FACTORS INFLUENCING SUSTAINABILITY OF RUMINANT LIVESTOCK PROJECTS IN THE DRY LANDS IN KALOLENI DISTRICT, KILIFI COUNTY, KENYA

BY

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DECLARATION

Except as acknowledged by references in this research project report on other authors and publications, this research project report is my original work and has not been submitted to any other institution or university that I know of for examination.

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REG NO: L50/66509/2011

This research project report has been submitted for examination with my approval as the university supervisor.

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DEDICATION

I dedicate this research project to my loving wife Juliana and my lovely children, Vivian, Brian, Birggita, and Eliud, who have been a great source of inspiration and encouragement.

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I wish you all good health and God’s grace.

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ABBREVIATIONS AND ACRONYMS

ASALs :	Arid and Semi-Arid Lands
AMREF:	African Medical Research Foundation
BSE:	Bovine Spongiform Encephalopathy
CBPP:	Contagious Bovine Pleuro-pneumonia
CUF:	Constituency Development Fund
DLPO:	District Livestock Production Officer
DVS :	Director of Veterinary Services
ERSWEC:	Economic Recovery Strategy for Wealth Creation and Employment
EDI :	Economic Development Institute
FAO :	Food and Agriculture Organization
FMD:	Foot and Mouth Disease
GDP :	Gross Domestic Product
GL-CRSP:	Global Livestock Collaborative Research Support Program
HlV:	Human Immune Deficient Virus
IFAD:	International Fund for Agricultural Development
KARl :	Kenya Agricultural Research Institute
-KLMC:	Kenya Livestock Marketing Council
KLN :	Kaloleni
LATF:	Local Authority Transfer Fund
LEWIS:	Livestock Early Warning Information System
LINKS :	Livestock Information Network and Knowledge System
LSD :	Lumpy Skin Disease
MBM :	Mammalian Meat and Bone Meal
MOA:	Ministry of Agriculture
MoLFD :	Ministry of Agriculture and Fisheries Development
NALEP :	National Agriculture and Livestock Extension Program
NLMIS:	National Livestock Marketing Information System

PPM :	Parts per Million
RVF :	Rift Valley Fever
TDS:	Total Dissolved Solids
UNEP:	United Nations Development Program
VCJD	Variant Crentefeidt Jacob Disease

ABSTRACT

This was a study on the factors influencing sustainability of ruminant livestock projects in Kaloleni district, Kilifi County, Kenya. The study was carried out in July covering the larger Kaloleni District. The study objectives were to investigate the influences of water provision, provision of veterinary care, community involvement in project planning and decision making, availability of adequate feeds throughout the year, skilled animal husbandry human labor, and availability of ready market for live animals and livestock products on sustainability of ruminant livestock projects in dry lands of kaloleni. The design of the study was a descriptive survey using questionnaires, observations as the main tools of data collection. The researcher traversed all the 20 sub-locations of the district and four sub- location in Rabai district, distributing and discussing the questionnaires as well as filling them. The exercise lasted two weeks. At the end of this period the unfilled questionnaires were left with the respondents and collected later. The population of kaloleni was estimated to be 173,050 persons with 35,134 farm families. These farm families formed target population for this study. To get ideal sample size, (O'Leary,Z,2004),Formula was used. According to O'Leary, sampling is the gathering and asking a range of individuals the same questions related to their characteristics, attributes, how they live, or their opinions. It also involves formula for calculating sample size as shown else- where in this report .Therefore the ideal sample size for the research obtained was 380. This sample was randomly selected from 24 sub-locations by considering 15 respondents per sub-location and 2 respondents per each sheep and goat group for the 10 groups studied. The 380 sample size obtained was further sub-divided to form two samples that were studied separately. One sample comprising of 185 respondents was used for study in high potential area, designated as zone 1 and the other 195 respondents were for the dry lands; zone 2. During the study 101 respondents turned up in zone 1 and 109 for zone 2; giving response rates of 55% and 56% respectively. The study focused more on the dry lands. Out of the six variables studied, five agreed with the research hypotheses and only one on the availability of livestock feeds varied. The study found out that provision of water, provision of veterinary care, community involvement in project planning and decision making availability of skilled human labor and availability of a ready market for live animals and livestock products had tremendous influence on the sustainability of ruminant livestock projects in the dry lands of Kaloleni. It was therefore recommended that concerted effort should be made by all the stake holders in livestock development to address these variables in order to enhance sustainable livestock production in kaloleni dry lands. Although the issue of feed availability did not feature clearly as expected, there is need to re- vi sit it especially during the dry season when livestock feed availability in this place is a night mare. Over reliance on natural vegetation for feeding livestock, decreasing grazing land, degrading rangeland and the changing climate is a big challenge that requires proper planning and utilization of these resources.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Sustainability of livestock projects, particularly those of the ruminants in dry lands is a blessing to the inhabitants of these areas especially in the developing world. Majority of the people living in those areas are livestock keepers; commonly referred to as pastoralists. About 95 percent live in extreme poverty, even though livestock keeping offers a promising opportunity to combat poverty in many developing countries, Kenya being among them (International Fund for Agricultural Development).

For poor people there are many benefits from livestock. Livestock are a form of currency. For many people livestock represent savings. The sale of livestock and manure can mean quick cash in hard times. Income from livestock and their many products- milk, meat, wool, leather can allow poor families to put food on the table, improve their nutrition, send their children to school and purchase medicine for themselves and their animals. Livestock acts as a kind of social glue. Loans and gifts of livestock connect people to other family members as well as communities and institutions. In many societies bride dowries are paid in livestock. Herders who share livestock with their relatives also share risks brought by drought and disease. Livestock are used to resolve conflicts, pay debts, and settle scores. A family's place in society is often measured by the amount and kind of livestock it owns. When women own livestock, their social status can be improved, empowering them participate in decision-making. Livestock serve a practical function too. They carry heavy loads, help plough fields and provide means of transportation. Their manure fertilizes the soil. Ruminants mostly graze on straw, grass, kitchen scraps, and other waste and thus convert unusable materials into high quality food for humans. Their meat adds protein to cereal based diets and can improve the nutrition of children. The presence of livestock reduces the need for human labor in the fields (Food and Agriculture Organization of United Nations, 2011)

Nearly one billion head of cattle are kept by more than eight million small farmers and herders in around the world. Most of these livestock keepers –about 95 percent live in extreme poverty. Even though livestock keeping offers a promising opportunity to combat poverty in many developing countries especially as the demand for animal products such as milk and meat continues to rise, most livestock policies and services tend to favor large scale production. In order to take advantage of emerging market demands and reduce their poverty, small farmers and herders need access to basic services and technologies such as veterinary care, good roads and grazing lands as well as policies and services that take account of their needs (Antonio & Sidahmed).

Agriculture is still the dominant activity in most African countries since about 70 percent of the people live and work in rural areas. In 1980, Agriculture, including both marketed and subsistence production, contributed US $20,000million to the gross domestic product (GDP). The share of livestock production was 8 percent of the total GDP and 25 percent of the total agricultural domestic product. If the value of manure and drought power were added, livestock's contribution would increase to 35 percent of the agricultural GDP. (Sansoucy et, al 1992).

The contribution of livestock to agricultural GDP varies between regions and countries and tends to increase inversely along the rainfall gradient; hence in countries in the drier zones livestock's contribution is greater than in countries located in wetter areas. In four countries Mauritania, Somalia, the Sudan and Botswana, Its' share is 50 percent; whereas in other countries it varies between 25 and 50 percent. In most African countries livestock production is extensive. This applies to pastoral and agro-pastoral systems in arid and semi- arid zones, where rainfall pattern preclude reliable cropping and limit the support capacity of land for people and livestock. These systems are predominant over more than 30 percent of the land and include more than 40 percent of cattle and small ruminants and all camels.(Leeuw & Rey ,1995).

Dry lands are also referred as rangelands and the herders are referred as pastoralists. Rangelands when properly managed have for centuries provided feed for grazing livestock under extensive systems and acceptable living conditions for populations living in arid and semi-arid areas (ASALs). The fluctuating rainfall patterns have meant that attempts to cultivate these areas have

generally been unsuccessful, unless irrigated (Shorbagy, 1998). Recurrent droughts and many rainfall fluctuations result in fluctuations in forage production. Rangelands in arid areas can be regarded as non- equilibrium environments (Scones 1995). The functioning and survival of range systems under these conditions are dependent on complex inter-relationship between people and domestic and wild animals, the vegetation and the physical environment (el-Shorbagy, 1998).The ability of pastoralists to survive has traditionally depended on their adoption of opportunistic mobility and adaptive strategies and drought management techniques. Some of the strategies are ecologically based such as raising of mixed species of livestock with different preferences for standing vegetation(Sidahmed,1993) while others depend on socio-economic relations such as reciprocal agreements for accessibility to communal grazing lands of neighboring tribes or groups in times of drought (Notenbaert et, al 2012)

Increasing population pressure and continued encroachment of farming into dry lands during the last decade, however, led to substantial change and weakening of traditionally viable grazing systems. Livestock numbers per hectare of rangelands increased leading to heavier and more continuous grazing pressure. Wide spread deterioration and degradation of arid and semi-arid rangelands has been reported (Mackel ,1995; Baas et al. 1991; FAO 1995; Mackel ,1995b). Socio-economic political changes (Zaroug, 1995) and major efforts have been made to improve or even replace traditional nomadic systems and to introduce new technologies often through large development programs and projects, many of which were initiated in the early70s and financially and technically assisted by multi and bilateral donors. The first generation of large rangeland development projects have addressed a number of issues including; sedentizing nomads, borehole provision, veterinary care, subsidized feeds and livestock production, revegetation of depleted ranges , feed reserves, establishment of fodder shrubs, creation of pastoral and fattening cooperatives and establishment of regulations to optimize utilization of rangeland resources(el-shorbagy, 1998). Retrospectively, however, it has been admitted that often projects have been hastily implemented with little consideration of the views or involvement of the local population. Any failure has been blamed on the reluctance of pastoralists to take up techniques or ideas proposed by outside “experts”, problems of land tenure, the inadequacies of administrations etc.(Baas et al ,1999).

Big changes are occurring in and to Africa's vast pastoral regions. Livestock herders' access to resources, options for mobility and opportunities for marketing are all evolving fast. Frequently depicted as in crisis, pastoralists are changing the way they live and work in response to new opportunities and threats revealing the resilience that pastoralists have demonstrated for millennia. Accessing new markets and innovating solutions to safeguard incomes, this often misunderstood as marginalized community is repositioning itself to make the most of the East African Economy (Cees de Haan,1995)

The pastoral way of life- synonymous with irreversible decline, 'crisis' and aid rescues-is poorly understood. And whistle ' pastoralism' and 'crisis' have become fused in the minds of many , there are positive signs of vibrant pastoralists livelihood that de-bank the usual reportage of pastoralists depicted as insecure, vulnerable and destitute. Failed by generations of unsuccessful state development plans and aid strategies, pastoralists have been let down because the real problems and issues they face have not been taken into account. A more accurate understanding of the processes of change happening within pastoralists areas which are significant and complex, has been obscured by the perpetuated myths of pastoralism in crisis. Understanding the complexity and potential for pastoralism is crucial to informing policies for securing the future of this age old and resilient sector in sub- Saharan (John & Barret, 2001)

The pastoral societies of East Africa (Kenya, Tanzania, Uganda) face more demands on their way of life than any previous time. Population growth, loss of herding lands to farmers, ranchers, game parks, and urban growth, increased commoditization of the livestock economy, out-migration by poor pastoralists, and dislocations brought about by drought, famine, and civil war are increasing throughout the region. The examples of the Maasai, Boran, and rendille of Kenya demonstrate that east African pastoralists are responding to the social, political, and economic challenges with increased market intergration. These changes result in increased social and economic stratification, urban migration, and diminished nutrition for women and children.(Elliot **,** 2001)

Over the past thirty years, east African livestock keeping peoples have faced large challenges to their economies and traditional ways of life. In the savanna regions of southern Kenya and Tanzania, Maasai and other groups have lost land to expanding farming populations, private ranches, wheat estates and expansion of tourist game parks. National governments lured by

investments and aid from the international donor community, have increasingly privatized formerly communal lands, encouraging the expansion of export and local market agriculture including beef and dairy marketing. In the more arid regions of northern Kenya, nothern Uganda, and southern Ethiopia, pastoral populations including Samburu, Pokot, Turkana, Rendille, Boran and Karamanjong have faced problems of drought and famine coupled with ethnic conflict and political insecurities, exacerbated by population growth and increased completion for range land and water resources. Inter-ethnic fighting has increased in violence as automatic weapons from civil wars in Sudan, Ethiopia, and Somalia are increasingly acquired by pastoral Tribes men (Lamwaka, 2006

According to Food And Agriculture Organization of the United Nations,(2005),Kenya is a low income economy with livestock contributing 12 percent to GDP. Since 1993, the government has been implementing orthodox macro-economic policies and structural reforms, which culminated in the June 2003 economic recovery strategy for wealth and employment creation. About 45 percent of the total land area is agriculturally productive; the other parts, mainly used for pastoral farming, are semi- arid to arid, and characterized by low, unreliable and poorly distributed rainfall. Access, control and management of land have been traditionally administered by indigenous communities, but the customary law has suffered through statutory allocation of land to individuals or government institutions. Today the largest quantities of land are in the hands of national and foreign corporations. Kenya livestock sector is dominated by small producers. The livestock population is concentrated in the arid and semi-arid lands (ASALs), which cover about 75 percent of the total land surface. In ASALs the livestock sector accounts for 90 percent of employment and more than 95 percent of family incomes. In spite of good natural potentials, however, these areas have the highest incidence of poverty (about 65 percent) and very low access to basic social services, such as infrastructure and education. The vast majority of cattle are kept by pastoralists in mixed herds; and only 5 percent of small holders practicing arable agriculture keep either ruminant or non-ruminant livestock. The government intends to undertake inventories of the nature of tenure arrangements; resource planning activities and land use; investigate and where necessary halting any on going adjudication processes particularly in tribal land areas, until necessary land reforms are legislated; establish credible land control boards that are acceptable and respected by the local communities. The department of veterinary services

(DVS) is responsible for controlling major animal diseases, but restricted funds limit its actions (Food and Agriculture Organization ,2005). The government plans to strengthen the animal health delivery system by providing mobile animal health clinics and screening units and disease surveillance mechanisms; strengthen disease control measures in partnership with regional animal health programs; create strategic disease free zones to facilitate export of live animals; increase cross border disease surveillance and management mechanisms.

