an amateur racing whereby the locals act as guides and help tourists participate in the event. The locals are excellent handlers and judges of animal's strength and potential for speed. This event gives the locals an opportunity to earn income, besides exciting activities. Winning in a Derby is a great local honour and each year the title is hotly contested. The Kenyan tourist board arranges camel *safaris* where

tourists go to the Mara and other game park safaris using camels (FAO, 2012). In addition to camel racing other events tourists are involved in are: running, biking events, donkey rides, local dancing, cultural displays and stalls where curios and handicrafts art are sold (Miami Herald, 2012). All these events have a potential to generate a lot of revenue to the local communities.

2.6.4 Household income, expenditure and savings in pastoral communities

A study carried out by Bukure (2008) on household income and expenditure of pastoral communities came out with the following findings: pastoral households engage in a variety of transactions involving livestock, livestock products, crops, handicrafts among others as a source of income to help meet their household needs. Animals and their products are sold to provide cash. Animals are also received, given or lent to kins as well as friends to strengthen social ties and ensure long-term security. Animals may be exchanged for social reasons or increase the productive capacity of the herds. Pastoral households also depend more on market transactions to satisfy their subsistence needs. GoK (2011) drought bulletin in Samburu listed the sources of income in the households as sale of livestock, casual labour, gift items, sale of charcoal, petty trade, remittances and sale of livestock products . According to (Little *et al*., 2000), in view of the data collected among the Maasai shows that dependence on livestock income had drastically decreased from (93%) in 1970s to 70% in 1980s (Campbell, 1978) and Bekure *et al.* (1991), an indicator of diversification.

According to Muchui (2012), banking system impact has not been felt in pastoral communities. SACCOs, mobile money transfer services such as M-pesa, Commercial banks and Micro-Finance institutions have not effectively penetrated these communities.

BOMA Project provides seed capital and training on the establishment of savings associations which are made up of several Rural Entrepreneur Access Project (REAP) business groups for women in Marsabit and Samburu counties. Women in Loiyangalani, Samburu, Marsabit, Laisamis and Archers have been imparted with business skills and how to operate a village (manyatta) bank. In Samburu and Marsabit Counties, tucking of money under the mattress is still a common practice which is mostly promoted by the mobility of the pastoralists and inaccessibility to commercial banks.

Saleemi (2005) noted that saving is determined by the *power* and *will to save*. The *power to save* depends on the level of income, rate of interest, banking system, peace and security. The *will to save* is affected by psychological characteristics of human nature, social practices and institutions. Friedman, 1957; Mayer, 1966 and 1972; Dynan, Skinner and Zeldes, 2004 pointed out that even if the saving rate is invariant with regard to life time income, we expect people with high income to save more than those with low-income as the marginal propensity to save increase with income.

The study tested hypothesis to ascertain the significance of milk and camel sales on the household income. This helped gauge the impact of camel sales on the household economy. Additionally, the study assessed the seasonal relationship between household income and savings. This helped ascertain the saving culture within the pastoralists. Finally, the seasonal household income and expenditure levels on food were determined. This analysis was is line with the Household Economy Approach (HEA) discussed in Chapter 3.

2.7. Livestock adaptability to drought in ASAL areas with reference to camels

2.7.1 The effect of drought in Arid and Semi-Arid Lands (ASALs)

As climate change drastically continues to alter the landscape, there are suggestions that raising camels could replace crops and other livestock in the hard hit arid areas of the continent that are no longer suitable for arable farming (Kaufmann and Binder, 2002; Jones and Thornton, 2008 and Belayneh *et. al*., 2009). Global warming has contributed to unpredictable weather patterns leading to extreme drought cases in Kenya, reducing water flow into rivers, increasing incidences of floods, water borne diseases and ultimately food insecurity (Kivoi, 2012). These hazards cause injuries and death to human, animals, loss of livelihoods and disruption of economic activities (Nyangena and Schaar, 2012). According to Migwi *et al*. (2013), changing climate is characterized by unpredictable weather events such as more frequent and intense drought, rising mean ambient temperatures and flooding. The higher mean ambient temperature decrease available moisture for plant growth and therefore lead to low crop yields as well as pastures. It is expected that climate change will impact negatively on smallholder livestock producers in ASAL areas, with disastrous effect foreseen on food security, biomass fuel availability and household income.

Drought is a deficiency in precipitation over an extended period, usually a season or more resulting in water shortage causing adverse impacts on vegetation, animals and people. It is a recurrent feature of climate that occurs virtually in all climatic zones. Drought is a temporary abnormality from normal climatic conditions and varies significantly within different regions. Human factors such as water demand and management exacerbate the impact of drought. However, drought may have different definitions depending on perspectives and interests (National Weather Service, 2008).

Drought in the Horn of Africa (Ethiopia, Eritrea, Somalia, Djibouti and Northern Kenya) drastically increased in the years: 1960-1961; 1968-1969; 1974-1976; 1979-1981; 1991-1993 and 1996 (Fratkin, 2001). Drought is a major problem in Kenya (Aklilu & Wekesa, 2002). In the year 1999-2001 an estimated 2.3 million shoats, over 900,000 cattle and 14,000 camels valued at Ksh. 5.8 billion died due to drought. This drought was cited as more severe than any previous episodes. Orindi, Nyong and Herrero (2007) concured that the 2000-2001 and 2006 droughts were the worst in the last 60 years. Kenya's ASAL lost a quarter of their Zebu herd in 2011 drought. 3.5 million head of cattle died with an estimated market value of Ksh 52 billion, 2.7 million goats worth Ksh 6.7 billion and 2.5 million sheep worth Ksh 5 billion (MoLD, 2011). In the face of climate change, adaptation of different livestock species becomes highly imperative (Osenu and Bebe, 2010). Konaya (1997) reported that serious droughts in Samburu county occurred in 1974, 1984 and 1994. Onono *et al*. (2010), concluded that the drought cycle of Samburu county recurred after every 4 years.

Herd recovery was only witnessed in the years 2002 – 2004 and 2006 – 2007 in Marsabit county according to (Ndikumana *et. al.,* 2008). Whereas drought in Kenya used to occur in ten year cycles in 1960s, it reduced to five year cycle in 1980s and this has further reduced to a two year cycle (Owino, 2001). Worse of, according to Kivoi (2012), the length of the drought cycle has now dwindled to 1 year i.e., therefore the severity of drought as defined by intensity and frequency appears to be on the increase.

Drought is one of the most detrimental disasters distressing African pastoralists. The short-term effects of drought are shocks caused by the heavy losses of animals due to drastic decline in grazing resources. Pasture, browse, dwindling water resources,

increased disease incidences, high ambient temperature, intense solar radiation etc, negatively affect livestock. The long-term effects of drought on pastoralists are decreased food security and loss of bargaining power (Nyariki *et. al.*, 2005). The more arid and remote an area is, the more dependent people are on a 'low input – low out put' livestock system (Simpkin, 2004). As a drought coping and self-restocking mechanisms in case of a disaster, herders prepare for drought and epizootics by lending their animals to relatives or friends (Blench, 2001). This study assessed the critical role played by different livestock species in different seasons; especially in the provision of the household milk.

2.7.2 Major challenges facing camel production in Arid and Semi Arid Land (ASAL)

Kaufman and Binder (2002) identified the major causes of camel losses as diseases and drought. They cited scarcity of water and pasture as reasons leading to wildlife encroachment. Huho *et al.* (2011) documented drought as the greatest cause of livestock mortality. According to Onono *et al*. (2010), despite the benefits associated with camel production in pastoral areas, camels still face challenges in their natural environment such as diseases, drought as well as predation. Megersa (2010) noted that camels are more susceptible to a large number of pathogenic agents. This statement disputed historical believe that they are less susceptible to most diseases that affect other livestock in the same ecological zones. (Noor *et al*., 2012) Isiolo study, revealed important diseases/cases of camels as: Camel trypanosomosis, Haemorrhagic Septicaemia (HS), Pneumonia, Mange, Camel pox and skin necrosis. A previous study conducted by (Langill and Ndathi, 1998) still mentioned Camel trypanosomosis, HS, Camel pox and cough. Samburu and Marsabit study by Gathuma and Makau (2005) cited: - Helminthosis, Mastitis, Tick infestation and plant poisoning. These diseases expose pastoralists to the risk of losing their source of livelihood. The 22 years retrospective study in this research helped

pastoralists take stock of mortality trends in their livestock herds and state the major causes of mortality. Musinga *et al*. (2008) reported of an initial resistance of camels in Maasailand. This study helped gauge the current perception of the Maasai community to camels.

A study carried out by (Tanwar, 2005) in India, found out that the camel population was reducing at a very high rate. This was attributed to shrinking grazing resources. Lack of feed was found to undermine the nutritional status of camel herds, making them vulnerable to diseases and negatively affecting their reproductive rates. Other problems included lack of access to prophylactic health care, lack of organized markets for camel milk, wool and leather. The study in India also noted other problems i.e. backward image of camel breeding, lack of encouragement and moral support to camel breeders.

2.7.3 Livestock species adaptability to ASAL areas with specific reference to camels

In arid areas, camels are better providers of food than cattle, which are severely affected by heat, scarcity of water and feed (Sweet, 1965). The economic potential of camels in ASAL is increasingly being recognized due to their comparative advantage over cattle and small ruminants in adaptability to harsh climatic conditions (Han, 2004). Ziervogel *et al*. (2006), appealed for the need to clearly understand variability in climate and devise methods of enhancing food security. In an effort to compare livestock species, this research ranked cattle, sheep, goats and camels ability to tolerate drought.

Wernery (2007) in the camel milk study highlighted that camels could be part of solution to the compounding problems of global warming, desertification and food insecurity. He re-affirmed early prediction by (Ndikumana *et al*., 2000) that the position of camels in

providing food for the pastoralists in Northern Kenya will be more vital in the face of climate change. This study provided an opportunity to learn lessons on the impact of camel stocking in non- traditional camel keeping communities, besides its importance in coping with drought.

Gabbras and Rendilles of Northern Kenya value camels as the most important livestock (Torry, 1973; Sato, 1976). Their culture revolves around the camel, due to its ability to survive extreme aridity and also supply milk. This is a crucial factor in the provision of food security in the households especially, during the dry season. Pavanello (2010) in the Kenyan-Ethiopian border areas study found out a gradual phase out of cattle through reduced restocking rates after drought. This demonstrated communities' realization of cattle vulnerability to drought. Camels are environmental friendly; (Musinga *et al*., 2008) emphasized that camels are far better suited than cattle, goats and sheep in Arid lands and do not destroy their habitat. On the contrary, goats are known to chew roots and denude areas around oases and other areas of concentrated herding.

Camels adaptability to harsh arid and semi-arid rangelands are due to unique dietary selection, drought resistance, spreading behaviour when foraging and travelling long distances between foraging areas (Mares, 1954; Mc Knight, 1969; Dahl and Hjort, 1979; Farid *et al*., 1979; Shalash, 1979; Knoess, 1979; Gauthier-Pilters and Dag, 1981; Morton, 1984; McDowell, 1984 ; Yagil and Etzion, 1985; Hjort, 1988). These authors agree that camels make minimum impact on dessert vegetation because of their free movement while foraging. From diverse ethnicity and ecology, this study sought to know pastoralists perceptions on various livestock species ability to withstand drought.

Camels browse forage species not within reach of the other domestic livestock such as trees upto 3-5m high (Richards, 1979; Gauthier – Pilters and Dagg, 1981). By having long necks, adaptive features of the mouth (slit upper lip; small tongue, hard upper gum and obliquely protruding lower teeth); camels are able to browse thorny shrubs, trees, young twigs hidden in bushes and nibble leaves from spiny stems (El-Amin, 1979; Gauthier – Pilters and Dagg, 1981; Wilson, 1984). These form versatile prehensile apparatus that helps camels to carefully feed on young highly nutritious leaves and twigs on the upper canopy of the browses. Younan *et al*. (2011) reiterated on the unique features in camels that facilitate their ability to withstand drought. Additionally, camels eat grasses and other herbaceous species in East Africa (Field, 1978) and North West Africa (Gauthier-Pilters and Dagg, 1981), thus increasing their survival options during extreme scarcity. Mckight, 1969; Gautheir- Pilters and Dagg (1981); reported that if camels browse repeatedly on certain plant species they eventually kill them such as old *Balanites rotundifolia* as experienced in Ceeldheer district. This isolated case portrays the negative aspect of camels on environment.

According to Coughenour *et al*. (1985) trees and shrubs are converted to milk more efficiently by camels than any other domestic animals. This was after determining the botanical composition of camel diets in different seasons and evaluating foraging strategy of milking and non milking camels. Camels widen their dietary foraging range during the dry seasons by eating more grasses, litter, leaves, vines and lignified twigs.

(Wernery, 2007; Musinga *et al*., 2008) reported that camels can secrete milk that is highly diluted with over 90% water content. In true ruminants; the reservoir for milk – water is lost for cooling, via the fecal and urinary excretion. Camel's body fluid tolerates a wide

range of temperature that allow heat accumulation in the body and therefore save on water that would have been used for evaporative cooling. Very few animals have this versatile ability to allow build up of heat in the body and tolerate increase in body temperature. (Yagil, 2000; Musinga *et al*., 2008) pointed out that protein, fat and lactose of camels is affected when they are dehydrated or hydrated.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The objectives of this study are to analyze the seasonal contribution of camel milk in the household's food basket; determine the seasonal contribution of camels and camel products in the household economy as well as assess the impact of drought on livestock species. To facilitate the achievement of these objectives; this section discusses the conceptual framework on camel stocking to the household food security. The conceptual framework articulates inter-related pathways by which camel stocking activity causes desired changes (outcomes) in the households, that impact on food security. This Chapter also discusses the research design, the study areas, study population, sampling methods, methods of data collection used and data analysis.

3.2 Conceptual framework of camel stocking contribution to the household food security

The primary focus of this study was to assess the impact of camel stocking as a long term strategy on the beneficiaries socio-economy and food security in a changing climate. A household is defined as a group of people, each with different abilities and needs, who live together most of the time, contribute to a common economy and share the food/other income from this (Holzmann, 2008). The food security framework used is a modification of *FAO framework*, as shown in figure 3.1.

Camels distributed through camel stocking projects are the *independent variables* in this framework. Camel keeping like any livelihood asset is affected by a number of cross cutting issues such as climate, politics, socio-economic environment, institutions, security, gender, culture, markets and policy environment.

The framework dependent variables include camel milk intake, income generated from camels & camel- product sales and health status attained from utilizing camel products. All these sources contribute towards the ***household food security***. However, each of these dependent variables rely on a number of factors that provide sustainability. Camel milk intake for instance, depends on a number of intervening variables, such as availability of camel milk and accessibility of camel milk from other sources. These intervening variables are discussed below:-

Availability of camel milk depends on the quantity of camel milk available from the stocked household's and camel milk trade within the market system. This contributes to the household food basket, that ultimately leads to household food security.

Access to camel milk refers to the capacity of the households to procure milk to satisfy their nutritional needs. This entails camel milk accessibility through purchases (income increases the purchasing power of the household), gifts, support given to friends, relatives, neighbours (social network) and borrowing. Drought disrupts the production strategies and threatens the general milk accessibility in the households.

The framework assesses the contribution of camels in the household economy focusing on ***Income generation*** as a *dependent variable*. However, it explores the various income sources from camels as *intervening variables*. These include camel sales, camel milk sales and other sources such as cash awards from the camel derby competition. Income generated is normally used by the households to access other household necessities including (foodstuff, medical costs, clothing, veterinary drugs, fodder etc), savings and other investments.

The framework also emphasizes on the ***health status*** as a *dependent variable.* Healthy members of the households are more productive and therefore effectively contribute towards a common household economy. A keen observation on camel milk/meat hygiene, camel health and husbandry practices are vital to attaining high household healthy status. In pastoral areas, environmental contamination plays a bigger role in the hygiene of raw camel milk than the initial bacterial contamination of camel milk (Eberlein and Fontainebleau, 2007).

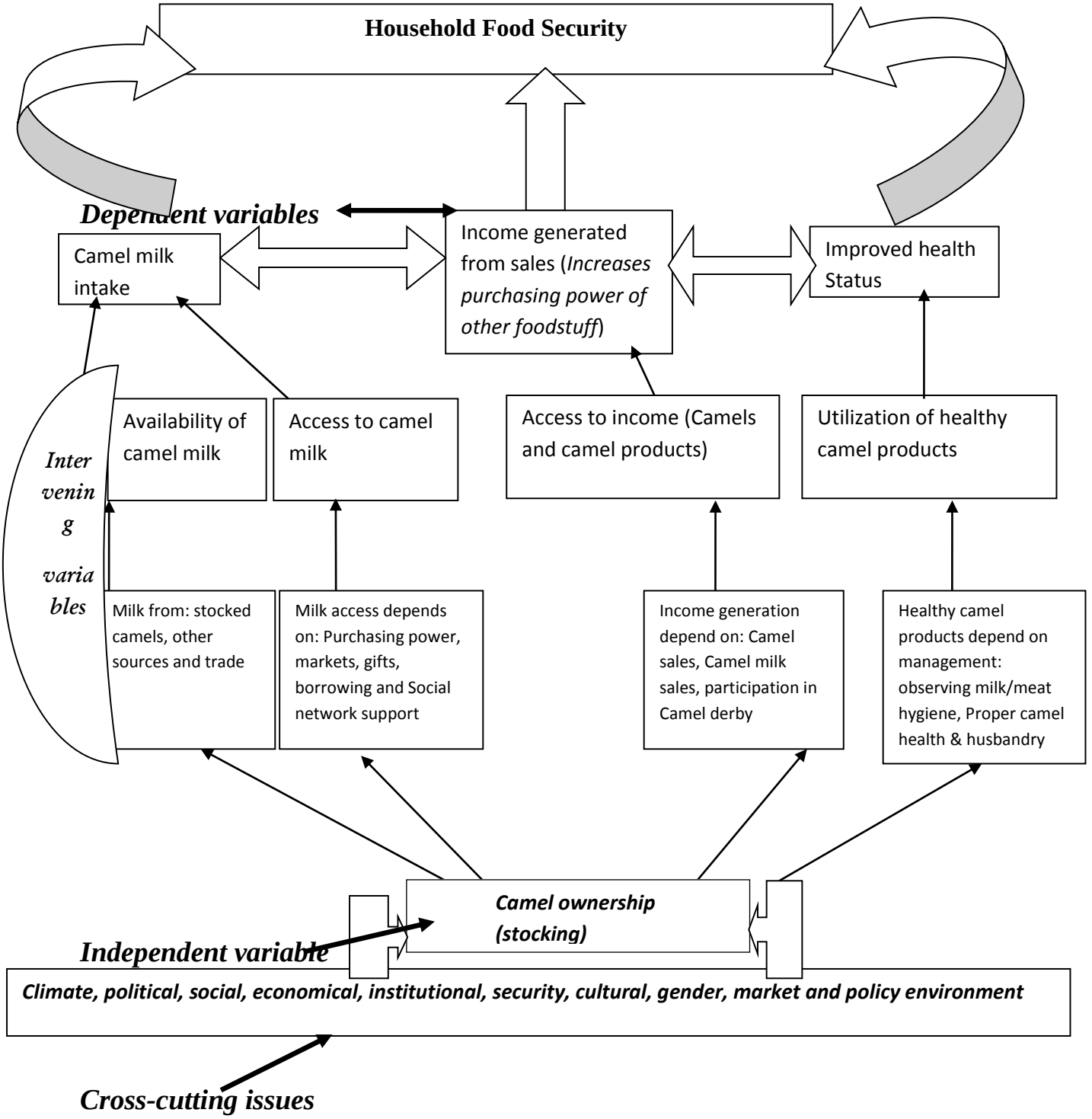

Figure3.1: ***Conceptual framework of camel contribution to the household food security (Source****: Modified - A climate change and food security framework document (FAO, 2008.)*

3.3 Research design:

The study took the form of a household survey. A comparative survey was done between the camel stocked households (intervention) and non-stocked households (control) residing in the same locality. Kajiado county and Ngurunit area were selected purposively, due to being beneficiaries of camel stocking programs. The research made use of a Quasi experimental design and a Household Economy Approach (HEA).

3.3.1 Quasi Experimental design

A Quasi-experimental design is an empirical study used to estimate the causal impact of an intervention on its target population. Any change witnessed at post-intervention, is likely attributed to the intervention. Quasi-experiments are chosen by experimenters because they maximize on internal and external validity. They are natural experiments, whose findings in one may be applied to other subjects and settings, allowing for some generalizations to be made about a population. It is a form of experimental research used extensively in social sciences and psychology. It involves selecting groups, upon which a variable is tested (Martyn, 2008).

The basic principle of experimentation involved comparing two groups, one which was exposed to an intervention (camel stocking beneficiaries) and another one which was not exposed to the same intervention (non-beneficiaries or controls) and attributing the differences between the two groups to the intervention (Treasury Board of Canada, 1998). The control group pastoralists were similar enough to the pastoralist beneficiary group that was involved in the camel stocking programs before stocking. This enabled the study to make some inferences that it attributed to the impact of camel stocking in these communities.

The groups were selected so as to allow comparison of the two groups in all respects except for the camel stocking intervention. Closer selection of the beneficiaries and controls who were in the same wealth groups before camel stocking helped isolate the contribution of the camel stocking program to the well being of the targeted communities. The control group household characteristics should have fitted in the initial selection criteria used to identify beneficiaries during the camel project inception period.

