

**ANALYSIS OF PASTORALISTS' PERCEPTION ON CHALLENGES AND
OPPORTUNITIES FOR SHEEP AND GOAT PRODUCTION IN
NORTHERN KENYA**

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DECLARATION

This thesis is my original work and has not been presented for award of degree in any other University. Where other people's work has been cited, this has properly been acknowledged and referenced in accordance with the University of Nairobi's requirements.

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TABLE OF CONTENTS

DECLARATION	ii
ACKNOWLEDGEMENTS	iii
LIST OF TABLES & FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	xii
CHAPTER ONE	1
1.0 INTRODUCTION	1
1.1 General Introduction	1
1.2 Problem Statement.....	2
1.3 Objectives	3
1.4 Justification.....	3
CHAPTER TWO	5
2.0 LITERATURE REVIEW	5
2.1 Introduction.....	5
2.1.1 Arid and Semi Arid Lands of the Horn of Africa.....	5
2.1.2 Sheep and goat farming in pastoral areas	6
2.1.3 Significance of sheep and goat farming	8
2.1.4 Challenges of goat and sheep production in the pastoralist areas	9
2.1.4.1 Sheep and goat diseases	9
2.1.4.2 Occurrence of Drought in Northern Kenya	10
CHAPTER THREE	13
3.0 Materials and methods	13

3.1 Description of the study area	13
3.2 Selection of study locations	14
3.3.1 Meeting venues and participant characteristics	16
3.3.2 Focus group discussions	16
3.3.3 Key informant interviews	18
3.4 Data Management	18
3.5 Materials used in the study	Error! Bookmark not defined.
3.6 Ethical consideration.....	20
CHAPTER FOUR.....	22
4.0 RESULTS	22
4.1 Introduction.....	22
4.2 Pastoralists' perception on the challenges of sheep and goat production.....	22
4.2.1 Description of groups included in the study	22
4.2.2 Characterization of sheep and goats production challenges	24
4.2.2.1 Identification of sheep and goats production challenges	24
4.2.2.2 Ranking of the identified sheep and goats production challenges	24
4.2.3 Identification and ranking of common diseases of sheep and goats	25
4.2.3.1 Identification and ranking of common diseases of goats	25
4.2.3.2 Identification and ranking of common diseases of sheep	26
4.2.4 Community PPR awareness	27
4.2.5 Local disease control measures.....	28
4.3 Key informant interview narratives	29
4.4 Opportunities for improvement	32

CHAPTER FIVE	34
5.0 DISCUSSION	34
CHAPTER SIX	38
6.0 CONCLUSION AND RECOMMENDATION.....	38
6.1 Conclusion	38
6.2 Recommendations.....	39
REFERENCES	40
APPENDICES	50
Appendix 1: FGD checklist/guiding questions	50
Appendix 2: Consent form.....	51
Appendix 3: University introductory letter.....	52
Appendix 4: Published journal article.....	53

LIST OF TABLES

Table 1: Demographics of FGD study participants, Mandera Kenya, 2016.....	23
Table 2: Scores & ranks for sheep & goats production challenges in Mandera, Kenya, 2016.....	25
Table 3: Scores & ranks for common goat diseases in Mandera, Kenya, 2016	26
Table 4: Scores and ranks for common sheep diseases in Mandera, Kenya 2016.....	26
Table 5: Local disease control strategies and their implications in Mandera, Kenya, 2016.....	29
Table 6: Demographics of KII study participants, Mandera, Kenya, 2016	30
Table 7: Small ruminant production challenges observed by stakeholders during the key informants' interviews in Mandera, Kenya, 2016	31
Table 8: Opportunities for improvement on sheep and goat production in Northern Kenya according to interviewed stakeholders in Mandera, Kenya, 2016	33

LIST OF FIGURES

Figure 1: Map showing Global PPR situation and occurrence of outbreaks (2007 – 2014)

LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
ASAL	Arid and Semi-Arid Lands
AU-IBAR	African Union- Inter-Bureau of Animal Resource
CAHWs	Community Animal Health Workers
CCPP	Contagious Caprine Pleuro-Pneumonia
CDVS	County Director of Veterinary Services
CIDP	County Integrated Development Plan
CMDRR	Community Managed Disaster Risk Response
FAO	Food and Agriculture Organization of the United Nations
FGDs	Focus Group Discussions
FMD	Foot and Mouth Disease
GDP	Growth Domestic Product
GoK	Government of Kenya
ICPALD	IGAD Centre for Pastoral Areas and Livestock Production
IGAD	Inter-Governmental Agency for Development
KARI	Kenya Agricultural Research Institute
KII	Key informant interviews
KNBS	Kenya National Bureau of Statistics
LPI	Livestock production Initiative
MS Excel	Microsoft Excel
NDMA	National Drought Management Authority
NGOs	Non-Governmental Organizations

ODA	Official Development Assistance
OIE	World Organization of Animal Health
PPR	Peste des Petits Ruminants
TBDs	Tick borne diseases
USD	United States Dollars

ABSTRACT

Small ruminants' production contributes to livelihood of pastoral communities, but this faces myriad constraints. This study aimed at identifying challenges facing producers of small ruminants, prioritizing diseases and their control measures and documenting opportunities for improvement. Sixteen focus group discussions with livestock owners and 13 key informant interviews were done in selected areas in Mandera County, Northern Kenya, and both quantitative and qualitative data collected using a questionnaire guide. Occurrences of diseases (27%) and drought (25%) were consistently ranked high in all groups. Other production challenges included increased predation of livestock, inadequate delivery of veterinary services, and increased livestock mortalities. Peste des Petit ruminants (PPR) was ranked high with a median rank of 22%, while contagious caprine pleuropneumonia and sheep and goat pox were ranked second and third, respectively. Other diseases included tick-borne diseases, helminthosis, and pneumonia. Vaccination was ranked as the most effective control strategy for infectious diseases. Other control measures included recitation of Quran and cauterization. However, several opportunities exist for support of small ruminants' production: increased budgetary allocation for disease control by government, initiation of projects that enhance livestock production in the region by government and its development partners. These findings are useful for policy makers for disease control and organizations that are working on projects that focuses on enhancement of pastoralists' resilience, while future research could also identify appropriate technologies that reduces these impacts.

Keywords: Production challenges - Participatory techniques - Pastoralists - Sheep and goats

CHAPTER ONE

1.0 INTRODUCTION

1.1 General Introduction

Livestock production play a significant role in the socio-economic well-being of people in most developing countries (Kosgey *et al.*, 2008, Behnke & Muthami, 2011). An estimated 330 million people in Africa and Asia keep livestock, mostly small ruminants (Behnke & Muthami, 2011). Globally, about 80% of global sheep and goat population is found in Asia and Africa (OIE & FAO, 2015). Small ruminant production contributes significantly to social, economic and cultural well-being of communities, as source of nutritious food, source of income, cultural functions and informal insurance during emergencies (Kosgey *et al.*, 2008; OIE & FAO 2015). These animals are known to utilize feed (grass and shrubs) more efficiently than other animals especially in the tropics where climatic conditions such as poor soil characteristics, and low rainfall distribution fail to favour crop production (Kosgey *et al.*, 2008). Further, small ruminants also prevail in the tropics where constraints such as poor roads, shortage of agricultural extension workers, harsh terrain, vast land sizes, relatively small but mobile human populations among others are the order of the day (Baker & Rege 1994; OIE & FAO 2015).