According to District Livestock Production Officer's Annual Report(2012),Like many districts in the coast province; kaloleni district located within Kilifi, County has over 75 percent of the land being arid and semi-arid and over 90 percent of all the ruminants reside here. Farmers in this place practice subsistence farming for both crop and livestock; they are referred as agro-pastoralists. Crops grown here are mainly maize, cashew nuts and cassava; but due to harsh climatic conditions crop failures are rampant. On the other hand the main types of livestock kept are the indigenous and some crosses between them. For cattle the zebu and Borans are the most common; while in goats are the small east African goat, the Galla and their crosses. Most common sheep is the local fat tailed and a few Dorper crosses. There are no camels despite good potential for the same. Animals are grazed freely on the natural pastures, forbs and browse found in the community owned range land. In the last decade the ministry of livestock development through its local extension staff, world vision, national agriculture and livestock development project, and arid lands resources management project have provided a lot of support in form of livestock extension, disease control, provision of superior breeding materials for sheep and goats to self help groups. Despite the existence of good animal production potential in the district as well as the concerted efforts by the above mentioned stake holders, no success stories of livestock projects have been reported or documented. Local leaders as well as the community members give priority to crop issues in planning meetings and other development forums over livestock. The main challenges faced by pastoralists in livestock production in this region are:- Inadequate drinking water for livestock, poor and fluctuation in pasture supply during the year, inadequate veterinary care and unskilled animal husbandry human labor, unorganized marketing of livestock and livestock products, lack of involvement of the local community by donors in livestock projects planning and decision making right from projects inception and animal disease incidences among others.

Subsistence farming based on crop production as the main enterprise in the rangeland; unless under irrigation present grave consequences on the environment and the socio-economic lives of this community. Opening up of land for crop cultivation generally exposes it to further environmental degradation and a cause for increasing desertification. While continued heavy investiment in crop production with the year in year out crop failures has the effect of impoverishing the community further. Hence the need to investigate the challenges hindering sustainability of livestock projects and enterprises in this area; with the hope that proper mitigation against the identified challenges will enable full exploitation of livestock potential and change the socio economic scenario of the community for better.(Shorbagy 1998)

1.2 Statement of the problem

Increasing population pressure in relatively high potential agricultural areas has forced more people to move and settles in the ASALs; considered as marginal areas. In Kenya ASALs occupy more than 80 percent of the country and are home for over ten million people. Despite the high development potential, the ASALs have the lowest development indicators and highest poverty incidence in amongst all areas in Kenya. More than 60 percent of ASAL inhabitants, for instance live in abject poverty subsisting on less than one US dollar per day. Reinforcing this endemic poverty is a cycle involving environmental degradation, insecurity, climatic shocks, diseases and general despondency. In the midst of the high incidence of poverty in the ASALs, lies the immense base of natural resources endowment among them is livestock. More than 70 percent of the national livestock population in Kenya is to be found in the ASALs. Therefore, there is growing recognition among various stakeholders and development experts that ASALs have the potential to transform the economy of the whole country and thus hold the key to accelerated development of this country. The interest in the ASALs, as the new frontier for the country's development is highlighted by the government of Kenya's economic recovery strategy for wealth and employment creation, which spotlight the immense, potential for wealth creation and employment in these areas. (Arid Lands Resource Management Project 11 and National Vision Strategy 2005-2015).

Kaloleni ASAL settlement situation represents a typical Kenyan scenario whereby as human population pressure increases on relatively high agricultural potential areas people move into ASALs with their farming practices of subsistence farming that is mainly crop oriented. However, scarce and unreliable rainfall patterns have rendered crop production unsuccessful unless irrigated. Further more opening up of more land for crop production exposes the environment to more degradation and is one of the causes of increasing desertification in these areas. Again heavy and repeated investment in crop farming with the resultant perpetual crop failures subjects farmers to greater poverty. Although challenges of livestock sustainability exist, there are local coping mechanisms to ensure some earnings from livestock and safeguard against total loss of livestock during drought. With appropriate government and donor support, livestock survival, productivity and therefore sustainability of livestock projects is likely to improve tremendously and in the process avoiding circumstance where farmers are forced resort into illegal ways of earning a living such as charcoal burning, logging, peddling in drugs and substance abuse, dealing with illicit brews, rural urban migration and so fourth. More over enhanced sustainability of livestock projects will attract more donor support.

1.3 Purpose of the study

The purpose of this study was to investigate the factors influencing sustainability of livestock projects in dry lands.

1.4 Objectives of the study

The objectives of this study were:

1.To determine the extent to which provision of water within short distances influences sustainability of livestock projects in dry lands.
2.To establish the extent to which provision of veterinary care influences sustainability of livestock projects in dry lands
3.To examine the extent to which involvement of the beneficiary community members in project planning and decision making influences the sustainability of livestock projects in dry lands.

4.To investigate the influence of availability of adequate livestock feeds throughout the year on the sustainability of livestock projects in dry lands

5.To examine the extent to which availability of skilled animal husbandry human labor influences sustainability of livestock projects in dry lands.

6.To assess the influence of availability of ready market for live animals and livestock products on the sustainability of livestock projects in dry lands

1.5 Research Questions

This research sought to answer the following six questions

1.How does the provision of water within short distance influence the sustainability of livestock projects in dry lands?

2 How does provision of veterinary care influence sustainability of ruminant livestock projects in dry lands?

3 To what extent does the involvement of the local beneficiary community in project planning and decision making influence sustainability of ruminant livestock projects in dry lands?

4 How does availability of enough feeds throughout the year influence sustainability of ruminant livestock projects in dry lands?

5 How does the availability skilled animal husbandry human labor influence

Sustainability of livestock projects in dry lands?

6 To what extent does availability of a ready market for live animals and livestock products influence sustainability of livestock projects in dry lands?

1.6 Research Hypothesis

The study tested the following six hypotheses:

1 $\mathbf{H_O}$: there is a positive relationship between provision of water and sustainability

of livestock projects in dry lands

H_1: there is no relationship between provision of livestock water and sustainability of livestock projects in dry lands

2.**H_O**: there is a positive relationship between provision of veterinary care a Sustainability of livestock of livestock projects in dry lands.

H_1: there is no relationship between provision of veterinary care and sustainability of livestock projects in dry lands

3. **H_O** there is a positive relationship between involvement of beneficiary community members in project planning and decision making and sustainability of Livestock projects in dry lands of kaloleni

H_1: there is no relationship between relationship between involvement of beneficiary Community members and sustainability of ruminant livestock projects in dry lands

4.:**H_O** there is a positive relationship between availability of adequate feeds throughout the year and sustainability of livestock projects in dry lands.

H_1: there is no relationship between availability of adequate feeds throughout the year and sustainability of livestock projects in dry lands

5 .**H_O**: there is a positive relationship between availability of skilled animal husbandry human labor and sustainability of livestock projects in dry lands

H_1; there is no relationship between availability of skilled animal husbandry human labor and sustainability of livestock projects in dry lands

6. **H_O** ; there is a positive relationship between availability of ready market for live animals and livestock products and sustainability of livestock projects in dry land

H_1: there is no relationship between availability of ready market for live animals and Livestock products and sustainability of livestock projects

1.7 Basic assumptions of the study

Provision of livestock water, provision of veterinary care, involvement of beneficiary community, availability of animal feeds through out the year, availability of skilled animal husbandry human labor, availability of ready market for live animals and livestock products were expected to have some influence in the sustainability of livestock projects in the dry lands of Kaloleni district. It was hoped that the researcher will receive the necessary corporation from the community members, local leaders and politicians alike; this being a highly political season could pose a lot of suspicion and resistance to the study.

1.8 Significance of the study

The study will without doubt be useful in providing valuable information and knowledge regarding the sustainability of livestock projects; especially of the ruminants type in the dry lands; to all key livestock stake holders in the country-namely the dry land inhabitants and investors, the government, local and external donors, researchers, as well as scholars in this field.

The study focused on the six major factors considered as exerting greatest influence on the sustainability of livestock projects in dry lands:- provision of livestock water, provision of veterinary care, involvement of the beneficiary community in project planning and decision making, availability of livestock feeds throughout the year, , availability of skilled animal husbandry human labor, availability of ready market for live animals and livestock products . The study document will guide the various livestock stakeholders in making wise investment decisions, policy formulation, and instituted appropriate intervention measures and developed recommendations for further study and research.

It is also hoped that adoption of the study findings and recommendations will result into sustainable livestock projects in these areas; creating a positive attitude of farmers towards livestock projects. Change from subsistence farming into commercial livestock keeping will salvage the dry land communities from extreme poverty, rural-urban migration, unemployment, food insecurity, environmental degradation and other socio-economic evils.

The study has suggested significant policy and knowledge statements based on Its' findings and recommendations. The study made recommendations on factors that influence success of livestock projects in ASALs and highlighted the huge livestock opportunities and potential that exist in these areas but have not successfully been exploited to improve socio-economic status of these communities.

1.9 Limitations of the study

The main limitations and challenges for the study were ; Inadequate time, finances, a wide study area coverage, Low rate of response and a big contrast between high potential block and the dry lands. Despite these limitations the study was very successful. To avoid too much influence of the high potential area on results of the study in the dry lands, the areas were divided into two zones ; the high potential zone and the dry lands were studied separately.

1.10 Delimitations of the study

The study focused on the factors that influence sustainability of ruminant livestock projects in the Kenyan dry lands; using kaloleni as a model ASAL district for the study. Incidentally the researcher has worked in this area as a livestock production officer for over seven years, hence well versed in this area and satisfied that the district was a typical representative of the ASAL environment found in Kenya and in particular coast province.

The on-going sub-division of community grazing land made the study of this area easier.

In the last decade concerted efforts by both the government of Kenya and Non-governmental organizations to provide water and superior breeding males and females for sheep and goats elicited good reception for the research by the respondents hoping for better things to come

1.11 Definition of significant terms used in the study

Sustainability- The ability of the project to continue being viable long after donor support has been with drawn.

Ruminants - Herbivorous animals such as cattle, sheep and goats that graze and later regurgitate their feed from their stomachs into mouth and chew cud.

Pastoralists- livestock herders living in the natural rangelands

Empowering Women- enable, develop their capacity or provide legal rights to women to be able to own, control and manage livestock independently.

Subsistence Farming- small scale, non-commercial farming aimed at meeting domestic food requirements for the family.

Drought Power- Animal energy that has been harnessed for use in ox-cat, ploughing and so fourth.

Agro-pastoral Farming- mixed farming involving crop and livestock keeping.

Small Ruminants- commonly used to refer to sheep and goats.

Range Lands- natural or improved lands where animals graze freely.

Forage- another name for animal feeds, behavior of wondering about in search of feeds.

Nomads- these are commonly pastoral communities who wonder from place with their animals in search of greener pastures.

Sedentazing Nomads- creation of a conducive environment to enable nomads to settle in one place permanently.

Forbs and Browse- plant leaves, branches, fruits, pods that serve as animal feeds.

1.12 Organization of the study

Chapter one deals with the background of the study, outlining the problem statement, significance of the study and states the objectives that guide the study in investigating the factors influencing sustainability of ruminant livestock projects in the dry lands. On the other hand chapter two focuses on literature review of the factors that influence sustainability of ruminant

livestock projects in dry lands. Chapter three examines the research design, location of the study, population, sampling, data collection and data analysis procedures that were used in the study.

Chapter four deals with data analysis, presentation and interpretation.

Finally chapter five provides a summary of the findings, discussions, conclusions and recommendations of the study and gives recommendations for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter attention is focused on the literature review of mainly the independent variables of this study, that is, factors influencing the sustainability of ruminant livestock projects in dry lands namely; provision of livestock water, provision of veterinary care, involvement of beneficiary community in project planning and decision making, availability of feeds throughout the year, availability of skilled animal husbandry human labor, availability of ready market for live animals and livestock products. It provides an in-depth analysis of these variables in an effort to explain how the variables are linked and the role they play in the sustainability of ruminant livestock projects in the Kenyan dry lands.

2.2 Provision of water and sustainability of livestock projects

Water is the basis of life. It is one of the main constituents on earth. Two thirds of the earth is covered by water. Every form of life on earth depends on water in one form or the other for its' subsistence (Christine & Michael, 2008).

According to United States Survey, (2013)Water makes up to 50 to 90 percent of the weight of living things. Protoplasm is a solution of water and fats, carbohydrates, proteins, and salts. Water transports, combines, and chemically breaks down these substances. Water also aids the metabolic break down of proteins and carbohydrates. The main sources of water are oceans, ice caps and glaciers, ground water, lakes, swamps, rivers and precipitation. On the other hand uses of water include agricultural, industrial, house hold, recreational and environmental activities. Virtually all of these human and livestock uses require fresh water.

Ninety seven percent of the water on the earth is salt water. However only 3% is fresh water; and slightly over two thirds of this water is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is found mainly as ground water, with only a small fraction present above the ground or in the air. Fresh water is a renewable resource, yet the world's supply of clean water, fresh water is steadily decreasing. Water demand already exceeds supply in many parts of the world and as the world population continues to rise, and so too does the water demand. (Coleride, 2006)

Human activities can have a large and sometimes devastating impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wet lands. Humans often increase run off quantities and velocities by paving areas channeling stream flow.

Natural surface water can be augmented by importing surface water from another watershed through a canal or pipeline. (International Conference, Paris France, 1998)

Subsurface water or ground water, is fresh water located in the pore space of the soil and rocks. It is also water that is flowing within aquifers below the water table. Subsurface water can be thought of in the same terms as surface water; inputs, outputs and storage. The critical difference is that due to it's slow rate of turn over, subsurface water storage is generally much larger compared to inputs, that it is for surface water. This difference makes it easy for humans to use subsurface water unsustainably for a long time without severe consequences. The natural input to sub surface water is seepage to the oceans. If the surface water source is also subject to substantial evaporation, a subsurface water source may become saline. In coastal areas, human use of subsurface water source may cause the direction of seepage to ocean to reverse which can cause soil salination . Humans can also cause subsurface to be 'lost' through pollution. Humans can increase the input to a subsurface water source by building reservoirs or detention ponds (International Conference, Paris, 1998).

Desalination, an artificial process by which saline water (generally sea water) is converted to fresh water; is mostly done through distillation and reverse osmosis. Desalination is currently expensive compared to most alternative sources of water, and only a very small fraction of total human use is satisfied by desalination. It is only economically practical for high valued uses (such as house hold and industrial uses) in arid areas. The most extensive use is in the Persian (Chandler, 2012)

2.2.1 Water Pans and sustainability of livestock projects in dry lands

Water pans are the most common water harvesting structures used in range land. During the rains a lot of water is lost in ASALs as surface run off. Harvesting of this run off and storage of the same into water pans makes it available for domestic and livestock use as well as for supplementary irrigation (National Drought Management Authority, 2013).

Water pans can either be natural or excavated. Natural water pans have provided water for wildlife, livestock and humans since ancient times. They form depressions in which rain water accumulates during rain season and they do not have an outflow. Today most natural water pans are used for watering livestock during rains and a few months there after. Some people still use for domestic water supply even though they are dirty and not suitable for drinking or washing (Thorp,1979)

Excavated pans: a pan can also be called a pond and it can be square, rectangular or round in cross section and impound and retain surface run off from uncultivated grounds, roads or laga (in Borana) and should be located in slopes not higher than 3%. Pans may require rehabilitation activities to make sure that adequate amount of water is retained at every rain season. Pans are located in the topographically low area where run off from can easily be harvested and where impervious soil s prevail to reduce seepage losses. Evaporation loss can be minimized by reducing amount of surface area in proportion to it's volume. The capacity is variable and depends on site conditions and how much one wants to invest. Common ones are $1500m^3$ to $5000m^3$ but the capacity can be increased with time to hold more water. Site selection is determined by the nature of the soils and the hydrological conditions (National Drought Management Authority, 2011).