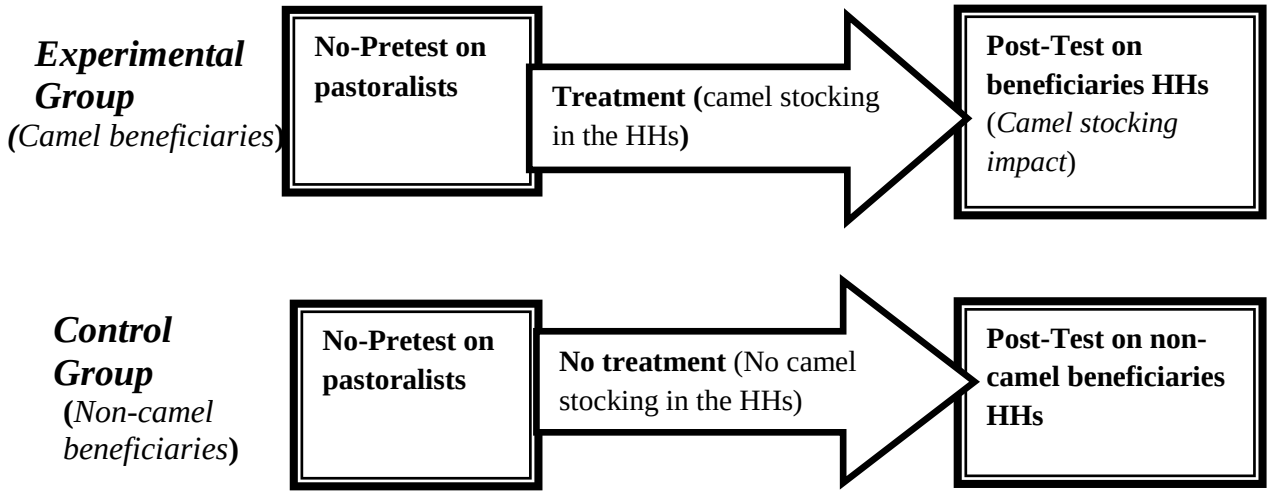

Figure 3.2: Diagrammatic presentation of the Quasi Experimental design showing 'before and after intervention'

3.3.2 Household Economy Approach (HEA)

The Household Economy Approach is a livelihood-based framework for analyzing the way people obtain/ access the things they need to survive and prosper. It helps determine people's food, income needs and identify appropriate means of assistance (Holzmann *et al*., 2008). HEA is an analytical framework and not a specific method of information collection. It defines the information that needs to be collected and the way in which it should be analyzed in order to answer a particular set of questions. It describes assets and

resources accessible to different types of households and how these resources are exploited to make ends meet. It is a framework for organizing a vast array of information – some of which is local knowledge and others census data. HEA functions as a powerful way to make practical use of both existing secondary sources of information as well as primary information (Boudreau *et al*., 2000). Key research areas addressed under the HEA in this study included: household assets, camel milk consumption, sources of income, expenditure patterns, savings and households linkage to Keynesian theory. This linkage helped determine the relationship between the household income and consumption level within the wet and dry seasons.

3.4 The study area

The study was conducted in Kajiado County and Ngurunit area (that falls within two administrative Sub-Counties of Samburu North and Marsabit South) in Samburu and Marsabit Counties, respectively.

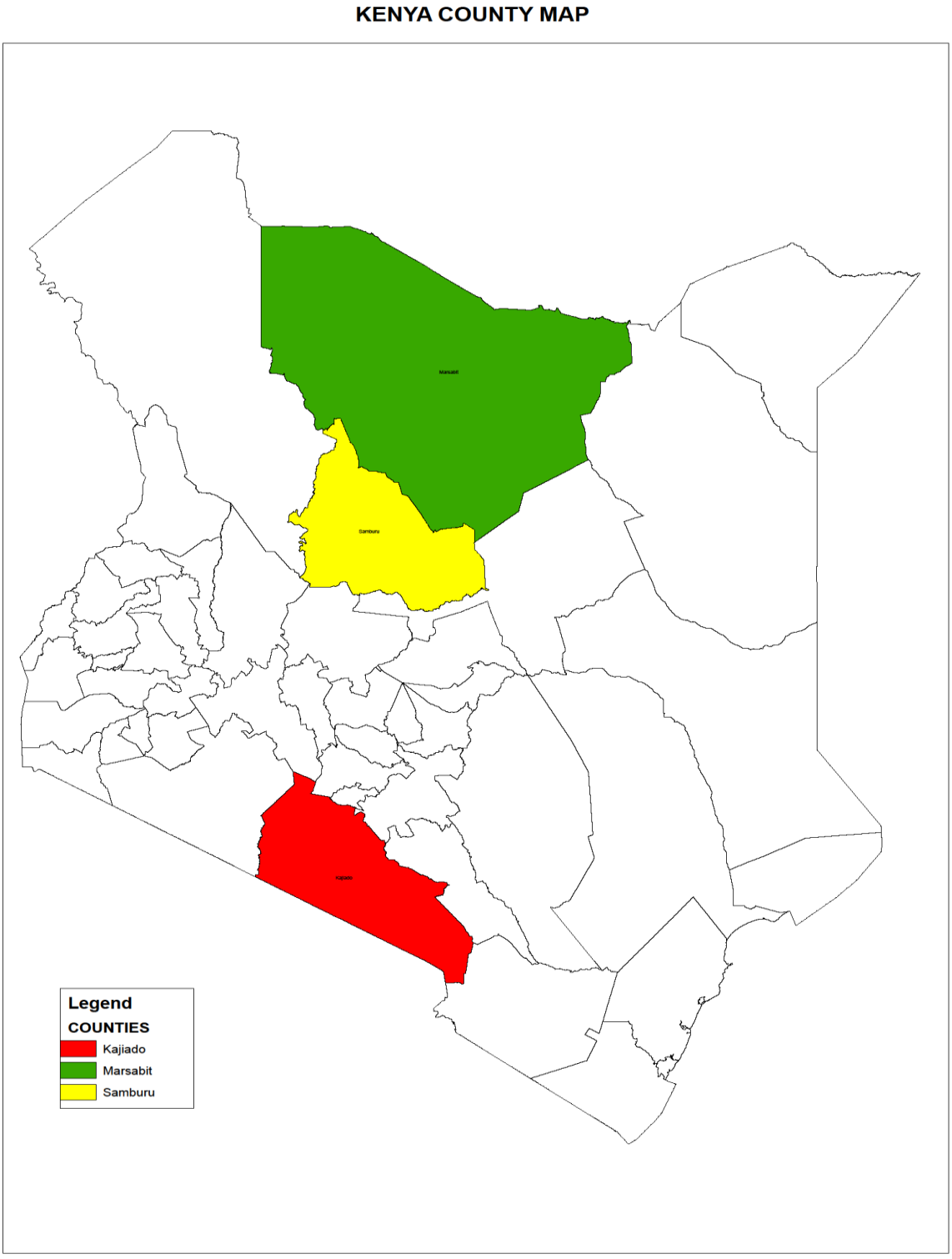

Figure 3.3: A map of Kenya showing the study- targeted counties of Kajiado, Marsabit and Samburu (Source: Survey of Kenya, 2016)

3.4.1 Description of Kajiado County

Kajiado County is situated within the former Southern part of the Rift valley province. It covers an area of approximately 15,546.6 Km^2. It is situated between longitudes 36^o 5' and 37^o 5' East and latitudes 1^o 0' and 3^o 0' South (Kajiado District Development Plan, 2008-2012).

Semi-nomadic pastoralism was the mode of life practiced on communal owned land but is now changing due to land adjudication and sub-divisions of group ranches into individual or free hold land tenure system. The county's proximity to Nairobi attracted high immigration to urban centres such as Ngong, Ongata Rongai and Kitengela , thus exposing it to high population growth. Changes in the land tenure policies favoured land privatization and fragmentation of former communal holdings leading to increased land sales that encouraged immigration to high potential areas of Kajiado (Orindi, Nyong and Herrero, 2007).

Plains, occasional volcanic hills and valleys are the main physical features of the county. Land varies in altitude from 500m around Lake Magadi to 2500m in Ngong hills area. Low depressions have steepy faults that give rise to plateau, escarpment and structural plains. The depression has features i.e. Lake Magadi, Suswa and Natron. These lakes have deposits of Soda ash commercially exploited in Lake Magadi. Nguruman escarpment has 3 rivers namely Oloibortoto, Entasopia and Sampu that are significant for horticultural crops production in Nguruman area. Ngong hills are catchment areas of the upper Athi River, Embakasi, Kitengela, Stony Athi, Kiboko River, Olkejuado and Selenkei. 92% of the county land is non-arable and only 8% supports subsistence farming (Kajiado District Development plan, 2008- 2012).

Kajiado has a bi-modal rainfall pattern. Short rain falls between October-December while the long rains fall between March-May. The annual rainfall is influenced by altitude. Ngong hills, Chylu hills and Nguruman escarpment receive an estimated 1250mm whereas Magadi receive less than 500mm per annum. Agro-climatic zones influence economic activities in Kajiado county. 55% of the larger Kajiado is under AEZ-V, 37% under AEZ-VI and 8% under AEZ II-IV; making it an ASAL county. Temperature range from a mean minimum of 34^0C around Lake Magadi and 22^0C on the slopes of Ngong hills (Kajiado DDP, 2008- 2012).

3.4.2 Description of Samburu North Sub-County

Samburu North Sub-County is situated in the Northern half of the former Rift Valley province. It lies between 0^o 40' North and 20^o 50' North of the equator and longitudes 36^o 20' East and 38^o 10' East of the Prime meridian. The total area of the sub-county is approximately 7005.7 Km^2. It is located on the northern interface between highlands and lowlands. The soils are rockier on the southern slopes of Mt. Nyiro and Ndoto. The Sub-County experiences both short and long rains. The long rain fall in the months of March – May and short rainy season in the months of July – September. However, the southern Horr short rainy season is between October-December. Temperatures vary with altitude and range between 23^oC - 33^oC (Samburu North District Development Plan, 2008-2012).

Livestock is the mainstay of the people and it supports majority of the people's livelihood. The main livestock species found in the sub-county include:-cattle, goats, sheep, camels, donkeys and poultry. The sub-county has a high potential for livestock production as it is dominated by 80% of the rangeland conditions. The forest cover has declined tremendously over the years due to encroachment. Pressure on grazing land

immensely contributed to rangeland degradation. The sub-county has the highest wildlife population density in the country and about 90% of the animals are resident on open grassland. The types of wildlife found in the sub-county are elephants, eland, buffaloes, zebras, giraffes, lions, baboons and few rhinoceroses. Wildlife forms a major source of income and employment for the local people. 6,600 Km^2 or (94%) of the land is not arable. The sub-county relies solely on relief food assistance in form of relief supplies (Samburu North District Development Program, 2008- 2012).

3.4.3 Description of Marsabit South Sub-County.

It is one of the sub-counties in former Eastern province and covers an area of 20265.7 Km^2 (inclusive of Loiyangalani). It is situated 36^o 40' between longitudes 36^o East and latitudes 0^o 15' South. The Southern part of the sub-county is characterized by steep ridges and valleys, occasionally interrupted by hills - Ndoto and Sori Adi. The sub-county is drained by the Melgis River which also drains in Samburu county and other short lagas that end up in Lake Turkana (Laisamis District Development Plan, 2008-2012).

Livestock production is the major economic activity in the sub-county. 80% of the sub-county population is engaged in livestock production and it is a major source of employment. Common livestock species kept in the sub-county are cattle, goats and camels in varying densities which are reared under extensive grazing systems. Climatic conditions are characterized by desert like temperatures. The hottest areas are low plains and plateaus, apart from the area on the slopes of Ngurunit, Oltorut, Ilaut and Nolpilpil. Temperature ranges between (18^oC-39^oC) whereas rainfall ranges between (120mm-350mm) per annum (Laisamis District Development Plan, 2008- 2012).

3.5 Study population and sampling methods

3.5.1 Target population, sample sizes and sampling procedure

The target population of the study was a 'whole' from which the sample was picked. This study focused on camel stocking projects and therefore camel beneficiaries formed the target population. The research also targeted community members who did not benefit (controls) from camel stocking projects. The control was from participants who had resided with beneficiaries in the same locality 'before camel stocking' and belonged in the same wealth groups during the intervention period.

The Household survey questionnaires were pre-tested in Merti Sub-County of Isiolo County. They were then reviewed, before the final data collection in the targeted study areas. Merti was a VSF-Suisse Camel stocking project area of Rehabilitation of Pastoral Livelihoods (RePAL) and Camel Restocking Project (CARES) projects funded by FAO and SDC. These projects aimed at improving food security and livelihood in the vulnerable pastoralist households through livestock asset redistribution. Camel distribution was done between October 2010 and January 2011.

The two study areas purposively sampled were Kajiado and Ngurunit. The target population for the study in Kajiado county was the beneficiaries of SNV/Ministry of Livestock Development (ASAL project) implemented in 1990 and those of ALRMP Pilot phase conducted in Lorngoswa during the 2008-2009 financial year. Non-camel beneficiaries in the localities were also included in the study. The target population for the Ngurunit study area were members of 5 women groups, who benefited from two phases of Camel stocking projects. These projects were implemented in 1998 and 2007 by PEAR Innovation through Heifer International funding. A settlement is a village

(locality) where the respondents resided (originated from) during the study period. Table 3.1 lists the targeted settlements during the study.

Table 3.1: Settlements covered within Merti, Kajiado and Ngurunit study area

Camel stocking by	**Sub-Counties**	***Settlements covered***
VSF Suisse	**Merti**	Biliqo Marara, Dima Ado, Bisan Biliqo, Bulesa, Goda, Awarsitu, Merti North and Merti South
SNV/MoLD	**Kajiado Central**	Enkaroni, Oltepesi, Maili Tisa, Meto, Torosei and Namanga
SNV/MoLD	**Kajiado North**	Magadi and Kamukuru
ALRMP	**Kajiado Central**	Lorngoswa
PEAR Innovation	**Marsabit South**	Lmasula, Lkijiji, Naloja, Salato (A.I.C), Lkunono, Lmuldanda, Kilabunyo, Lorora, Lukumai, Lmaitaga, Lmoti, Dubsahai, Sikawai, Lonyori pesheu, Lekirisha, Town and Lkirne.
	Samburu North	Ntepes, Pidipido, Ndikiro, Learani, Lekiji, Siangan, Loburku uponi, Gile, Sirata, Ltorobo, Salato, Ltabas and Lparwa.

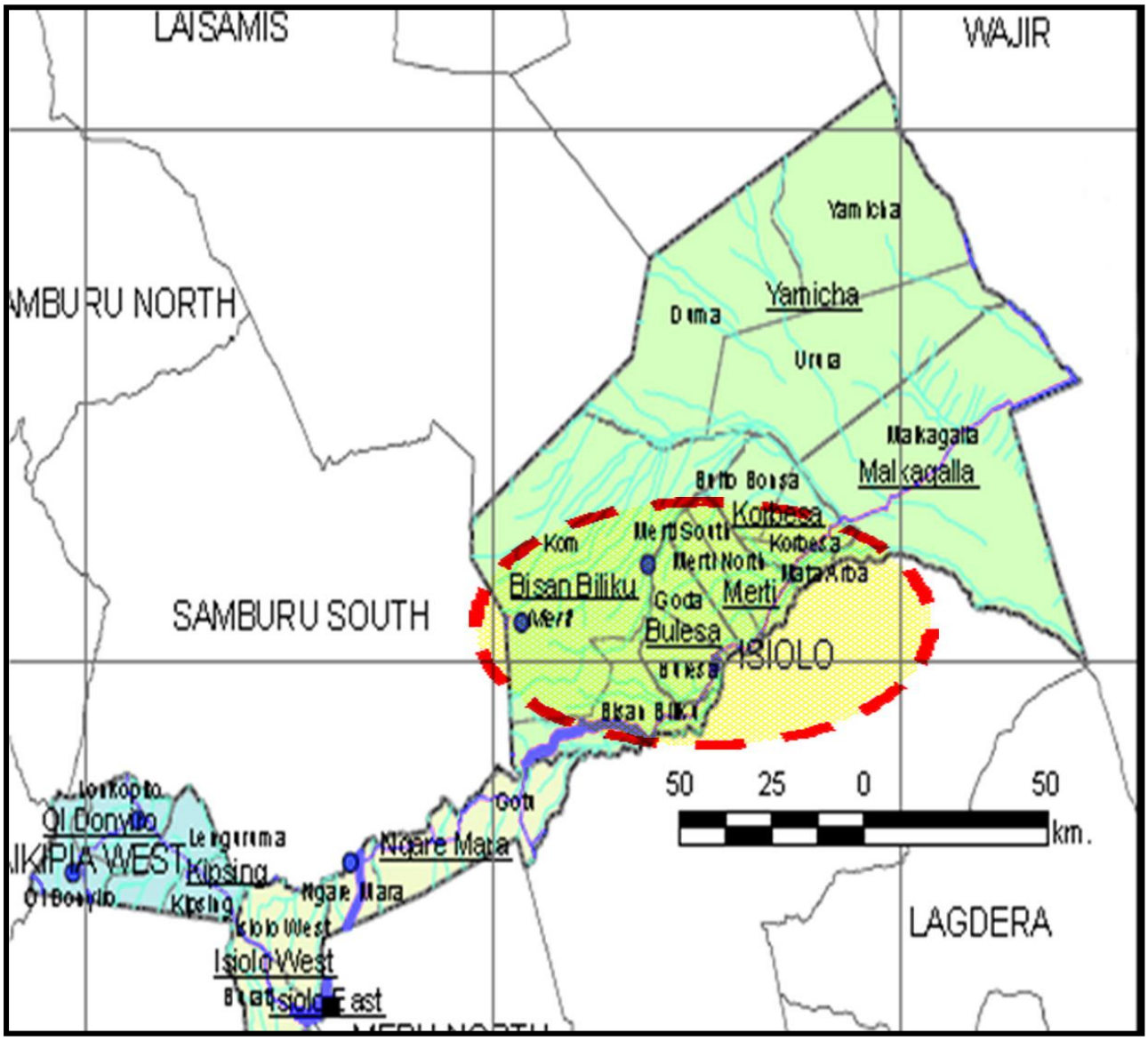

Figure 3.4: A map showing VSF-Suisse Project sites in Isiolo (Merti Sub-County)

VSF SUISSE	**Targeted Camel Project Sites (Questionnaire Pre-tested area)**

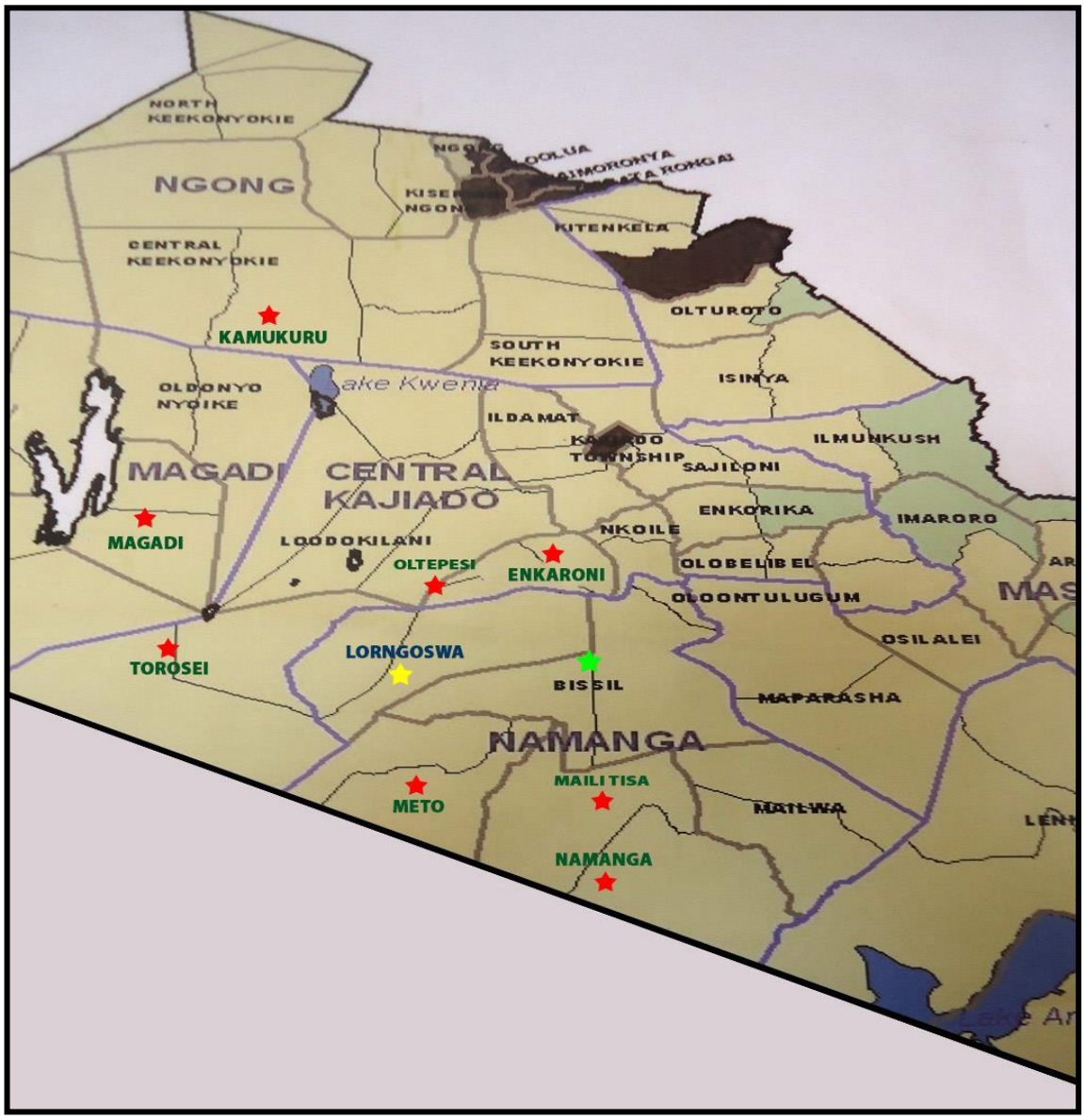

Figure 3.5: Amap of Kajiado County showing SNV/MoLD and ALRMP (NDMA) project sites