In Kenya, most of the goats (91%) and sheep (87%) are raised in the arid and semi-arid pastoralist areas (KNBS 2010, Behnke & Muthami, 2011). Their potential is constrained by a number of factors including drought, diseases, poor infrastructure, insufficient extension and animal health services. Drought is a common phenomenon in Northern Kenya resulting in decreased vegetation cover and frequent drying up of available water sources. This often leads to loss of livestock and therefore lost sources of livelihoods for pastoralist communities (Nkedianye

et al., 2011; Nicholson 2014; Opiyo *et al.*, 2015). The frequent outbreak of diseases hinder productivity and negatively impact local and national economies (Gitao *et al.*, 2008; Gitonga 2011; OIE & FAO 2015; Gitonga 2015). The diseases which frequently affect sheep and goats in these pastoralist areas include contagious caprine pleuropneumonia (CCPP), Heart-Water, Peste des Petits Ruminants (PPR), tick borne diseases, Foot and Mouth disease (FMD) and sheep and goat pox (Gitao *et al.*, 2008; Gitonga 2011; Kihu *et al.*, 2015; OIE & FAO 2015).

1.2 Problem Statement

Sheep and goat farming is popular in pastoralist areas of Northern Kenya where the animals serve as significant livelihood sources to local communities. However due to factors such as the arid nature of the region, historical marginalization of the people living in the region, poor infrastructure and illiteracy, inhabitants of Northern Kenya, predominantly pastoralists', are faced with numerous challenges, which hinder development in the region.

Droughts and diseases are some of the major challenges facing small ruminants' producers. Among the major diseases affecting sheep and goats in Africa is Peste des petit Ruminants (PPR); it is an emerging disease of sheep and goats. The disease is considered a threat to 1.7 billion (81%) goats and sheep out of the total World population of 2.1 billion (Nyamweya *et al.*, 2009; OIE & FAO, 2015).

Past research has focused largely on understanding what challenges affect sheep and goat production in pastoralist areas, however, the magnitude and order of priority of the various challenges faced by the pastoralists and opportunities for improvement is lacking. Prioritising these challenges through ranking and establishing what opportunities exist would help in defining the particular aspects of value chain where future interventions will be directed to achieve solutions to the challenges, improve production and ultimately support local livelihoods.

In addition, the diseases which affect the sheep and goats and the local response strategies have not been prioritised. Such an exercise would help in ensuring efficient allocation of the scarcely available resources both at the national and county levels.

This study sought to examine these knowledge gaps through adoption of participatory approaches i.e. focus group discussion and key informant interviews. Data on diseases that affects sheep and goats production were collected, analysed and prioritised. Data on measures employed by pastoralist to control small ruminant diseases were also collected and analysed.

1.3 Objectives

Overall Objective

The main aim of this study is to investigate pastoralists' perception on challenges and opportunities for improved sheep and goat production in Northern Kenya

Specific Objectives:

The specific objective of the study was to analyse perceptions on challenges and opportunities of sheep and goat production in Northern Kenya.

1.4 Justification

The importance of small ruminants' production to the pro-poor pastoralists in the horn of Africa cannot be overemphasised. They particularly appeal to the livestock producers inhabiting the arid and semi-arid areas of the horn of Africa; sheep and goats are cheaper to obtain, maintain, have high turnover, can easily be traded with cash, adapt well to arid and semi-arid areas, can easily be kept by women and elderly people and form an essential for rebuilding herds after environmental shocks. However, the production of these essential animals face a number of challenges and this study sought to identify and prioritise the challenges and opportunities for

improvement through participatory research techniques and key informer interviews. Although much has been studied on challenges affecting sheep and goat production in the arid and semi-arid areas, there is very little that has been documented on potential opportunities on these systems. Such would help in defining the particular aspects of value chain that should be targeted for interventions to support local livelihoods. Furthermore, the diseases which affect the sheep and goats and the local coping strategies have not been prioritized. Such an exercise would help in ensuring efficient allocation of the scarcely available national and county resources.

The study findings generated priority challenges and diseases faced by sheep and goats. This will help the county government and other policy makers in the livestock sector to prioritise and address the most important challenges affecting sheep and goat production when designing projects. The findings would further help the livestock and veterinary service practitioners in giving more attention to the priority challenges and diseases leading to improved health and production, further increasing the incomes of pastoralists' communities in Northern Kenya. In light of the findings, future studies can also focus on specific challenges.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter highlights literature review in relation to the objectives of the study. It specifically deals with climatic conditions in the Horn of Africa, sheep and goat production systems, significance of sheep and goat farming in the economies of the horn of Africa countries, and challenges encountered by the pastoralist in the farming of sheep and goats.

2.1.1 Arid and Semi Arid Lands of the Horn of Africa

The horn of Africa countries consist of Kenya, Somalia, Ethiopia, Eretria and Djibouti. The arid and semi-arid lands (ASAL) of the horn of Africa are predominantly inhabited by pastoralist communities (Hesse & Macgregor, 2006; Kirkbride & Grahn, 2008; Kosgey et al., 2008). These areas are characterized by high temperatures and low rainfall distribution and pattern (Tolera & Abebe, 2007; Nassef *et al.*, 2009). Dry lands occupy approximately 70% of the horn of Africa countries, ranging from 95% in Somalia, over 80% in Kenya, more than 60% in Uganda and Ethiopia. Since most of the livestock in these countries are kept in ASAL areas, that means the bulk of these countries wealth in the dry land areas (Aklilu & Catley 2014; Hesse & Macgregor 2006; Kirkbride & Grahn 2008).

Dry lands support livestock production, rain fed agriculture, wildlife resource harvesting and tourism, thus playing a very important role in ensuring national food efficiency (Nori & Davies, 2007; Mortimore *et al.*, 2008; Nassef *et al.*, 2009). However, the importance of dry lands in the national economies of the horn of Africa is usually underrated through lack of understanding and misconceptions (Behnke & Muthami 2011a; Behnke & Muthami 2011b; Hesse & Macgregor 2006). For instance, Behnke & Muthami (2011a) in their analysis in the IGAD livestock initiative policy

report established that the Kenya National Bureau of Statistics (KNBS), the body responsible for compiling national accounts, used a non-accurate estimation method to measure contribution of pastoralism in livelihoods. The body uses the commodity flow approach commonly used for the small scale farmers to estimate pastoralist contribution to the national economy, this is considering the challenges in sampling nomadic households in the dry lands of Kenya (Behnke & Muthami, 2011b). They could have used research approach that is specifically designed for the pastoralist community so as to retrieve information on actual contribution of the pastoralist to the economy. Recent research indicates that livestock sector contribute up to 13% to the Kenyan economy, 150 times higher than previously thought (Behnke & Muthami, 2011; KNBS, 2010; REGLAP, 2012). The dry lands of Kenya, Ethiopia and Uganda are disadvantaged not because the land is dry or climate change, but because of inequalities in resource allocation, poor infrastructure and political power. These areas have huge potential for growth, if the respective governments give the necessary attention (REGLAP, 2012). *'The solution will require time, multi-sectoral collaboration and radical shifts in thinking and approach'* (The ASAL secretariat, 2012). Table 1 below highlights some of the misconceptions surrounding pastoralism and the reality of its role in supporting rural economies.

2.1.2 Sheep and goat farming in pastoral areas

Farming systems are often classified based on their different functions (management, research, extension and policy) and various system components (agro-climatic zones, feed resources, economic value, sociology and the livestock species and their genotypes and products) (Jahnke, 1982). The sheep and goat systems in Kenya have been classified based on their genotypes and the agro-ecological zones (KARI/ODA, 1995). The goat breeds includes the small east African goat raised in agro-ecological zones V-VII; small east African goat raised in agro-ecological zone I-IV, and the galla goat, whereas the sheep production systems were classified as meat

sheep raise in agro-ecological zone I-IV, meat sheep raised in agro-ecological zone V-VII, and the meat and wool sheep. The meat sheep system common in agro-ecological zone V-VII are the predominant in Northern Kenya due to the arid climatic conditions (Jahnke, 1982).