According to Southern and Eastern Africa Rain water Network (2011), water pan is the most popular source of water with many reports of success stories in ASALs because they are simple to construct and are able to provide water both for domestic and livestock use as well as for supplementary irrigation ;they are simple to operate and maintain, community mobilization can be done easily through participatory rural appraisal, for a communal water pan to ensure ownership and quarantee future operation and maintenance. Labor can be sourced from humans, drought animals or earth moving machinery depending on the size of the pan.

2.2.2 Earth Dams and sustainability of livestock projects in dry lands.

These are very suitable water harvesting structures in ASALs because they are simple and inexpensive , most of the construction materials are easily available locally, less operation and maintenance costs compared to bore holes and other communal dams. Evaporation is minimized under sun surface. Water quality is improved by filtration through the sand and prevention of direct contact with pollutants. They are socially acceptable as they improve traditional sources of water to support domestic, livestock and micro-irrigation using hand watering, low head drip irrigation systems and treadle hand pumps. They enhance environmental conservation enables community to make contribution to enhance sustainability in terms of labor, local materials and traditional knowledge (Njigua, 2013).

2.2.3 Piped Water and sustainability of livestock projects in dry lands

According to Kaloleni water office report(2013), Piped water from mzima springs and Baricho in Malindi is the most reliable and permanent fresh water source for both domestic and livestock use, but availability of this water is inadequate and more so in the dry lands. However there is on-going efforts to cover these areas.

Water is a critical nutrient for livestock and poultry. As with feed ingredients, livestock water should meet the nutritional needs of the animal. An adequate and safe water supply is essential to the production of healthy livestock and poultry. Water that adversely affects the growth, reproduction, or productivity of livestock and poultry cannot be considered suitable. Although there is scant research data on the economic effects of water quality on livestock performance, logic tells us that farm water supplies, either surface or ground, should be protected against contamination from microorganisms, chemicals and other pollutants. Substances that originate from livestock farms and often contaminate water supplies include nitrates, bacteria, organic materials and suspended solids. A high level of suspended solids and an objectionable taste, odor or color in water can cause animals to drink less than they should (Food and Agriculture Organization 2005).

Surface water supplies to which livestock have ready access are always potential candidates for contamination. Shallow dug wells without good surface drainage away from the well is an indication that surface water is finding its' way into the well. In karst topograghy, sink holes, losing streams and porous soils may allow direct contamination of fractured rock aquifers. Water can serve as a reservoir for many different disease organisms and toxins. Stagnant water contaminated with manure or other nutrients may develop blue-green algae, which can poison livestock causing muscle tremors, liver damage, and death. Farm pond water needs to be observed for the presence of algae and other harmful organisms during hot, dry weather. Leptospirosis and fusobacterium are two bacterium contaminants that often use water and mud respectively as modes of transportation from animal to animal. Leptospirosis is spread through urine of carrier animals. This disease often manifests itself as reproductive problems. Problems may range from infertility, to low milk production, to wide spread late term abortion. The organism can survive for extended periods of time in surface waters. One should take care to avoid forcing livestock to drink from water sources that may be contaminated with urine. (Pfost & Fulhage, 2013)

Fusobacterium infection is more commonly known as “foot rot. The bacterium is a soil-borne organism found virtually throughout the wet areas in the tropics. It is carried in the feet of animals, which on the feet of animals, which then serve to contaminate anybody of water they enter. The bacterium then enter through the cuts, bruises or puncture wounds or damaged feet of other animals. Once inside an animals’ body, they multiply rapidly and serve to spread the disease. Clinical signs of” foot-rot” are most commonly seen as chronic lameness, often with swelling above the foot. “foot-rot” can usually be effectively treated with penicillin and sulfa. When water is suspected of causing health problems in livestock, veterinary assistance should be sought to determine the actual disease. Laboratory diagnostic examination of animals as well as water supply may be necessary to evaluate the problem. Temporarily changing to a known safe water supply is a useful test to determine whether the health problems can be solved. Water too often is blamed for production or disease problems; thus the importance of an accurate diagnosis must be emphasized (Pfost& Fulhage, 2013).

Water is too often blamed for production or disease problemsThus, the importance of an accurate diagnosis must be emphasized.

Tables 1 through 4 in this guide show the recommended limits of certain pollutants and other substances commonly found in water used for livestock and poultry.

Note: These tables should not be used as diagnostic indicators of health problems in livestockToxicity from a specific mineral or compound depends on its concentration and on relative levels of other components with which it interacts

2.2.4 Common Water Contaminants and sustainability of livestock projects in dry lands.

The U.S. Environmental Protection Agency recommends that livestock water contain less than 5,000 coliform organisms per 100 milliliters; fecal coliform should be near zero. Alkalinity is expressed either as a pH or as titratable alkalinity in the form of bicarbonates. A pH of 7 is neutral; a pH between 7.0 and 8.0 is mildly alkaline; and a pH of 10 is highly alkaline. Excessive alkalinity can cause physiological and digestive upsets in livestock. Desired and potential

problem levels of some common pollutants in livestock water supplies are listed in Table 1. Table 2 shows the safe upper limits for several substances that may be contained in livestock wat

Table 2.2

Desired and potential levels of pollutants in livestock water supplies.

Substance	Desired range	Problem range
Total bacteria per 100 milliliters	<200	>1,000,000
Fecal coliform per 100 milliliters	<1	>1 for young animals >10 for older animals
Fecal strep per 100 milliliters	<1	>3 for young animals >30 for older animals
pH	6.8 to 7.5	<5.5 or >8.5
Dissolved solids, milligrams per liter	<500	>3,000
Total alkalinity, milligrams per liter	<400	>5,000
Sulfate, milligrams per liter	<250	>2,000
Phosphate, milligrams per liter	<1	not established
Turbidity, Jackson units	<30	not established

source

from the agricultural waste management field handbook, page 1 to 16.

Note:1 milligram per liter (mg per L) is approximately equal to 1 part per million (ppm).

Table 2.3

Safe upper limits for several substances that may be contained in water for livestock and poultry.

Substance	Safe upper limit of concentration
Aluminum (Al)	5 ppm
Arsenic (As)	0.2 ppm
Boron (B)	5 ppm
Cadmium (Cd)	0.05 ppm
Chromium (Cr)	1 ppm
Cobalt (Co)	1 ppm
Copper (Cu)	0.5 ppm
Fluoride (F)	2 ppm
Lead (Pb)	0.05 ppm
Mercury (Hg)	0.01 ppm
Nitrate + Nitrite	100 ppm
Nitrite	10 ppm
Selenium (Se)	0.05 to 0.10 ppm
Vanadium (V)	0.1 ppm
Zinc (Zn)	24 ppm
Total dissolved solids	10,000 ppm
Magnesium + sodium sulfates	5,000 ppm
Alkalinity (carbonate + bicarbonate)	2,000 ppm

source

When Is Water Good Enough For Livestock? montana state extension.

Table 2.4

Effect of salinity of drinking water on livestock and poultry (Water Quality Criteria, 1972).

Soluble salt (mg per L)	Effect
<1,000	Low level of salinity; present no serious burden to any class of livestock or poultry
1,000 to 2,999	Satisfactory for all classes of livestock and poultry; may cause temporary, mild diarrhea in livestock; and water droppings in poultry at higher levels; no effect on health or performance
3,000 to 4,999	Satisfactory for livestock; may cause temporary diarrhea or be refused by animals no accustomed to it; poor water for poultry causing watery feces and, at high levels, increased mortality and decreased growth (especially in turkeys).
5,000 to 6,999	Reasonable safety for dairy and beef cattle, sheep, swine, and horses; avoid use for pregnant or lactating animals; not acceptable for poultry, causes decreased growth and production or increased mortality.
7,000 to 10,000	Unfit for poultry and swine; risk in using for pregnant or lactating cows, horses, sheep, the young of these species, or animals subjected to heavy heat stress or water loss; use should be avoided, although older ruminants, horses, poultry, and swine may subsist for long periods under conditions of low stress.
>10,000	Risks are great; cannot be recommended for use under any conditions.

Table 2.5

Guide to use of waters containing nitrates for livestock.

Nitrate content* as parts per million (ppm) of nitrate nitrogen (NO3-N)**	Comments
Less than 100	Experimental evidence indicates this water should not harm livestock or poultry.
100 to 300	This water by itself should not harm livestock or poultry. If hays or silages contain high levels of nitrate this water may contribute significantly to a nitrate problem in cattle, sheep, or horses.
More than 300	This water could cause typical nitrate poisoning in cattle, sheep, or horses, and its use for these animals is not recommended. Because this level of nitrate contributes to the salts content in a significant amount, use of this water for swine or poultry should be avoided.

water quality for livestock and poultry, fo-1864-go. university of minnesota extension division, 1990source.

**1 ppm of nitrate nitrogen is equivalent to 4.4 ppm of nitrate (no3).

Note

The maximum level of nitrate as n in water for human consumption (as set by the us epa) is 10 milligrams per liter

2.4 Provision of veterinary services and sustainability of ruminant livestock projects

Pastoralists in most parts of the world can be considered highly vulnerable to herd losses caused by:-

Individual risks such as non-epizootic animal disease, predation and poor management decisions. All around the world, but particularly in Africa, such vulnerability can too easily reduce large numbers of pastoralists to destitution, and sometimes cause a large scale exodus from pastoralism (often only to low-grade urban unemployment or long term relief dependency). Evidence of this vulnerability is found in a long record, since 1970s, of catastrophic droughts causing mass mortality of livestock. Pastoralists especially in the horn of Africa, continue to be victims of recurrent droughts and large scale international food aid continues to be necessary in response to those droughts. Pastoralists are not just poor and vulnerable, but they are also marginalized(Department for international development 2011)

The department of veterinary services has placed great attention to animal disease control in order to protect Kenya animal resource base. The focus has been in the control and eradication of notifiable epizootic trans-boundary animal diseases of major economic and public health importance in order to promote sustainable livestock farming and to facilitate trade in animals and animal products. The major epizootic animal diseases include Foot and Mouth Disease (FMD), Contagious Bovine Pleuro-Pneumonia (CBPP), Rinderpest, Rift Valley Fever (RVF), African Swine Fever (ASF), and Lumpy Skin Disease (LSD). Other important diseases are Rabies, Anthrax/Blackquarter, Contagious Caprine Pleuro-Pneumonia and Newcastle Disease.

Kenya is a key market for livestock from the neighbouring countries due to a marked livestock price differential with the neighboring countries. This occasions a heavy net inflow of livestock into the country leading to an in increase in trans-boundary disease challenge and a depression of local producer livestock prices which has acted as a disincentive to investment in the sector. This, coupled with the large scale and massive livestock movement by pastoralists, has inordinately stretched the country veterinary disease control services. The incidence of Trans-

boundary diseases in the country remains an effective barrier to trade and has continued to deny livestock access to alternative international markets.

The provision of veterinary services has been constrained by inadequacy of operational funds, shortage of transport and veterinary inputs, poor infrastructure and shortage of veterinary personnel. Additional constraints include inadequate diagnostic facilities which has led to the upsurge of diseases and spread into previously clean areas.

In order to achieve better results, Strategic measures to prevent entry of exotic and emerging diseases such as avian influenza into Kenya are being put in place, including regional approach to trans-boundary disease control. The department has also enhanced stakeholder participation in disease control as a new approach to manage livestock diseases. A process to establish disease free zones has also been initiated to facilitate export of livestock and livestock products. In addition extensive surveillance and regular vaccinations against notifiable epizootic diseases are carried out in order to improve herd immunity.

2.3.1 Pest control and sustainability of livestock projects

Pest control has remained a major priority for the department of veterinary services. The focus has mainly been on the tick and tsetse control. Ticks transmit various tick-borne diseases especially the East Coast Fever which cost the country nearly Ksh 855 million per year. During the 1990s, the government handed over the management of dips to farmers but the department has retained the regulatory role of tick control with respect to testing and registration of new acaricides and issuing guidelines on their use. In addition, the department has continued training farmers and dip committees on dip management through extension. Currently, only about 40% of the 5,000 communal cattle dips are operational. The department is encouraging the communities to rehabilitate the remaining dips through the Constituency Development Fund (CDF) and Local Authority Transfer Fund.

On the other hand, about 51 districts in the country comprising of 25% of the total land mass and 60% of productive rangelands are infested with tsetse flies. Tsetse transmits trypanosomiasis to cattle and sleeping sickness to humans which lead to huge losses. The department has retained tsetse control as a core function due to the trans-boundary nature of the vector and has embraced participatory approach as a means to ensure sustainability in tsetse control. It is also implementing the(PATTEC) project which is a six year regional programme aimed at eradicating tsetse in Africa (Veterinary Services, November 2011)

The department of veterinary services (DVS) is responsible for controlling major animal diseases, but restricted funds limit its actions. The government plans to:-

Strengthen the animal health delivery system by providing mobile animal health clinics and screening units and disease surveillance mechanisms; 2) strengthening disease control measures in partnership with regional animal health programs; 3) create strategic disease free zones to facilitate the export of live animals; 4) increase cross-border disease surveillance and management mechanisms (Dr.Alfred. Muthee , 2006).

Handling of minor disease cases has been privatized and these cases are attended at farmers cost by private animal health service providers or by pastoralists themselves.

2.4 Community involvement in project planning and decision making and sustainability of livestock products

Community involvement in any project right from project inception to the end is very important and forms a participatory approach to development. Participatory development is the most important approach towards enabling communities to help themselves and sustain efforts in development work. Communities are no longer seen critical stakeholders that have an important role play in the management of programs as recipients of development programs; rather, they have become and projects in their areas (Economic Development Institute, 1986).

At a 1986 Economic development institute (EDI)-sponsored workshop, the value of community participation in development projects was emphasized, including greater responsibilities for project efficiency and effectiveness, cost-recovery, social acceptability, and sustainability. Among the possible dangers brought out at the workshop were included: delays, additional costs, sabotage by powerful economic or social groups, hostility to or distrust of the government, intensification of community conflicts, and diversion of benefits to the well-established rather than to women or disadvantaged. Some of these potential problems can be reduced by careful research, flexible project design, appropriate technology and two- way flows of communication (Michael Bamberger, 2006).

A community's members are a rich source of knowledge about their community and of energy and commitment to that community. When public health professionals envision a program to address health issues in a particular community, tapping into the community's expertise and enthusiasm is frequently an essential issue. Genuine participation by community members, including youth, is the key. Community members control the project at the same time that professional partners build the community's capacity to make informed decisions and to take collective action. *Experience has demonstrated that people can devise their own … alternatives if they are allowed to make their own decisions.*

Community participation is a proven approach to addressing health care issues and has been long utilized in HIV prevention in the United States and in development internationally, in projects varying from sanitation to child survival, clean water, and health infrastructure. However, the quality of participation varies from project to project. Moreover, in spite of the failure of many health programs designed *without* the participation of target communities, some professionals continue to question the value of community members' participating in program design, implementation, and evaluation. A Youth do not live in a vacuum, independent of influences around them. Rather, social, cultural, and economic factors strongly influence young people's ability to access reproductive and sexual health information and services. To improve young people's sexual and reproductive health, therefore, programs must address youth *and* their

environment. In order to address youth adequately and appropriately, programs should be designed and implemented with the meaningful involvement of youth. To address youth's environment, planners must acknowledge that community and families significantly influence youth (Transitions, Community, Participation 2002) controversial and/or taboo, it is critical to bring other community members into the process so that they, too, can support healthy change.