★	**SNV/MoLD (Targeted camel beneficiary settlements)**
★	**ALRMP (NDMA) Targeted camel beneficiary settlement**
★	**LIVESTOCK MARKET**

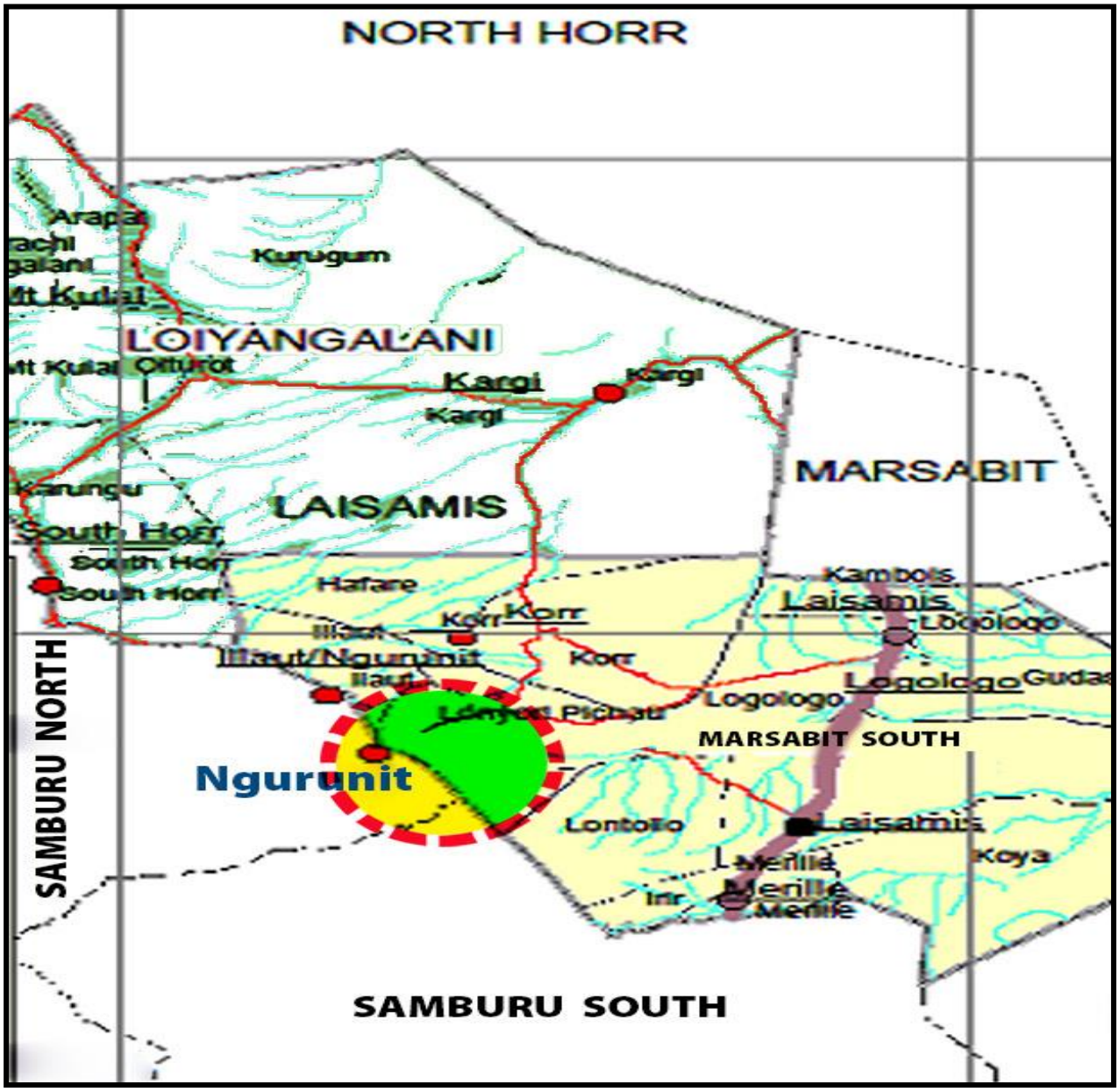

Figure 3.6: A map of Ngurunit areas (Marsabit South & Samburu North Sub-counties)-P.E.A.R Innovation targeted Camel project area

P.E.A.R Innovation	**Targeted Settlements within Marsabit South Sub-County**
	Targeted Settlements within Samburu North Sub-County

3.6 Inclusion and exclusion criteria:

The study targeted camel beneficiaries of 1990 (SNV/ MoLD project) and 2008-2009 (ALRMP project) in Kajiado county. It also targeted 1998 and 2007 (PEAR Innovation projects) camel beneficiaries in Ngurunit. The Control groups comprised of residents in the same study areas.

The study excluded camel beneficiaries from other programs, such as TEAR Fund, Christian Blind Mission and ALRMP in Ngurunit. It also excluded ALRMP beneficiaries in Kajiado of (2009-2010 and 2010-2011) financial years as well as NALEP December 2011 beneficiaries. These projects were left out as they were more recent and thus their benefits were yet to be realized. The study also excluded FGDs photographs in the main thesis due to ethical consideration.

3.7 Sample size

41% ($^{36}/_{88}$) respondents were randomly selected from Merti pre-testing sub-county as shown in Table 3.2. Overall, 73 respondents were interviewed in Kajiado study area. 74% ($^{32}/_{43}$) of the SNV/Ministry of Livestock Development beneficiaries were interviewed in Kajiado. 71% ($^{10}/_{14}$) of the ALRMP beneficiaries in Lorngoswa settlements were also interviewed as shown in Table 3.2. Purposive sampling was largely used to select Kajiado beneficiaries due to the low number of beneficiaries in the settlements except for groups and settlements that had many beneficiaries. 31 Non-camel beneficiaries were interviewed as controls in Kajiado. 5 Focus Group Discussions (FGDs) comprising of non- camel beneficiaries in the community except for Oltepesi were conducted. FGDs were conducted in Oltepesi, Meto, Namanga, Lorngoswa and Kamukuru. Elders played a crucial role in the FGDs responses as the SNV/MoLD project had been implemented 22 years back. Table 3.2 provides targeted beneficiaries breakdown in the study areas.

In Ngurunit, 73% of the Pilot project beneficiaries of 1998 and an average of 36% of 2007 (Group II-V) beneficiaries were interviewed as shown in Table 3.2. Overall, 46% ($^{180}/_{390}$) of PEAR Innovation beneficiaries in Ngurunit were interviewed. According to (Gay, 1996) at least 10% of the total population is representative, whereas (Gall and Borg, 2003) recommend 30%. Based on these scholars, this study effectively surpassed the basic representative requirements of 10% or 30% as shown in Table 3.2. Stratified random sampling was used to select a representative sample in Ngurunit. The entire population was divided into smaller groups (strata). This technique was used as it ensures the presence of key sub-groups within the sample and has a high statistical precision. Beneficiaries were first categorized within the existing 5 women groups. From each women group, a representative (%) sample as shown in Table 3.2 was tabulated. A random sample from each of the stratum (5 groups) was taken in a number proportional to the stratum's size when compared to the population. More beneficiaries were sampled from Group I (Salato) as the project had taken longer time and had a large group of member's population. The group members random sample was based on stratified characteristics of age, education, settlement of origin and ethnicity. 24 non-camel beneficiaries were interviewed as controls in Ngurunit due to reduced cases of *non-beneficiaries* as a result of camel stocking interventions from other organizations, large scope of 'pass- on calves' beneficiaries and traditional stocking systems i.e leasing of camels, cultural changes in use of camels as dowry across the tribes among others. 2 FGDs of elders drawn from Samburu North and Marsabit South sub-counties sides of Ngurunit were conducted separately. 5 additional FGDs with representative women group officials and members in the range of 5 – 12 members were conducted. Six enumerators recruited from Ngurunit were trained to assist in the individual household data collection.

Table 3.2: Camel beneficiaries, settlements and sample sizes in the study areas

Camel restocking by	Year of camel distribution	Settlements covered	Beneficiaries	No. of beneficiaries interviewed	% Sample size	No. of FGDs
VSF Suisse	2010	8	88	36	41	4
SNV/MoLD	1990	8	43	32	74	4
ALRMP	2008	1	14	10	71	1
P.E.A.R	1998		105	77	73	
Innovation	2007	30	285	103	36	7

Nb: *VSF-Suisse site was only used as a pre-test. P.E.A.R Innovation's 1998 distribution benefited the 1st Women Group (I)-Salato, whereas 2007 distribution benefited 4 women groups (Group II-V) namely: Salama, Stargille, Saidia and Nkejuk.*

3.8 Methods of data collection

Data was collected from primary and secondary sources providing both quantitative and qualitative data. Methods employed were;

1. Survey: A household survey questionnaire was developed to capture the quantitative data needs of the study. A random stratified sample and purposive sampling was extracted from the targeted camel beneficiaries and control groups and a similar questionnaire administered to both groups. The household questionnaire also collected qualitative data during the study.
2. Focus Group Discussions: Focus Group Discussions (FGDs) were conducted among the respondent groups. The information collected during the FGDs was useful in providing an in-depth explanation of the survey data and helped validate the household's findings through verifications from more sources in a group set-up. Participatory Impact Assessment (PIA) tools were used during the data collection process in both individual respondents and FGDs. These tools included: time lines, rankings, scoring and proportional piling. Proportional piling is a method that helps to obtain data from respondents in percentages, especially when

dealing with illiterate respondents. Stones were largely used in the study for quantification. The number of stones allocated per item by the respondents, was divided by the total number of twenty stones used, then multiplied by 100.

3. Literature Review: This involved perusal of printed material in the form of program reports from VSF-Suisse, SNV, P.E.A.R Innovation and other program implementers' such as Government documents, County Development Plans, publications among others.

3.9 Data analysis:

Field data was first checked for completeness, coded and analyzed using Statistical Package for Social Science (SPSS) version 11.5. Descriptive analysis i.e. frequencies, percentages, means and standard deviation were used in quantitative data presentation. Microsoft Word and Excel were used in the preparation of summary tables and developing graphs. Inferential analysis was used to test hypothesis especially the Analysis of Variance (ANOVA). Data was then interpreted in relation to the research objectives guiding the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Demographic characteristics

4.1.1 Settlements covered within the study areas

This study covered a total of 39 settlements. Ngurunit study area had 30 settlements, whereas Kajiado had 9. These settlements were distributed within the sub-counties as shown in figure 4.1.

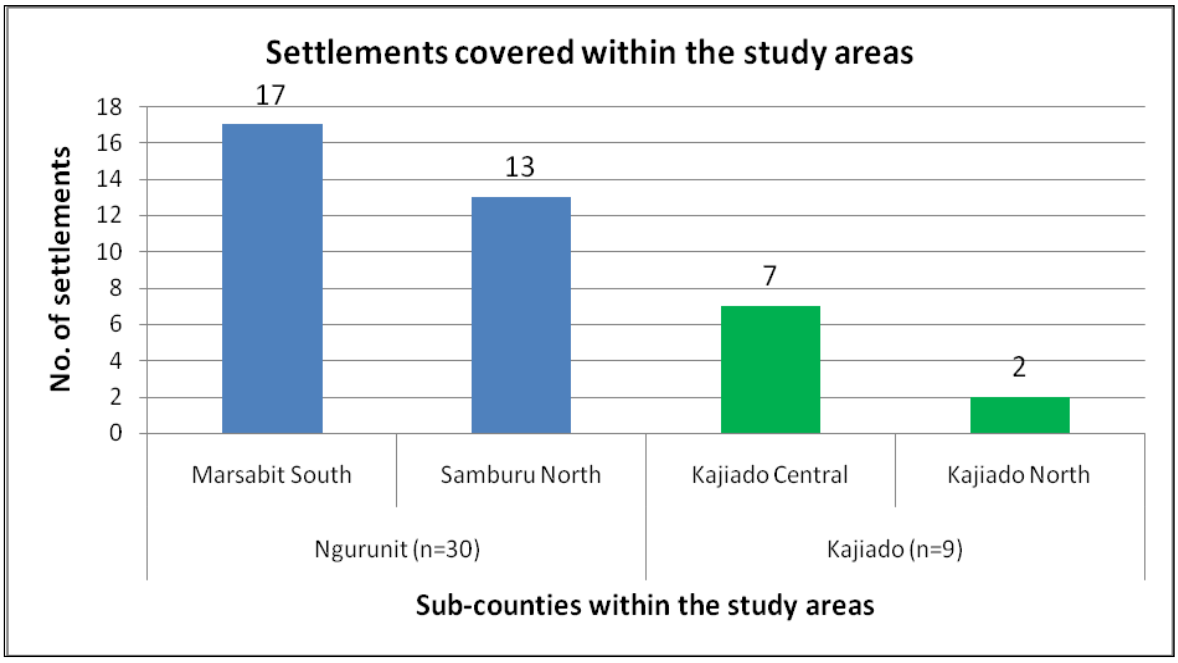

Figure 4.1: Settlements covered within the study areas

4.1.2 Respondents (households) within the study areas

Results in Table 4.1 provide a summary of 204 and 73 respondents from Ngurunit and Kajiado study areas respectively. The respondents from Ngurunit were 180 camel beneficiaries and 24 controls, while the corresponding numbers from Kajiado were 42 and 31.

Table 4.1: The number of respondents (households) within the study areas

Study areas	Number of respondents		Total
	Beneficiaries	Controls	
Ngurunit	180	24	204
Kajiado	42	31	73

Table 4.2 shows a breakdown of respondents from Ngurunit who came from the administrative Sub-Counties of (Samburu North and Marsabit South). The same table provides similar information for Kajiado study area.

Table 4.2: The number of respondents (households) from administrative Sub-counties within the study area

Study areas	Sub-county	Number of respondents		Total
		Beneficiaries	Controls	
Ngurunit	Marsabit South	105	18	204
	Samburu North	75	6	
Kajiado	Kajiado Central	37	24	73
	Kajiado North	5	7	

4.1.3 Gender

Table 4.3 shows the gender of the respondents in the two study areas. In Ngurunit 201 or 98.5% of the respondents were female, while 3 (1.5%) were male. They came from the five women groups namely: Salato, Salama, Star gille, Saidia and Nkejuk within the community. These groups were beneficiaries of the camel restocking project. The high number of female respondents in Ngurunit was due to the fact that PEAR Innovation targeted women in the camel stocking projects. Twenty-two (30.1%) of the respondents in Kajiado were female, while 51 (69.9%) were male.

Table 4.3: Gender of respondents within the study area

Study area	Number of respondents			
	Male	(%)	Female	(%)
Ngurunit(n=204)	3	1.5	201	98.5
Kajiado(n=73)	51	69.9	22	30.1

4.1.4 Ethnicity

The study established the ethnicity of the interviewed respondents and their couples. This helped understand the origin of the respondents residing in Ngurunit cosmopolitan area and the issue of traditional as well as non-traditional camel ownership. Overall, couples ethnicity analysis revealed that majority of respondents, 103 (51%) were Samburus (Samburu-Samburu), 72 (35%) were Rendilles (Rendille-Rendille), 28 (14%) were Ariaal (Samburu-Rendille) and only 1 couple had an intermarriage between a (Samburu & Ariaal). These results are presented in Figure 4.2.

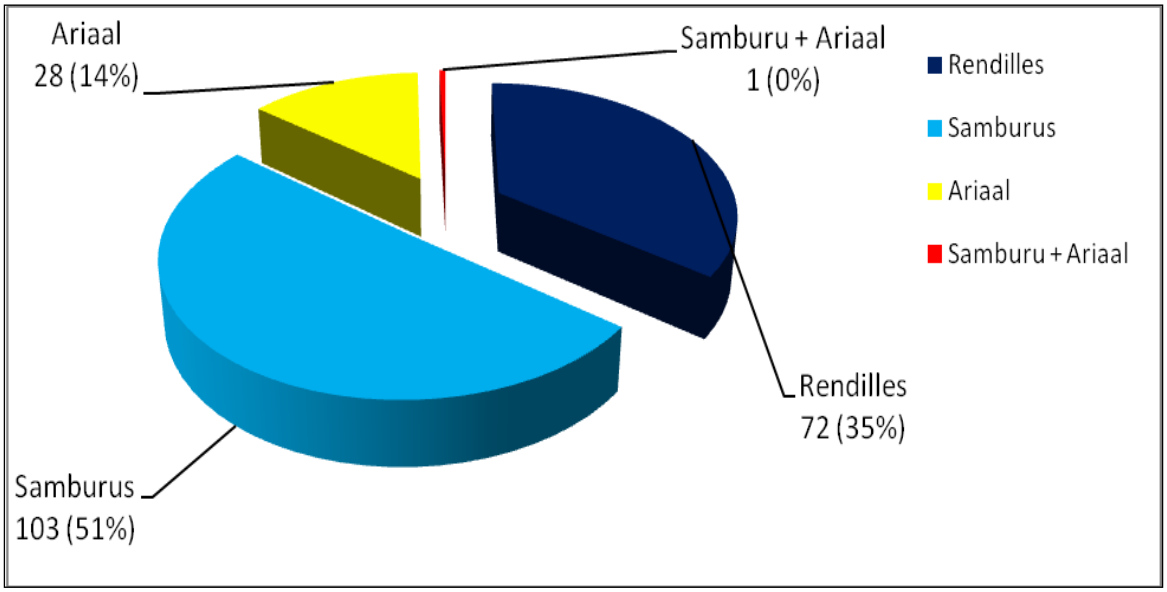

Figure 4.2: Respondents (couples) tribe in Ngurunit study area (n=204)

Kajiado County is cosmopolitan especially, in the urban centres due to its proximity to Nairobi. 95% of the respondents were originally from the Maasai community whereas 5% were from the Somali community residing in the study area. Figure 4.3 shows the result of respondent's tribe in Kajiado.

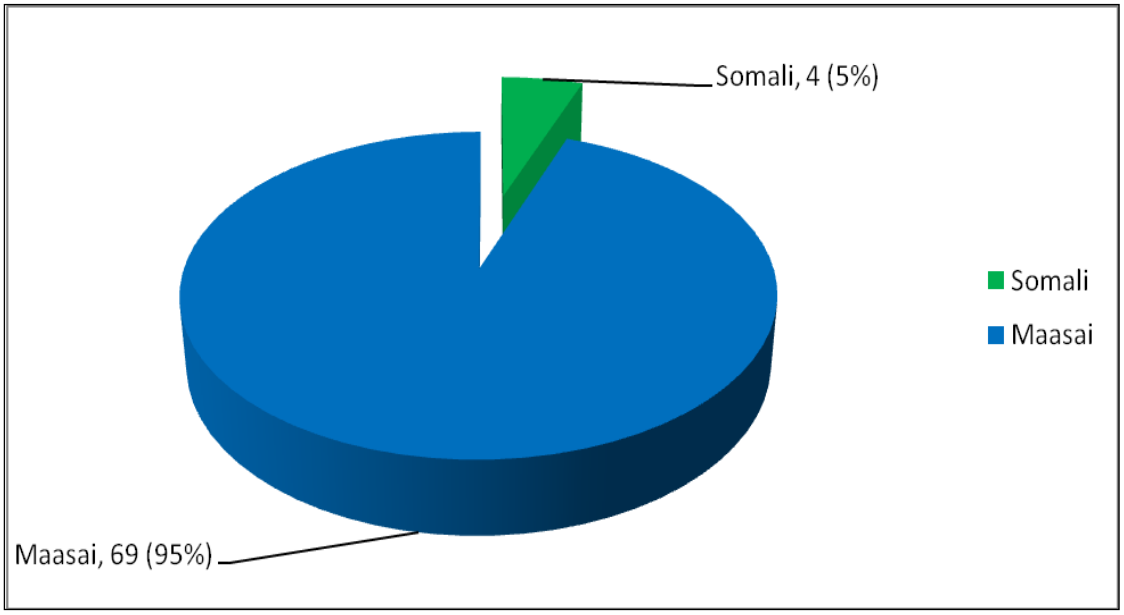

Figure 4.3:Respondents tribe in Kajiado study area (n=73)

4.1.5 Camel stocking projects

Table 4.4 shows the breakdown of organizations that implemented camel stocking projects, the year when stocking was done and the number of camel beneficiaries interviewed within Kajiado study area. Most of the respondents, 32 (76%) received camels from SNV/MoLD project, although there was some contribution from ALRMP (24% of respondents).

Table 4.4: The composition of Kajiado (beneficiaries) respondents from targeted camel projects

Camel stocking by	Year of Camel stocking	Respondents (n=42)	
		Frequency(f)	(%)
SNV/MoLD	1990	32	76
ALRMP	2008	10	24
TOTAL		42	100

4.1.6 Household size and composition.

4.1.7 Household sizes

The respondents were asked to indicate the number of people staying in their households. These numbers were then broken down into smaller sizes of 5 people each. Polygamous families for instance, have a large household size (*as they comprise of a number of children from different houses, wives and sometimes a few relatives*), but under the care of the household head. A majority 137 (67%) and 26 (35%) respondents had households sizes with 6-10 members in Ngurunit and Kajiado respectively as shown in Table 4.5. There were no respondents in Ngurunit with household sizes above 20, unlike Kajiado whose household size rose upto (51-55). The reason for Kajiado having households with more than 16-20 members (37%) was due to polygamy.