Sheep and goat numbers are increasing tremendously in the developing countries, particularly in pastoralist areas, compared to the more developed countries (FAO, 1986). This is because small ruminants can be produced and maintained on low cost feed, can adapt to difficult environments and it reflects their suitability to the small farmers of the low income households in the pastoralist areas of the developing countries that need extra food and additional income (Baker & Rege 1994; FAO, 1986). However, the growth of household economy cannot be based on the sheep and goat population growth alone, greater production efficiency needs to be achieved, because, for instance, meat output per sheep and goat are much lower in Africa and Asia than the more developed countries of Europe and North America. The level of small ruminant production e.g. breed improvement, disease control, etc are far much behind those practiced in the more developed countries (Timon & Hanrahan 1985). The potential is there but lacks necessary support; the sector, if provided with the necessary support can achieve maximum benefits to both the pastoralists and the national economy.

Unlike in the developed world where sheep and goats farming are purposely kept for economic return, farmers in the less developed countries keep sheep and goats for household nutrition and as a sign of wealth and prestige. Wool, meat, milk and skin are the main products obtained from sheep and goats. Dung, mainly for fuel and fertilizer, and ghee are some of the by-products (Baker & Rege, 1994; Kosgey *et al.*, 2008). Small ruminants, together with poultry and pigs are the main farm animals of the poor in the least developed countries.

2.1.3 Significance of sheep and goat farming

Goats popularly referred to as the ‘cattle of the poor’ and sheep not only provide meat and milk, but also as source of income that can easily be mobilized for household expenses, especially during emergencies like drought (FAO, 2009).

An estimated 330 million people in Africa and Asia keep livestock mostly sheep and goats (OIE & FAO, 2015). The importance of these animals, to the social, economic and cultural well-being of the people in the developing countries of the tropics in terms of nutrition, income, cultural functions and emergencies, cannot be overemphasized. Sheep and goats provide meat, milk and associated by – products (wool and fibre) which, when sold, are significant sources of income (OIE & FAO, 2015). The products (meat and milk) present an affordable source of protein to local communities. Sheep and goats also play a complementary role to other livestock in the utilization of available feed resources and provide the most practical ways of using the vast land of natural grassland where crop production is not feasible (Kosgey *et al.*, 2008).

Sheep and goat production is popular because the animals, compared to the larger livestock species, are cheaper to buy and maintain, reproduce rapidly hence have high turnover and are easily traded for either cash or for barter trade exchanges. The animals, in addition, are known to adapt well to pastoralist and agro-pastoralist ecological systems common in Africa. It is because of the simplicity of sheep and goats keeping that disadvantaged groups particularly women often rely on their production. Small ruminant production is an important component of pastoralist`s coping mechanism, being used as a strategy to rebuild herds after environmental and political shocks (IGAD, 2014).

Moreover, it is estimated that over 70% of all livestock in Kenya are found in the ASALs and 90% of the ASAL human population rely on livestock for their livelihood (KNBS, 2010). The livestock sub-sector contributes to 10% to Kenya's GDP and approximately 42% to the agricultural GDP (KNBS, 2010). However, a new study conducted jointly by the IGAD/ LPI and KNBS in 2011 found that livestock contribution to Kenya's agricultural GDP was two and a half times more than the official estimates of 2009 (Behnke & Muthami 2011). The study used the commodity flow approach and found that ruminant livestock contribution to agricultural GDP was close to Kshs 345.448 billion. This was two and a half times more than the 2009 official estimate of Kshs 127.723 billion (Behnke & Muthami 2011).

2.1.4 Challenges of goat and sheep production in the pastoralist areas

Even though the goat and sheep production present the main source of livelihood for the pastoralist communities, the livelihood of these communities is faced by various challenges (Kipronoh, 2015). The following sub-sections presents details on disease constraint and drought for sheep and goat production.

2.1.5 Sheep and goat diseases

Diseases of sheep and goats can be classified as infectious, parasitic, nutritional, reproductive or due to injuries (Kinyua, 2009). Sheep and goat diseases significantly reduce productivity irrespective of the ecological zone. Mugerwa (1996) observed that Contagious Caprine Pleural Pneumonia (CCPP) and Peste des Petite Ruminants (PPR) are widely distributed diseases which unless properly controlled, can limit animal production over wide areas.

Livestock diseases were ranked as the main livestock production challenge in pastoralist areas (FAO, 2009; Kipronoh, 2015). A study conducted in Pokot, Turkana and Kajiado counties have identified livestock diseases (89%) as the predominant constraint facing livestock production (Kipronoh,

2015). While a study conducted in Degehabur, Ethiopia showed that livestock disease is the major challenge facing sheep and goat production (Fikru & Gebeyew, 2015). The common diseases affecting sheep and goats include *peste des petits ruminants* (PPR) (Diallo, 2014; Gitao *et al.*, 2008; Gitonga, 2011; Kihu *et al.*, 2015; Misinzo & Albano, 2011; Parida *et al.*, 2015; Roger, 2005; Swai *et al.*, 2009), contagious caprine pleuropneumonia (CCPP) (Asmare *et al.*, 2016; Bo *et al.*, 1996; Fasil *et al.*, 2015; OIE, 2008; Thiaucourt *et al.*, 2000; Wesonga *et al.*, 2004), Tick borne diseases (Hassan *et al.*, 2013; Irvin *et al.*, 1996; Rochi & Mbe, 2015) and sheep and goat pox (Abbas *et al.*, 2014; AU-IBAR, 2009; IGAD, 2015). When they occur, livestock diseases cause devastating economic effects to the already vulnerable pastoralist communities. Some of the diseases are zoonotic, for example Brucellosis and Rift valley fever and negatively impact on the health of people (AU-IBAR, 2009 & IGAD, 2015).

Reducing the effect of disease in pastoral herds has become more difficult as crop farming and other activities such as creation of new settlements due to increase in population have eaten into pastoral territory (Nyariki *et al.*, 2009). Pastoralists in the past use to follow a cycle of reducing the accumulation of certain predisposing factors to disease by applying nomadic pastoral techniques such as moving between and within seasons to safe areas, and avoiding areas of high disease incidence, such as those infested with biting flies and ticks. However, they are currently being squeezed into smaller territory; hence face new situations that require new approaches to disease control (Nyariki *et al.*, 2009)

2.1.6 Occurrence of Drought in Northern Kenya

Drought has become frequent and intense worldwide over the last four decades. The following are some definition of drought for better understanding. Drought is a deficiency in precipitation

over an extended period, usually a season or more, resulting in a water shortage causing adverse impacts on vegetation, animals, and/or people. It is a normal, recurrent feature of climate that occurs in virtually all climate zones, from very wet to very dry (National Weather Service, United States, 2008). Drought is a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area (Brookings, 2016). Drought is generally defined as an extended period - a season, a year, or several years - of deficient precipitation compared to the statistical multi-year average for a region that results in water shortage for some activity, group, or environmental sector (FAO, 2008). In metrological science, drought can be described as a period when precipitation departs from long-term normal. Drought can be described agriculturally, when there is no sufficient soil moisture that meets the needs of a particular crop at a particular period. It can also be described hydrologically when deficiencies occur in surface and sub-surface water supplies. Lastly, drought can also be described socioeconomically, when human activities are affected by reduced precipitation and related water availability (FAO, 2008). Drought has both direct and indirect impacts. The direct impacts include reduced crop, forest and rangeland productivity, reduced water levels, increased fire hazard, damage to wildlife and fish habitat, increased livestock and wildlife mortality rates, increased insect infestations, increased plant diseases and increased wind erosions. In addition the indirect drought impacts include reduced income for farmers, and agribusiness, risk of foreclosures on bank loans to farmers and businesses, increased price for timber and food, increased unemployment, reduced tax revenues, increased crime and insecurity and increased migration (FAO, 2008).

Periods of dry spells is increasingly becoming emergencies in the horn of Africa. The frequent droughts in recent years have had a devastating effects thus pastoralists' households are finding it difficult to rebuild their assets including livestock resulting in spiral chronic food insecurity and poverty (Mortimore *et al.*, 2008; Nori *et.al.*, 2007; Oxfam, 2008). Studies have shown a change in trend, from drought related emergencies occurring every ten years, to a current occurrence of every five years. This is a sign of increased vulnerability of pastoralists, having led to animals not having enough time to recover physically from the short cycle of the droughts and are increasingly finding it difficult to withstand the dry spells (Nkedianye *et al.*, 2011; Opiyo *et al.*, 2015; Oxfam, 2008). Feed shortage due to droughts is a major challenge in the dry lands of Ethiopia, and this is thought to contribute to the decrease in sheep and goat production (Fikru and Gebeyew, 2015).