2.5 Feed availability and sustainability of livestock projects

Animal feed is food given to domestic animals in the course of in the course of animal husbandry. There are basically two forms of feeds, fodder and forage.”Fodder” refers particularly to food given to the animals (including plant cut and carried to them), rather than that which they forage for themselves. It includes hay, straw, silage, compressed and pelleted feeds, oils and mixed rations, and sprouted grains and legumes.” Forage” is plant material (mainly plant leaves and stems) eaten by grazing livestock. Historically, the term forage has meant that only plants eaten by animals directly as pasture, crop residue, immature cereal crops, but is also used more loosely to include similar plants cut for fodder and carried to the animals, especially as hay or silage (Small-Scale Dairy Farming Manual).

Livestock play an important role in most small-scale farming systems throughout the world. They provide traction to cultivate field, manure to maintain crop productivity, and nutritious food products for human consumption and income generation. Despite the importance of livestock, inadequate nutrition is a common problem in the developing world, and a major factor affecting the development of viable livestock industries in poor countries.(K.C Paudel& B.N Tiwari).

International Fund for Agricultural Development recognizes both the significant role that improved animal feed and feeding practices can play in the long-term alleviation of rural poverty and their specific benefits to the rural poor such as increased livestock productivity, house hold food productivity and income. Availability of adequate feed is the major constraint to livestock

production in the dry lands of south eastern Kenya .Pasture grasses served as the only fodder for domestic animals in the period of nomadic livestock raising (Kenya Agricultural Research Institute).

Animal feed is feed given to domestic animals in the course of animal husbandry. There are basically two types of feeds; fodder and forage(Small Scale Dairy Farming Manual Volume 3)

2.5.1 Fodder Production

This refers to particularly to feed given to the animals (including plants cut and carried to them), rather than which they forage for themselves. They include hay, straw, silage, compressed and pelleted feeds, oils and mixed rations and sprouted grains and legumes. The most popular fodder crops in Kenya are the nappier grasses, desmodium and sweet potato vines (Small Scale Dairy Farming Manual Volume 3). Fodders are mainly suitable under zero grazing and semi-zero grazing in high potential farming areas.

2.5.2 Forage production

This refers to the natural vegetation in form of grasses, browse and forbs; what Food and Agriculture Organization refers as permanent pastures which occupy between 4% (Mauritius) and 73% in Botswana of the total land area. In majority of the countries pastures occupy 23% to 60% of the land area. Virtually all permanent pastures are not improved and therefore ruminants depend on natural forages and browses which vary widely in quantity and quality during dry season. As a result livestock productivity varies with seasons. While technologies for improving natural pastures are available, they face serious constraints such as communal ownership and grazing in the traditional sector currently the traditional grazing system is under pressure. Human population is increasing, arable cropping is expanding and grazing areas are decreasing
(Abate, Dzowela & Kategile, 2013)

Feed availability and the impact of grazing on natural on natural vegetation is clearly demonstrated by the study done in the Mediterranean with similar conditions as those prevailing in the tropics:

Vegetation in the Mediterranean basin has been developed over thousands of years depending on the natural processes and human intervention (e.g. wood cutting, fire and grazing (Kutie et al, 2000). Many natural grasslands have been destroyed by cultivation or modified by grazing from livestock (Watkinson and Ormerod, 2001). Alfara's area has suffered from two factors that affect the natural vegetation diversity and lead to severe range deterioration; grazing by domestic livestock and land reclaimation (EQA, 2004). Heavy grazing by domestic livestock and misuse of rangeland in the last 40 years is thought to have resulted in the depletion of many shrubs, grasses, and many palatable plants (Ministry of Agriculture, 2004).

The dominant grazing system is known where shepherds move their animals to rich grazing lands as soon as the forages start their life cycle at the on- set of short rains, in February or march. Hence the plants have no chance to grow and give high forage quantities due to early grazing (Ministry of Agriculture, 2004). Under these conditions, grasslands were degraded and only provide forages for free grazing within 2 to 3 months during good rainy seasons (Ministy of Agriculture, 2004).

The impact of grazing on plant community structure and ecosystem functioning is a key issue for range management as well as for nature conservation. On the other hand, range managers emphasize the long term sustainable maximization of livestock production and profitability of the operation, while conservationists seek to high biodiversity (Talman et-al. , 1996, Noy-meir et al, 1989). Mediterranean ecosystems are distinguished by high seasonality in resource availability, large component of annual plants in the flourestic composition and a long history of grazing and disturbance (Noy-meir & Seligman, 1979). Domestic livestock have grazed Mediterranean ecosystems and particularly those of the middle east for more than 5000years (Edelstain & milevsky, 1994). It is therefore not unusual to find many species well-adapted to grazing, expressing high degree of resilience following defoliation (Perevolotsky &Seligman,

1998). Heavy grazing pressure has been reported to reduce the diversity of herbs and shrubs in the rangelands (Zhao et al, 2006). Due to overgrazing, the vegetation species composition, richness and productivity has changed over the past decades, some species have disappeared, while others have survived through the use of morphological or other adaptations (wang et al, 2002). Grazing can influence the structure and organization of plant communities in different ways (Noy-Meir et al, 1989). The direct effect of Herbivory occurs by the selective and differential removal of plant tissues or species. Indirect effects on botanical composition and species diversity can occur when selective grazing on dominant species reduces their vigor and presence, thus favoring the spread of less competitive but more grazing tolerant plants. Previous research in these communities has suggested that the responses of vegetation to grazing are associated with plant growth form, mainly plant height, and to a lesser extent with palatability and spines (Noy-Meir et al, 1989). In the southern part of the west bank the rangeland was found to suffer from severe deterioration, due to overgrazing, improper grazing time, uses of trees and shrubs as sources of fuel, and cultivation of marginal land (Mohammed, 2005). These factors are thought to have lead to the current poor condition the rangeland, characterized by damaged vegetation cover, low productivity, increase of poisonous and unpalatable plant species, low vegetation cover, and presence of large percentage of weed like sarcopoterium species.

The recurrent drought also affects seasonal mobility of pastoral household due to livestock loses leaves many with few heads of livestock (Yonnis, 2002). The use of wet season grazing landscapes for crop production (private farming) also exposes the ecosystem to extreme soil degradation. This will eventually undermine the potential to achieve food insecurity for vulnerable households whose livelihoods is entirely depend on livestock production (Amaha, 2006). There have been a number of studies undertaken on rangeland conditions (Ahmed, 2003; Belaynesh, 2006; shashe, 2007; Alemu, 2008) and feed resources characterization (Seyoum and Zenash, 2001),. There studies emphasizing on identification of challenges and opportunities in pastoralists mobility as traditional grazing land management that helps conserve feed for dry season (Homann, et al, 2004; Proud, 2009).

Livestock play an important role in pastoral households in tropical dry lands. They provide food in terms of milk, meat, and blood, traction for cultivation and transport, cash from sale to meet recurrent needs, a symbol and store of wealth and varied roles in festivals, rituals, cementing relationships (warzinger et al2008). In livestock production, feeding is the major constraint especially during dry season and drought (Lukuyu et al 2011, Njarui el al 2011, sere et al 2008). However tropical dry lands produce adequate high quality feed materials that can be fed livestock throughout the year if well managed and conserved. The major cause of feed shortage south-eastern Kenya has been lack of appropriate feed harvesting, processing and conservation technologies. Feed conservation strategies currently being promoted in Kenya are inaccessible to resource poor small holder farmers utilizing these dry lands (mworia and kinyamario 2008). However, farmers in these dry lands have over years developed and have been using a wide range of feed conservation strategies that have achieved the intended purposes to varying degrees. In south-eastern Kenya dry lands, a large number of farmers conserve grass hay but quantities conserved are not enough to feed animals throughout the dry seasons and the drought periods (Njarui at al 2011). With increasing demand for feeds as demand for livestock products increase(Delgado 2005) and expected increase in drought frequency with climate change (Adger et al 2003), there is need to evaluate and improve conservation strategies being used. Farmers will benefit more if they continue to produce quality livestock products deeper into dry seasons and drought periods because of higher price of the products during the dry seasons compared to the wet seasons.

Pasture improvement is undertaken to increase nutritional value and performance of pasture grasses and legumes. Improved pastures can also contribute to soil nitrogen levels. Improved pastures may be in the form of: sowing pastures into tilled soil, over sowing into established pastures, applying fertilizer or increasing or increasing the decomposition of soil organic matter by soil cultivation (Pasture improvement- land managers' monitoring guide).

"Because of feed insufficiencies, animals reared by smallholders often exhibit high mortality, high susceptibility to diseases, low calving periods, late maturity, infertility and reduced reproductive parameters- all of which have obvious negative impacts on house hold food security

and income. Poor feeding practices are primary reasons for low animal production in developing countries (International Fund for Agricultural Development, 2005).

2.6 Availability of human labor and sustainability of livestock projects

Availability of animal husbandry skills are necessary for successful livestock keeping. These skills are normally acquired through exposure and experience in animal herding or through training. Skills in animal husbandry will enable a pastoralist detect and manage common and routine problem occurrences in livestock animal husbandry skills are similar skills possessed by livestock extension officers. In most cases pastoralists use family labor including child labor. For this reason a lesson can be learned from studies conducted on the adoption of dairy technologies done in coast province.

Wambugu (2004) identified extension contact as having a positive effect on knowledge and adoption of dairy technologies independent of income level. Overholt et al (1985) had also identified access to training and extension services to farmers and farm workers important factors that enhanced agricultural productivity just as (Cloud et al 1985) had also showed positive effects of training on technology adoption and agricultural productivity.

Nakamanee (1999) realized that the level of commitment from development and extension workers as well as farmers to make and or use silage as a prerequisite to adoption. Silage making needs a lot of resources which may not be available to farmers thus making it difficult to engage in silage making. However it was not clearly stated what type of commitment was needed so as for the adoption to be enhanced. Rangnekar (1999) noted that in India farmers felt that benefits from silage making were not commensurate with the effort and time spent for ensiling. In Central and Western India most extension staffs were aware of silage making processes and had basic information but lacked in depth knowledge and with only 15% having practical experience. In Kenya especially in the coastal region the situation was similar to that of India as extension staff rarely ever got chances to participate in silage making exercises. There is no study done especially in the coastal region on the technical capability of both the farmers and the extension staff on the various fodder conservation technologies leading to endemic low adoption of fodder conservation technology in the region. (Provincial Director of Livestock Production, Coast

2008). In Thailand farmers were not adopting silage making because the production from the cows was not adequate thus not cost effective. (Poathong et al, 2001). Appropriate technology for silage making and use that suits the type or scale of livestock production system influenced adoption of silage making technologies in Malaysia. Plastic drums became popular because, besides the convenience for use, were not easily gnawed through by rats, causing spoilage, as when using plastic bags or plastic film wrappings (Chin , 2002)

Ojeda (1999) observed that funding for researchers and extension staff was not adequate to enable development of appropriate technologies and transfer them appropriately. Lack of knowledge of silage making principles by the people and specialists involved in livestock farming had been identified as a limitation in the production of silage. This therefore called for an in depth study of the adoption status of fodder conservation technologies so as to enable stakeholders in the dairy industry re- focus their attention to worth wile interventions.

Uaiene et al (2009) in their study on the determinants of agricultural technology adoption in Mozambique found, access to credit, high level of education, access to extension advisory services and being a member of a farmers association as factors influencing adoption of agricultural technologies. The study was however, based on secondary data and may have faced limitation on gender characterization for making valid inferences. Access to credit did not necessarily reflect the income status of the farmers since farmers sometimes feared acquisition of credit. Inaizumi et al (1999) reported that development of technologies with comparative advantages in farmers agro ecological and socio economic condition that also provided them with new opportunities for income generation and diversification was of crucial importance, thus recommended that, for any rapid adoption of agricultural technologies poor farmers required their increased participation in the technology development and evaluation process in order to ensure that the technology was appropriate to their needs. Also to speed up dissemination and wide spread adoption there was need to involve national agricultural extension services and Non-governmental organizations as well as private sector.. Lionberger, (1968) had also noted that farmers needed to perceive a need for the new technology in order to adopt and many innovations from Research and Development Innovations were not accepted because they were not demand driven. Practices compatible with the existing farmers' conditions were most likely to be adopted quickly as observed by (Bwisa & Gacuhi, 1997). It was therefore paramount for

the reasons behind non adoption or adoption of technologies be reviewed for enhanced and sustained adoption leading to increased milk production.

In Ghana, (Michael and Doss 1999) reported that the uptake of new technologies was often influenced by the farmer's contact with extension services, since extension agents provided improved inputs and technical advice. Women reported fewer or no contacts with extension agents thus low adoption levels.

Mathur and Singh (2001).observed that in India, Researchers often did not have a proper understanding of the problems and environment of the smallholder dairy farmers, and there were weak linkages between the farmers and extension functionaries. It was, therefore, considered necessary to evolve, develop and transfer new technologies suitable to resource poor smallholders so that the benefits of development could be evenly distributed. The technologies evolved by different research institutions had to simultaneously tackle social, economic, administrative, organizational and technical issues. Shapiro et al (1998) similarly observed that farmers in Ethiopia perceived non availability of seed and lack of extension services as reasons for not adopting farm grown forages. However the study never elaborated whether the non availability was in terms of cost or access. It was necessary to establish whether farmers had resources for accessing both the extension services and inputs alongside other factors of production.

Wanyama et al (2003) while assessing factors influencing adoption of pastures and fodders amongst smallholder subsistence farmers in selected districts in Western Kenya observed that increased contact with extension/Research staff and more farmer participation in on farm trials/ demonstrations were likely to increase adoption of forage establishment. However the study never indicated whether adoption was sustained after participation in on farm trials or demonstration. Sinjal et al (2004) on fodder legumes technology and farmer to farmer extension on *Desmodium* and *Calliandra* study in central Kenya found the characteristics of the farm and technology, resource endowment and influence of the farmer as important factors affecting

diffusion of technology. However the study did not focus on the intensity of adoption and apart from making an inference from the farmer's characteristics did not get the specific reasons behind the technology diffusion so as to understand the trend and possible area of intervention

2.7 Availability of market for livestock and livestock products and sustainability of livestock projects

Livestock marketing is an important aspect of any livestock marketing system whereby producers exchange their livestock and livestock products for cash. The cash is used for acquiring goods and services which they do not produce themselves, in order to satisfy a variety of needs ranging from food items, clothing, medication and schooling to purchase of breeding stock and other production of inputs and supplies.