Table 4.5: Household sizes of respondent's households in the study areas

Household size category	Ngurunit (n=204)		Kajiado(n=73)	
	f	(%)	f	(%)
(≤ 5)	46	22.5	5	7
6 – 10	137	67.1	26	35
11 – 15	20	9.8	15	21
16 – 20	1	0.6	8	11
21 – 25	0	0	10	14
26 – 30	0	0	3	4
31 – 35	0	0	3	4
51 -55	0	0	3	4

4.1.8 Composition of parents

The study first established the current composition of parents in the households. A majority 152 (74%) of the respondents indicated the existence of both parents (nuclear family) in Ngurunit study area as shown in Figure 4.4.

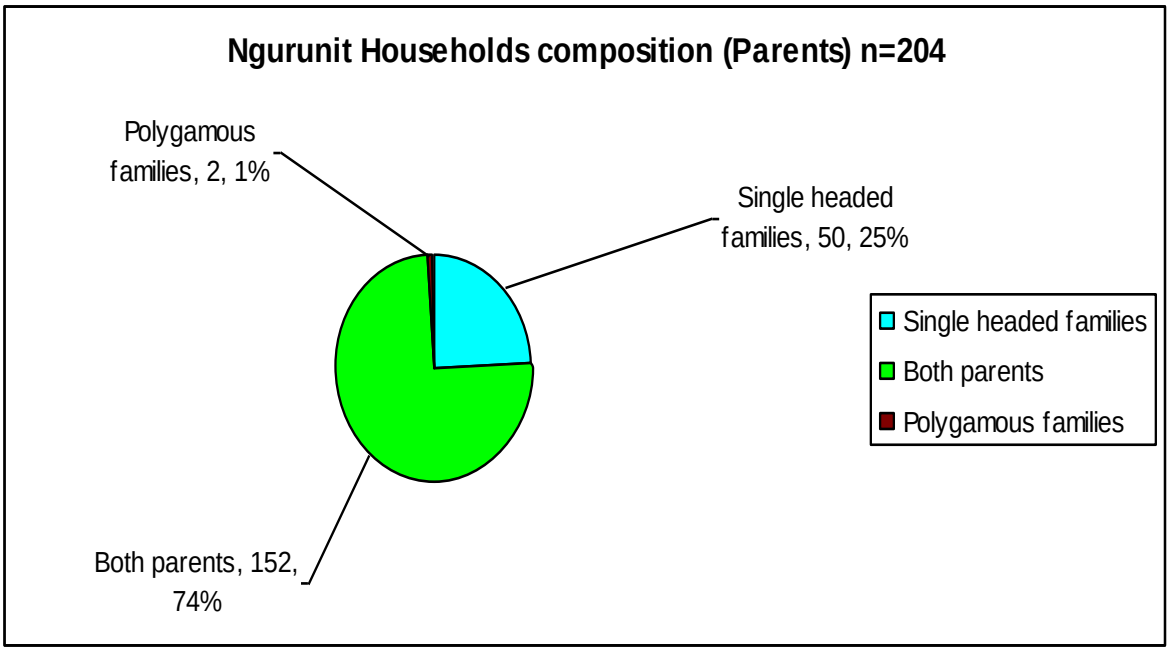

Figure 4.4: The composition of parents in Ngurunit respondent's households

Kajiado respondents indicated 32 (44%) of the households from monogamous families and 32 (44%) consisting of respondents from Polygamous families as shown in figure 4.5.

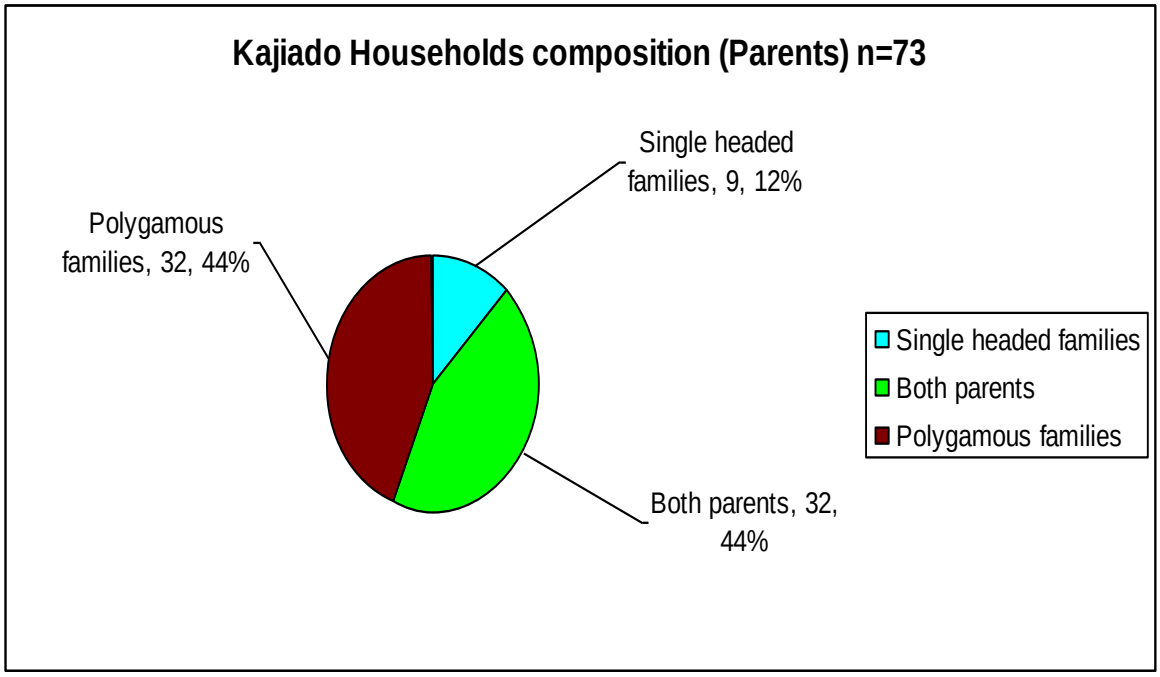

Figure 4.5: The composition of parents in Kajiado respondent's households

4.1.9 The number of children in the households

The study revealed that a majority of respondent's households had 5-9 children in both Ngurunit and Kajiado as shown in table 4.6. The second largest group in Ngurunit comprised of 88(43.1%) households with less than 4 children, Kajiado second group had 16 (21.9%) HHs with 10-14 children. The results on the number of children in the households are presented in table 4.6.

Table 4.6:The numberof children in Ngurunit and Kajiado respondent's households

No. of Children	Ngurunit (n=204)		Kajiado(n=73)	
	f	(%)	f	(%)
(≤ 4)	88	43.1	10	13.7
5 – 9	114	55.9	31	42.5
10 – 14	2	1	16	21.9
15 – 19	0	0	8	11
20 – 24	0	0	2	2.7
25 – 29	0	0	3	4.1
30 – 34	0	0	1	1.4
40 – 44	0	0	2	2.7

4.1.10 Number of relatives staying in the respondents households

The findings showed that 124 (60.8%) and 46 (63%) of respondent's households in Ngurunit and Kajiado respectively did not stay with any relative. However, 66 (32.4%) and 20 (27.4%) of the respondents households in Ngurunit and Kajiado respectively, stayed with at least 1-2 relatives. 4(5.5%) households in Kajiado had (≥ 5) relatives in their households. Results on the number of relatives are presented in table 4.7

Table 4.7: The number of relatives staying in Ngurunit and Kajiado respondent's households

No. of Relatives	Ngurunit (n=204)		Kajiado(n=73)	
	f	(%)	f	(%)
None (0)	124	60.8	46	63
1 – 2	66	32.4	20	27.4
3 – 4	14	6.9	3	4.1
(≥ 5)	0	0	4	5.5

4.2 The current livestock ownership by the respondents

In order to assess the impact of drought on livestock species and (livestock) households' assets, the respondents were asked to indicate the number of their livestock. The type of livestock considered were camels, cattle, sheep and goats. The livestock numbers were distributed into categories of 0 (None), 1-4, 5-9, 10-19, 20-29, 30-39, 40-49, 50-59,60-69, 70-79, 80-89, 90-99 and 100 & above.

4.2.1 The current livestock holdings in the study areas

Most of the beneficiary households in Ngurunit owned 1-4 heads of cattle, 1-4 camels and 1-4 sheep. The findings show that a majority 116(64.4%) HHs owned 1-4 camels, 67(37.2%) owned 1-4 cattle and 64(35.6%) HHs with (1-4) sheep. Most households kept a range of (10-19) goats with a leading 23.9%, as shown in table 4.8.

Table 4.8: The current ownership of livestock among Ngurunit beneficiaries (n=180)

No. of livestock	Camels		Cattle		Sheep		Goats	
	f	(%)	f	(%)	f	(%)	f	(%)
0 (None)	45	25	27	15	35	19.4	5	2.78
1 – 4	116	64.4	67	37.2	64	35.6	25	13.9
5 – 9	11	6.11	42	23.3	39	21.7	35	19.4
10 – 19	5	2.78	32	17.8	26	14.4	43	23.9
20 – 29	1	0.56	4	2.22	14	7.78	27	15
30 -39	1	0.56	5	2.78	1	0.56	16	8.89
40 – 49	1	0.56	1	0.56	0	0	11	6.11
50 – 59	0	0	1	0.56	1	0.56	11	6.11
60 – 69	0	0	0	0	0	0	5	2.78
70 – 79	0	0	0	0	0	0	1	0.56
(≥ 100)	0	0	1	0.56	0	0	1	0.56

A majority 8 (33.3%) of Ngurunit controls (non-beneficiary) had 1-4 cattle, 6(25%) with 1-4 sheep and 8(33.3%) with goats in the same range as illustrated in table 4.9. It was only goats that the control respondents owned in large numbers beyond (20-29). There was no ownership of camels among this control group as shown in table 4.9.

Table 4.9: The current ownership of livestock among Ngurunit controls (n=24)

No. of livestock	Camels		Cattle		Sheep		Goats	
	f	(%)	f	(%)	f	(%)	f	(%)
0 (None)	24	100	12	50	9	37.5	2	8.33
1 – 4	0	0	8	33.3	6	25	8	33.3
5 – 9	0	0	2	8.33	3	12.5	5	20.8
10 – 19	0	0	2	8.33	4	16.7	3	12.5
20 – 29	0	0	0	0	2	8.33	1	4.17
30 -39	0	0	0	0	0	0	2	8.33
40 – 49	0	0	0	0	0	0	2	8.33
50 – 59	0	0	0	0	0	0	1	4.17

Table 4.10 shows a wide disparity in cattle ownership among Kajiado beneficiaries. A majority 10(23.8%) owned 1-4 cattle followed by 8(19%) with 5-9 cattle. A majority 8(19%) of respondents had 1-4 camels, 12(28.6%) with 10-19 goats and 9(21.4%) with 10-19 sheep. A small proportion of Kajiado households had livestock in the excess of 100 category.

Table 4.10: The current ownership of livestock among Kajiado beneficiaries (n=42)

No. of livestock	Camels		Cattle		Sheep		Goats	
	f	(%)	f	(%)	f	(%)	f	(%)
0 (None)	25	59.5	2	4.8	1	2.4	1	2.4
1 – 4	8	19	10	23.8	2	4.8	0	0
5 – 9	4	9.5	8	19	3	7.1	3	7.1
10 – 19	0	0	7	16.7	9	21.4	12	28.6
20 – 29	0	0	2	4.8	5	11.9	6	14.3
30 -39	0	0	0	0	7	16.7	2	4.8
40 – 49	3	7.1	2	4.8	2	4.8	1	2.4
50 – 59	0	0	1	2.4	1	2.4	2	4.8
60 – 69	0	0	1	2.4	0	0	2	4.8
70 – 79	0	0	0	0	1	2.4	1	2.4
80 – 89	0	0	0	0	1	2.4	2	4.8
90 – 99	0	0	0	0	1	2.4	0	0
(≥ 100)	0	0	8	19	8	19	9	21.4

Kajiado controls had livestock sizes ranging from (None) to (100 and above). A majority 6(19.4%) of respondents had 1-4 cattle, 8(25.8%) with (100 and above) sheep and goats. Kajiado control group had no ownership of camels as shown in table 4.11.

Table 4.11: The current ownership of livestock among Kajiado controls (n=31)

No. of livestock	Camels		Cattle		Sheep		Goats	
	f	(%)	f	(%)	f	(%)	f	(%)
0 (None)	31	100	5	16.1	2	6.5	1	3.2
1 – 4	0	0	6	19.4	0	0	1	3.2
5 – 9	0	0	4	12.9	4	12.9	4	12.9
10 – 19	0	0	3	9.7	3	9.7	4	12.9
20 – 29	0	0	2	6.5	3	9.7	3	9.7
30 -39	0	0	3	9.7	0	0	1	3.2
40 – 49	0	0	1	3.2	4	12.9	3	9.7
50 – 59	0	0	3	9.7	2	6.5	1	3.2
60 – 69	0	0	0	0	1	3.2	1	3.2
70 – 79	0	0	0	0	1	3.2	3	9.7
80 – 89	0	0	1	3.2	3	9.7	1	3.2
90 – 99	0	0	0	0	0	0	0	0
(≥ 100)	0	0	3	9.7	8	25.8	8	25.8

4.3 Objective 1: The contribution of camel milk in the household food basket during the wet and dry seasons

The study assessed camel milk production per household in (litres or cups) and on average, how the milk was utilized in the household. The major focus on utilization was on own household camel milk consumption, sales and support to other community members. The measuring unit for milk in the two study areas was first harmonized. 1 cup of milk in Ngurunit was equivalent to 0.35 litres of milk in Kajiado. Kajiado respondents measured milk in *Litres* whereas Ngurunit used *Cups*. For uniformity purposes, the study findings are presented in litres using the conversion rate of 1 Cup = 0.35 Litres.

4.3.1 Availability and accessibility of camel milk to the households during the wet season

The results on quantity of camel milk obtained in the households per day are presented in table 4.12. The study revealed that 79.4% (143) of beneficiary respondents in Ngurunit obtained camel milk during the wet season. A majority 56 (31.1%) obtained 0.35-1.4 litres (1-4 cups) and 56 (31.1%) obtained 1.75-2.8 litres (5-8 cups) per day during the wet season as shown in table 4.12. 31(73.8%) of camel beneficiaries obtained camel milk during the project lifespan in Kajiado. A leading 12 (28.6%) HHs obtained 0.35-1.4 litres (1-4 cups) followed by 11(26.3%) beneficiaries who obtained ≥ 5.95 litres ($\geq$ 17 cups) of camel milk in Kajiado. 13 (54.2%) controls in Ngurunit obtained 0.35-1.4 litres(1-4 cups) of camel milk during the wet season. 93.5% of Kajiado controls did not obtain any camel milk.

Table 4.12: The quantity of camel milk obtained (Litres) per day in the households during the wet season

Quantity of Camel milk Litres	**Ngurunit beneficiaries (n=180)**		**Ngurunit Controls (n=24)**		**Kajiado beneficiaries (n=42)**		**Kajiado Controls (n=31)**	
	f	(%)	f	(%)	f	(%)	f	(%)
None (0)	37	20.6	11	45.8	10	23.8	29	93.5
0.35 – 1.4	56	31.1	13	54.2	12	28.6	1	3.2
1.75 – 2.8	56	31.1	0	0	1	2.4	0	0
3.15 – 4.2	23	12.8	0	0	0	0	1	3.2
4.55 – 5.6	4	2.2	0	0	7	16.7	0	0
($\geq$ 5.95)	4	2.2	0	0	11	26.3	0	0

4.3.2 Availability and accessibility of camel milk in the households during the dry season

One forty one (78.3%) of Ngurunit beneficiaries obtained camel milk during the dry season, with most of them 112 (62.2%) accessing between 0.35 and 1.4 litres of camel milk per day. However, only (25%) of the control group in Ngurunit accessed camel milk during the dry season.

Quantities of camel milk obtained among the camel beneficiaries in Kajiado varied from none (0) to (≥ 50.75 litres). A majority 12 (28.6%) of Kajiado beneficiaries obtained 0.35-1.4 litres of camel milk during the dry season. There was a slight increment in camel milk accessibility among Kajiado controls during the dry season with 4(12.9%) households accessing 0.35-1.4 litres and 1(3.2%) accessing 1.75-2.8 litres and 3.15-4.2 litres. Detailed presentation on camel milk accessibility during the dry season is presented in table 4.13.

Table 4.13: The quantity of camel milk obtained per day in the study areas during the dry season

Quantity of Camel milk	Ngurunit beneficiaries (n=180)		Ngurunit Controls (n=24)		Kajiado beneficiaries (n=42)		Kajiado Controls (n=31)	
Litres	f	(%)	f	(%)	f	(%)	f	(%)
0	39	21.7	18	75	10	23.8	25	80.6
0.35 – 1.4	112	62.2	6	25	12	28.6	4	12.9
1.75 – 2.8	24	13.3	0	0	6	14.3	1	3.2
3.15 – 4.2	3	1.7	0	0	2	4.8	1	3.2
4.55 – 5.6	0	0	0	0	2	4.8	0	0
(≥5.95)	2	1.1	0	0	10	23.8	0	0

4.4 Utilization of camel milk

4.4.1 The quantity of camel milk consumed (litres) per day in the households during the wet season

Ninety-five (52.8%) of beneficiaries from Ngurunit consumed 0.4-1.1 litres (1 – 3 cups) of camel milk per household during the wet season. In Kajiado, the proportion consuming the same volume of milk was lower at 31%. However, Kajiado beneficiaries consumed camel milk in their households in varying quantities upto (≥ 6.65 litres) during the project period. Whereas 13 (54.2%) of Ngurunit control households consumed camel milk in the range of 0.35-1.05 litres; only 6.4% controls of Kajiado HHs did. Results on consumption of camel milk during the wet season are presented in table 4.14.

Table 4.14: The quantity of camel milk consumed (litres) per day in the households during the wet season

Quantity of Camel milk	Ngurunit beneficiaries (n=180)		Ngurunit Controls (n=24)		Kajiado beneficiaries (n=42)		Kajiado Controls (n=31)	
Litres	f	(%)	f	(%)	f	(%)	f	(%)
0	37	20.6	11	45.8	10	23.8	29	93.5
0.35 – 1.05	95	52.8	13	54.2	13	31	1	3.2
1.4 – 2.1	35	19.4	0	0	3	7.1	0	0
2.45 – 3.15	6	3.3	0	0	2	4.8	1	3.2
3.5 – 4.2	4	2.2	0	0	2	4.8	0	0
4.55 – 5.25	1	0.6	0	0	4	9.5	0	0
5.6 – 6.3	2	1.1	0	0	1	2.4	0	0
(≥6.65)	0	0	0	0	6	14.3	0	0

4.4.2 The quantity of camel milk consumed (litres) per day in the households during the dry season

A majority 128 (71.1%) of Ngurunit beneficiaries consumed 0.35-1.05 litres (1-3 cups) of camel milk per day in their households during the dry season. In Kajiado, a majority 16 (38.1%) beneficiaries consumed 0.35-1.05 litres of camel milk per day. Only 25% of Ngurunit controls consumed 0.35-1.05 litres of camel milk during the dry season. Kajiado controls households consumed varied quantities of camel milk with a leading, 4 (12.9%) consuming 0.35-1.05 litres as shown in table 4.15.

Table 4.15: The quantity of camel milk consumed (litres) per day in the households during the dry season

Quantity of Camel milk	**Ngurunit beneficiaries (n=180)**		**Ngurunit Controls (n=24)**		**Kajiado beneficiaries (n=42)**		**Kajiado Controls (n=31)**	
Litres	f	(%)	f	(%)	f	(%)	f	(%)
None (0)	40	22.2	18	75	10	23.8	25	80.6
0.35 – 1.05	128	71.1	6	25	16	38.1	4	12.9
1.4 – 2.1	10	5.6	0	0	5	11.9	1	3.2
2.45 – 3.15	0	0	0	0	3	7.1	1	3.2
3.5 – 4.2	0	0	0	0	0	0	0	0
4.55 – 5.25	0	0	0	0	3	7.1	0	0
5.6 – 6.3	2	1.1	0	0	0	0	0	0
(≥6.65)	0	0	0	0	5	11.9	0	0

4.4.3 The quantity of camel milk given to community members during the wet season

Overall 100(55.6%) of Ngurunit beneficiaries gave out camel milk to other community members. A majority 94(52.2%) of Ngurunit beneficiaries gave out 0.35-0.7 litres (1-2

cups) of camel milk per day during the wet season. Only six (14.4%) of Kajiado beneficiaries managed to give out camel milk to other community members. Of these HHs, 5 (12%) gave out (≥3.15 litres). None of the control groups in both Ngurunit and Kajiado managed to give out the camel milk they accessed. Results on camel milk given to other community members per day during the wet season are presented in table 4.16.

Table 4.16: The quantity of camel milk given to other community members during the wet season:-

Quantity of Camel milk	**Ngurunit beneficiaries (n=180)**		**Ngurunit Controls (n=24)**		**Kajiado beneficiaries (n=42)**		**Kajiado Controls (n=31)**	
Litres	f	(%)	f	(%)	f	(%)	f	(%)
None (0)	78	43.3	24	100	36	85.7	31	100
0.35 – 0.7	94	52.2	0	0	0	0	0	0
1.05 – 1.4	3	1.7	0	0	1	2.4	0	0
1.75 – 2.1	2	1.1	0	0	0	0	0	0
2.45 – 2.8	1	0.6	0	0	0	0	0	0
(≥3.15)	0	0	0	0	5	12	0	0

4.4.4 The quantity of camel milk given to other community members during the dry season

Overall 57(31.7%) of Ngurunit beneficiaries gave out camel milk to other community members during the dry season. A majority 54(30%) gave out 0.35-0.7 litres (1-2 cups) of camel milk per day during the dry season. 8(19%) of Kajiado beneficiaries also managed to give out camel milk to other community members per day during the dry season. A majority 4(9.5%) of Kajiado beneficiaries gave out (1.05-1.4 litres) and (≥ 3.15 litres) to

other community members. These community members included immediate neighbours, friends and relatives. None of the controls in Kajiado or Ngurunit managed to give out any of the camel milk accessed during the dry season. Results on camel milk given to other community members during the dry season per day are presented in table 4.17.