2.1.7 Other challenges facing sheep and goat production

Other challenges facing smallholder livestock production include, insufficient veterinary and extension personnel, predators, cattle rustling, poor market prices, climate change among others. In pastoral areas of Kenya, animal health facilities are inadequate and where they exist they are concentrated in urban and peri-urban areas (Nyariki, 2009). Literature on challenges such as poor marketing, insufficient veterinary and extension services, climate change and predators are scarce.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the study area

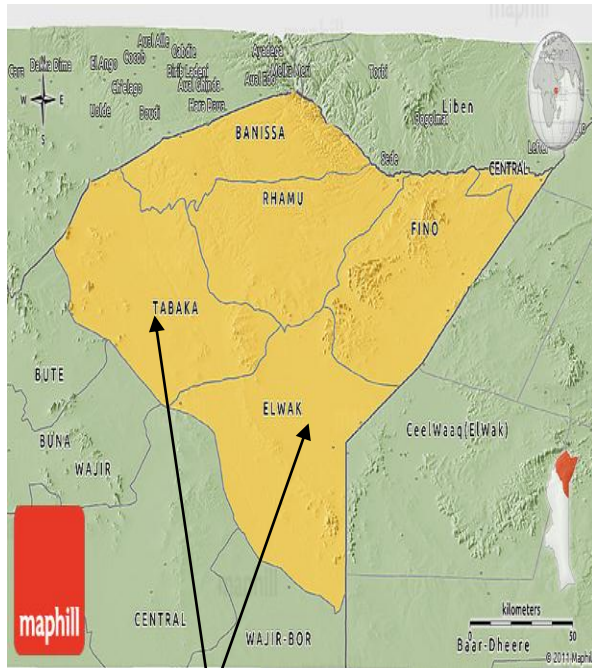
The study was conducted in Mandera County, an area of about 25,797.7 km², that lies between 2° 11' N 4° 17' N and 39° 49' E 41° 48' E and shares international boundaries with Ethiopia to the North, Somalia to the East and Wajir County to the West and South West (CIDP, 2013). The county is composed of six administrative sub-counties and is predominantly inhabited by the Somali community. Temperature ranges between of 24 and 42°C and rainfall is scanty and unpredictable averaging only 255 mm per annum. The high temperature leads to the rapid drying of little vegetation that resulted from the scanty rainfall. According to the Mandera County Integrated development plan, these areas are predominantly inhabited by pastoralist communities who keep camel, cattle, sheep and goats and is classified as an arid land (CIDP, 2013).

Mandera County has a population of 1,025,756 persons (Male 54.6%, female 45.4%). The population density is 39 people per km² and the national percentage is 2.7% while annual growth rate is 3.96% (KNBS, 2009). The County has a sheep and goat population of 986, 632 and 2,314, 939 heads, respectively (KNBS, 2009). Being predominantly pastoralists, the resident Somali clans rely on livestock production for their subsistence and economic needs. But there are those who derive their livelihood mainly from Agro-pastoralism along the Daua River (CIDP, 2013). The poverty level in Mandera County is the third highest in Kenya with 87.8% of the population living below the poverty line compared to the national average of 46% (KLBS, 2009). According to the County Veterinary department, the common sheep and goat diseases reported by County

disease reporters include, PPR, CCPP, Sheep and goat pox, Mange, Pneumonia, Helminthosis, orf and foot rot.

3.2 Selection of study locations

Mandera South and Mandera West sub counties were purposively selected based on the following criteria: history of frequent infectious disease outbreaks, county government reports indicating infectious diseases are endemic in these areas, the prevailing peace and Security, and ease of accessibility (Figure 1). Locations/villages were used as the sampling units and these were defined as administrative areas within a sub-county. Sixteen locations (8 in each sub-county) were randomly selected from a total of 50 locations. Because of the time and cost implications all the locations could not be sampled and the fact that the people inhabiting these areas have similar climatic conditions and the sixteen groups can give representative information that can be extrapolated to the other areas. The selected locations included: Borehole 11, Ellele, Wargaduud, Burmayo, Fincharo, Shimbir Fatuma, Dabacity and Kutulo locations of Mandera South, and Takaba town, Afalo, Diidkuro, Kob Adaadi, Gither, Burduras, Dandu and Ayana of Mandera West sub-county. The study was conducted during the months of November and December 2016.



Study areas

Figure 1: Map of Mandera County showing selected study areas (Source: Maphill, 2011)

3.3 Data collection

3.3.1 Meeting venues and participant characteristics

Permission to conduct the study was sought from the County Director of Veterinary Services (CDVS) of the Mandera County government, through a letter of introduction by the University of Nairobi. Village elders and disease reporters in the areas of the study were then contacted and informed about the study, including a brief of the objectives and research design. Group meetings were organized through County disease reporters, formerly Community Animal Health Workers (CAHWs). In some cases, the discussions were held informally without prior arrangement. The discussions were held in open grounds, mostly under trees, though informal tea kiosks were also used in areas where these were available. The groups comprised of village elders and older men with knowledge of sheep and goat production. The elders had experience of livestock keeping and were therefore thought to be invaluable informants. Other groups interviewed included local government veterinary officers, livestock extension officers, and representatives of various relevant non-governmental organizations.

3.3.2 Focus group discussions

A total of 16 focus group discussions were conducted from 16 randomly selected locations in Mandera West and Mandera South sub-counties. The participants were selected based on their experience on sheep and goat production. County disease reporters in the areas helped in selecting the participants. The number of participants per group ranged between 8 and 12. A set of guiding questions were asked and probing was done to obtain as much information as possible. The discussions were conducted in Borana (the people are Somali by ethnicity, but speak Borana) language and responses were recorded in a note book. The discussions were held by the researcher who is also fluent in Borana Language. A flip chart was used where listing and

ranking was required. The following were the guiding questions; list the common production challenges for sheep and goats?; why are these considered as challenges?; what are the local solutions to these challenges?; which common diseases do you encounter in sheep and goats?; what are the local control measures for the listed diseases?; which are the most effective control methods?. Additionally the participants were presented with photographs of diseased animals and they were asked to identify the disease(s) in the photos and whether they are the diseases that affect their sheep and goats.

Simple ranking was used to prioritize the challenges and disease conditions identified by pastoralist. Ranking was done according to the procedure described by previous authors (Catley et al. 2014; Catley, 1999; Catley et al. 2012; Chatty et al. 2003). Briefly, participants were asked to list all challenges and diseases impacting on local sheep and goat production. After the list was exhausted, participants were then asked to vote for each item by raising their hands, when everyone voted for the challenges/diseases, the number of votes was counted and each disease/challenge was allocated number of votes (scores) received. The numbers were then used to order the diseases and challenges according to their importance to the community; the disease with the highest vote count was ranked first. A part from the quantitative scores which were obtained through voting, qualitative data was also collected from the participants and these were recorded in note books. These included narratives summaries, for example, why some diseases were ranked higher than others, and list of challenges and opportunities for rearing of both sheep and goats in pastoral areas.

3.3.3 Key informant interviews

All those interviewed as key informants were based at the sub-county headquarters and were interviewed individually and the interview mode was face to face, though some calls were made to key stakeholders for clarification on certain issues. The guiding questions for these key informant interviews included, list of common production challenges for sheep and goats? Why these were considered as challenges? What were the local solutions to these challenges; which diseases were encountered in sheep and goats?, what were the available control measures for the listed diseases?, which were the most effective control measures? In addition, calls were made to selected stakeholders and policy makers in the livestock sector, among them County government personnel, representative of Non-governmental organizations particularly those managing local World Bank projects, and drought management authority (NDMA) to collect data on the opportunities for improvement of sheep and goat production and how to mitigate the identified production challenges. The advantages of small ruminant production over other livestock highlighted by the key stakeholders were obtained through telephone interviews.