As already stated, in most African countries there is severe paucity of time series data on livestock prices as well as on performance and efficiency of livestock marketing system. Ironically, livestock marketing happens to be a favorite sector, where African governments choose to intervene in a variety of ways. These interventions range from outright fixing of whole sale and retail meat (e.g. Benin Ethiopia ,Togo) to monopolizing the export market (e.g. Botswana, Kenya), yet in many instances policy decisions on livestock on livestock marketing are taken in the absence of vital information on how they affect livestock producer, traders, slaughter-houses, butchers and consumers. Very often price fixing at unrealistic levels leads open black markets, where the real prices sustainability differ from those officially listed. In spite of this the official prices constitute the price series data, which clearly distort any analysis based on them. Even when governments pursue price stabilization policies it is difficult, in the absence of livestock market data, to establish to what degree their effects are transmitted to the level of producers (Food and Agriculture Organization,2013).

The ability of agro-climatic variables to explain differences in poverty indicates poverty in remote areas may be linked to natural resource availability and lack of market access (Pender, et al, 1999, Pender, 2001), in this case for animals. Better road and access to markets are expected to favor better returns among the livestock keepers and should therefore contribute to better welfare or higher incomes (Pender et al, 1999)

For many pastoral house holds in east Africa, selling livestock is the primary method of monetary income generation. At the same time, house holds are reluctant to sell livestock because of their utility as food sources, stores of wealth and status. When sales are conducted, it is essential to meeting house hold incomes. Though well intentioned, such approaches were often costly and unsustainable and had little measurable impact on the targeted communities (swift,1991; Hodgson, 1999, Fratkin, 2001). Pastoral communities are beset by many problems, including lack of access to transport, infrequency and unavailability of profitable markets, unavailability of established prices based on market mechanisms of supply and demand, and the frequent rejection of animals by certain markets (Mc Peak & Little, 2006). Like most pastoralists communities of northern Kenya's rangelands, most of the people of 11 Ngwesi are impoverished, hold few non-livestock assets, have limited access to wage-earning employment and keep only a small number of livestock. In late 2007, half of them owned fewer than eight cattle and 68 small stock (Baldwin, 2008). The primary method of income generation for most house holds. Primary goal is to maximize the size of its livestock herds, most animals are sold for house hold consumption smoothing purposes and not in response to market prices. Income from livestock sales is most often used for food, school fees or health care. For this reasons, raising producer income from such sales should be a common goal of development projects in the region (Mc Peak & Little, 2006). Currently, livestock marketing efficiency in 11Ngwesi is hampered by several obstacles. Principal among these is the poor condition of regional infrastructure. Producers almost universally trek their animals to market, walking for hours or even days. In rainy season, many of the road become impassable. Once producers arrive at the market, they often subject to broker-buyer collusion, combined with the unpredictable nature of supply and demand at area markets, often means that producers do not make a sale or a subject holds up that lead to extremely low prices. At the market 11 Ngwesi, producers reported that

nearly 30% of their trips to the market did not result in a sale. Never the less, some area markets are known attracting more buyers and thus offering higher price distributions. In deed,(Bailey et al, 1999) concluded that concluded that market price variability is linked to either variations in quality or individual market characteristics.

Pastoralists communities receive highest levels of humanitarian aid in the horn and East Africa(OCHA et al, 2010). Livestock marketing understood as the process through which live animals change ownership , is increasingly perceived as critical for improving pastoral house hold income. However there is relatively little analysis of the structure and performance of livestock marketing systems.

Marketing remains one of the greatest challenges in the development of livestock industry in Kenya. Regardless of the emergence of organized market intelligence particularly in relation to prices at terminal markets, lack of and need for price information in many of the pastoral areas remains a critical concern by producers, traders and policy makers. The livestock information network and knowledge system(LINKS) of the global livestock collaborative research support program (GL-CRSP) have responded to this need. It has developed a livestock marketing information system based on information communication technologies that has now been adopted as the basis for developing a national livestock marketing information system for Kenya. The development, testing, implementation and expansion of the system have all been made possible through collaboration among different stakeholders with interest in livestock marketing information. It is expected that provision of such information and improvement of the capacity to communicate the same. This will have a positive effect on market transactions in terms of improving sales and identifying markets offering better prices (G.Kariuki, 2013)

It is estimated that livestock contributes upwards of 10% and 25% to kenya's GDP (of US$ 10.1million) and agriculture sector respectively. Most of these livestock are produced and marketed from the arid and semi-arid areas of Kenya which account for about 8% of the

country's population and occupy roughly 63% of the total land area (Narman,1990; Republic of Kenya ,1994). Livestock has acquired a niche in the in the national, regional and global livestock trading chains and livestock producers are part of the commercial webs of trade relationship among people and countries in different locales (Kariuki, 2001). However, despite its importance and contribution to the national economy, the development of livestock sub-sector has faced numerous challenges. The lack of transparent, timely, and efficient livestock marketing infrastructure is recognized as the major factor hindering the improvement of gains to livestock trade in order to benefit the national economy through derived taxes and more importantly perhaps to benefit the communities of livestock producers (Aklilu, 2002; GL-CRSP, 2003). A reliable livestock market information system is a key element supporting decision-making of other players such as traders, middle men, and policy makers and contributes to the development of pastoral areas (Barret & Luseno, 2001; Kaitho et al, 2003). Provision of marketing information or the improvement of the capacity to communicate the same will have a positive effect on market transactions in terms of improving sales and identifying markets offering better prices, identifying market hot spots and where to source for animals that meet expected quality and health standards for local and international markets. It is against this background that the LINKS project of the GL-CRSP initiated a livestock marketing information system geared towards addressing the needs for timely and reliable information for producers, traders and policy makers in the sub-sector. The system was developed and tested in collaboration with a number of organizations including the ministry of livestock and fisheries development (MoLFD), the Kenya livestock marketing council(KLMC), Food and agriculture organization(FAO), arid lands natural resource management project(ALRMP), Food and agriculture research management- Africa(FARM-Africa), veterinaries sans frontiers(VSF) sussie, University of Nairobi(UoN) and the international livestock research institute(ILRI).(G.kariuki & R. Kaitho)

For almost 3 years now, the LINKS project has focused on developing a new generation of technologies that addresses the livestock marketing needs identified in the in the LEWIS project while continually improving the early warning technology across the eastern Africa region. Out of this process has emerged a new generic livestock marketing information system that allows reporting of market prices and volumes of cattle, sheep, goats, camels and donkey. To take advantage of the increasing expansion of cell phone technology, a coding system has been developed and accepted to report market conditions. The system provides codes for markets,

animal species, breeds, age and sex categories. Trained monitors collect livestock prices and volumes through interviews during peak of a market day. They have to interview 5 cases of each of the dominant breeds, classes and grade combination of animals on that market day in order to generate data then calculate the average prices for each animal category along with the total of livestock supplied to the market by animal species. The data is then coded and is sent into the data base system. The coded market information is sent to automated country servers which, in turn, are linked to a global server allowing viewing of market data across country borders through the internet. The system provides timely information to enhance transparency and efficiency in livestock marketing and support decision-making that provides alternatives to source and dispose livestock through markets offering better returns for producers and traders.. in addition to information technology development, considerable efforts have been made to build stakeholder consensus on how to report market dynamics and agree on to a livestock grading system. Training courses are designed and conducted to ensure monitors know how to report prices and volumes in a manner that is acceptable to pastoralists, traders and middlemen. Building s strong foundation in reliable technology and fundamental organizational buy-in has positioned the LINKS project to enter the next phase of challenges and issues that need to be addressed to ensure stability sustainability of the system.

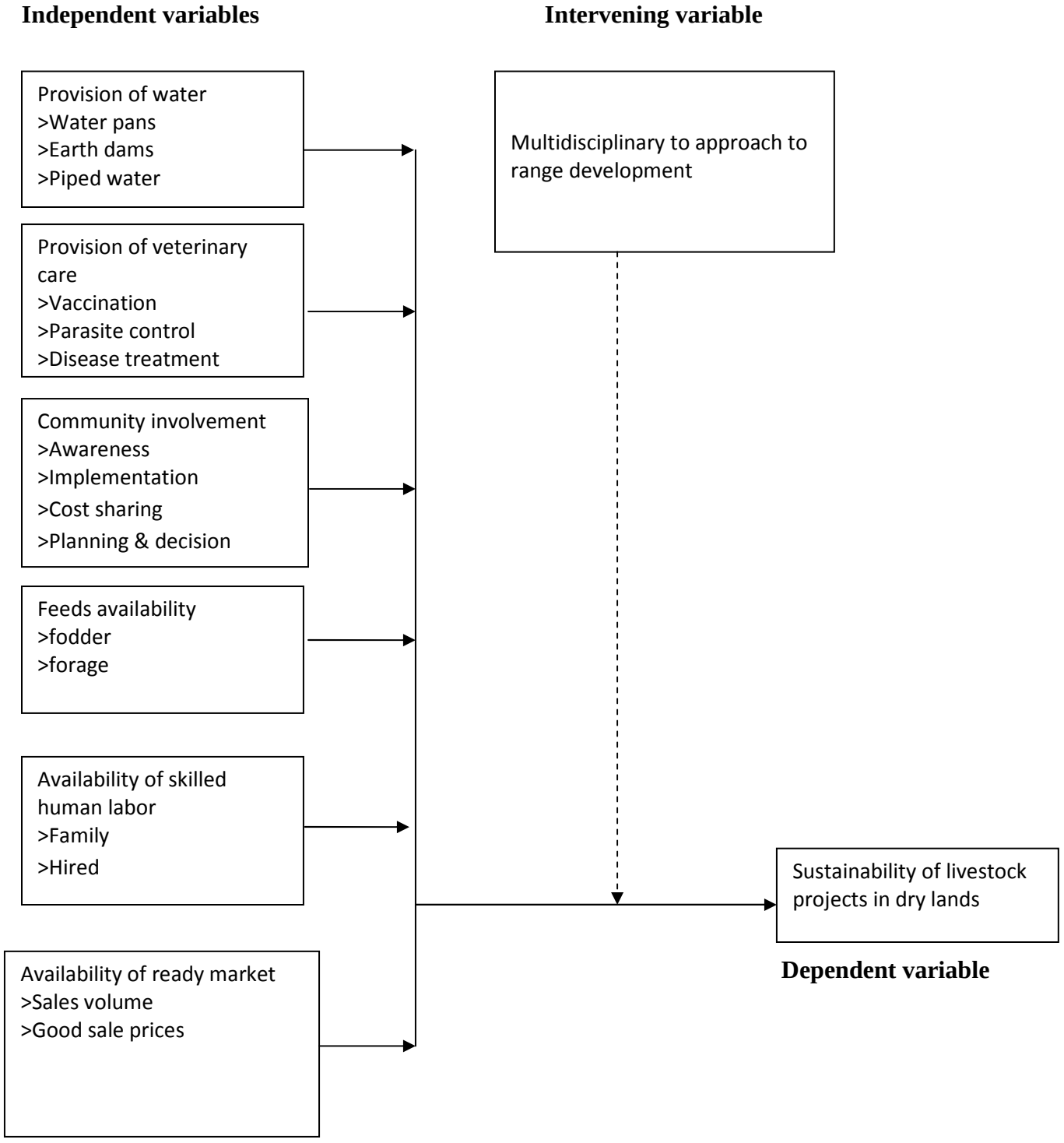
Lack of reliable and timely livestock marketing information is one of the major constraints in developing the livestock trade especially in the arid and semi-arid lands where livestock is the major source of livelihood(Agref 2005, Kariuki and Kaitho, 2006).LINKS has responded to the livestock marketing information needs by designing an information communication technology infrastructure for reporting and requesting information on livestock prices and sales volume from a network of different of different markets in Kenya. Through collaboration with MoLFD and KLMC, LINKS has been integrated into a national livestock marketing information system(NLMIS) that facilitates dissemination of information so as to reach end users in the remote livestock producing areas. The objectives of the NLMIS are to avail information through various media to stakeholders in livestock marketing, establish a livestock marketing database for reference in planning, research and monitoring of marketing trends, and to provide early warning information for disaster preparedness. The activities to achieve these include training of

field data collectors in the techniques of data collection and reporting and training of all stakeholders on the interpretation and use of information available from the NLMIS. There is also training on how to download, analyze and summarize the information for transmission to end users in a form that that fits their requirements. To date, the net result is a basic network of organizations that are using livestock marketing information from a number of markets in the country in conjunction with the existing LEWIS technology. These include the ministry of livestock and fisheries development, concern worldwide, famine early warning system network, and arid lands resource management project among others. The information is also shared with agriculture and livestock working group of the Kenya food security meeting (Agref 2005, Kariuki& Kaitho,2006).

2.8 Conceptual framework

The conceptual framework was developed through explaining and ascertaining the relationships and interconnectivity of the objectives of this\ study.

Figure 1 Conceptual framework



In this study the following variables have been identified as independent variables: provision of water, feed availability, provision of veterinary care, Availability of human labor, availability of market for livestock and livestock products and community involvement. On the other hand, Multi-Disciplinary Approach to range development, sustainability of livestock projects and the role of the government in ensuring appropriate land tenure regulations are in place, are moderating, dependent and intervening variables respectively.

Figure 1 on page 41 for the conceptual framework; shows a diagrammatic representation of the relationships, linkages, and the interaction of the variables necessary for successful and the subsequent sustainability of the ruminant livestock projects in the dry lands.

Lack of consideration or omission of any one of the independent, dependent, moderating or intervening variables at project conception, planning and implementation level may jeopardize project sustainability of ruminant livestock project in dry lands. It is also equally important for the project management team to consider all the key stakeholders for the project and involve them all the way from project planning, implementation, monitoring and evaluation and the decision making process. This kind of strategy will ensure that all stakeholders including the beneficiary community have a sense of project maintenance and ownership long after project completion. However, mobilization of all the necessary stakeholders and the resources for the project posses a great challenge to the project management team.

2.9 Summary of Literature Review

This chapter covered literature review on factors influencing sustainability of ruminant livestock projects in dry lands; mainly focusing on Kenya and the tropical dry lands. An account of the importance of water to living organisms, sources of water, contamination and safe drinking water for human and livestock has been given.

Provision of veterinary services is necessary to avoid massive animal loses through death and loss of livestock productivity. Adequate veterinary care ensures that the overall livestock performance and productivity is enhanced. The main veterinary services required are the control of parasites and diseases through dipping, spraying with acaricides, treatment of diseases and vaccinations. Likewise the importance of livestock feed availability throughout the year has been emphasized; bearing in mind that in dry lands livestock depend on mainly natural vegetation.

Community involvement at all stages of the project cycle is necessary in that community members are a rich source of knowledge about their community and of energy and commitment to that community. The issues of future project continuity after donor with drawl as well as project ownership call for community involvement in the project right from the beginning of a project.