Table 4.17: The quantity of camel milk given to community members during the dry season:-

Quantity of Camel milk	**Ngurunit beneficiaries (n=180)**		**Ngurunit Controls (n=24)**		**Kajiado beneficiaries (n=42)**		**Kajiado Controls (n=31)**	
Litres	f	(%)	f	(%)	f	(%)	f	(%)
None (0)	123	68.3	24	100	34	81	31	100
0.35 – 0.7	54	30	0	0	0	0	0	0
1.05 – 1.4	2	1.1	0	0	4	9.5	0	0
1.75 – 2.1	0	0	0	0	0	0	0	0
2.45 – 2.8	1	0.6	0	0	0	0	0	0
(≥3.15)	0	0	0	0	4	9.5	0	0

4.5 Livestock milk preferences in the wet season

The study assessed the respondent's milk utilization preference in the wet season. This depended on the ability of the household to access a variety of milk or given an opportunity to select. The higher (1^{st}) the rank, the higher the household preference. Milk preference plays a choice- role in dietary intake that could influence food utilization in the households.

A majority 154 (75.5%) of Ngurunit respondents preferred cow's milk. They ranked cattle milk higher than any other during the wet season. Fifty-nine (80.8%) of Kajiado respondents also ranked cow's milk as first preference. Whereas 73 (35.8%) of Ngurunit

respondents ranked camel milk as their second preference, 48 (65.8%) ranked goats milk 2nd in Kajiado. 120 (58.8%) respondents in Ngurunit ranked goat's milk as their third preference and 37 (50.7%) respondents in Kajiado ranked sheep milk as their 3rd preference. 123 (60.3%) respondents in Ngurunit ranked sheep milk as their fourth preference whereas 37% respondents in Kajiado ranked camel milk as their 4th preference. Results on ranking household milk preference during the wet season in Ngurunit and Kajiado are presented in figure 4.6 and 4.7 respectively.

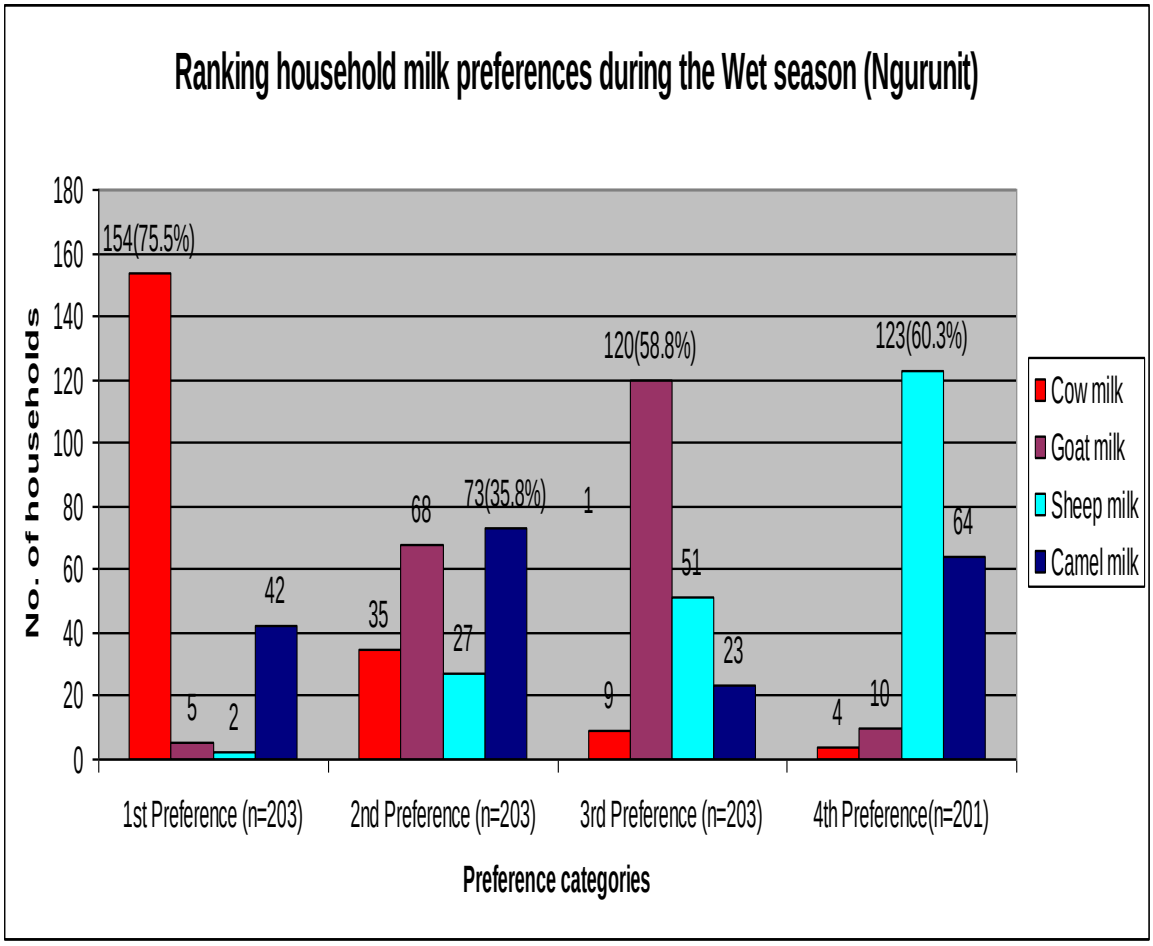

Figure 4.6: Livestock milk preferences in Ngurunit during the wet season

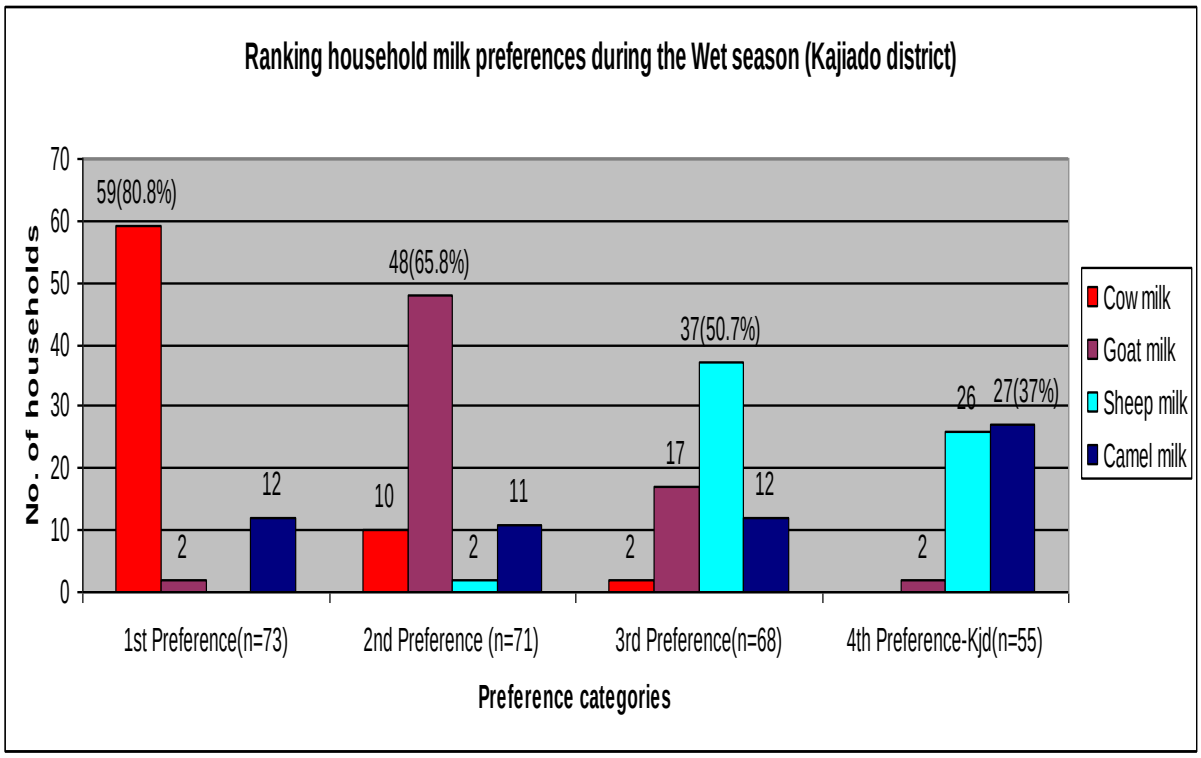

Figure 4.7: Livestock milk preferences in Kajiado during the wet season

4.5.2 Livestock milk supply reliability in the dry season and during the drought period:-

The dry/drought season is normally accompanied with scarcity of milk in Arid and Semi Arid lands. This study established the type of milk the targeted communities relied on during these critical times. This helped gauge the role of camel milk in the household's food basket. The type of milk was only mentioned if the targeted households used it. The higher (first) the rank, the higher the household milk reliability and vice versa.

In Ngurunit, camel milk ranked first in reliability with 122 (59.8%) respondents; goat milk ranked second with 101 (49.5%); sheep milk ranked third with 46 (22.5%) whereas cow milk ranked fourth with 22 (10.8%) respondents. Results on livestock species milk reliability during the dry/drought period in Ngurunit is illustrated in figure 4.8.

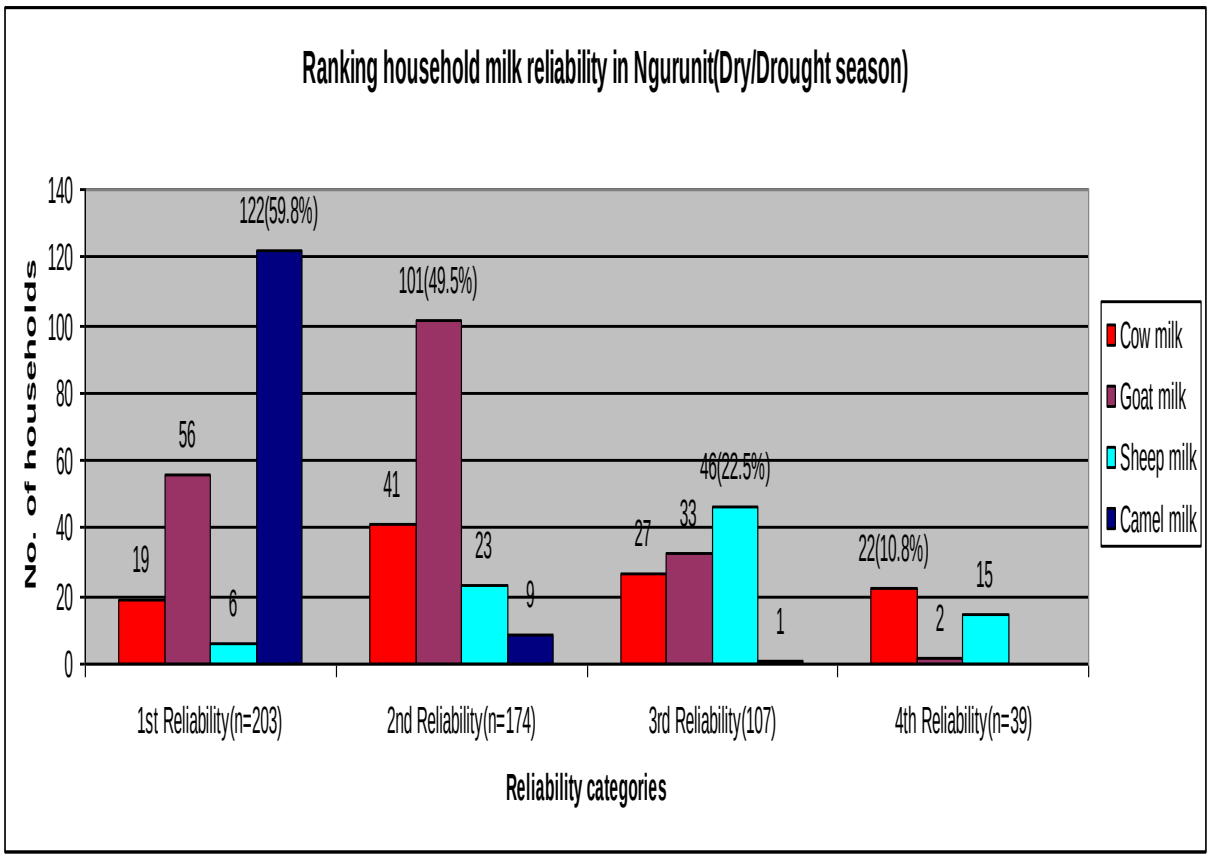

Figure 4.8: Livestock milk reliability in Ngurunit during the dry/drought period

In Kajiado; goat's milk ranked *first* by 38 (52%) respondents (households) and cow's milk *second* with 33 (45%) respondents. Sheep milk ranked *third* with 26 (35.6%) respondents and camel milk ranked *fourth* with 7 (9.6%) respondents as shown in figure 4.9. Despite the fact that camel milk ranked 4th (last) overall in Kajiado; 15 (21%) HHs ranked it *first* in dependability.

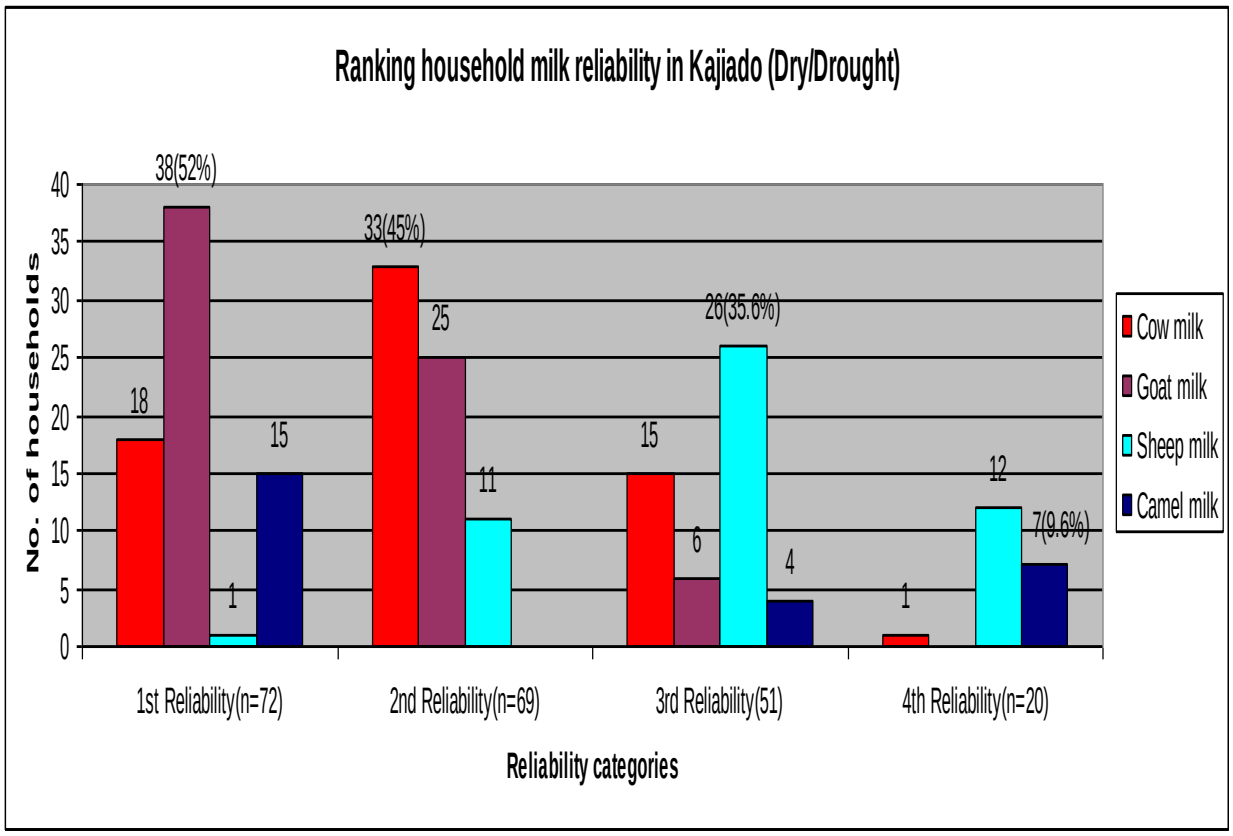

Figure 4.9:Livestock milk reliability in Kajiado during the dry/drought period

4.6 Test of Hypothesis 1

The study tested four hypotheses stated from the null.

Significance Level

Significance level is the probability value that forms the boundary between rejecting and not rejecting the null hypothesis (Ogula, 1998). In this study, the researcher chose to use the significance level of ($P < 0.05$) to test the hypothesis. The *decision rule* applied is; If the P value is greater than 0.05 (do not reject the H_o) and if it is less than or equal to 0.05 (reject the H_o).

Statement:-

Null hypothesis 1

H_o 1a: ***Camel ownership has no effect on camel milk consumption in the households during the wet season***

H_o 1b: ***Camel ownership has no effect on camel milk consumption in the households during the dry season***

Result

The significance level of Ngurunit beneficiaries is 0.000 in both the wet and dry seasons as presented in Appendix 4a & 4b. In this case, the established levels of significance (0.000) and (0.000) are lower than the p-value (0.05); therefore we reject the Null hypothesis (H_o) and accept the alternative (H_a). Thus, the independent variable of camel ownership in the households is a better predictor of camel milk consumption. In conclusion, there was a significant effect of camel ownership on camel milk consumption during the wet and dry seasons among Ngurunit beneficiaries.

The established values for Kajiado beneficiaries are (0.327) and (0.214) for the wet and dry seasons respectively. These obtained values were more than the p-value of (0.05). In this case, we do not reject the Null hypothesis (H_o) for Kajiado. In conclusion, there was no significant effect of camel ownership on camel milk consumption during the wet and dry seasons among Kajiado beneficiaries. This implied that camel ownership could not be used to determine camel milk consumption in Kajiado and that there could be other factors influencing camel milk consumption levels. ANOVA results for the wet and dry seasons are presented in Appendix 4a & 4b.

4.7 Objective 2: The contribution of camels & camel products in the household economy during the wet and dry season

The study assessed the various sources of income in individual households in both the wet and dry seasons. The respondents listed the sources and used proportional piling to

estimate their contribution. The proportions were then converted into percentages. The percentage levels of cash contribution from the various sources of income was broken down into various categories: Very low income source (1-19%); Low income source (20-39%); Average income source (40-59%); High income source (60-79%) and Very high income source (80% and above). Livestock sales varied in terms of seasonality, prices and numbers sold. Prices also depended on the respondent's ability to recall.

4.7.1 Camel sales as a source of cash income during the wet and dry seasons.

Fifteen (8%) and twenty-two (12%) of Ngurunit beneficiaries depended on camel sales as their source of income during the wet and dry seasons respectively. Out of this 12% reported during the dry season, a majority 10 (5.6%) of the households relied on camel sales as a low source of income. Results on camel sales as a source of income in Ngurunit are presented in figures 4.10

Camel sales as a source of income among Ngurunit beneficiaries during the wet and dry seasons.

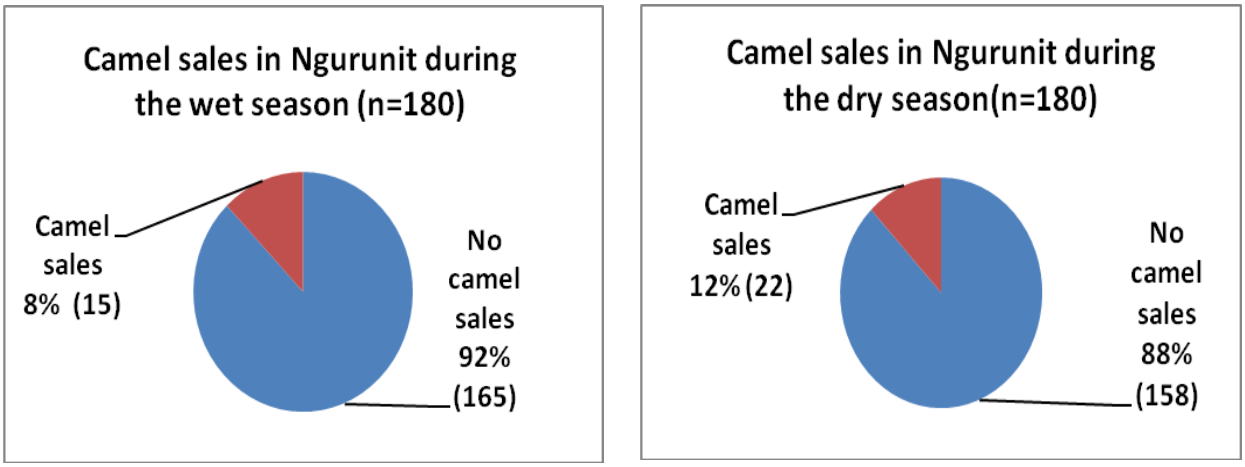

Figure 4.10: Camel sales as a source of income in Ngurunit in the wet & dry seasons

Camel sales as a source of income among Kajiado beneficiaries during the dry season

One (2%) household beneficiary in Kajiado depended on camel sales as an average source of income (40-59%) as shown in figure 4.11. None of the control groups in the study areas relied on camel sales as their source of income. Camel sales did not feature (0%) as a regular source of income among Kajiado beneficiaries during the wet season.