3.4 Data Management and analysis

Data that were collected during the Focus group discussion and key informant interviews were recorded (flip charts, note books) and later entered into a database developed in Microsoft Excel 2007 spreadsheet. Quantitative data from the FGDs were exported and analyzed using Genstat statistical package Discovery 4th edition (VSN International, 2011). The data analyzed were scores from 1) ranking of production challenges 2) ranking disease problems by different groups in different locations and 3) ranking of disease control measures. These scores were standardized through conversion to percentages (the number of votes received by each challenge was divided with total number of participants in the groups and then multiplied by 100). For the qualitative

data, the analysis followed a framework analytical approach, where different themes and patterns were identified based on the responses from participants in the various groups (Gale *et al.*, 2009). The identified themes included, the challenges pastoralists faced on sheep and goat rearing, the opportunities for improvement of sheep and goat productions, how the communities were responding to presence of disease within their flocks and their perception on the effectiveness of these response measures.

3.4.1 Measuring the level of agreement amongst groups

Non-parametric tests namely Kendall's coefficient of concordance (W) and Spearman's correlation coefficient (r) were used to measure the level of agreement on the median rank orders amongst groups/raters by use of Genstat statistical software® (4th edition). The statistical test results for sheep and goat production and sheep and goat diseases were presented in tables. Kendall's coefficient of concordance gives the degree of association or agreement among ranks assigned by different raters/groups on different variables. It is represented by W and the formula is;

$$W = \frac{12R}{m^2(k^3 - k)} \text{ where:}$$

R = sum of squares (R_i from the \hat{R} (mean);

m= number of judges/groups ranking the variables;

k = number of variables that is evaluated by the groups.

$0 < W < 1$; can be negative or positive.

However, W is not a correlation coefficient and cannot be used to for interpretation or judgment about a correlation coefficient, thus linear transformation of W correlation coefficient (Spearman's) was used using the formula:-

$$r = \frac{mW - 1}{m - 1} \text{ where:}$$

W = Kendall's coefficient of concordance (as computed above); and

m = number of judges or groups.

Interpretation of the Spearman's rank correlation (r) was done based on the following correlation criteria (Legendre, 2010)

r = 0: no correlation, r = 0.25: weak Correlation, r = 0.5: median correlation, r = 0.75 strong correlation, r = 1: perfect correlation. $0 < r < 1$; It can be negative or positive.

3.4.2 Testing whether the median ranks are significantly different

The median ranks of the study variables (production challenges, sheep and goat diseases and local production challenges) was tested for any significant difference among the 16 groups using the Kruskal Wallis One way analysis of variance (ANOVA) for inferential analysis at alpha of 5%. The Kruskal Wallis One way ANOVA was used to compare the median ranks for the identified challenges; challenges with higher median ranks would ordinarily have z values of more than 1.96 (P value < 0.001).

The results were presented as tables and graphs. Qualitative data from the different groups and from the key informant interviews were organized and summarized using tables and as narratives. However, the data from the KIIs was entered in Microsoft Word Excel (2007) and not analysed in Genstat statistical package since their response was not ranked, and information such as sheep and goat production challenges, sheep and goat diseases, disease management measures and opportunities for improvement was generated and reported as narratives and in tables.

3.5 Ethical consideration

The study process followed the University of Nairobi regulations. Briefly, a letter was written by

the chairman of the department of Public Health, Toxicology and Pharmacology, University of Nairobi, to the County Director of Veterinary services, Mandera County Government (Appendix 3). Before the group discussions and the interviews began, each of the respondents was informed of the purpose of the study. They were also told about the confidential nature of the study and were assured that the information collected would only be used for research purpose. The respondents enjoyed the right to decide whether they would participate or not and also were free to withdraw at any stage of the interviewing process. The consent form used for this purpose is attached in Appendix 2.

CHAPTER FOUR

4.0 RESULTS

4.1 Introduction

This study was carried out in Mandera County, Kenya during the months of November and December, 2016. This section gives the finding of the study in detail including the description of the study participants, identification and ranking of sheep and goat production challenges, knowledge and awareness of sheep and goat diseases by the participants, identification and ranking of sheep and goat diseases and their control measures. The information was provided by pastoralists in focus group discussions and technical personnel of the livestock department in Mandera County. The findings were presented in tables, graphs and narratives.

4.2 Pastoralists' perception on the challenges of sheep and goat production

4.2.1 Description of groups included in the study

A total of 16 focus groups were conducted in Mandera South and Mandera West sub-counties. Each focus group was composed of between 8-14 participants. Participants in all the groups were of male gender since female participants could not be accessed due to cultural limitations and the fact that the study was conducted during the rainy season and women were usually busy around this time. Attempt to get them during their free time was futile because of culture sensitivity. Table 1 below summarizes the demographics of the focus groups. Participants discussed the challenges encountered in sheep and goats' production, common diseases affecting sheep and goats, local control measures, perceived effectiveness of the different control measures, and the challenges and opportunities that exists in the control of diseases of small ruminants in Mandera, Kenya.

Table 1: Demographics of FGD study participants, Mandera Kenya, 2016

FGD No	Study area	No of participants			Comments
		Male	Female	Total	
1	Takaba South	8	0	8	Middle aged to old men
2	Hafalo	10	0	10	Middle aged to old men
3	Diid Kuro	9	0	9	Middle aged to old men
4	Ayana	11	0	11	Middle aged to old men
5	Gither	8	0	8	Middle aged to old men
6	Dandu	10	0	10	Middle aged to old men
7	Kob adaadi	11	0	11	Middle aged to old men
8	Burduras	9	0	9	Middle aged to old men
9	Wargadud	12	0	12	Middle aged to old men
10	Kutulo	10	0	10	Middle aged to old men
11	Dabacity	8	0	8	Middle aged to old men
12	Shimbir	9	0	9	Middle aged to old men
13	Fincharo	10	0	10	Middle aged to old men
14	Ellele	11	0	11	Middle aged to old men
15	Borehole 11	10	0	10	Middle aged to old men
16	Burmayo	8	0	8	Middle aged to old men

4.2.2 Characterization of sheep and goats production challenges

4.2.2.1 Identification of sheep and goats production challenges

The following challenges were identified in all groups; drought, infectious diseases, predators, non-existent extension services (inadequate veterinary services), tick infestations and high mortality of the small ruminants. In addition, few of the groups identified insecurity, poor infrastructure, reduction in size of available grazing land and livestock trade restrictions as additional challenges faced by the pastoralists.

4.2.2.2 Ranking of the identified sheep and goats production challenges

Diseases and drought were consistently ranked high by the respondents in almost all groups (Table 2). The persistent drought resulted to lack of water and limited pasture, which meant movement of animals from one place to another resulting in reduction of body weight, reduction of market value and sometimes death of the animals. Inadequate veterinary and extension services were ranked third and fourth respectively by the participants as challenges that hampers production of small ruminants in northern Kenya. The participants observed that government veterinary and extension officers were only found at sub-county level and therefore not accessible by pastoralists. The inadequate extension services and limited access to veterinary services forced the livestock keepers to return to cultural practices, for example, recitation of Quran and use of herbal remedies in an effort to protect their animals from the rampant disease occurrences. The results showed weak agreement among the groups on the rank orders for the common production challenges which were identified as evidenced by the negative Spearman's rank correlation coefficient for common production challenges ($r = - 0.04$). For instance, regions that border Somalia (Kutulo and Dabacity) had security as their main challenge unlike other areas that had consistently ranked diseases and drought as their main challenge. In addition, the

Kruskal Wallis one way ANOVA showed significant difference for the median ranks for each production challenge that were identified ($p < 0.001$).