On the other hand natural vegetation is rainfall dependant, hence its availability and amounts vary with seasons.This fluctuation in natural feed supply calls for conservation during the time of plenty. Availability of skilled animal husbandry human labor has been identified as an important aspect and contributes significantly to the sustainability of livestock projects. On the other hand availability of ready market for livestock and livestock products depends on the infrastructure and distance of the rangeland to major livestock markets, that is major towns and cities. The main livestock buyers here are the middle men buy livestock at very low prices. In Kenya LINKS has responded to the livestock marketing information system needs by designing an information communication technology infrastructure for reporting and requesting information on livestock and sales volume from a network of different markets in Kenya.

Community involvement at all stages of the project cycle is necessary in that community members are a rich source of knowledge about their community and of energy and commitment to that community. The issues of future project continuity after donor with drawl as well as project ownership call for community involvement in the project right from the beginning of a project. The interdependence and relationship among the various variables has been illustrated diagrammatically in conceptual frame work, figure 1, on page 41

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with research design, the location of the study, population, sample size, data collection and data analysis procedures that were used during the study. It presents in detail what was done.

3.2 Research Design

A descriptive survey research design was employed; a present oriented methodology used to investigate populations by selecting samples to analyze and discover occurrences (Oso and Onen, 2009). It was used to provide numeric descriptions of some part of the population. The design is suitable for this study because it is economical, simple, and clear and helped in understanding the entire population from the selected part of it.

3.3 Target population

This study was conducted in the entire and larger kaloleni district. This is the original Kaloleni District before Rabai distrct was curved out of it. This was necessary to enable the study capture the entire donor funded ruminant livestock projects that cut across the two districts, namely sheep and goat projects that were funded by world vision and arid and semi-arid lands resources management project. Kaloleni district, within Kilifi County, covers an area of 909km squared with about 758 km squared being arable land. The district is administratively divided into 3 divisions, 9 locations and 20 sub-locations. Human population is estimated at 173,050 and with 35,134 farm families. The main ruminant livestock populations for beef cattle, goats and sheep are estimated at 48000, 30000, and 8000 respectively. Over 80 percent of this district is arid and semi-arid with the dominant economic activity being beef production, sheep and goats rearing. The target population for this study was 35,134 farm families.

3.4 sample size and sampling procedure

Sampling is the gathering and asking of a range of individuals the same questions related to their characteristics, attributes, how they live, or their opinions. It also involves the collection of relevant information (O' Leary, 2004)

The following formula was utilized in calculating the sample size.

$$N = \frac{Z^2 \times (p) \times (1-p)}{d^2}$$

N=the desired sample size

Z=the standard normal deviate at the required confidence level (1.96 for 95% confi8dence level)

P=the proportion in the target population estimated to have characteristics being measured

d=the level of statistical significance test

Thus,

$$N = \frac{(1.96)^2 \times (0.50) \times (1-0.5)}{(0.05)^2} = 384$$

However, because the target population was known and was more than 10,000, the final estimate was calculated using the following formula.

Correction for Finite Population

$$nf = \frac{n}{1 + \frac{n-1}{N}}$$

Where:

N=target population

Hence:

$$n_f = \frac{3840}{1 + \frac{384 - 1}{35{,}134}} = 380 \text{ farm families}$$

Therefore the ideal sample for the research was 380; the figure the researcher used to work with. Out of the 380 respondents, 185 were apportioned and used in zone 1 and 195 for zone 2

Table 3.4. Sampling of the respondents

Target group	No. of respondents
Zone 1-high potential area	185
Zone 2-dry lands	195 including all 10 sheep and goat groups
Total number of respondents	380

All the respondents were drawn from farm families at random living in the rural- 15 respondents per sub-location and 2 per sheep and goat groups. A total of 24 sub-locations were considered and10 sheep and goat groups

3.5 Data collection methods

Questionnaires and interviews were both used as the main tools for primary data collection from the various respondents and selected for the study. A questionnaire, which is a collection of items to which a respondent is expected to react to in writing was constructed by the researcher and administered to the various respondents in the study in the following ways: he personally administered all of the questionnaires to the respondents by hand and through the provincial administration in the study area. These particular questionnaires contained basic demographic information like gender, age, marital status, socio-economic status in the form of employment, level of education etc. They also contained both open and closed ended questions.

The open ended questions required the respondents to construct answer using their own words.

Without a doubt, through these, they were able to offer information and to express their opinions regarding the various variables of the study as they wished and deemed fit. The closed ended questions restricted the respondents to choose from a range of predetermined responses that gave them a range of answers from which they chose from.

All the questionnaire interview sessions were recorded through respective appropriate answers taken; note taking or jottings at the bottom of the questionnaires that were made at the time of the interviews and typed transcripts created from such notes soon afterwards, more often that same day. Most of the interviews were conducted in both English and Swahili.

Participant observation is a systematic method of data collection that relies on a researcher's ability to gather data through his or her senses; it is to notice, using a full range of appropriate senses, to see, hear, feel taste and smell (O'Leary, 2004). Indeed, the nature of information which the researcher sought to obtain is what led him to adopt this particular method of study. By using this method, the researcher saw for himself what the people and the various key informants do in the course of their duties and by doing this he was able to bridge the gap between what the people said and what they actually did. This method will allowed the researcher to gain firsthand experience without necessarily utilizing informants whose views at times could be misleading; the researcher recorded information obtained here as it occurred.

Document analysis is also another method of data collection that was utilized by the researcher in the course of this study. This method involved a collection, review, interrogation, and analysis of various forms of texts on the issues and subject of sustainability of ruminant livestock projects in dry lands that the researcher used as a secondary source of research data. These included censuses, surveys, books, journals, independent inquiries and reports prepared on the issues and problems related to sustainability of livestock ruminant livestock projects. The researcher also utilized personal communication in the form mobile phone calls. He also used historical documents in the form of articles and various books that have been written on the various issues of the study. The purpose of this particular method was to obtain unobtrusive information that was done at the pleasure of the researcher

without interrupting the research process. Through this the researcher was able to obtain the language and words of the informants who by their nature are the authors of these documents; he was able to access data at his convenience. Overall the researcher was able to save time and expense in transcribing this data.

3.6 Validity and Reliability of research instruments

The researcher sought to establish reliability and validity of the data collection instruments as described below:

3.6.1Realiability of research instruments

According to Mugenda and Mugenda (2003) realibility is a measure of the degree to which research instruments yield consistent results or data after repeated trials. To ensure reliability of research instruments, the study area was apportioned into two zones, zone1 and zone2. The study sample was also sub-divided into two almost equal parts. The study for the two zones were carried out concurrently and the results compared for consistence. The results obtained were consistent with insignificant variation, in the attendance for the exercise. Male/female ratio of the respondents who attended in both zones was more or less the same. These results indeed confirmed that the questionnaire and observations used were reliable research instruments.

3.6.2 Validity of research instruments

Validity is the accuracy and meaningfulness of inferences which are based on the research results. It is the degree to which are based on the research results. It is the degree to which results obtained from the analysis of data actually represent the phenomena under study (Mugenda & Mugenda 2003). The validity of the research instruments used were confirmed by the results obtained from data analysis using Chi-square. The results obtained were as per the expectations of the hypotheses.

3.7 Data collection procedures

Both qualitative and quantitative techniques were used. In descriptive analysis it included measures of central tendency for instance mean and statistical analysis using frequency distribution. Apart from the use of descriptive statistics, sets of data were described using tables

and percentages. Chi- square was used in testing hypothesis. Tables were titled and well labled

3.8 Ethical considerations

The ethical problems encountered in this study, were that some respondents especially females were uncomfortable with disclosing their ages and marital status, while men concealed the number of livestock they owned. All in all confidentiality of the respondents was upheld and respondents were allowed to answer and fill the questions they preferred and without writing their names on the questionnaire.

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Table 3.1 Operations definition of variables

Objectives	Variable	indicators	Measurement	Scale	Type of research	Level and Tools of analysis
To determine the extent to which water provision influences sustainability of ruminant livestock projects in dry land	Independent variable water provision	Quantity Quality of water	Distance to water source Degree of water pollution	Ordinal ordinal	Survey survey	Hypothesis testing using Chi-square
To examine how does provision of veterinary care influence the sustainability of ruminant livestock projects in dry lands	Independent variable Provision of veterinary care	Disease cases Losses from disease	Degree of disease incidences Frequency of disease	ordinal ordinal	survey	Hypothesis testing using Chi-square
To establish how involvement of beneficiary community members in project planning and decision making influence sustainability of ruminant livestock projects in dry	Independent variable Involvement of beneficiary community members in project planning and decision making	Attendance and participation in project programs	Number of members involved in project activities	ordinal		Hypothesis testing using Chi-square

lands						
To identify the degree to which availability of feeds throughout the year influences sustainability of ruminant livestock projects in dry lands	Independent variable: Availability of feeds throughout the year	Presence of green vegetation in grazing lands	Percentage of vegetative cover on the ground	Nominal Ordinal ordinal	Survey survey	Percentage and frequency of responses
To assess the extent to which availability of skilled animal husbandry human labor influences sustainability of ruminant livestock projects in dry lands	Independent variable: availability of skilled animal husbandry human labor	Presence of trained personnel in animal husbandry	Skilled man hours spent	ordinal ordinal	survey	Percentage and frequency of responses
To examine the level to which availability of ready market for live animals and livestock products influence s sustainability of ruminant livestock projects in dry lands	Independent variable: availability of ready market for live animals and livestock products	Status of sales and revenue flows	Sales volume and revenue received	Ordinal Ordinal	survey	Percentage and frequency of responses

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

This chapter presents research findings, analysis of the data and the interpretation of data collected from respondents in the sub-locations and the women groups.

It also presents findings of the observations and discursion on the moderating variables; that is multidisciplinary approach to range development and the intervening variable; the role of government in ensuring that appropriate land tenure regulations are in place. The data collected was analyzed and the findings were presented using frequencies and percentages outlined in the frequency tables.

4.2 Response Rate

A total of 330 questionnaires were distributed and administered to 185 respondents in zone 1 and 195 respondents in zone 2.

A total of 210 questionnaires were returned giving an average response rate of 56% for all the respondents.

Table 4.1 Response Rates

Location	Number of Questionnaires		Percentage
	Issued	Completed	
Zone 1	185	101	55
Zone 2	195	109	56
Total	380	210	111
Mean	190	105	56

Note: Zone 1 is respondents from the High potential area Zone 2 is respondents from the Dry lands

The mean response rate of 56% obtained and shown in table 4.1 was used for the study.

4.3 Demographic Characteristics

The study required to establish the pattern in the personal data of the respondents who attended this exercise as an indicator of interest and availability in future livestock forums. The personal data captured is shown in table 4.2 below:

Table 4.2 Personal Data

Variable	Percent Response	
	Zone 1	Zone 2
Gender		
Male	76	81
Female	24	19
Marital Status		
Married	90	95
Age brackets in years		
Under 36	19	21
35-45	32	23
46-55	30	23
56-65	19	17
Level of Education		
Illiterate	8	18
Primary certificate	58	54
Diploma	13	10
Post graduates	9	3

Personal data characteristics outlined in table 4.2 are important for the development of a training curriculum targeting a particular group of participants expected to attend the training, for example the turn out for male in both zone 1 and 2 is very high; 76% and81% respectively out of 109 respondents present, compared to female counterparts at 24% and 19% respectively.This could mean that men are more interested in livestock matters than women or women are reluctant to reveal their personal data. Other notable observations are that married couples frequency is quite high both zones at 90% and 95% for zones 1 &2 respectively. Similarly most of the respondents have attained primary level certificate.

4.4 Factors influencing sustainability of livestock projects in dry lands

These factors were;-provision of water, provision of veterinary care, involvement of beneficiary community in project planning and decision making, availability of skilled human labour and availability of ready market for live animals and livestock products.

4.5 Provision of water and sustainability of livestock projects in dry lands.

The study wanted establish the influence of adequate water provision on sustainability of livestock projects in dry lands of kaloleni. The respondents were asked to indicate their opinions :tabulated in table 4.3 shown below

Table 4.3 Consequences of Inadequate Water

Basis of Analysis	Frequency	Percentage
Livestock survival	30	28
Fertility rates	10	9
Growth rates	40	37
Market value	29	26
Total	**109**	**100**

From the above it can be seen that observable consequences of inadequate water provision are low animal growth rates at 40%, survival at 30%, a reduced market value at 29% and low fertility rates of 10%. The degree of water scarcity was reflected by the distances and time taken to access water. On average distance to watering was found to be within a radius of 2km during rains and a radius of up to 10km during drought. Livestock water was found to be suitable and no water borne diseases were reported

4.4.2 Testing of Hypothesis on provision of water

H_O: There is a positive relationship between provision of water and the sustainability of livestock projects in dry lands of Kaloleni.

H_1 : There is no relationship between provision of water and sustainability of livestock projects in dry lands of Kaloleni

The hypothesis was tested and calculated using Chi-square and the results were shown in table 4.4 below:

Table 4.4 Chi-square test on water provision

Testing of independence between rows and columns (Chi-squares)		
Chi-squares	$1 \times {}^{2}1$	3.195
DF		1
Chi-square	$X^2_{0.05}$	3.841
Level of significance		0.05

Decision: Since $X^2_{0.05} > 1 \times {}^{2}1$. We accept **$H_O$** and reject **$H_1$**

4.6 Provision of veterinary care and sustainability of livestock projects in dry lands

The study sought to establish whether provision of veterinary care had any influence in the sustainability of livestock projects in dry lands. Consequently respondents were asked to state in their opinion what they considered to be key aspects for the provision of veterinary care in their area. The parameters considered and their sores were recorded as shown in table 4.5 below.

Table 4.5 Key aspects in the provision of veterinary care in kaloleni dry lands

Basis of Analysis	Frequency	Percentage
Vaccinations	43	39
Deworming	30	28
Tick control	28	26
Presence of a veterinarian	8	7
Total	109	100

From the above results in table 4.5; it is obvious that the most required veterinary services in this area are: vaccinations at 39%, deworming at 28% and tick control at 26%. Presence of a veterinarian scored the lowest because private service providers are available and some pastoralists are able to attend to sick animals. The first three services above are expensive for pastoralists to undertake on their own while tick control is even more of a challenge because of inadequate water.

4.4.4 Testing of hypothesis the provision of veterinary care

Ho: there is a positive relationship between provision of veterinary care and sustainability of livestock projects in dry lands

H_1: there is no relationship between the provision of veterinary care and sustainability of livestock projects in dry lands. The result are shown on table 4.5 below.

Table 4.6Testing of a hypothesis on the provision of veterinary care

Testing of independence between the rows and the columns (Chi-squares		
Chi-square	$1x^2 1$	3.782
Chi-square	$X^2_{0.05}$	3. 841
Df		1
Level of significance		0.05

Decision: Accept $\mathbf{H_O}$ and reject $\mathbf{H}_1$ for the same reasons sited in table 4.4 that is

Since $X^2_{0.05} > 1\ X^2 1$ we accept the **Ho**, that there is a positive relationship between provision of veterinary care and sustainability of ruminant livestock projects in the dry lands of Kaloleni.