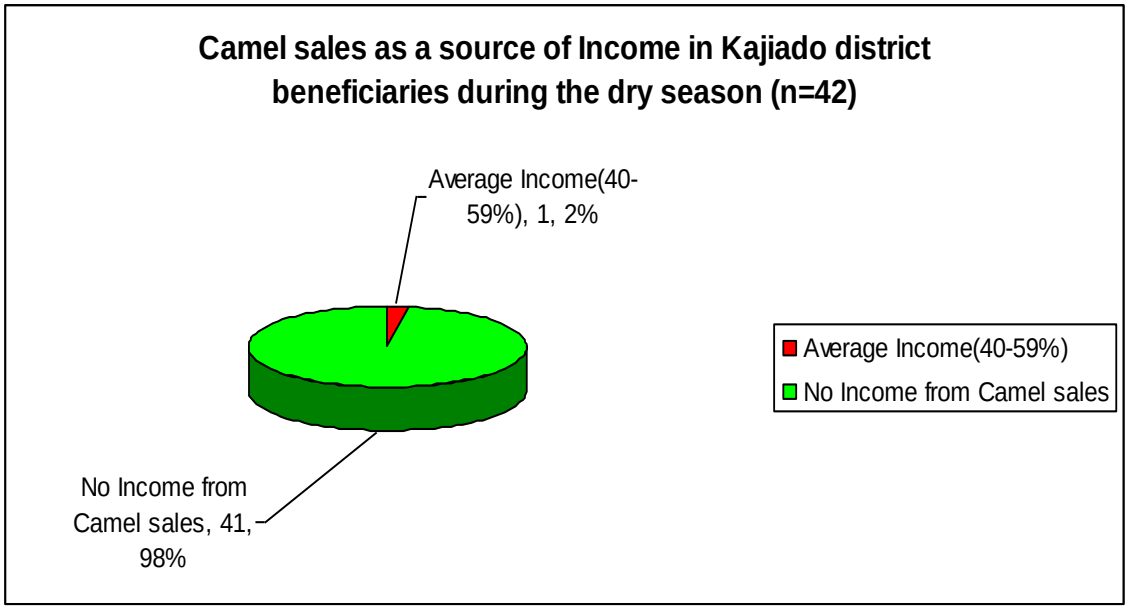

Figure 4.11: Camel sales as a source of income in Kajiado during the dry season

4.7.2 Income from historical camel sales and years of camel sales since stocking (in the study areas):-

Since the study targeted long-term projects; historical information on camel sales was sought to clearly understand the frequency of sales, the period and returns over time. The study established that 23 (12.8%) beneficiaries' households in Ngurunit had sold their camels for various reasons since stocking. 7 (3.9%) HHs sold their camels making an income range of (Ksh 10,000 & below) and (Ksh 10,001 - 25,000) as shown in Figure 4.12. Six (3.3%) HHs transacted through in kind payment.

For the case of Kajiado beneficiaries; 27 (64.3%) HHs generated income from camel sales within the camel rearing period. A majority 12 (28.6%) HHs earned income in the range of (Ksh 10,001- 25,000) each, through group shared returns. 4 (9.5%) HHs earned (Ksh 500,001 & Above). Results on Income from historical camel sales for the two study areas are illustrated in Figure 4.12.

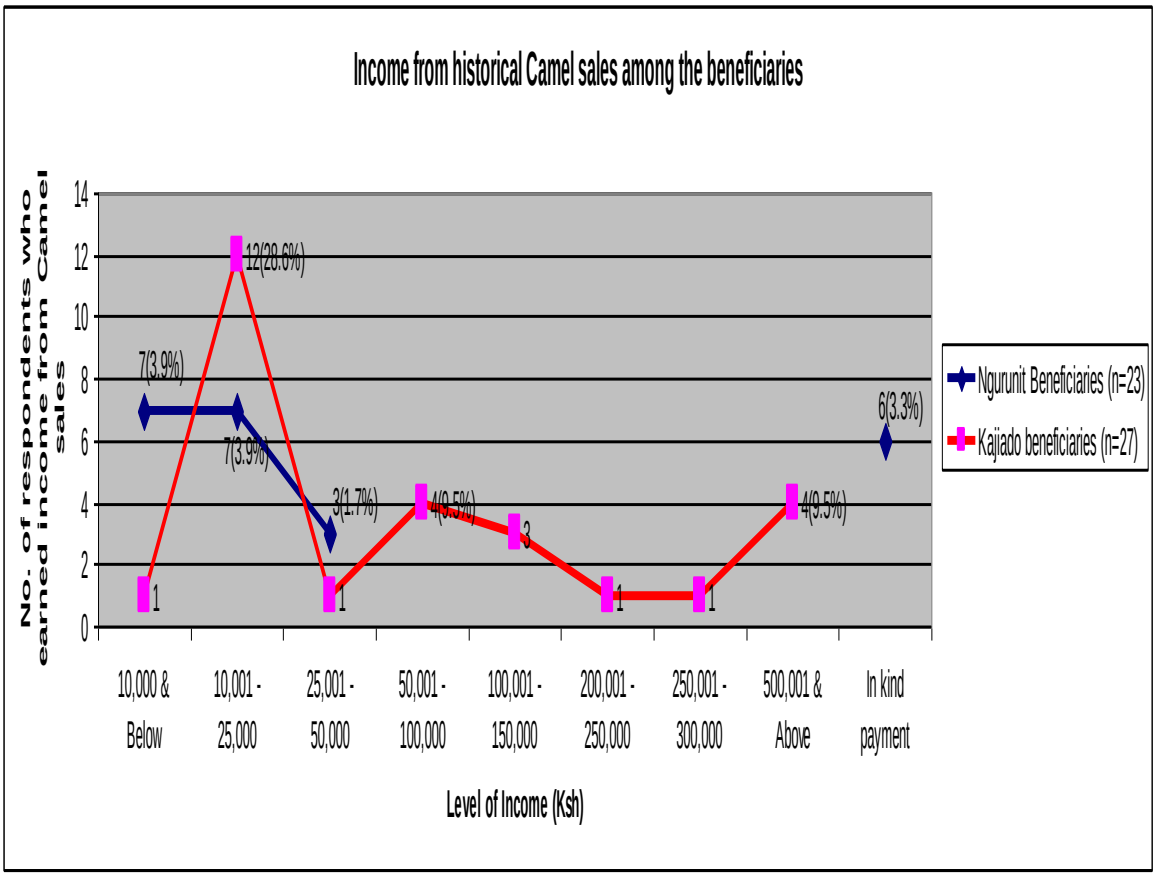

Figure 4.12: Income (Ksh) from historical camel sales among the beneficiaries' households

Years taken by camel beneficiaries before they started selling camels in the study areas.

While monitoring the contribution of camel sales in the household economy, the study also captured the period of these earnings. This was meant to understand the camel selling frequency among the beneficiaries.

Ngurunit beneficiaries started selling their camels, (7-9 years) after stocking; unlike Kajiado beneficiaries who started selling their camels (1- 3years) of stocking. However, most of the HHs in Kajiado, 12 (28.6%) sold their camels after (13-15 years). Fourteen (7.8%) HHs in Ngurunit sold their camels within a period of 10-15 years of stocking. Results on camel selling period in the study areas are presented in figure 4.13.

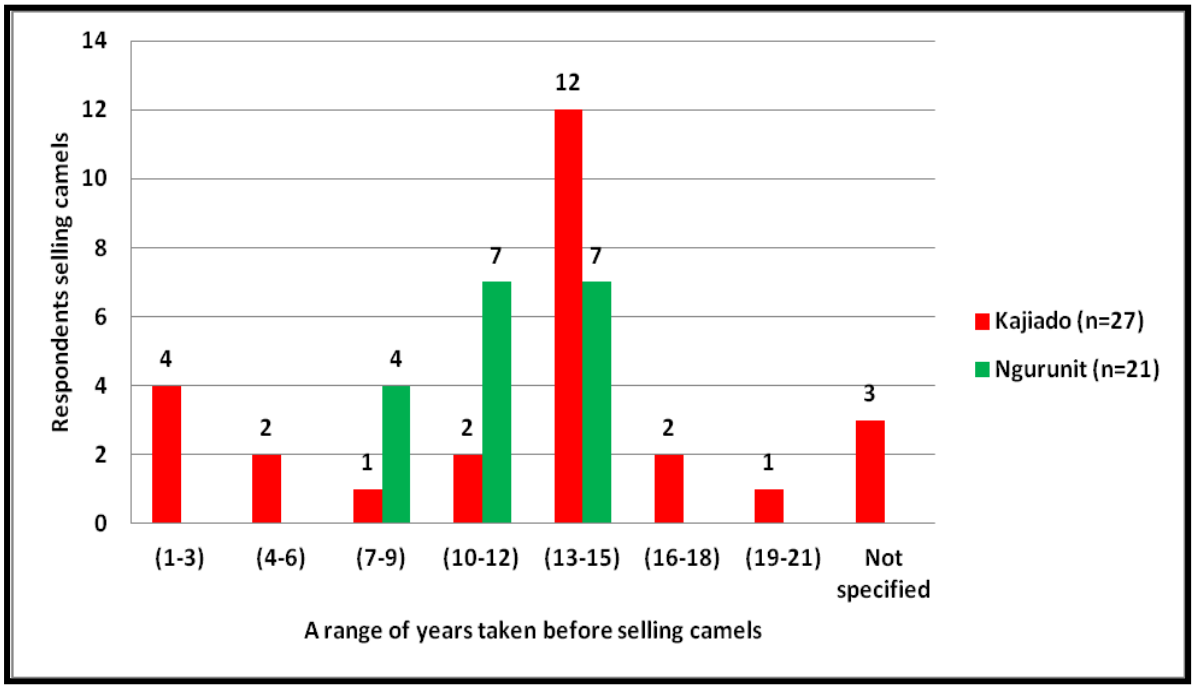

Figure 4.13: Years taken before beneficiaries started selling stocked camels in the study areas.

4.7.3 Camel milk sales as a source of income in the study areas:-

The quantity of camel milk sold (litres/cups) in Ngurunit per day during the wet and dry seasons:-

The study finding showed that 121 (67.2%) and 98 (54.4%) respondent beneficiaries sold camel milk in Ngurunit during the wet and dry seasons respectively. A majority 94 (52.2%) HHs sold camel milk in quantities of 0.35-0.7 litres (1-2 cups) per day in the wet season and the same quantity by 93 (51.7%) during the dry season as shown in table 4.18. The price of milk per cup (0.35 litres) in Ngurunit was Ksh 20; therefore they earned an

average income of (Ksh 600-1,200 per HH per month). 94 HHs each selling (1-2 cups) per day; guaranteed accumulative income of Ksh 56,400 -112,800 to Ngurunit camel beneficiaries per month during the wet season.

Table 4.18: The quantity of camel milk sold by Ngurunit beneficiaries during the wet and dry seasons

Milk Quantity		**Wet Season (n=180)**		**Dry Season(n=180)**	
Litres	Cups	f	(%)	f	(%)
None (0)	0	59	32.8	82	45.6
0.35 – 0.7	1 – 2	94	52.2	93	51.7
1.05 – 1.4	3 – 4	26	14.4	5	2.8
1.75 – 2.1	5 - 6	1	0.6	0	0

Camel milk sales in the wet and dry seasons in Kajiado study area.

Overall, twelve (28.6%) and thirteen (31%) of the beneficiaries households in Kajiado sold camel milk in the wet and dry seasons respectively. In the wet season, a leading 3 (7.1%) of the beneficiaries sold 3.2-3.5 litres of camel milk per day, while 3 other respondents sold (≥ 21.35 litres per day). 4 (9.5%) HHs of Kajiado beneficiaries sold camel milk in the range of 1.1-1.4 litres (3-4 cups) per day during the dry season. Households selling camel milk in Kajiado during the dry season were widely distributed from a range of 1.05 – 1.4 litres to ≥ 21.35 litres as illustrated in table 4.19.

Table 4.19: The quantity of camel milk sold by the beneficiaries in Kajiado during the wet and dry seasons

Quantity of Camel milk	Wet Season (n=42)		Dry Season(n=42)	
Litres	f	(%)	f	(%)
None (0)	30	71.4	29	69
1.05 – 1.4	0	0	4	9.5
1.75 – 2.1	1	2.4	1	2.4
3.15 – 3.5	3	7.1	1	2.4
5.25 – 5.6	1	2.4	2	4.8
5.95 – 6.3	1	2.4	0	0
10.15 – 10.5	1	2.4	0	0
15.05 – 15.4	0	0	1	2.4
17.85 – 18.2	0	0	1	2.4
19.95 – 20.3	2	4.8	1	2.4
(≥ 21.35)	3	7.1	2	4.8

4.8 Income from livestock milk sales in the household '*before and after camel stocking'*

To assess the impact of camel stocking over time, the participants were asked to rank income from milk sales of the four livestock species (cattle, goats, sheep and camels) in their households. Respondents reflected on the two periods and gave their rankings based on (income earned or no income) from individual livestock species milk. Reference years before camel stocking in Kajiado were (1990 and 2008) as shown early in Table 4.4 depending on the project. In Ngurunit it was (1998 and 2007) depending on the Women group as shown early in Table 3.2.

4.8.1 Ranking income from milk sales in Ngurunit 'before and after' camel stocking

The beneficiaries from Ngurunit ranked their income from milk sales before camel stocking as follows: cow's milk was ranked 1st by 118 (65.6%) of the households, which was followed by goat milk by 77(42.8%) of the households, sheep milk was ranked 3rd with 40 (22.2%) HHs and camel milk 4th with 2 (1.1%) HHs. The control group in Ngurunit ranked cow's milk 1st with 10 (41.7%) HHs, goat's milk 2nd with 6 (25%) HHs and sheep milk 3rd with 5 (20.8 %) HHs.

Camel restocking beneficiaries from Ngurunit were asked to rank the current income from livestock milk. Camel milk was ranked 1st by 86 (47.8%) respondents, while cow milk was 2nd (35% of respondents). Goat and sheep milk were ranked 3rd and 4th by 26% and 11% of the respondents, respectively. The control respondents in Ngurunit '*currently*' ranked cow milk 1st with 12 (50%), goat's milk 2nd with 29.2% HHs and sheep milk 3rd by 8.3% HHs. The ranks of income from milk sales in Ngurunit are presented in table 4.20 and 4.21.

Table 4.20: Ranking income from milk sales among Ngurunit beneficiaries (before & after camel stocking)

Rank		Before Camel stocking (n=180)		(Milk)	After (n=180)	
	(Milk)	F	(%)		f	(%)
1st Rank	Cows	118	65.6	Camel	86	47.8
2nd Rank	Goats	77	42.8	Cows	63	35
3rd Rank	Sheep	40	22.2	Goats	46	25.6
4th Rank	Camel	2	1.1	Sheep	19	10.6

Table 4.21: Ranking income from milk sales among Ngurunit controls (before & after camel stocking)

Rank		Before Camel stocking (n=24)			After (n=24)	
	(Milk)	F	(%)	(Milk)	f	(%)
1st Rank	Cows	10	41.7	Cows	12	50
2nd Rank	Goats	6	25	Goats	7	29.2
3rd Rank	Sheep	5	20.8	Sheep	2	8.3

4.8.2 Ranking income from milk sales in Kajiado 'before & after camel stocking'.

Kajiado beneficiaries ranked income '*before camel stocking*' in the following manner:- cow's milk ranked 1st by 19 (45.2 %) HHs, goat's milk 2nd with 10 (23.8%) HHs and sheep milk ranked 3rd by 5 (12%) HHs. There was no income from camel milk. The control group respondents ranked cow's milk 1st with 9 (29%) HHs, goats milk 2nd with 6 (19.4%) HHs and sheep milk 3rd with 5 (16.1%) HHs.

Currently; Kajiado beneficiaries' respondents ranked income from milk sales in the following sequence:- Overall, cow's milk ranked 1st by 27 (64.3%) HHs, goats milk 2nd with 12 (28.6%) HHs and sheep milk ranked 3rd with 7.1%. Despite camel milk ranking 4th overall, 5(2%) HHs ranked them as 1st and 4 (9.5%) HHs as 2nd respectively. For the

control households in Kajiado; cow's milk income was ranked 1st by 18 (58.1%) HHs, goat's milk 2nd with 9 (29%) HHs and sheep milk 3rd within 10 (32.3%) HHs. There was no income from camel milk. The ranks of income from milk sales in Kajiado are presented in Table 4.22 and 4.23.

Table 4.22: Ranking income from milk sales among Kajiado beneficiaries (before & after camel stocking)

Rank	Before Camel stocking (n=42)			After (n=42)		
	(Milk)	F	(%)	(Milk)	f	(%)
1st Rank	Cows	19	45.2	Cows	27	64.3
2nd Rank	Goats	10	23.8	Goats	12	28.6
3rd Rank	Sheep	5	11.9	Sheep	3	7.1
4th Rank	Camels	0	0	Camels	0	0

Table 4.23: Ranking income from milk sales among Kajiado controls (before & after camel stocking)

Rank	Before Camel stocking (n=31)			After (n=31)		
	(Milk)	F	(%)	(Milk)	f	(%)
1st Rank	Cows	9	29	Cows	18	58.1
2nd Rank	Goats	6	19.4	Goats	9	29
3rd Rank	Sheep	5	16.1	Sheep	10	32.3

4.9 Test of Hypothesis 2a

Statement:

Null hypothesis 2a

H_o 2ai: ***There is no effect of camel sales on Ngurunit household monthly income during the wet season***

H_o 2aii: ***There is no effect of camel sales on Ngurunit household monthly income during the dry season***

Result:
The established levels of significance for both the wet and dry season was (0.268) and (0.286) as shown in Appendix 5a & 5b respectively. These values are greater than the p-value of (0.05). Therefore, we do not reject the Null hypothesis that the independent variable camel sale is not a better predictor of monthly income in Ngurunit households. In conclusion, there was no significant effect of camel sales on the household monthly income during the wet and dry seasons in Ngurunit. The ANOVA results for both the wet and dry seasons are presented in Appendix 5a & 5b.

4.10 Test of hypothesis 2b

Statement:

Null hypothesis 2b

H_o 2bi: ***There was no effect of historical camel sales on the household monthly income during the wet season***

H_o 2bii: ***There was no effect of historical camel sales on the household monthly income during the dry season***

Result

The established significance value was (0.505) and (0.337) for Ngurunit beneficiaries' during the wet and dry seasons respectively as shown in Appendix 6a & 6b. Since the

established values (0.505) and (0.337) are greater than the p-value of (0.05), we do not reject the Null hypothesis.

The significance value was (0.007) and (0.008) for Kajiado beneficiaries in the wet and dry seasons respectively as presented in Appendix 6a & 6b. Since the established levels of significance (0.007) and (0.008) are lower than the p-value of 0.05; we reject the Null hypothesis and accept the alternative (H_a). In conclusion, there was no significant effect of historical camel sales on the average household monthly income of Ngurunit beneficiaries during the wet and dry seasons. However, there was a significant effect of historical camel sales on the average monthly income of Kajiado camel beneficiaries during the wet and dry seasons.

4.11 Test of Hypothesis 3

Statement:

Null hypothesis 3

H_o 3a: ***There is no effect of milk sales on the household's monthly income during the wet season***

H_o 3b: ***There is no effect of milk sales on the household's monthly income during the dry season***

Result

The established levels of significance were (0.000) and (0.006) in Ngurunit during the wet and dry seasons respectively as shown in Appendix 7a & 7b. Since the established values of (0.000) and (0.006) are lower than the p-value of (0.05); we reject the Null hypothesis and accept the alternative.

The significance value was (0.107) for Kajiado (wet season) and (0.029) for the (dry season) as illustrated in Appendix 7a & 7b. Since the established level of significance

(0.107) is greater than the p-value (0.05); we do not reject the Null hypothesis in Kajiado during the wet season. However, since the obtained value (0.029) is lower than the p-value (0.05); we reject the Null hypothesis and accept the alternative for Kajiado during the dry season.

In conclusion, there was a significant effect of milk sales on the overall household monthly income in Ngurunit during the wet & dry seasons and in the dry season for Kajiado only. On the contrary, there was no significance effect of milk sales on the household monthly income in Kajiado during the wet season.

4.12 Test of Hypothesis 4

Statement:

Null hypothesis 4

H_o 4a: ***There is no relationship between household monthly income and savings during the wet season.***

H_o 4b: ***There is no relationship between household monthly income and savings during the dry season.***

Result

The established levels of significance were all (0.000) in Ngurunit and Kajiado during the wet and dry seasons as presented in Appendix 8a & 8b. Since the established values of (0.000) are lower than the p-value of (0.05); we reject the Null hypothesis and accept the alternative (H_a). We therefore conclude that, there was a significant relationship between the household's monthly income and household's monthly savings during the wet as well as dry seasons in both Ngurunit and Kajiado.

4.13 Keynesian Consumption Function

Consumption function (propensity to consume) shows how expenditure (consumption) varies with variation in income. According to Keynesian Theory, income depends upon effective demand. Effective demand depends on consumption and investment. Consumption depends on income, family members, price levels, taste and habits (Saleemi, 2005). Keynesian theory is concerned with the total consumption of all the individuals.