Table 2: Scores & ranks for sheep & goats production challenges in Mandera, Kenya, 2016

Production challenges	Median (%)	Average rank	Z score	Rank
Diseases	27.35	111.31	5.4	1
Drought	25	107.59	4.97	2
Predators	15.5	68.38	0.45	3
Limited veterinary services	11.05	64.44	-0.01	4
Limited extension services	8.7	51.03	-1.55	5
High mortality rates	0	32.62	-3.67	7
Tick infestations	1.95	29.81	-4	8
Others*	9.7	50.81	-1.58	6

*Others – insecurity, poor infrastructure, reduced grazing land and trade restrictions.

4.2.3 Identification and ranking of common diseases of sheep and goats

4.2.3.1 Identification and ranking of common diseases of goats

All the 16 groups mentioned a number of diseases which were affecting their flocks: Contagious caprine pleuropneumonia (CCPP) (*Sombes*), Peste des petits ruminants (PPR) (*furi*) sheep and goat pox (*Baga*), Tick Borne disease (TBDs) (*shilme*), pneumonia (*dugut*), mange infestation (*chito*) and helminthosis (*Muuqi/goryan*) (Table 5). However, symptoms such as diarrhea (*halbati*) in young goats, increased mortality, Orf (*Bacha*) and abortion/still births (*dicis*) were rarely mentioned and are therefore grouped as others in this report. PPR was ranked first in all the groups as the commonest disease of goat which greatly impacted on pastoralist livelihood with a score of 21.5%. Respondents described PPR as “*a recently acquired disease with a devastating economic impact*”. PPR is known to spread fast, initially in the neighboring herds, resulting in high mortalities. Local measures used to control the disease included restricting animal movements, treatment with antibiotics and cultural practices such as recitation of *Quran* and herbal remedies.

Other diseases that were ranked high were contagious caprine pleuro-pneumonia (CCPP) (20.8%) and goat pox (21.9%) as shown in table 3). The results showed weak level of agreement among the groups on the rank orders for the common goat diseases which were identified as evidenced by the weak Spearman's rank correlation coefficient ($r = 0.02$). This is a clear indication that respondents differed in the ranking order for these diseases. For instance locations that border Somalia (Kutulo and Dabacity), Marsabit County (Gither) and Wajir County (Dandu and Kutulo) had ranked PPR as their most common disease, followed by CCPP and goat pox. PPR was not a major problem in other areas and was ranked lower than other diseases. The Kruskal Wallis one way ANOVA showed significant level of difference for the median ranks for each disease that was identified ($P = 0.001$).

Table 3: Scores & ranks for common goat diseases in Mandera, Kenya, 2016

Common goat diseases	Median (%)	Average rank	Z score	Rank
PPR	21.45	101.6	4.28	1
CCPP	20.75	95.9	3.62	2
Goat pox	21.9	93.5	3.35	3
TBDs	18.5	88.7	2.79	4
Pneumonia	3.3	39.2	-2.91	5
Mange	3.15	33.8	-3.54	7
Helminths	1.45	25.5	-4.5	8
Others*	4.05	37.7	-3.09	6

*Others include Mortality, diarrhoea (young), abortions/ stillbirth and orf

4.2.3.2 Identification and ranking of common diseases of sheep

Like common goat diseases, all the groups mentioned a number of diseases which were affecting sheep production: Peste des petits ruminants (PPR) sheep and goat pox, Tick Borne disease (TBDs), pneumonia, mange infestations and helminthosis. However, diseases such as diarrhoea in young sheep mortality, orf and abortion/still births were rarely mentioned and were therefore

grouped as others in this report. PPR was the commonest sheep disease. PPR (82%) was ranked high in locations that border other counties and Somalia. Sheep pox (78%) and Tick borne diseases (73%) were ranked second and third respectively, while helminthosis was ranked the fourth with an average rank of 69%; the other diseases (pneumonia, mange infestation mortality, diarrhoea (young), abortions/ stillbirth and orf) had an average rank of less than 50% (Table 4). The results showed weak level of agreement among the groups on the rank orders for the sheep diseases which were identified as evidenced by the weak Spearman's rank correlation coefficient ($r = -0.03$) This is a clear indication that respondents differed in ranking of diseases.

Table 4: Scores and ranks for common sheep diseases in Mandera, Kenya 2016

Common sheep diseases	Median (%)	Average rank	Z score	Rank
PPR	22.8	81.9	3.38	1
Sheep pox	24.3	77.8	2.84	2
TBDs	20	73.3	2.23	3
Helminths	19	68.5	1.6	4
Mange	3.6	23.8	-4.4	7
Pneumonia	3.9	34.5	-2.93	6
Others*	4.6	35.7	2.76	5

Others* - diarrhoea in young sheep, mortality, orf and abortion/still births

4.2.4 Community PPR awareness

The participants explained the occurrence of the different diseases of sheep and goats but have identified PPR to be the most problematic. PPR was considered a relatively new disease having been locally introduced in the last 10 years. The disease was said to have been introduced by herders who had crossed borders (Somalia and Ethiopia) in search of water and pasture. They identified diarrhoea (*halbati*), lacrimation (*ilme*), nasal discharges (*furi*), mouth lesions (*afan mata*) and death as the main clinical features of PPR in sheep and goat flocks. The disease is locally called *Furi* (A Borana term for nasal discharges). The respondents reported that the

disease does not respond to antibiotics treatment administered to sick sheep and goats. Sharing of grazing and watering points, lack of government response or involvement during new outbreaks and low vaccination coverage were thought to be the main reasons why PPR has continued to persist in Northern Kenya. Interestingly, unlike diseases such as CCPP, sheep and goat pox and TBDs, PPR was thought to be easy to control and prevent, with participants giving various suggestions through which this could be achieved; - organizing frequent vaccinations, improving on vaccination coverage, improvement of veterinary services and extensions, synchronization of vaccination across neighbouring counties and countries and exclusive and thorough PPR awareness campaign.

4.2.5 Local disease control measures

The respondents ranked vaccination (33%), though occasionally provided by the government and relevant non-governmental organizations (NGOs), as the most effective control measures, followed by antibiotic treatment mainly PenStrep (Penicillin and Streptomycin) and Oxytetracycline (25%), movement control (21.5%) and cultural practices (cauterization and *Quran* recitation) (20.5%). The respondents were of the view that, the reason why cultural practices such recitation of *Quran* was not as effective as vaccination was because this method was employed after all other methods had been tried and the effect of the disease was severe. The findings showed poor agreement among the groups on the rank orders for the different control strategies listed by the respondents as evidenced by the weak Spearman's rank correlation coefficient ($r = 0.06$). Vaccination is usually provided by the government and relevant Non-governmental organizations (NGOs). It is not coordinated and is done when available hence frequency and coverage is very low. Details of the disease control strategies and implications are presented in table 5.

Table 5: Local disease control strategies and their implications in Mandera, Kenya, 2016

Current disease management & control strategies	Implications for disease transmissions and control in herd/flocks
Vaccination	<ul style="list-style-type: none"> - All respondents reported this method to be the most effective of all other methods - This method is provided either by the government or NGOs - The frequency and coverage is very low
Treatment	<ul style="list-style-type: none"> - Pastoralist treat clinical cases with antibiotics like Oxytetracycline and PenStrep (penicillin and streptomycin) and reported that drugs give temporary relief and do not prevent the spread of the disease
Cultural practices	<ul style="list-style-type: none"> - Includes Quran recitation and herbal medicine are mainly used - Quran recitation is mainly used after all possible methods are used when impact of the disease has reached an alarming rate
Movement control	<ul style="list-style-type: none"> - Pastoralist either move away from infected locations or deny infected herds into healthy locations through local mechanisms - A case in point is that during one of the group discussions, an argument started when a participant confronted another and accused him of bringing his infected animals to one of the vaccination centers when other healthy animals were there.