4.7 Community Involvement in project planning and decision making and sustainability of livestock projects in dry lands

The study needed to find out the extent to which community involvement in planning and decision making influences sustainability of ruminant livestock projects in dry lands of kaloleni. Using the questionnaire respondents were asked to give their opinion on the level of participation they preferred in donor funded projects and their responses were recorded as shown in table 4.6 below:

Table 4.7 Preferred level of community participation in livestock projects

Basis of Analysis	Frequency	Percentage
Planning and decision Making	8	7
Implementation	36	33
Cost sharing	20	19
Awareness	45	41
Total	109	100

From the above results it can be said that most of the respondents at 41% will be satisfied with awareness creation for the donor funded livestock projects in their area. While those for implementation are 33% , cost sharing 19% and 7% in favor of involvement in planning and decision making.

4.4.6 Testing of hypothesis on community involvement in project planning and decision making

H_O: there is a positive relationship between community involvement in project planning and decision making and sustainability of livestock projects in dry lands.

H_1: there is no relationship between community involvement in project planning and decision making and sustainability of livestock projects in kaloleni dry lands.

The results for the Chi- square tests were recorded as shown in table 4.7 below

Table 4.8 Chi-square on community involvement in project planning and decision making and sustainability of livestock projects in dry lands

Test of independence between the rows and the columns (Chi-square)		
Chi-squares (observed)	$1x^2 1$	2.178
Chi-square table value	$X^2_{0.05}$	3.841
Df		1
Level of significance		0.05

0.05

Decision:

Since X^2 is $>1X^2 1$then we accept **Ho**: that there is a positive relationship between community involvement in project planning and decision making and reject $\mathbf{H_1}$

4.8 Availability of feeds through out the year and sustainability of livestock projects in dry

The study sought to find out whether the pastoralists have noticed any changes in the availability of feeds in form of natural vegetation as a result of decreasing grazing land, climate change, over grazing and environmental degradation among others in the. Similarly the study wanted to establish whether seasonal fluctuation in feed supply, lack of feed conservation and over dependence on natural vegetation **lands.** was a concern in the near future. See table 4.7 below the results

Table 4.9 Trends for feed availability in the last 10 years

Basis of analysis	frequency	percentage
Increasing	10	9
Decreasing	55	50
Normal	30	28
No idea	14	13
Total	109	100

From the results of table 4.7, 50% of the respondents were of the opinion that that pasture availability is decreasing over the last 10 years, 28% found it normal, 13% had no idea and 9% felt that it was on the increase. the responses to this issues were not in line with the study expectation most likely because the study was conducted during rains when pastures were plenty and more so this rains were above normal. coping strategies for feeding animals during drought are grazing in conservation areas known as the kayas and search for greener pastures along kombeni and nzovuni river banks. some migrate with their animals outside the district

4.4.8 Testing of hypothesis on availability of adequate feeds throughout the year and sustainability of livestock projects in dry lands.

The results for Chi-square test are shown in table 4.8 below:

Table 4.10 feed availability trends in the last 10 years

Testing of Independence between the rows and the columns (chi-squares)		
Chi-squares	$1 \times {}^{2}1$	31.484
DF		1
Chi-square	$X^2_{0.05}$ $_{0.05}$	3.841
Level of significance		0.05

Decision$^{0.05}$: Since $X^2_{0.05} <$ l $x^2 1$ we reject $\mathbf{H_O}$ and accept $\mathbf{H_1}$ in that there is no relationship between feed availability through out the year and sustainability of livestock projects in dry lands.

4.9 Availability of skilled human labor and sustainability of livestock projects in dry lands of kaloleni.

The study sought to establish the extent to which availability of skilled human labor influenced sustainability of livestock projects in dry lands.

To address the above issue some questions were structured and the responses recorded.

The main source of labor for the care taking of your animal is:

Hired human labor [15]

Family labor [94]

The number of respondents with skills in animal husbandry in this area are:

Many [10]

Adequate [30]

Non-existent [24]

Few [45]

These responses were recorded in table 4.9 as shown below;

Table 4.11 Availability of skilled human labor in dry lands of kaloleni

Basis of analysis	Frequency	Percentage
Many	10	9
Adequate	30	28
Non-existent	24	22
Few	45	41
Total	109	100

From table 4.9 41% of the respondents believed that the number of people available with skills in animal husbandry are few; 30% felt that is adequate number of people with animal husbandry skills; 24% there are no people with any animal husbandry skills and 10% felt that there many people with animal husbandry skills. Levels of animal husbandry skills can be measured by considering the overall management of animals in terms of grazing management, herd selection, culling, and routine management such as regular de-worming, hoof trimming, de-horning and many more.

4.4.10 Testing of hypothesis on availability of skilled human labor

H_O: There is a positive relationship between availability of skilled animal husbandry skilled labor and sustainability of livestock projects in dry lands

H_1: there is no relationship between availability of skilled animal husbandry human labor and sustainability of ruminant livestock projects in dry lands.

The results of Chi-square test are as shown in table 4.4.10 below

Table 4.12 availability of skilled human labor

Testing of independence between the rows and the columns (Chi-squares)		
Chi-square	$1x^2 1$	1.129
Chi-square	$X^2_{0.05}$	3. 841
Df		1
Level of significance		0.05

Decision: Since $X^2 > 1\ X^2 1$ we accept H_O and reject H_1

4.10 Availability of ready market for live animals and livestock products and sustainability of livestock projects in dry lands.

The study in this case was required to find out the extent to which availability of a ready market for live animals and livestock products influences sustainability of livestock projects in dry lands.

Some of the indicators for availability of a ready market are the proximity to sale yard, high demand for livestock and their products, high sale prices and good infrastructure development

Responses to these factors were recorded in table 4.11 shown below

Table 4.13 availability of ready market for livestock and livestock products

Basis of analysis	Frequency	Percentage
Proximity to sale yard	38	35
High demand for goods	22	20
High sale prices	25	23
Level of infrastructure development	24	22
Total	109	100

35% of the respondents had the opinion that they were close to Tsangatsini sale yard, 23% felt that prices offered for their goods were high enough. 22% said that the level of infrastructure development especially the roads were passable and 20% felt that demand for their goods is high.

4.4.12 Testing of Hypothesis on the availability of a ready market for live animals and livestock products

Ho: there is a positive relationship between availability of a ready market and sustainability of livestock projects in dry lands.

H_I: there is no relationship between availability of a ready market and sustainability of livestock projects in dry lands

Table 4.14 Testing of hypothesis on availability of a ready market for live animals and livestock products.

Testing of independence between the rows and the columns (Chi-squares)		
Chi-square	$1x^2 1$	1.676
Chi-square	$X^2_{0.05}$	3. 841
Df		1
Level of significance		0.05

Decision: Since $X^2 > 1\, X^2 1$ we accept $\mathbf{H_O}$ and reject $\mathbf{H_1}$

CHAPTER FIVE

SUMMARY OF FINDINGS, DISCUSSIONS, CONCLUSION AND RECOMMNEDATIONS

5.1 Introduction

The summary of findings, discussions, conclusions and recommendations arrived at in this chapter are restricted to the mandate and objectives of this study. Suggestions for future research have also been made in this chapter.

5.2 Summary of findings

The study was designed to examine the factors influencing sustainability of ruminant livestock projects in dry lands of kaloleni district in Kilifi County. The response rate for this study was 56% for the entire study area and the respondents, study for zone 1 served as a control for zone 2. Six main variables were identified by the study for investigation.

These were provision of water, provision of veterinary care, involvement of beneficiary community, availability of livestock feed throughout the year, availability of skilled human labor and availability of ready market for live animals and animal products. The study answered six research questions and tested six hypotheses covering all the variables.

On the research questions, the study observed that inadequate water provision affected livestock performance as follows:

Livestock survival was affected by 28%, fertility 9%, growth rates 37% and market value by 26%. Similarly on the provision of veterinary services the most needed services in kaloleni dry lands were vaccinations 39%, de-worming 28%, tick control 26% and presence of a veterinarian at 7%.On community participation in project planning and decision making, the community preferred 41% involvement in awareness, 33% implementation, 19% cost sharing, and 7% in planning and decision making. Availability of feeds provided the following results-the trends in

the availability of feeds for the last 10 years were: decreasing feed availability trends scored 50%, normal 28%, no idea 13% and increasing at 9%. On availability of skilled human labor the respondents provide varied views: those who felt there many skilled people in their area were 9%, adequate 28%, non-existent 22% and few at 41%. Availability of market for live animals and livestock products gave the following answers: 35% felt that sale yard was available nearby, 20% felt that there was high demand for their animals and their products. 23% opinioned that sale prices for their animals were quite high, while 22% said that the level of infrastructure development was good. The issue of environment was also high lighted at the respondents said that their land was degrading. As regards government policy on land tenure it was observed that sub-division of communal grazing land is taking place.

Hypothesis testing confirmed that provision of water, provision of veterinary services and involvement of beneficiary community in project planning and decision making, skilled animal husbandry human labor and availability of ready market for live animals and livestock products had a positive relationship with sustainability of ruminant livestock projects in dry lands of kaloleni district. The chi-square $x^2_{0.05}$ of 3.841 was greater than the observed chi-squares of 1 x^2 1 of 3.195, 3.782, 2.178, 1.129, and 1.676 for the respective five variables excluding feed availability. On feed availability the calculated Chi-square value was abnormally high-31.484, thus in variant the null hypothesis..

5.3 Discussions

Inadequate water provision affected livestock performance in terms of survival rate by 28%, fertility 9%, growth rates 37% and market value by 26%. The overall effect is a lowered is a lowered sustainability of livestock projects in dry lands.

Farmers cope with drought by taking their animals afar away in search of water and greener pastures. Off take as a form of mitigation against drought is rarely practiced. Testing of hypothesis on water provision confirmed that there is a positive relationship between water provision and sustainability of livestock projects in kaloleni dry lands. Water provision through

water pan and earth dams covers only 50% of this area and the water is seasonal. Piped water which is a permanent source has not reached this place.

On veterinary care, vaccinations, de-worming, tick control as well as government veterinary officers are inadequate. vaccinations against notifiable diseases that is solely provided by the department of veterinary services are irregular and there is inadequate coverage of this area. The coverage is poor because of inadequate government veterinary officers in the district.

De-worming and tick control that have so far been liberalized are irregular and inadequate, affecting sustainability of livestock projects significantly in this area. The costs of drugs for de-worming and tick control are prohibitive and most pastoralists are unable to purchase them. The problem of tick control is made worse by water scarcity particularly during drought. Pastoralists use spraying to control ticks, because dips are not functional. Using spraying as a method of tick control is more expensive than dipping.

Community involvement in livestock projects in planning and decision making for the donor funded projects was low at all levels compared to the community preference of 45% involvement in awareness, 36% in project implementation, 20% in cost sharing and 8% in planning and decision making. It was also believed that inadequate involvement of the community in the projects contributed to low sustainability of the project in this area; this fact was confirmed by hypothesis testing on the same which confirmed that there was a positive relationship between community involvements in donor funded livestock projects and sustainability of these projects in kaloleni dry lands.

Feed availability during the study period was found to be adequate and the animals were indeed well fed and in good condition; although this situation was feared to be short lived before the period of starvation sets in. feed for the animals were in form of natural pastures or vegetation. No conservation of feed was practiced such that the problem of seasonal feed fluctuation keeps on reccuring every now and then. It was also observed that feed availability in this area is a big problem especially during dry periods when pastoralists have to trek long in such of greener pastures along river banks and in conservation areas called the kayas. Significant animal losses occur during this period and as much as over 50% of the herds perish. Farmers were advised to do off take before the on set of dry period to reduce animal losses. There is an overall trend of

reducing natural feed availability over the last 10 years and that land degradation was increasing. Rainfall amounts and availability have been decreasing over the years.

Availability of skilled human labor for the care taking of livestock was found to be inadequate. Most of the human labor is provided by family members that have acquired some local experience handed over from generation to generation. For pastoralists to acquire necessary animal husbandry skills, training on the same is necessary. Inadequate animal husbandry skills among family members contributed to poor management of their livestock projects in this area.

Hypothesis testing on availability of skilled human labor confirmed that there is a positive relationship between availability of skilled human labor and sustainability of ruminant livestock projects in this area. On availability of market for live animals and livestock products, the study realized that most of the respondents keep animals purposely for subsistence reasons.e.i. livestock serve as a form of savings in that it can easily be converted into cash in times of great need. Local market for live animals is available in form of auction yards where middle men go and purchase their animals at prices they felt satisfied with. Livestock products are hardily available at the local market. To enhance market availability, it was felt that rehabilitation of existing sale yard was necessary as well as promotion of livestock market information.

Hypothesis on ready market for livestock and livestock products confirmed existence of a positive relationship between market availability and sustainability of ruminant livestock projects in dry lands of kaloleni.

5.4 Conclusions

Provision of adequate water is one of the most important variable affecting sustainability production in this area. Water affects animals' growth rates, survival, sale value and fertility rates among others. Severe water shortage results into dehydration and death of animals. Availability of fresh water is a big challenge in this area. The most dependable source of fresh water is rain water harvesting by use of water pans and earth dams. Rainfall is scarce and water pans and earth dams only cover 50% of this area; making water availability to be seasonal and inadequate.

Provision of piped water still remains a dream in this area due to limited water sources. Government and non-governmental support to provide adequate water in this area will greatly improve livestock projects sustainability in this area.

Provision of adequate veterinary care is also a critical factor influencing sustainability of livestock projects in dry lands. Inadequate provision of veterinary care into considerable animal losses and loss of animal productivity. The most critical veterinary services that need to be addressed are the vaccinations against notifiable diseases, de-worming, parasite control and provision of a veterinarian in this area.

Community involvement in project planning and decision making plays a significant role in the sustainability of livestock projects in dry lands. The community has to be involved at all stages of the project cycle in order to enable them claim ownership of the projects long after donor with drawl. The community expressed their wish to be made aware of the existence of donor projects, to participate in project implementation, and to be involved in planning and decision making process. The community would not mind to be involved in cost sharing especially contribution in kind and at levels not exceeding 20%.

Availability of feeds throughout the year has influence on the sustainability of livestock projects in dry lands. Even feed supply throughout the year requires proper grazing management as well as feed conservation during the rains for use during dry periods. Bush control, re-seeding of denuded grazing areas as well as de-stocking during the on set of dry periods is necessary. Due to the on going sub-division of communal grazing land, pastoralists may be forced to engage in individual on farm pasture establishment and management

Skilled animal husbandry human labor should be made available by way of training pastoral families on simple and routine animal husbandry skills in order to improve on the sustainability of livestock projects in this area.

Animal husbandry skills such as handling of animals, selection, detection of sick and any abnormalities, isolation of sick animals, hoof trimming, castration, de-horning, and so fourth should be imparted to pastoral families.

Last but not least, availability of ready market for live animals and livestock products has been identified as an important contributor to the sustainability of ruminant livestock projects in the dry lands. Improvement in the local infrastructure especially auction yards, feeder roads, livestock marketing information networks should be prioritized. This will enable competitive buyers to reach their market and buy their animals at competitive prices.