Expenditure (C) =f(Y)

Where Y= income; this is the Keynesian consumption function

$C= c_1Y+e$……without autonomous expenditure

Where C = Consumption /Expenditure

c_1 = Marginal propensity to consume

e = Error term

Y = Household income

An Analysis of Variance (ANOVA) of monthly income and expenditure on food in the study areas during the wet and dry seasons

Result

The model was statistically significant as indicated by p-values of (0.000 and 0.000) during the wet and dry seasons respectively as shown in Appendix 9a & 9b. In addition, the results indicate that the relationship between the monthly income and expenditure on food during the wet and dry seasons is positive and significant. This is supported by a regression coefficient (ß) of (0.143 and 0.183) during the wet and dry seasons respectively, as shown in Appendix 9c & 9d. The relationship is significant because the t-values (11.285 and 11.660) as shown in Appendix 9c & 9d are both greater than the tabulated t- statistics. Moreover, the significance values of (0.000 and 0.000) in both coefficient tables are less than the critical p-value of 0.05.

The **equation** is **$C= c_1Y+e$**

Substitute: **c_1** = (0.143) and (0.183) for the wet and dry seasons respectively, in the equation.

Therefore; the **Final equation for the *Wet season***: **C= 0.143Y**

Final equation for the *Dry season*: **C= 0.183Y**

The *positive* marginal propensity to consume (**c_1**) indicates that the data conforms to *Keynesian Consumption function* which states that there is a positive relationship between income and consumption.

4.14 Objective 3:-Determining the impact of drought on livestock species and households coping level

4.14.1 Causes of livestock mortality and other forms of herd exits in the households (from 1990 to date):-

The study assessed the major causes of livestock mortality from *1990 to date.* These exits were then categorized as: Very high exits (≥ 80%), High exits (60-79%), Moderate exits (40-59%), Low exits (20-39%) and Very low exits (1-19%).

A majority thirty-four (46.6%) of Kajiado households mentioned drought as having contributed to *very high mortalities* (exits) followed by 26 (35.6%) HHs with *high exits*. In Ngurunit, a majority 108 (52.9 %) HHs cited drought to have contributed *moderately to the exits*, followed by 68 (33.3%) HHs placing it under *high exits*. Results on livestock mortalities caused by drought are presented in figure 4.14.

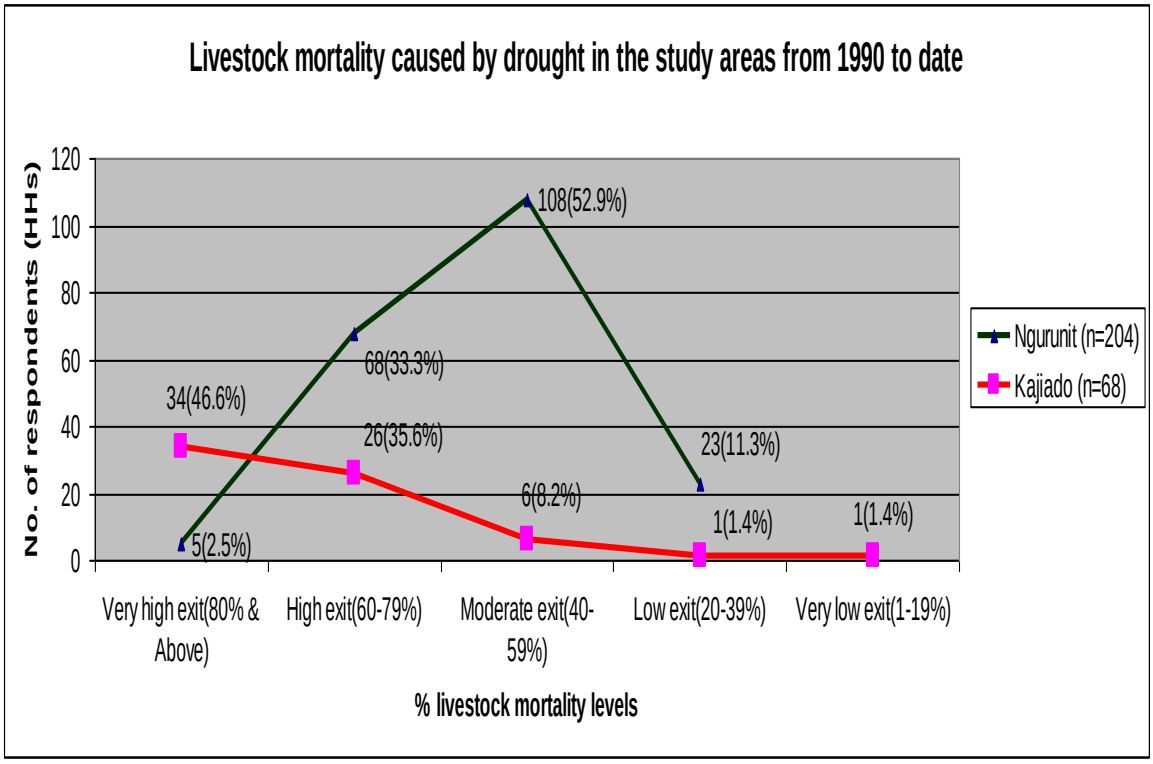

Figure 4.14:Livestock mortality caused by drought in the study areas from 1990 to date

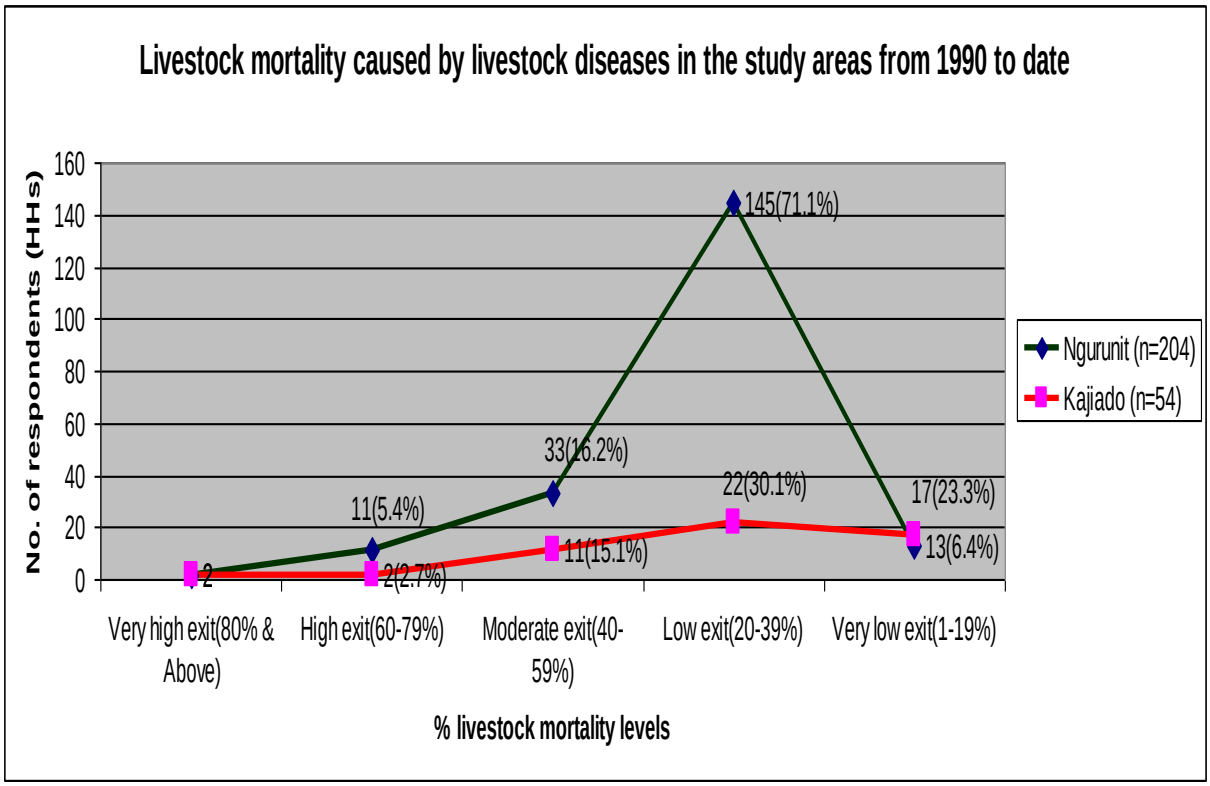

Figure 4.15: Livestock mortality caused by livestock diseases in the study areas, from 1990 to date

A majority 145 (71.1%) households and 22 (30.1%) respondents mentioned livestock diseases to have contributed to *low mortalities* (20-39%) in Ngurunit and Kajiado respectively. There was slightly a greater- impact of livestock diseases in Ngurunit than Kajiado as shown in figure 4.15.

Other causes of exits with low livestock mortality in the study areas were: predation, death through accidents caused by fall from the steepy terrain, livestock raids in Ngurunit, plant poisoning and ingestion of polythene bags.

4.14.2 Ranking livestock species ability to withstand drought in targeted communities

The study assessed the respondent's perceptions on various livestock species ability to cope with drought from experience. 203 (99.5%) HHs in Ngurunit ranked camels 1st and goats 2nd in ability to withstand drought. Additionally, 188 (92%) HHs in Ngurunit ranked sheep 3rd and cattle as 4th (last) in their ability to tolerate drought as shown in figure 4.16.

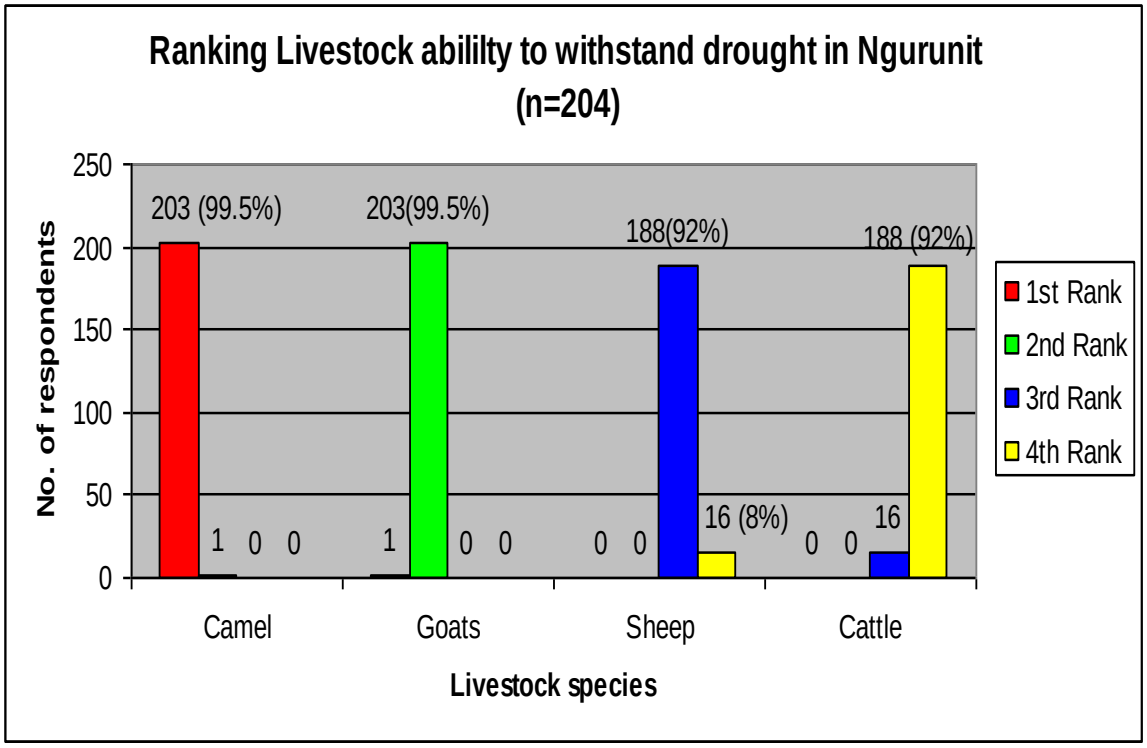

Figure 4.16: Ranking livestock species ability to withstand drought in Ngurunit

For the case of Kajiado, 40 (100%) beneficiaries ranked camels as 1st whereas 39 (98%) HHs ranked goats as 2nd. Kajiado beneficiaries and controls ranked them in the same sequence as shown in Table 4.24. However, 9 (29%) control group HHs had difficulties in ranking the 4 species especially, camels which they had no rearing experience. Results for Kajiado beneficiaries and controls are presented in Table 4.24.

Table 4.24: Ranking livestock ability to withstand drought in Kajiado among the camel beneficiaries and controls

Rank	Camel beneficiaries (n=40)			Kajiado Controls (n=31)		
	Species	F	(%)	Species	f	(%)
1st Rank	Camels	40	100	Camels	20	65
2nd Rank	Goats	39	98	Goats	18	58
3rd Rank	Cattle	23	58	Cattle	15	48
4th Rank	Sheep	23	58	Sheep	8	25.8

4.14.3 Households rating on their 'current' ability to cope with drought:

The study assessed the responded household ability to cope with drought (*Now*). In their own perception, the respondents rated themselves on a scale of 1-10, on their ability to cope with drought. The scales were subdivided into five categories: Very low ability (1-2), Low ability (3-4), Moderate ability (5-6), High ability (7-8) and Very high ability (9-10). The higher the *ability* to cope with drought, the higher the score and vice versa. In a nutshell, there was a more negative impact of drought on households with lower scores (1-2) than those with higher scores (9-10).

In relation to the households ability to cope with drought (*Now*):- a majority 93 (51.7%) HHs of Ngurunit beneficiaries rated themselves with *moderate ability* (5-6) as shown in table 4.25. In Ngurunit control group, most HHs (66.7%) rated themselves with *moderate*

ability (5-6) to deal with drought '*Now*'. Results on Ngurunit scores are summarized in table 4.25.

Table 4.25: The ability for Ngurunit respondents to deal with drought 'currently'

Ability to deal with drought (Score)	**Ngurunit beneficiaries (n=180)**		**Ngurunit Controls (n=24)**	
	f	(%)	f	(%)
Very low ability (1 -2)	2	1.1	1	4.1
Low ability (3 – 4)	53	29.4	7	29.2
Moderate ability (5 – 6)	93	51.7	16	66.7
High ability (7 – 8)	32	17.8	0	0
Very high ability (9 – 10)	0	0	0	0

A majority of Kajiado beneficiaries, twenty-one (50%) households had *moderate ability* (5-6) to cope with drought 'currently'. 66% of the beneficiaries are currently able to cope with drought now compared to (51.7%) of their counterparts who never received any camel. Kajiado beneficiaries and controls ability to deal with drought 'currently' is presented in Table 4.26.

Table 4.26: The ability for Kajiado respondents to deal with drought 'currently'

Ability to deal with drought (Score)	Kajiado beneficiaries (n=42)		Kajiado Controls (n=31)	
	f	(%)	f	(%)
Very low ability (1 -2)	4	9.5	10	32.3
Low ability (3 – 4)	8	19	5	16.1
Moderate ability (5 – 6)	21	50	14	45.2
High ability (7 – 8)	4	9.5	2	6.5
Very high ability (9 – 10)	3	7.1	0	0

4.15 DISCUSSIONS

4.15.1 Objective 1: The contribution of camel milk in the household food basket during the wet and dry seasons

Camel milk availability and consumption in the households within the study areas

Camel stocking had a great impact on camel milk availability and accessibility in the beneficiaries' households during the lifespan of the projects. The findings on the ability of the beneficiaries (in both study areas) to obtain and consume camel milk in their households by >73% in both seasons is evident of the positive impact of camel stocking. This also shows the acceptance and adoption of the new camel concept in Kajiado whose respondents had (nil) no ownership of camels before the SNV/MoLD project was initiated. Even though Kajiado findings doesn't reflect the true status now, due to camel sales over time; the project impact was realized and there is still potential from recent stocking. Ngurunit beneficiaries made a great stride as only 26% of beneficiaries (households) had camels before PEAR Innovation intervention. These projects improved the nutritional status of the vulnerable members of the community and by extension, ensured household food security. The finding supports (Wilson, 1984; Schwartz and Dioli, 1992) observation that dromedaries are important livestock species in the provision

of food security. Galvin (1992) reiterated that milk and milk products account for >60% of the dietary energy of East African pastoralists. Kamau *et al*. (2008) concurred that camel milk contributed about a half of the nutrient intake of most camel keepers in Kenya. Currently, camel milk remains a staple food in Ngurunit and in some beneficiary households in Kajiado. One beneficiary in Ngurunit had this to say while appreciating the role of camels in addressing the household food security during the dry season, "*Siku hizi tumesahau kitu kinaitwa siturungi, hatuwezi kukosa maziwa kama tunakamua Ngamia*" literally interpreted to mean "These days, we have forgotten about taking black tea (tea without milk) due to the camels we are milking".

Provision of camel milk (by camel beneficiaries) to the wider community

A social benefit impact through the support of camel milk to immediate neighbours, friends and relatives was revealed in all the study areas. The findings demonstrated a strong social network within the Maasai, Samburus and Rendilles. Wabekbon Development Consultants (2009) study finding is in agreement that milk is used to build goodwill and reputation among friends and relatives. Social support networks as cited by Rutten (1998) in a food security study among the Maasai included assistance from friends and relatives. This was common in terms of money, labour, animals and food. Bukure (2008) also mentioned income as a source of strengthening social ties and ensuring long term security. This social network strongly promoted unity within Ngurunit ethnic communities. It was also noted that sharing of camel milk builds friendship. Over half (56%) of Ngurunit beneficiaries gave out camel milk to other community members during the wet season. Camel milk support to other community members, demonstrated the impact of camel projects on indirect beneficiaries; showing a *spill- over effect* (multiplier effect) of benefits beyond the target group.

Ranking livestock milk preferences in the study areas during period of abundance

There was a variation in the ranking on livestock milk preferences during the wet season. However, cows' milk ranked 1st in preference in both study areas. Majority of the respondents preferred cow's milk because of being tasty, nutritious, has a high butter fat content and its good for making ghee. Camel milk ranked 2nd in Ngurunit and 4th in Kajiado. The participants appreciated camel milk in terms of its medicinal value (*citing treatment of cold, malaria, diabetes, infertility and blood pressure*), its good for making tea, highly digestible, has a long shelf life and its ability to quench thirst. Pastoralists' acknowledgement of the medicinal value in camel milk is in line with the findings of various authors (Gast *et al*., 1963; Rao *et al*., 1972; Akundov *et al*., 1972; Yagil, 1982; Yagil, 1985; Restani *et al*., 1999; Eberlein, 2007; Seifu, 2007; Musinga *et al*., 2008; Layline, 2011). The only negative aspect mentioned on camel milk was on being dilute and bitter. According to Kamau *et al*. (2008), camels produce dilute milk especially, in the hot weather when water is scarce. Camel milk has a sharp taste and is salty. Studies conducted by (Yagil and Etzion, 1980) showed an increase of sodium and chloride in camel milk that is attributed to the salty taste felt by the participants. Perhaps excretion of Na^+ Cl^- through lactation rather than urinary route helps in water conservation during the dry period. Having Na^+ in urine would mean more water needed for urination. Motivating factors for the preference of goat milk was: it is highly concentrated and thus the best for making tea. Sheep milk ranked poorly as it is 'smelly'. Pastoralist's perceptions on sheep were: it has tiny teats, little milk, not docile (especially during milking time) and it is rarely milked.

Ranking livestock milk supply reliability (dependability) during the dry/drought period in the study areas

In regard to livestock milk reliability, camel milk ranked first (1st) in Ngurunit whereas goat milk ranked first (1st) in Kajiado during the dry/ drought period. Some of the factors that could be attributed to camels taking the lead in Ngurunit were:- the long lactation period, drought resistance, ability to sustain milk production during the drought period, browsing on a variety of forage, height advantage when browsing, less watering frequency and camels remained near the settlements during drought. Sustained milk production during the drought period is in line with the findings of (Nori *et al*., 2006; Musinga *et al*., 2008; Onono *et al*., 2010 and Younan *et al*., 2011). The availability of camel milk during the drought period promotes the growing trend in the acceptability of camel milk among non- traditional consumers of camel milk (Musinga *et al.*, 2008). Goat milk ranked 1st in Kajiado and 2nd in Ngurunit in dependability because goats are: fairly drought tolerant, a browser and with a high population within the household herds. The performance of cows during the drought period was hampered by cows inability to withstand drought, drying off and migration to far-off places. Han (2004) study revealed that camels had a comparative advantage over cattle in adaptability to harsh climatic conditions and therefore can cope with climate change. The 2nd rank of cow's milk in Kajiado could be attributed to the herd size advantage that guaranteed at least some little milk, lactating cows being left behind during migration and other forms of milk accessed through purchases. Sheep milk ranked 3rd in both study areas as majority of the households milk them during critical times (milk scarcity).

Testing hypothesis of camel ownership on camel milk consumption in the study areas

There was a significant effect of camel ownership on camel milk consumption in Ngurunit in both the wet and dry seasons. By camel milk ranking 2nd in milk preference

(wet season) and 1st in milk reliability (dry/drought period) in Ngurunit, clearly demonstrated the important role that camel milk played in the household food basket. This significance is also an eye-opener to change agents that camels can be used as a tool to increase household food security and cope with drought. It also proves that the initial objective of PEAR Innovation of increasing food security through camel milk consumption was achieved. Additionally, it highlighted the truth in Ndikumana (2000) prediction (statement) that camels could be a solution to ASAL areas in future and Wernery (2007) on global warming and desertification. In fact, more stocking will have a 'multiplier effect' on more vulnerable households.