4.3 Key informant interview narratives

In addition to the focus group discussions, a total of 13 key informant interviews were conducted, the participants included 11 males and 2 females government veterinary officers from Mandera West and South sub-counties (Table 6). The key informants identified a number of production challenges including disease, limited animal health care, and inadequate feeds. Like the FGDs, they have ranked diseases and drought as the most important challenges. They have also reported challenges like climate change, inbreeding, infertility and poor husbandry practices as some of the other challenges besides the ones given by the respondents in the FGD. The KII respondents have also mentioned PPR, CCPP, helmenthosis, sheep and goat pox, orf and tick borne diseases as some of the diseases affecting sheep and goats in Mandera County. When asked about what are some of the local control measures that are required for mitigating the

challenges of sheep and goat production, they have mentioned drought preparedness, construction of dams and wells, training of both government personnel and pastoralists on proper husbandry, mass vaccination of common diseases and mass treatment of helminthes and skin problems (Table 7).

Table 6: Demographics of KII study participants, Mandera, Kenya, 2016

KII No	Gender	Institution	Role
1	Male	Mandera County Government	Vet officer
2	Male	Mandera County Government	Animal Health officer
3	Male	Mandera County Government	Animal Health officer
4	Female	Mandera County Government	Animal Health officer
5	Male	Mandera County Government	Animal Health officer
6	Male	Mandera County Government	Animal Health officer
7	Male	Mandera County Government	Animal Health officer
8	Male	Mandera County Government	Animal Health officer
9	Male	Mandera County Government	Vet officer
10	Female	Mandera County Government	Vet Assistant
11	Male	Mandera County Government	Livestock production officer
12	Male	Mandera County Government	Livestock production officer
13	Male	Mandera County Government	Livestock production officer

Table 7: Small ruminant production challenges observed by stakeholders during the key informants' interviews in Mandera, Kenya, 2016

Production challenges	Reason for persistence
Diseases	<ul style="list-style-type: none"> - Poor surveillance - Poor vaccination coverage - Inadequate veterinary & extension services - Poor nutrition - Porous border - Poor husbandry practices
Drought/decreased pasture and water	<ul style="list-style-type: none"> - Climate change - Poor grazing management - Arid and semi arid nature of the area - Overstocking - Reduced grazing areas due to human encroachment
Inbreeding/low fertility	<ul style="list-style-type: none"> - Poor extension services - Free range system - Poor husbandry practices
Predation	<ul style="list-style-type: none"> - Poor fencing system - Free range system
Poor infrastructure	<ul style="list-style-type: none"> - Lack of crushes for restraining animals during vaccination and treatment

Most of the respondents (85%; n=13) identified drought and diseases as their main challenges.

Challenges observed only by the key informants and not by the FGD participants included; climate change, low fertility, poor husbandry practices, inbreeding and poor disease surveillance were more technical and only reported by the key informants.

PPR was identified as the main disease affecting sheep and goats production in the study areas.

Other diseases observed included contagious caprine pleura-pneumonia (CCPP), sheep and goat pox, tick borne diseases (TBDs), pneumonia, helminthes, mange and enterotoxemia. The key informant interview respondents gave vaccination as the most effective control methods but only when given on a regular basis. Movement restriction, proper surveillance, border control and

good husbandry practices were some of the other control measures mentioned by the respondents.

4.4 Opportunities for improvement

The opportunities for improvement data were collected from Key informant interviews; the FGD respondents have not given any opportunity for improvement. The CDVS and the head of resilience project in Mandera County have given opportunities such as increase in vaccination coverage (30-40%) for PPR, CCPP and sheep and goat pox; increase in budgetary allocation of livestock department and employment of more technical staff as some of the opportunities for improvement (Table 8). They have also noted that the interventions have reduced mortality of sheep and goats as a result of the impacts of sheep and goat diseases and droughts.

Table 8: Opportunities for improvement on sheep and goat production in Northern Kenya according to interviewed stakeholders in Mandera, Kenya, 2016

Stakeholder(s) interviewed	Identified opportunities for sheep and goat improvement
Director of veterinary services, Mandera County	<ul style="list-style-type: none"> - Small ruminants utilizes feed efficiently than camels and cattle and they do not stamp on vegetation due to their small sizes; - sheep and goats are cheaper to buy and maintain; they reproduce twice a year hence have high turnover; - They can easily be traded for either cash or barter trade exchanges; these animals are also known to adapt well to pastoralists and agro-pastoralist ecological systems; - They are kept by disadvantaged groups, i.e., women and the elderly rely on them; and more importantly they form an essential component of coping mechanism used as a strategy to rebuild herds after environmental and political shocks. - Current projects include breeding improvement through purchase of equipment's and employed personnel to carryout artificial insemination; the county government in collaboration with other agencies such as Islamic Relief, Save the Children, Agency for Technical Cooperation and Development (ACTED) and World Bank have provided training and seedling for fodder production. The fodder is stored and used during droughts. That is the reason why no deaths of livestock were reported in Mandera County during the last devastating drought - There is a 70% increase in the budgetary allocation for livestock since the start of devolution
Head of World bank Resilience project in Mandera County	<ul style="list-style-type: none"> - Increased vaccination coverage to about 30-40% in the last 2 years for PPR, Sheep and goat Pox (SGP) and contagious caprine pleuropneumonia (CCPP) due to proper coordination among the different stakeholders, increased personnel - Training of technical staff and pastoralists on fodder production, good husbandry practices and community managed disaster risk reduction (CMDRR).

CHAPTER FIVE

5.0 DISCUSSION

Livestock production has been described as the main source of livelihood for the pastoralist in Africa and it provides a global average of about 40% to the Gross domestic product (GDP) of national agriculture (OIE & FAO, 2015). This study used participatory data collection techniques to prioritize sheep and goat production challenges and opportunities for improvement in Northern Kenya. Participatory data collection has been highly rated as one of the most effective methods of obtaining information from rural pastoralist (Catley 1999; Catley *et al.*, 2007; Catley *et al.*, 2012; Catley *et al.*, 2014; Mariner *et al.*, 2000). Because of the harshness of the area, rough terrain, relatively small and mobile population, with limited modern infrastructure and services, frequent insecurity and lack of baseline data to inform random sampling procedures, and immense traditional knowledge of the pastoralists in Northern Kenya, collecting data through the conventional quantitative and data driven approaches were considered untenable and expensive (Bett *et al.*, 2009; Catley 2002; Majekodunmi 2011). In that regard participatory data collection was selected as the appropriate method that could provide representative data.

All the sixteen groups and thirteen key informers identified diseases and droughts as the main challenges affecting sheep and goat production in Northern Kenya. Inadequate veterinary and extension services, tick infestations, poor infrastructure, predators, reduced grazing land and insecurity are the other challenges mentioned in the study. Droughts and diseases were consistently ranked high in all the group discussions and interviews, this is in agreement with previous studies which had examined challenges faced by livestock producers in the arid and semi-arid lands (Behnke & Muthami 2011; Fikru & Gebeyew 2015; Kosgey *et al.*, 2008).

According to these authors disease conditions and droughts are the main challenges affecting the productivity and production of livestock in the pastoralist areas in Kenya and Ethiopia, and are therefore a threat to sources of livelihoods of these communities. The effects of persistent drought conditions include lack of water and pasture for livestock resulting in reduced body weight, reduced market value and death of animals.

Peste des Petit Ruminants (PPR) was identified by all the groups as the most important disease of sheep and goats in Northern Kenya followed by CCPP and sheep and goat pox. The respondents described PPR as a relatively new disease and ranked it first during the discussions in all the groups. . The locations that border Somalia (Kutulo and Dabacity), Marsabit County (Gither) and Wajir County (Dandu and Kutulo) ranked PPR higher than the other diseases. This was partly blamed on the uncontrolled movement of sheep and goats between inter-county and inter-country borders. Contagious Caprine Pleuropneumonia (CCPP) and sheep and goat pox were considered as relatively old diseases and had become endemic within all the study areas, despite their high morbidity, the mortality was reported to be very low in flocks. These findings were in agreement with studies by Kihu *et al.*, (2015) and Nyamweya *et al.*, (2009), which studies showed that PPR was a relatively new disease in Kenya, and had within a short period of time after its introduction caused huge economic losses to the pastoralists in Northern Kenya, with estimated economic losses from outbreaks estimated at about \$15 million per year. According to Nyamweya *et al.*, (2009), over 5 million sheep and goats were lost during the 2006 and 2009 outbreaks.