5.5 Recommendations

1. Effort should be made to provide permanent source of fresh water in this area.
2. Rain water harvesting in form water pans and dams should be enhanced to adequately cover the whole area.
3. Government and NGOs should provide more support to pastoralists in disease and parasite control.
4. Community involvement should be enhanced. The community should be involved right from project inception to the end so to make use of their local knowledge and allow greater participation.
5. Great improvement is required in the flow of market information to and from this place improvement in the livestock auction ring is necessary to allow proper animal handling.
6. Environmental conservation efforts involving all the stakeholders should be instituted.
7. Trainings in all aspects of livestock production and environmental conservation should be given priority

5.6 Suggestions for further research

Comparative studies on sustainability of small stock and that of large stock should be carried out in this area..

REFERENCES

Abate, Dzowela & Kategile,(2013), *Intensive Animal Feeding Practices for Optimum Feed Utilization.*

Agricultural Waste Management Field Hand Book, *Desired and Potential Levels of Pollutants in Livestock Water Supplies*, pages 1-6

Akililu,(2002) & GL-CRSP (2003), *An Audit of the Livestock Marketing Status in Kenya, Ethiopia and Sudan Volume 1*

Antonio & Sidahemed,(2010), IFAD's Livestock Position Paper, *Livestock Planning, Challenges and Strategies for Livestock Development in IFAD*

Arid Lands Resource Management Project ii and National Vision Strategy (2005-2015), Arid and Semi Arid Lands (ASAL*), National Vision and Strategy, National Resource Management 2005-2015*

Baas, Reynolds, Batello, (1999), The Food and Agriculture Organization of the United Nations (FAO*), Rangeland Management and Conservation, Lessons Learnt from Planner's Point of View*

Bamberger (2006*), Community Participation in Development Projects*

Cees De Haan, (1995), *Balancing Livestock and Environment, The Grazing System,*

Chandler, (2012), MTI News Office, *A New Approach to Water Desalination,* Graghine Sheets with Precisely Controlled pores have Potential to Purify Water more Efficiently than existing methods

Chin (2002), *Ensiling of Tropical Forages with Particular Reference to South East Asian Systems*. Paper Presented at the xiith International Silage Conference 11-13th September 2002.

Christine & Michael (2008), Women on the Water 2nd Annual Conference, November 6-8, 2008.

Coleride, (2006), Global Ground Water Out Spaces Supply, Human Appropriation of the World's Fresh Water Supply; The Water Resources of the Earth

Department for International Development, (2011*), Livestock Pastoralists and Vulnerability*,

DFID research: Pastoralists: Moving with Times. *Pastoralists are Changing the way they live and work in response to new opportunities and threats.*

District Livestock Production Officer's annual report (2012), for Kaloleni district

DOSS,(2013), Understanding Farm Level Technology Adoption; Lessons Learnt From

CIMMYT's Micro survey in East Africa. CIMMYT Economics Working Paper 03-07 Mexico, D.F: CIMMYT

Elliot, (2011), *East African Pastoralism in Transition, Maasai, Boran and Rendille cases* Published by African Review Studies.

Food And Agriculture Organization of the United Nations, (2005) (FAO), *Livestock Information Sector Analysis and Policy Branch*, AGAL

Food And Agriculture Organization of the United Nations, (2011), *Livestock Assets, Livestock Income and Rural House Holds.*

Homann, (2004) & Proud (2009*), Traditional Grazing Management*

International Conference, Paris, France (1998), *Recommendations of the International Conference on World Water Resources at the Beginning of the 21st Century; Water: A Looming Crisis*

International For Agricultural Development,(2013) (IFAD*), Dimensions of Rural Poverty, Livestock and Rural Poverty*, Rural Poverty Portal.

Inazuimi, Singh, Sanginga, Manyonyi, Adesina, & Tarawali (1999*), Adoption and Impact of dry season dual Purpose cowpea in the semi-arid zone of Nigeria.*

John & C. Barret (2001), *Risk Differential Exposure and Scholastic Poverty Traps among East African Pastoralists*

Kariuki & Kaitho, (2005), *Early Warning Systems Targeted at Reducing the Prospects of Disasters due to Reccurent Droughts* (USAID 2005)

Lamwaka (2006), *Ugandan Pastoralists hit by Market Reforms*, Panos, Landon Illuminating Voices.

Leeuw & Rey (1995), *Analysis in the Current trends in the distribution Patterns of ruminant Livestock in Tropical Africa*

Mathuri & Singh, (2001), *Impact of Intergrated Dairy and Crop Technologies on Small Holder Dairy Production in Haryana,* Indian National Dairy and Research Institute (NDRI), Indian Council of Agricultural Research (ICAR) Karnal 132001, India.

Montana State Extension, *Safe Upper Limits for Several Substances that may be contaminated in water for Livestock and Poultry*

Mugenda & Mugenda (2003), Research Methods, Quantitative and Qualitative Approaches, Nairobi, Centre for Technology Studies (ACTS) Press.

Muthee, (Dr.),(2006), AU-IBAR and NEPDP: Kenya Livestock Sector, An Analysis of Pastoralist's Livestock Products, Market Value Chains and Potential External Markets for Live Animals and Meat

National Drought Management Authority, Kilifi County,(2013*), Kilifi/Kaloleni/Ganze Districts EWS Drought Monitoring Bulletin for the Month of April 2013*

Narman (1990), Republic of Kenya (1994), *Livestock Contribution to Kenya's GDP*

Njigua, (2012),*The Potential of Sand Dams for Rural Water Supply* Kenya Rain Water Association Experience in Upper Kitui County.

Notenbaert, Jonathan, Leeuw, Mohammed, Hetero, Monzano, Waithaka, Aboud, and Omondi,(2012), *Policies in Support of Pastoralism and Biodiversity in the Heterogenous dry lands of East Africa.*

Peak T.G & Little,(2006), *Livestock Marketing in Eastern Africa Research and Policy Challenges*, ITDG, Publications.

Pfost & Fulhage,(2001), University of Missouri Extension, EQ381, New may 2001, *Water Quality for Livestock Drinking.*

Provincial Director of Livestock Production ,Coast, (2009), *Annual Livestock Production Report for 2008, for Coast Province, Kenya.*

Sansoucy, Jabbar, Ehui & Firzhugh (1992), Key note Paper, *The Contribution of Livestock in Tropical Africa*

Southern and Eastern Rain Water Network, (2011), 16th Sear Net International Conference; *Water Harvesting Technologies Revisited: Potentials for Innovations, Improvements and upscalling in Sub-Saharan Africa (WHaTer*).

Thorp, (1979), Technical Hand Book No.32, *A Zambian Hand Book Pasture and Fodder Crops*

Uaine, Arudit, & Masters (2009), *Determination of Agriculture Technology Adoption in M*

ozambique. Discussion Papers No.67E, January 2009, National Directorate of Studies and Policy Analysis, Republic of Mozambique.

United States Geological Survey, (2013), *Water Resources of the United States*

Veterinary Services, (2011), *Animal Disease Control and Pan African Trypanosomiasis and Tsetse Eradication and Control*

Wambugu, (2004*), Extension and its Effect on Dairy Cattle Nutrition and Productivity in Small Holder Dairy Enterprises in Kiambu District*. A Master of Science thesis, University of Nairobi.

Appendix 1: LETTER OF TRANSMITTAL

CHARLES AZEY MWAWSI
BOX 250, KALOLENI
26-06-2013

Deputy County Commissioner,
Kaloleni Sub- County
P.O. Box 1
KALOLENI

Dear Sir,

RE: PERMISSION TO CONDUCT RESEARCH

I am a master's student at the University of Nairobi, Mombasa campus, as well as a civil servant working in kaloleni as the District Livestock Production officer. I intend to carry out a study on the factors influencing sustainability of ruminants livestock projects in dry lands, the case of Kaloleni District, Kilifi County, Kenya in partial fulfillment of the requirement of the course.

Kindly allow me to traverse the district meeting with various respondents in the sub-locations in the sub-county.

It should be noted that the study is purely for academic purposes and sharing of the final report once the study is completed guaranteed.

Yours Sincerely

CHARLES AZEY MWAWASI

L50/66509/2011

OFFICE OF THE PRESIDENT
MINISTRY OF INTERIOR AND CO-ORDINATION OF NATIONAL GOVERNMENT.

Telegrams: "DISTRICTER" KALOLENI.
Telephone: (020) 3502704
Fax☹041) 2001703
Email: kalolenidc@yahoo.com
When replying please quote

Deputy County Commissioner
Kaloleni Sub County
P.O Box 1,
KALOLENI.

Ref.No: ADEM. 15/3 VOL.I/74

2nd July, 2013

All Chiefs,
KALOLENI SUB COUNTY

RE: RESEARCH: MR. CHARLES AZEY MWAWASI

The above named is doing a master programme part of which he must do research.

Please find his research schedule attached.

Accord him all the necessary support to enable him complete his master's programme.

F. O. AYIEKO
DEPUTY COUNTY COMMISSIONER
KALOLENI SUB COUNTY

Copy to;

All Assistant County Commissioners
KALOLENI SUB COUNTY

Mr. Charles Azey Mwawasi
DLPO – KALOLENI: (Your letter Ref. No. DLPO/KLN/ADM/14/VOL.I dated 1st July, 2013 refers.)

Appendix 2

SECTION ONE

Name of respondent……

Name of sub-location…….

Contact…….

Personal Data

Gender (please tick one)

Male [ ] Female [ ]

Marital status (please tick one)

Married [ ] Single [ ] Divorced [ ] Widowed [ ]

Age brackets in years (please tick one)

Under 36 years [ ] 36-45 years [ ]

46-55 years [ ] 56-65 years [ ]

Above 65 years [ ]

Highest level of education (please tick one)

Primary school certificate [ ]

Diploma certificate [ ]

Undergraduate [ ]

Post graduate

(Certificate, Diploma, Masters, Phd) [ ]

Occupation (please tick one)

Government employment [ ]

Private employment [ ]

NGO [ ]

I don't work [ ]

Am a student [ ]

SECTION TWO

Provision of water

6. Please indicate the extent to which you agree with the following statements in reference water availability for domestic and livestock use by ticking in the boxes provided

Do you experience water scarcity?

For domestic use [ ]

For livestock use [ ]

What is your water source for:

Domestic use [ ]

Livestock use [ ]

Do you share the same water source for livestock and domestic use?

By what means do you fetch water for domestic use?

How long does it take you to set domestic water home by the said means above?

During wet season [ ]

During dry season [ ]

How long does it take you to take animals to the watering?

During wet season? [ ]

During dry season? [ ]

Water is the frequency of watering for your livestock?

Has water availability have any influence on the number and type of livestock you have?

What are the consequences of severe water scarcity on the livestock in relation to:

Survival rate [ ]

Fertility rate? [ ]

Growth rate? [ ]

Market value [ ]

How do you cope with water scarcity during severe drought?

Do you experience water borne diseases during the year on your animals?

SECTION 3

7. Provision of veterinary care

a) Do you practice tick control on your animals?

Yes [ ] No [ ]

b) How do you control ticks?

Explain..

Mention 5 most common disease problems affecting your livestock!

c) Do you seek any assistance when your animals are sick?

Yes [ ] No [ ]

d) What do you get assistance from?

Government (ii) Private service Providers (iii) Self

e) Do you receive regular vaccinations for your animals?

Yes [ ] No [ ]

f) what do you consider to key veterinary aspects in the improvement of veterinary care in your area?

Regular vaccinations [ ]

Deworming [ ]

Tick control [ ]

Presence of a veterinarian [ ]

8. Community Involvement

a) Are you aware of any donor funded ruminant livestock project in your area for the last 5 years?

Yes [ ] No [ ]

b) Have you been involved in the project at any one time?

Yes [ ] No [ ]

c) What was your level of involvement?

Explain e.g beneficiary service provider, cost sharing, implementation and decision making

d) Do you consider the level of involvement adequate?

Yes [ ] No [ ]

e) Do you think inadequate involvement in these projects may be the cause of the failure of those projects?

Yes [ ] No [ ]

f) What is the preferred level of community participation in livestock projects?

Planning and decision making [ ]
Implementation [ ]
Cost sharing [ ]
Awareness [ ]

9. Rangeland Management

a) Is your rangeland improving or degrading?

Explain

b) Are you aware of any future plans for the utilization and management of your rangeland?

Yes [ ] No [ ]

Explain

c) In your own opinion what are the key factors influencing sustainability of livestock projects in your area?

Explain

10. Feed Availability

7. Please indicate the extent to which agree with the following statements in reference to the activities by ticking [ ] in the appropriate space

Are your animals correctly well fed?

Yes [ ] No [ ]

Does the current food availability allow you to keep more animals?

Yes [ ] No [ ]

On average, how long does feed availability take during a season like this?

Are there any coping strategies for feed availability during seasons

Plenty? [ ]

Scarcity? [ ]

What is the highest percentage of animals you have ever lost during severe drought?

Do you consider feed availability a big challenge in this area?

Trends of feed availability in the last ten years

Increasing [ ]

Decreasing [ ]

Normal [ ]

No idea [ ]

Apart from livestock, what crops do you grow?

What do you consider to be most sustainable farming?

Crop framing [ ]

Livestock farming [ ]

Yes [ ] No [ ]

11. Human Labor

a) Do you consider availability of human labour for the care taking of your animals a big challenge?

Yes [ ] No [ ]

b) Who takes care of your animals?

(i) Family members [ ] (ii) Self [ ] (iii) Children [ ] (iv) Hired labour [ ]

c) How long have you been into livestock keeping business

d) Do consider yourself as having adequate animal husbandry skills?

Yes [ ] No [ ]

Explain …

e) How did you acquire animal husbandry skills?

Through experience [ ]

Through formal training [ ]

Through internal training [ ]

g) What kind of training do you require in animal husbandry practices?

Explain ……

What are the main causes of your poor animal body conditions?

Water scarcity [ ]

Diseases [ ]

Inadequate feed [ ]

Poor management [ ]

All of the above [ ]

h) Availability of skilled human labour

Many [ ]

Adequate [ ]

Non-existent [ ]

Few [ ]

12. Market availability

What is your main objective for livestock keeping?

Commercial purposes [ ]

Cultural purposes [ ]

Hobby [ ]

b) How frequent do you sell your animals?

c) Where do you sell your animals? To:

Middlemen [ ]

Butcher [ ]

Processors [ ]

d) How many animals did you sell last year? How about this year?

e) Do you sell any livestock products?

Yes [ ] No [ ]

f) What type of products do you sell?

Explain

g) What are the prices for cattle, sheep and goats within this area?

Cattle …….

Sheep ……..

Goat ……..

h) What are the Prices for animals products:

Milk ……. Per litre

Meat …… per kg

Skins (i) goat …… per piece

Sheep …….. per piece

Hides ……. Per kg

i.Availability of ready market for livestock and livestock products.

Proximity to sale yard [ ]

High demand for goods [ ]

High sale prices [ ]

Level of infrastructure development [ ]

Do you consider the prices for your animals and their products favourable?

Explain

Are you aware of any markets outside your district?

Yes [ ] No [ ]

Are you aware of carpet market outside Kenya?

Yes [ ] No [ ]