Camel rearing being a new concept in Kajiado; a gradual adoption rate on the utilization of camel milk in the households was expected. Musinga *et al*. (2008) mentioned of an initial resistance of camels in Maasailand which tends to prove the fact that it was a new venture. Slow/gradual adoption rate is a common phenomenon with a new concept (new technologies). There is still dominance of the other livestock species milk as highlighted in milk preferences and reliability ranks, where camel milk in Kajiado featured in the 4th rank. The above factors justify why there was no significant effect of camel ownership on camel milk consumption in Kajiado households. However, a few progressive camel beneficiaries in Kajiado had realized the great market potential of camel milk in Nairobi (Eastleigh) and Namanga. This could be exploited for future commercialization.

4.15.2 Objective 2: The contribution of camels & camel products in the household economy during the wet and dry season

Camel sales in the study areas

The findings revealed low camel sales in the study areas. Factors that could be attributed to low camel sales were age at maturity and long gestation period. This meant that patience (time) was required to accumulate a sizeable camel herd and therefore it was not

easy to sell. Ownership of few camels, with the high value attached to camels, made selling decisions difficult to make. PEAR Innovation/HI Project policy stressed on the need to pass on 'gifts' (calves), thus limiting flexibility to sell at will. This regulation was well adhered to and is reflected in the 7-9 years that beneficiaries took before they started selling their camels. It implies that Ngurunit beneficiaries never sold their breeding stock. Several spot checks in the vibrant Ilbisil livestock market (Kajiado) during the study, did not find any camel in the market. Furthermore, the frequency of slaughtering camels in the local butcheries was quite low. It was only once per month in Ngurunit and once per week in Namanga. This showed the difficulties experienced in accessing camels even for slaughter. Therefore, camel meat consumption in the study area was rare. The difficulty in accessing camel meat for processing by Salato Women group in Ngurunit according to Muniafu *et al*. (2007), confirms the scarcity, as they had to buy it from Maralal town. Younan *et al*. (2011) are in agreement with camel meat scarcity, Gabbras and Rendilles only slaughter camels during: severe drought, weddings, death of prominent persons and peace talks. Most camel slaughter cases were as a result of injuries from the steepy terrain/gullies that were common in Ngurunit. Ultimately, a regression analysis on both the current and historical data of Ngurunit revealed that there was no significant effect of camel sales on the household monthly income during the wet or dry seasons.

There was, however, a lucrative business in historical camel sales in Kajiado. A regression analysis in Kajiado indicated that there was a significant effect of historical camel sales on the household monthly income during the wet and dry seasons. Most historical camel sales from the SNV/MoLD project were influenced by:- demand for school fees, high medical bills, injuries from the steepy terrain, restocking other livestock (during the recovery phase), attitude, high demand from commercial ranchers, group herding challenges and alternative investments (e.g. land purchases and construction

among others). A majority of beneficiaries earned a substantial amount of income through these sales. The 22 years project lifespan provided an opportunity for the beneficiaries to accumulate stock. This implies that time is of essence in camel herd accumulation. It gave a strong foundation of camel sales as a key contributor in the household economy.

Camel milk sales featured strongly as a regular source of cash income in the study areas

(67.2% & 54.4%) of Ngurunit beneficiaries and (28.6% & 31%) of Kajiado beneficiaries sold camel milk in the wet and dry season respectively. Milk sale is the domain of women. These cash trickled down to the households and largely contributed to the purchase of household foodstuff, clothing, educational material and veterinary drugs. This finding is supported by Muchui (2012) responses from Ngurunit, where men were doing away with strong cultural beliefs and appreciating their women in reducing the burden of fending families. IWGIA (2012) concurs that women in indigenous societies play an important complementary role in the households. PEAR Innovation project which targeted women had a great impact on economic empowerment.

There was a significant effect of milk sales on the overall household monthly income during the wet and dry season in Ngurunit. 89% of Ngurunit participants were involved in general livestock milk sales during the wet season. This was a daily business in the local market. A regression analysis revealed that there was no significant effect of milk sales on the household monthly income in Kajiado during the wet season. This finding is attributed to availability of milk in the households due to improved forage situation in the rainy season. Increased milk supply lowered market demand, therefore leaving it for home consumption. An analysis of Kajiado during the dry season revealed that there was a significant effect of milk sales on the household monthly income. This could be due to:

increased milk sales to meet other basic household needs and the low milk supply attracting a higher milk selling price. Cattle normally dry-off during critical drought period, and according to (Herren, 1990), the daily milk off take per dam is as low as 1 litre. There was a high demand for camel milk in Namanga and Eastleigh, where a litre of camel milk fetched upto Ksh 100. A ½ litre pack of Vital camel milk in Tuskys supermarket chains in Nairobi is Ksh 150. (FAO, 2012; Africa Procasur, 2012) also noted this booming business of fresh camel milk in Nairobi where a litre sells at Ksh 100 in comparison to cow's milk that fetches Ksh 30 per litre in towns of origin. All camel milk entering the national urban market goes through Eastleigh where it is traded in the 7th, 12th and Jam streets (Musinga *et al*., 2008).

Comparing income from milk sales 'before & after camel stocking'

A comparative analysis showed that camel milk ranked 1st (48% HHs) in income '*nowdays*' in Ngurunit, far away from the 4th rank (1 % HHs) held '*before camel stocking*'. This difference shows a positive impact of camel milk sales on the household income as a result of camel stocking. Camel milk surpassed all the other livestock (species) milk over time including cow's milk that had been ranked (1st) 'before *camel stocking*' by (66% HHs).

Despite the fact that camel stocking in Kajiado was a new concept and overall ranked camel milk 4th on income; (12% HHs) ranked it 1st and (9.5% HHs) 2nd. These demonstrated a fast adoption rate amongst the pioneer camel keepers. From a historical perspective (*before 1990*), there were very few cases of milk business in Kajiado. This was due to focus on household milk consumption, lack of transport from rural to urban market centres, lack of local dairies, low milk demand (as milk was available in most households), free milk and not valuing milk as a business. The control group's rank in

Kajiado and Ngurunit remained constant within the two periods. This clearly demonstrated the impact of camels in the beneficiaries' household income.

Monthly income and savings in the households:-

Ngurunit and Kajiado respondent households had diverse sources of income. In Ngurunit, major income sources in the wet season were from sheep, goats and milk sales. Moderate sources of income were from: - cattle sales and handcraft, especially during the dry season. Low income sources were from: poultry/egg sale, petty trade, casual work, remittance, formal employment, charcoal burning, borrowing, herding income, camel sales, honey sales, local brew sales and firewood sales. Other sources of low income during the dry season were from: water sales, sand harvesting and fodder sales.

In Kajiado, most HHs during the wet & dry seasons had a low income source from:- sheep & goat sales, poultry/egg sales, cattle sales, milk sales, sale of crop products, petty trade, casual work, remittance, formal employment, charcoal burning, quarrying, borrowing, 'bodaboda' cyclist business, herding income, camel sales, basketry and sand harvesting.

Majority of Ngurunit beneficiaries and controls made savings in the range of Ksh 1-1,000 during the wet season. However, majority of Kajiado beneficiaries had savings in the range of Ksh. 4,501-5,000. The findings revealed that Ngurunit had a higher household percentage with a saving culture than Kajiado, irrespective of the amount. The dry/drought period impacted negatively on the saving levels of all the respondent categories. The study areas analysis showed a significant relationship between the household monthly income and savings during the wet and dry seasons. Most households in both study areas rarely kept their savings in the bank. They used it to restock herds as a livelihood investment and in meeting household needs during emergency. This finding

indirectly supports Muchui (2012) observation that tucking of money under mattresses was still common in Samburu and Marsabit counties due to pastoralist's lifestyle and inaccessibility to commercial banks.

4.15.3 Objective 3: Determining the impact of drought on livestock species and households coping level

Drought had more negative impact on livestock species in Kajiado than Ngurunit.

FGDs conducted in Kajiado: Oltepesi, Namanga, Meto, Lorngoswa and Kamukuru mentioned the following years as drought years:- 1984, 1986, 1994, 1996, 1997, 2000, 2005, 2006, 2009 and 2010. In these years, cattle and sheep were the most affected by drought, whereas camels were least affected. This study established that despite the cyclic droughts, camels led in ability to cope with them. This resilience is backed by (Han, 2004; Ziervogel *et al*., 2006) that camels have a comparative advantage over cattle and small ruminants in withstanding harsh climatic conditions. Fratkin (2001) gave a background of early drought years beyond the FGDs reference years. These were: - 1960-61, 1968-69, 1974-76 and 1979-81. (Aklilu & Wekesa, 2002; Watson, 2011) mentioned 1996-97 and 1999-2001 drought years which fall within FGDs years. Onono *et al*. (2010) also mentioned the drought of 1984 and 2005-2006 that concured with the FGDs findings. Huho *et al*. (2011) cited drought as the greatest cause of livestock mortality. This finding was clearly demonstrated in Kajiado which was adversely affected. Kaufman and Binder (2002) reported drought as a major cause of camel losses. According to (Musinga *et al*., 2008), global climate change led to the increase in drought thus contributing to the acceptability of camels among non-traditional camel keepers.

Two FGDs carried out in Samburu North and Marsabit South Sub-counties ranked drought years as: 2011, 2008 and 1984 in an ascending order of severity. 1984 featured strongly among the most severe drought in the former Samburu district (Konaya, 1997

and Onono *et al*., 2010). The community remembers 1984 as the year they were provided with yellow Maize (relief food) and 2011 for the migration of their livestock to Baragoi.

The impact of livestock diseases in the study areas with emphasis on camels

There was a more negative impact of livestock diseases in Ngurunit than Kajiado, especially in camels. Camel diseases were not a major challenge in Kajiado. Common camel cases in the study areas were: Camel trypanosomosis, mange and wounds. Camel diseases in Ngurunit included: Camel Trypanosomosis, Haemorrhagic Septicaemia (HS), Tick infestation, Mange, abscesses and abortion cases. Isiolo study by (Noor *et al*., 2012) also reinforced the prevalence of Camel Trypanosomosis, Haemorrhagic Septicaemia and Mange. Additionally, a previous study by (Langill and Ndathi, 1998) reported the same camel diseases (Camel Trypanosomosis, HS, Camel pox and cough cases). Marsabit and Samburu study by Gathuma and Makau (2005) is in agreement with the findings on camel diseases in Ngurunit except for Helminthosis and Mastitis.

Notifiable cattle diseases that could pose as a threat in Kajiado according to the Veterinary Office were: Foot and Mouth Disease (FMD), Lumpy Skin Disease (LSD) and Anthrax. Contagious Bovine Pleuropneumonia (CBPP), Anthrax, FMD and Blackleg featured among cattle diseases in the Dessert Margin program (Langill and Ndathi, 1998). Contagious Caprine Pleuropneumonia (CCPP), Sheep & goat pox, Peste des Petits Ruminants (PPR), Rift Valley Fever (RVF) and Enterotoxaemia were the challenges mentioned in small stock.

Kaufman and Binder (2002) highlighted diseases and drought as major causes of camel losses. Onono *et al*. (2010) also reiterated that despite the benefits of camel production in pastoral areas; camels still face challenges in their natural habitat in terms of diseases, drought and predation. In disputing the common notion that camels are less susceptible to

most of the diseases that affect other livestock, (Megersa, 2010) found out that camels are susceptible to a large number of pathogenic agents. Observations among some beneficiaries in Ngurunit supported Megersa (2010) findings, where they likened '*camels to human beings'* in terms of their vulnerability to diseases. One beneficiary in Ngurunit had this to say in reference to camel diseases, "*I lost hope when my camel died and nowdays, whenever I see a camel walking, I feel like crying*". This shows the high value attached to camels. It is also a wakeup call to project implementers to intensify camel health component in camel stocking programs.

Livestock species ability to withstand drought in the targeted project areas

Based on the study findings, camels ranked highest as the best livestock species with the ability to withstand drought in ASAL areas. Beside Kajiado controls showing limited knowledge on camels, more than (99%) of the other respondents ranked camels highest in ability to withstand drought. One of the camel beneficiaries gave this analogy while appreciating camels resilience to drought; "*a camel can handle all problems, it is like a tree; it can even stay without water*". Goats featured 2nd in their ability to tolerate drought after camels. These findings boost browsers rating on their ability to withstand climate change related challenges. The long term project in Kajiado, provided an ample time for the community *to learn and help disapprove the initial misconception that camels bring drought. It had been rumored earlier, that it could never rain where a camel had stepped.* As a learning experience, the period also exposed the vulnerability of grazers to drought. In support to the findings, camels adapt well to harsh rangelands as cited by (Mares, 1954; Mc Knight, 1969; Dahl and Hjort, 1979; Farid *et al*., 1979; Shalash, 1979; Knoess, 1979; Gauthier-Pilters and Dag, 1981; Morton, 1984; McDowell, 1984; Yagil and Etzion, 1985; Hjort, 1988). Younan *et al*. (2011) pointed out some of the unique features

necessitating this adaptability as lips, eye lashes, nostrils, ear, nose, neck, legs, pads, tail and hump. Besides camels being environmental friendly, (Moris, 1988; Fry, 1988; Hogg, 1985; Oxby, 1994; Musinga *et al*. 2008) acknowledges that they are better suited than cattle, sheep and goats in arid lands. The ability of camels to eat grass and other herbaceous species is also a survival adaptation during periods of extreme feed scarcity (Field, 1978; Gauthier-Pilters and Dagg, 1981). In appreciating the vital role played by camels, (Kaufmann and Binder, 2002; Jones and Thornton, 2008; Belayneh *et al*., 2009) suggested that camels could be a good substitute to crops or other livestock in hard hit areas on countering the negative effects of climate change.This suggestion is in line with Wernery (2007) observation that camels could be part of a solution to compounding problems of global warming, desertification and food insecurity.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents conclusion and recommendations of the study. Conclusions and recommendations are based on the research objectives and the key findings of the study.

5.2 Conclusion

Based on the findings of the study, the following conclusions were made:

Objective 1: The contribution of camel milk in the household food basket during the wet and dry season

a) The targeted camel projects had prospects of increased camel milk production and utilization in future. The study had incorporated recent beneficiaries whose camels were yet to calf-down.

b) The ability of camel milk to trickle down to the wider community showed a '*multiplier effec*t' the projects had on indirect beneficiaries, therefore impacting positively on the projects. Camel milk sharing demonstrated a strong social network within the targeted communities.

c) By ranking cow's milk (1^{st}) in milk preferences, reinforced the fact that the Maasai and Samburus communities *still* treasure and maintained a strong attachment with cattle to date.

d) By the study communities ranking browsers (camels & goats) highest in milk reliability during the drought period, is a clear lesson for pastoralists, to embrace browsers as a food security strategy during drought.

e) There was a significant effect of camel ownership on camel milk consumption in Ngurunit during the wet and dry seasons. This demonstrated that the camel stocking project in Ngurunit; that was geared towards increasing the household food security attained its objective.

Objective 2: The contribution of camels & camel products in the household economy during the wet and dry season

a) Camel sales didn't feature as a major source of cash income in the short term in both seasons. However, there was a significant effect of historical (long term) camel sales on the household income during the wet and dry seasons in Kajiado. This was due to the cumulative herd sizes and lucrative business.

b) Camel milk sales featured strongly as a regular source of income in the study areas. There is a great potential for commercializing camel milk in Kajiado due to the established market outlets in Eastleigh and Namanga.

c) Camel milk ranked 1st in income generated from milk sales nowdays in Ngurunit. Women economic empowerment is demonstrated through increased income from camel milk sales.

Objective 3:-Determining the impact of drought on livestock species and households coping level

a) Historical experiences proved that drought had a more negative impact on livestock species in Kajiado than Ngurunit, especially in cattle.

b) Camel diseases were more prevalent in Ngurunit than Kajiado. The most common cases in the two study areas were:- Camel trypanosomosis, mange and wounds.

c) Browsers rated highest in their ability to withstand drought in all the study areas. Camels took the lead, followed by goats.

d) Camels provided a strong foundation (resilience) among the beneficiaries in coping with drought compared to their (*control*) counterparts.

5.3 Recommendations

Camel stocking

Upscale camel stocking initiatives in Kajiado. The concept is now being appreciated, as community members have learned lessons overtime from camel rearing households. There are also established market opportunities for camel milk.

- Replicate camel stocking approaches used in Ngurunit among other vulnerable members of the society. This will improve household nutrition, economic strengthening and coverage within Samburu and Marsabit counties.

Capacity building:

- More sensitization and training of camel keepers on will be required on:-
  - Camel health and husbandry practices
  - Group dynamics and business management skills
- Facilitate exposure visits of non-traditional camel keepers to increase their knowledge, skills and share experiences through camel forums, conferences, camel derby, field days as well as study tours.

Camel breeding centres and strengthening of market linkages:

- Establish and/or strengthen camel breeding centres, especially in Agricultural research Institutes for future sourcing of the breeding stock
- Strengthen the existing camel milk supply chain in Kajiado. Explore ways of incorporating camel milk with operational large processors such as New KCC, Brookside Dairies among others. Gradually introduce camel milk products in the existing supply chains such as local retail outlets and supermarkets.

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APPENDICES

Appendix 4a: ANOVA results of the relationship between household camel ownership and camel milk consumption in the study areas during the wet season

Var0001	Respondents	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	Beneficiary	1	Regression	25.407	1	25.407	27.344	.000
			Residual	165.393	178	.929		
			Total	190.800	179			
Kajiado	Beneficiary	1	Regression	22.424	1	22.424	.989	.327
			Residual	839.320	37	22.684		
			Total	861.744	38			

Appendix 4b: ANOVA results of the relationship between household camel ownership and camel milk consumption in the study areas during the dry season

Var0001	Respondents	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	Beneficiary	1	Regression	13.867	1	13.867	29.415	.000
			Residual	83.911	178	.471		
			Total	97.778	179			
Kajiado	Beneficiary	1	Regression	24.443	1	24.443	1.596	.214
			Residual	581.957	38	15.315		
			Total	606.400	39			

Appendix 5a: ANOVA result for camel sales and HH monthly income in Ngurunit during the wet season.

Var0001	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	1	Regression	3.176	1	3.176	1.340	.268
		Residual	30.824	13	2.371		
		Total	34.000	14			

Appendix 5b: ANOVA result for camel sales and HH monthly income in Ngurunit during the dry season.

Var0001	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	1	Regression	2.644	1	2.644	1.203	.286
		Residual	43.947	20	2.197		
		Total	46.591	21			

Appendix 6a: ANOVA results of the effect of historical camel sales on monthly income among the camel beneficiaries during the wet season.

Var0001	Respondents	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	Beneficiary	1	Regression	2.039	1	2.039	.461	.505
			Residual	92.917	21	4.425		
			Total	94.957	22			
Kajiado	Beneficiary	1	Regression	680.179	1	680.179	8.766	.007
			Residual	1862.167	24	77.590		
			Total	2542.346	25			

Appendix 6b: ANOVA results of the effect of historical camel sales on monthly income among the camel beneficiaries during the dry season

Var0001	Respondents	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	Beneficiary	1	Regression	3.156	1	3.156	.965	.337
			Residual	68.670	21	3.270		
			Total	71.826	22			
Kajiado	Beneficiary	1	Regression	693.356	1	693.356	8.474	.008
			Residual	1963.606	24	81.817		
			Total	2656.962	25			

Appendix 7a: ANOVA results of a relationship between milk sales and household monthly income during the wet season in the study areas

Var0001	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	1	Regression	108.828	1	108.828	48.761	.000
		Residual	386.109	173	2.232		
		Total	494.937	174			
Kajiado	1	Regression	279.031	1	279.031	2.692	.107
		Residual	4975.049	48	103.647		
		Total	5254.080	49			

Appendix 7b: ANOVA results of a relationship between milk sales and household monthly income during the dry season in the study areas

Var0001	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	1	Regression	41.743	1	41.743	8.143	.006
		Residual	328.075	64	5.126		
		Total	369.818	65			
Kajiado	1	Regression	570.182	1	570.182	6.176	.029
		Residual	1107.818	12	92.318		
		Total	1678.000	13			

Appendix 8a: ANOVA result of the relationship between household monthly income and household monthly savings during the wet season

Var0001	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	1	Regression	289.950	1	289.950	107.801	.000
		Residual	537.936	200	2.690		
		Total	827.886	201			
Kajiado	1	Regression	878.977	1	878.977	20.352	.000
		Residual	2979.952	69	43.188		
		Total	3858.930	70			

Appendix 8b: ANOVA result of the relationship between household monthly income and household monthly savings during the dry season

Var0001	Model		Sum of Squares	df	Mean Square	F	Sig.
Ngurunit	1	Regression	28.861	1	28.861	27.675	.000
		Residual	208.570	200	1.043		
		Total	237.431	201			
Kajiado	1	Regression	660.855	1	660.855	22.539	.000
		Residual	2023.088	69	29.320		
		Total	2683.944	70			

Appendix 9a: ANOVA results of monthly income and expenditure on food during the wet season

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	420.838	1	420.838	127.360	.000
	Residual	892.162	270	3.304		
	Total	1313.000	271			

Appendix 9b: ANOVA results of monthly income and expenditure on food during the dry season

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	612.049	1	612.049	135.961	.000
	Residual	1228.951	273	4.502		
	Total	1841.000	274			

Appendix 9c: Regression Coefficient results of monthly income and expenditure on food during the wet season

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Average Monthly income (Ksh) Wet season	.143	.013	.566	11.285	.000

Appendix 9d: Regression Coefficient results of Monthly Income and expenditure on food during the dry season

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Average Monthly income (Ksh) Dry season	.183	.016	.577	11.660	.000

Appendix 10a: A FIELD PHOTOGRAPH OF KAJIADO STUDY AREA

Watering Camels in Kajiado district

Appendix 10b: A FIELD PHOTOGRAPH OF NGURUNIT STUDY AREA

Camels basking in the sun in Ngurunit