Participants described vaccination, antibiotic treatment, movement control, Quran recitation and cauterization as some of the control measures they employed to control livestock diseases

outbreaks in the region. Vaccination services which were occasionally provided by the county government was ranked as the most effective control strategy for infectious disease, followed by antibiotic treatment, movement control and cultural practices. The participants argued that movement control was an effective way of controlling spread of livestock diseases during outbreak, but it was difficult to implement since livestock within these areas shared grazing fields and watering areas. However, due to the inadequate vaccination services and the unsuitability of the movement control strategies, respondents reported to have resorted to other cultural practices such as cauterization and *Quran* recitation. According to the respondents these practices usually have little or no effects because they are administered during the later stages when the disease has already caused devastating effects. The application of these cultural practices for disease control are in agreement with findings from a study by (Swaleh 1999), whose findings from Tana River County in Kenya reported Quran recitation and cauterization as some of the measures which were practiced by pastoralists' to control and respond to occurrence of diseases.

Diseases with high impact are considered as one of the main factors restricting efficient livestock production in the developing countries (Penrith 2011). This is made worse by the fact that the capacity and financing of controlling these diseases are often limited by low budgetary allocation for disease control by the respective governments (OIE & FAO, 2015). The opportunities which were identified offers hope for improvement in sources of livelihoods in these areas. For example, the increased budgetary allocations of up to 70% to the livestock departments within the ASAL counties since the start of devolved system of government in the Northern Kenya have resulted in the prioritization of important projects that would improve on the production of

livestock such as sheep, goat, cattle and camel. These projects include livestock breeding and improvement, wide vaccination and surveillance coverage, fodder production, construction of dams, increased drilling of boreholes carried out by the county governments and their partners.

Since the study was carried out at the onset of the November-December short rains, there is a possibility that the previous drought and disease events might have been fresh in the minds of the pastoralists and that could be the reason as to why drought and diseases were ranked high as the most occurring challenges. Given the nature of the design which requires that participants recall past events, recall bias could also be a limitation because the groups and key informant interviews were required to recall past events and which may introduce bias to the findings. Finally, the study was also not gender sensitive since all the groups were composed of only male participants since women were unavailable. The reason for their unavailability is that, women traditionally do not sit with men in group meetings especially in the village set up. The other reason given is that women are busy attending to household chores such as cooking, taking care of the children and young animals and fetching water.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

In conclusion, the study has identified the level of knowledge by pastoralists in Northern Kenya on the challenges facing sheep and goat production. Diseases and drought were constantly mentioned by both Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) as the most significant challenges encountered in the production of sheep and goats. Of the diseases which were identified, Peste des Petit Ruminants (PPR) and Contagious Caprine Pleuropneumonia (CCPP) were frequently mentioned by pastoralists. The livestock owners have no proper access to veterinary services especially during the times of disease outbreaks, which resulted in them relying on cultural measures of disease control like recitation of verses from Quran and cauterization of infected animals. However, these measures are not known to be effective in disease control and prevention since they are administered during the later stages of the disease. Though, numerous challenges were identified, it is worth noting that the various stakeholders are addressing most of the challenges. According to the KIIs, recent developments following the introduction of devolved system of governance in Kenya has resulted in increased budgetary allocation for livestock departments in these northern frontier counties. Besides there are several intervention projects which are implemented by development partners which would support extension and disease control services in the area/region. These results will also be used as a benchmark for future where a more detailed participatory research with wider geographical and gender representation can be done.

6.2 Recommendations

From the study findings and conclusions, the following recommendations were made for policy makers and other stakeholders:

1. There is need for future research that can identify the appropriate technologies that can be utilized to reduce the impact of the identified production constraints including diseases.
2. Despite the challenges, there are potential opportunities for improvement. These opportunities need to be prioritized and coordinated by policy makers so as to realize efficient interventions.
3. Control of the priority diseases of small ruminants should be enforced/prioritized since these livestock cushions families from adverse effects of climate change and poverty.

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APPENDICES

Appendix 1: FGD checklist/guiding questions

- Ask for consent from the participants. Clearly, explain to them the purpose of the discussions.
- Date, time, moderator, assistant
- Registration details of participants (take the names, gender, locations, age categories, contact details and signature of all the participants)

Guiding questions

1. List the common production challenges in sheep and goats, rank them (pairwise ranking/proportional piling), why these challenges? Any local solutions?
2. Which common diseases do you encounter in sheep and goats (different lists for sheep and goats), pair wise ranking/proportional piling
3. What are the control measures you are practicing, list, which is the most effective
4. Sharing of photos to see whether they can identify (CCPP and PPR)
5. What have you been doing to control PPR?
6. What is your role (livestock owners)? What are the roles of others, i.e government? NGOs etc? do they play their roles well?
7. Is PPR still a problem? Why is it still a problem (list challenges)
8. What needs to be done to minimize / control the disease? (new strategies, improvement of existing strategies)

Appendix 2: Consent form

Consent form

Dear Sir /Madam,

Invitation to participate in the study

My name is Mohamed Abdilatif Haji (Reg. No. J56/85146/2016), a student pursuing MSc degree in Veterinary Epidemiology and Economics at the University of Nairobi, intend to conduct a research on Challenges and Opportunities of Peste des Petis Ruminants (PPR) control in Northern Kenya. The research will be specifically conducted in Mandera County. The output from the research, when available, will contribute to improvements in the livestock sector. You are therefore kindly requested to provide information requested in the blank spaces provided in the questionnaire. The information you provide is purposely for academic purposes and will be kept confidential. Therefore feel free to answer all questions if you can.

I..... agree to participate in this study and the information provided to you is the truth.

Date: Tel. No:

Thank you

Appendix 3: University introductory letter



UNIVERSITY OF NAIROBI
COLLEGE OF AGRICULTURE AND VETERINARY SCIENCES
FACULTY OF VETERINARY MEDICINE

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Pharmacology and Toxicology
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10th November, 2016

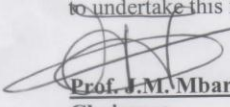
Ref: J56/85146/2016
The Director of Veterinary Services
Mandera County Government
P. O. Box 58-70300,
Mandera, Kenya

Dear Sir

RE: MSc Student Research: “Challenges and Opportunities of Peste des Petis Ruminants (PPR) control in Northern Kenya”

Dr. Mohamed Abdilatif Haji (Reg No. J56/85146/2016) is an MSc student pursuing a degree in Veterinary Epidemiology and Economics. He intends to conduct a research on “Challenges and Opportunities of Peste des Petis Ruminants (PPR) control in Northern Kenya”. PPR is an important trade-sensitive disease with serious economic implications particularly in the pastoralist areas. Mohamed has proposed to use a number of data collection tools including focus group discussions, semi-structured interviews with key informants in the livestock sector and desk review of literature. The focus group interviews and stakeholder interviews are to be done in Mandera County specifically in Mandera South and Mandera West sub-counties. Outputs from the research, when available, will contribute to improvements in the livestock sector.

The purpose of this letter is to kindly request you to accord him the necessary support he requires to undertake this field activity.


Prof. J.M. Mbaria

**Chairman,
Department of Public Health Pharmacology & Toxicology**

**CHAIRMAN
DEPT. OF PUBLIC HEALTH,
PHARMACOLOGY & TOXICOLOGY**

CC
Chief Officer
Livestock Department (PPR or pestes des petis ruminante)

Appendix 4: Published journal article